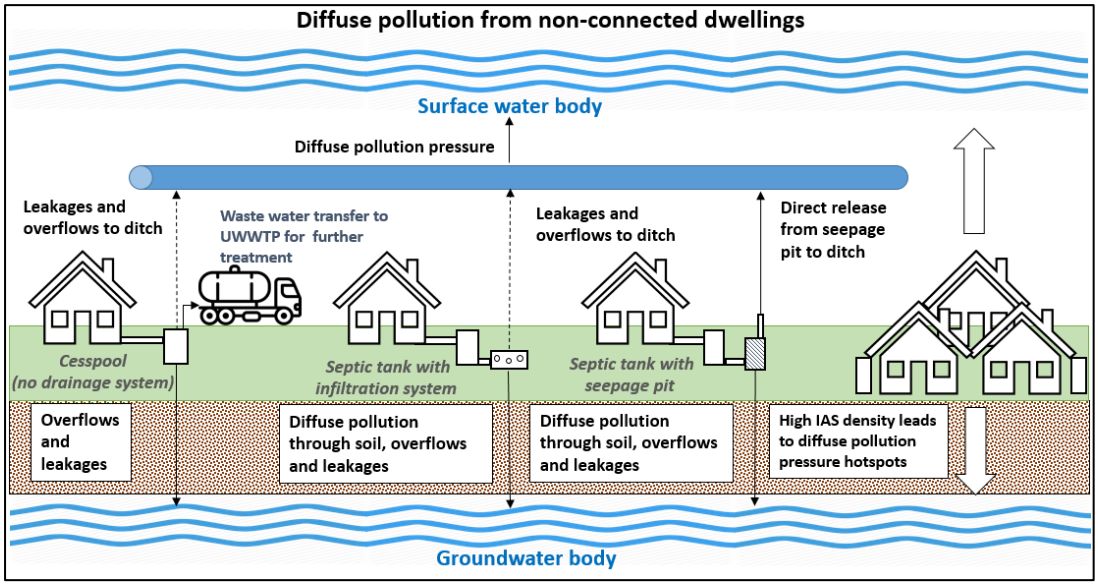
European Environment Agency

Urban Waste Water – Non-Connected Dwellings

Final report

Date: 4th December 2019



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Contents

Acknowledgements

Many thanks to the following organisations and people who made this report possible:

Ministry of Environment and Water, Bulgaria
Finnish Environment Institute, Finland - Riikka Malila
Ministry for Ecological and Solidarity Transition, France - Jean-Louis Pasquier and Victor Le-Boulch
Environment Protection Agency, Ireland
Polish Waters, Poland
Environment Agency of Iceland, Iceland
Federal Office for the Environment, Switzerland
Ministry of Environment and Urbanisation, Turkey

Furthermore, we would like to thank the representatives of the Eionet group from Bulgaria, Finland, France, Ireland and Poland who assisted us by coordinating the inputs from the relevant experts.

Disclaimer

This report has been produced within contract 3415/B2019/EEA.57638 with the European Environment Agency. The opinions expressed are those of the Contractor only and do not represent the Agency's official position.

Acronyms

AEC	Area of Environmental Concern
AHC	Area of Health Concern
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CEN	European Committee of Standardisation (Comité Européen de Normalisation)
BWD	Bathing Water Directive
DWWTS	Domestic Waste Water Treatment System
EEA	European Environment Agency
EEA-33	The 28 EU Member States plus Iceland, Lichtenstein, Norway, Switzerland and Turkey
EFTA	European Free Trade Association
Eionet	European Environmental Information and Observation Network
EU-28	The 28 EU Member States
IAS	Individual or other Appropriate Systems
LAWPrO	Local Authority Waters Programme
NCWWTS	Non-Collective Waste Water Treatment Systems
N	Nitrogen
NIP	National Inspection Plans
NPMWW	National Programme on Municipal Waste Water
P	Phosphorus
PANANC	Action Plan on Non-Collective Waste Water Treatment Systems (Plan d'actions national sur l'assainissement non collectif)
p.e.	Population equivalents
RBD	River Basin District
RBMP	River Basin Management Plan
SAGE	Water Management Plan (Schéma d'Aménagement et de Gestion des Eaux)
s.l.	*sine loco* (No place of publication given)
s.n.	*sine nomine* (No publisher is given)
SYKE	Finnish Environment Institute (Suomen ympäristökeskus)
UWWTD	Urban Waste Water Treatment Directive
UWWTP	Urban Waste Water Treatment Plant
WWTP	Waste Water Treatment Plant
WFD	Water Framework Directive

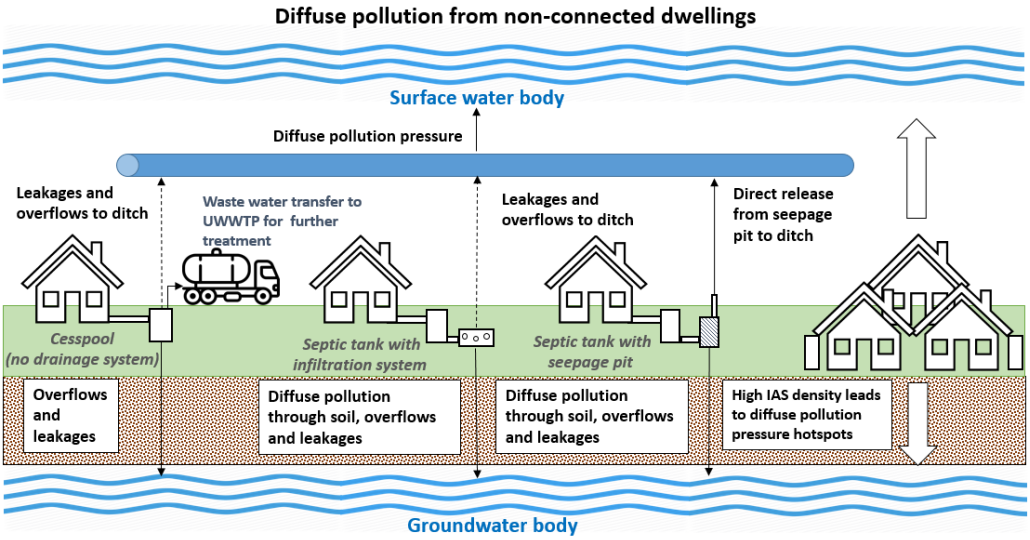
Executive summary

The European Union (EU) has placed significant efforts in protecting the quality of European waters and human health from hazards related to untreated waste water. It has introduced an extensive legislation package, including the Urban Waste Water Treatment Directive 91/271/EEC which imposes specific requirements on waste water collection and treatment in agglomerations[1] of more than 2 000 population equivalent (p.e.) and the Water Framework Directive 2000/60/EC which aims at protecting surface and groundwater bodies across Europe.

However, these Directives have only partial or indirect effect on waste water collection and treatment in smaller areas not connected to sewerage. In 2017, approximately 11 % of the EU population was not connected to waste water collection (Eurostat, 2019)[2]. Furthermore, the most recent reporting under the Water Framework Directive showed that pressures from non-connected dwellings are significant[3] in 19 reporting countries (EEA, 2019). However, the precise sources of this issue and the approaches to addressing it are poorly understood.

In general, non-connected dwellings can be a source of diffuse pollution where individual or other appropriate systems are applied to treat waste water on-site but are not maintained and operated in a suitable manner, or where these are not applied and waste water is released directly to the environment (European Commission, 2007). Figure 0-1 provides an overview of the most common pathways of diffuse pollution from non-connected dwellings.

Figure 0-1 Pathways of diffuse pollution from individual or other appropriate systems (IAS)[4]



Source: Own compilation

The aim of this study is to provide a better understanding of these pressures presented by discharges from dwellings not connected to sewerage through an in-depth consideration of the situation in five contrasting European countries (Bulgaria, Finland, France, Ireland and Poland). In addition, the report examines country-specific topics such as:

[1] An agglomeration is an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point.
[2] Data for Italy, Cyprus and the United Kingdom was not available. Furthermore, data for Austria, Germany, Greece, was extrapolated from 2016 and data for Finland and Spain was extrapolated from 2014 due to data gaps.
[3] Meaning more than 10 % of the diffuse pollution pressures originate from non-connected dwellings.
[4] Further explanation on the specific technologies mentioned in the figure is available within the report.

- Bulgaria: Barriers to access to sanitation;
- Finland: Operation of individual and other appropriate systems in cold climates;
- France: Prioritising action on non-connected dwellings in areas of health concern;
- Ireland: Issues related to the operation and maintenance of individual and other appropriate systems; and
- Poland: Operation of individual and other appropriate systems in mountain areas.

The assessment of the five countries is complemented by an analysis of EEA Member countries not reporting under the Water Framework Directive, including Iceland, Switzerland and Turkey.

Common themes

Overall, all five countries have introduced regulatory frameworks that require the use of individual and other appropriate systems. However, enforcement problems have been experienced in all countries. Similar reasons for non-compliance have been reported in all five countries, namely:

1. The significant costs associated with individual or other appropriate systems that are borne by homeowners;
2. The improper operation and/or maintenance of individual and other appropriate systems due to lack of awareness or resources; and
3. Difficulties with inspections on private land.

In addition, the data availability for agglomerations not in the scope of the Urban Waste Water Treatment Directive has been identified as a challenge to the better understanding of the situation.

Specific challenges

Individual and other appropriate systems could be influenced by local environment conditions specific only to some countries, such as climate, type of soil (in the cases where soil filtration methods are applied), and terrain (where it poses infrastructural challenges). Other country-specific issues identified relate to regulatory gaps where regulations in place have unclear and/or incomplete scope and limit the possibility of applying more treatment options.

Key needs

The key needs to improve the situation with respect to diffuse pollution pressures from dwellings not connected to sewerage include:

1. Improvements of central waste water collection and treatment in sufficiently accumulated areas;
2. Provision of more coherent national regulatory framework to address non-connected dwellings;
3. Provision of further investments, financial assistance, and awareness campaigns for homeowners to improve compliance rates;
4. Regular inspections of non-connected dwellings; and
5. Systematic data collection to improve the understanding of the problem.

Future outlook

With respect to future outlook, improvements in the five examined countries are likely since they have planned further investments and/or regulatory changes to further improve the situation. However, in countries where full compliance with the waste water collection requirements of the Urban Waste Water Treatment Directive has not yet been achieved, the policy and investment focus is placed on agglomerations larger than 2 000 p.e. As such, there is a gap in the mitigation efforts in smaller agglomerations. In comparison, the planned investments in countries that have achieved full compliance with the requirements of the Directive relating to the rehabilitation or development of individual and other appropriate systems.

1 Introduction

1.1 This report

This report examines the extent to which waste water discharges from non-connected dwellings affect the status of surface water and groundwater bodies in Europe. In this context, non-connected dwellings are dwellings not connected to a central waste water collection system. In many cases, these dwellings apply on-site waste water treatment systems known as individual or other appropriate systems (IAS). Alternatively, they apply no treatment at all. Where IAS are not well maintained and operated or not applied at all, the waste water produced on-site could enter the environment and create pollution pressures source to water bodies. However, the scale of this issue is poorly understood on European level due to limited data availability.

The aim of this study was to, therefore, provide a better understanding of the pressures presented by discharges from dwellings not connected to sewage systems in Europe through an in-depth consideration of the situation in five geographically spread European countries. The study had three primary objectives:

- To provide a detailed description of the situation relating to diffuse[5] pollution from non-connected dwellings for five selected European countries;
- To examine the reasons causing diffuse pollution from non-connected dwellings in these countries; and
- To provide an outlook on how the pressures from non-connected dwellings will evolve in the future in these countries.

1.2 Policy context

Urban waste water treatment has a dual importance in the European Union (EU):

1. It protects human health by addressing sanitary hazards related to microbiological pollution, i.e. presence of microorganisms such as bacteria, viruses and protozoa in water. The threat to human health from microbiological pollution by waste water occurs through ingestion of or contact with polluted water.

2. It protects quality of surface waters and groundwater from the potential adverse impacts of substances such as nitrogen and phosphorus present in the waters.

The EU has introduced an extensive package of water legislation to protect the quality of waters and to regulate the operations of urban waste water treatment plants (UWWTPs)[6]. As a result, monitoring and reporting shows that water quality and waste water treatment levels have improved (EEA, 2016). However, these policies regulate the discharges from dwellings not connected to the waste water collection only partially or indirectly. Key European legislation is introduced below, in the context of its relevance to non-connected dwellings.

1.2.1 The Urban Waste Water Treatment Directive

The Urban Waste Water Treatment Directive governs waste water treatment in agglomerations of more than 2 000 population equivalent (p.e.). It requires that all dwellings in these agglomerations are connected to waste water collection and treatment. Where a waste water collection system is not in place and the development of such is associated with disproportionate

[5] Pollution from widespread activities with no one discrete source, i.e. diffuse pollution source (EEA, 2019a).

[6] In the context of this study, "urban waste water treatment plants" are treatment plants which fall within the scope of the Urban Waste Water Treatment Directive. All other treatment plants are referred to as "waste water treatment plants".

costs, individual or other appropriate systems which provide the same level of environmental protection could be applied instead.

Waste water treatment in agglomerations of less than 2 000 p.e. is not governed by the Directive unless waste water collection system is in place and the agglomerations discharge in freshwaters and estuaries. However, non-connected dwellings in agglomerations of less than 2 000 p.e. may be subject to national law requirements.

The Urban Waste Water Treatment Directive 91/271/EEC (UWWTD) was introduced to protect the environment from the adverse impacts of waste water discharges from urban areas and the food and drink sectors. It regulates collection, treatment and discharge of urban waste water comprising domestic waste water or the mixture of domestic and industrial waste waters and run-off rain:

- Collection and treatment are required in all agglomerations[7] of more than 2 000 p.e.;
- More stringent treatment[8] is required in all agglomerations of more than 10 000 p.e. discharging in designated sensitive areas;
- Appropriate treatment is required in agglomerations of less than 2 000 p.e. connected to collection systems and discharging to fresh water and estuaries and discharges to coastal waters from agglomerations of less than 10 000 p.e.

Article 3 of the Directive states that, in agglomerations of more than 2 000 p.e., "*where the establishment of a collecting system is not justified either because it would produce no environmental benefit or because it would involve excessive cost,* ***IAS*** *which achieve* ***the same level of environmental protection*** *shall be used*". IAS are typically divided into two types – contained and uncontained systems (European Commission, 2007). These are summarised below and a more detailed overview of the most common types of IAS is provided in **Section 1.2.3** and **Annex 2.**

Contained systems are storage tanks and other types of contained systems that can be considered to be in conformity with the requirements of the UWWTD if they are impervious, do not have an overflow, and if the waste water and sewage sludge is regularly collected and transported to a treatment plant (European Commission, 2007).

Uncontained systems are typically not watertight, have direct contact with the surrounding environment and/or are equipped with an outflow/overflow. They are commonly referred to as septic tanks (European Commission, 2007). Alone, they can only reach a level of primary treatment[9] but combined with other IAS, they can reach a level of secondary[10] or more stringent treatment (European Commission, 2007).

Further guidance on the interpretation of "same level of environmental protection" in the context of IAS use in agglomerations larger than 2 000 p.e. is available in judgements of the European Court of Justice (ECJ), such as C-119/2002 Commission v Greece (European Commission, 2007). In this case, the ECJ decided that indirect discharges of waste water through septic tanks and seepage pits should meet the same treatment requirements as urban waste water discharges (Commission v Greece, 2004). This means that where the waste water from non-connected dwellings is discharged in sensitive areas, more stringent treatment should be applied (Commission v Greece, 2004). Furthermore, the same decision ruled that local authorities should make adequate arrangements

[7] An agglomeration is an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point. Member States need to assess and decide on case-by-case basis, and according to local conditions, the limits of each agglomeration (European Commission, 2007).
[8] Biological treatment to remove dissolved and suspended organic compounds.
[9] Removal of heavy solids.
[10] Physical phase separation to remove settleable solids.

for the waste water collection from cesspools (for a definition see **Section 1.2.3**) (Commission v Greece, 2004).

Under the reporting requirements of the UWWTD, the **level of connectivity to sewerage in the EU is reported only for agglomerations of more than 2 000 p.e.** One of the reporting categories refers to the use of IAS. It is, however, important to remember that urban agglomerations are areas with concentrated population and/or activities. In principle, IAS should be rare in such areas because a collection system should be in place to deal with the high amount of effluent. IAS would only be needed where connection to waste water collection system is technically complex (e.g. due to slope or other biophysical characteristics) or economically challenging (due to disproportionate costs). Member States are free to define the boundaries of individual agglomerations. In most Member States boundaries of agglomerations do not correspond to boundaries of municipalities, with the rural area of a municipality often not being included in the reporting on IAS.

Agglomerations of less than 2 000 p.e. without collection systems are outside the scope of the UWWTD. Regulations for such settlements could exist at a national level. Technical standards for smaller agglomerations also exist (see Box 1-1).

It is noteworthy that the UWWTD applies to all European Free Trade Association (EFTA) countries[11], however, these do not have to meet the same reporting requirements.

Box 1-1 Technical standards for small waste water systems for up to 50 p.e.

Although the performance of small waste water treatment systems is not regulated by the UWWTD, a range of European technical standards developed by the European Committee for Standardisation (CEN) set the general requirements for the technical performance of the equipment used in waste water treatment systems serving less than 50 p.e. (CEN, 2019). These are referred to as standards EN 12566 and cover a range of topics such as package units, infiltration systems and others.

1.2.2 The Water Framework Directive

The Water Framework Directive introduces a framework for the protection of surface and groundwater bodies. It indirectly concerns the operation of IAS in non-connected dwellings as it requires that its operation does not impose significant pressures on the aquatic environment.

The Directive requires Member States to introduce comprehensive packages of measures to attain good ecological and chemical status of surface and groundwater bodies. These include basic measures for the attainment of the goals of EU water policy such as the Urban Waste Water Treatment Directive, including the development of waste water collection and treatment infrastructure, and supplementary measures for the attainment of the broader goals of the Water Framework Directive.

The Water Framework Directive 2000/60/EC (WFD) was introduced in 2000 to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. It aims to ensure that all aquatic ecosystems and terrestrial ecosystems and wetlands meet **'good ecological status' and 'good chemical status'** and sets ambitious deadlines for this. Under the WFD, Member States are required to develop a set of cost-effective measures summarised in comprehensive river basin management plans (RBMPs) for each designated river basin district (RBD) that are updated every six years. The Directive specifies two key types of measures: basic and supplementary measures. Basic measures refer to all

[11] Iceland, Liechtenstein, Norway, and Switzerland.

measures that are required for the implementation of other EU water legislation preceding the WFD, including compliance with the UWWTD, as well as some additional requirements such as cost recovery in the water sector (Article 9). Such measures include the development of waste water collection and treatment systems in agglomerations of more than 2 000 p.e. to meet the requirements of the UWWTD and reduce pressures on the aquatic environment. Supplementary measures are all additional measures that can be introduced to attain the objectives set in the WFD.

While the WFD does not regulate non-connected dwellings directly, discharges from these should be of such quality so as to allow the receiving waters to meet the relevant quality objectives of the WFD.

The WFD ensures coherence with other EU water policy, referring to, amongst others, the UWWTD, the Bathing Water Directive 2006/7/EC (BWD) (see Box 1-2) and the Drinking Water Directive 98/83/EC (DWD). It outlines a list of priority substances that should be reduced or phased out, and therefore influences the choice of treatment techniques in UWWTPs.

Box 1-2 The Bathing Water Directive

Bathing waters can be affected by both point and diffuse pollution sources. The major sources of faecal bacteria in bathing waters include insufficiently treated urban waste water as a result of system failures and scattered houses with poorly installed or maintained IAS (EEA, 2019b).

In 1976, the first BWD 76/160/EC came into force to protect human health and the aquatic environment in coastal and inland areas from faecal pollution. It requires Member States to create management plans for each site to minimise risks to bathers based on an assessment of the sources of contamination that are likely to affect it. It also imposed a monitoring requirement and an obligation on Member State authorities to inform the public about the status of the waters they bathe in. Furthermore, if the quality standards are not met, remedial measures must be taken which may include the construction or improvement of sewage collection and treatment works and disinfection plants. Bathing waters may be designated as 'sensitive areas' under the UWWTD, meaning that more stringent waste water treatment should be applied prior to discharging waste water to these bodies. In the C-119/2002 Commission v Greece, the ECJ ruled that this level of treatment should be applied even in dwellings not connected to the sewage system (Commission v Greece, 2004).

1.2.3 Ongoing evaluation of the EU Water Policy

The EU's water policy is currently undergoing an extensive evaluation, as summarised in **Box 1-3**.

Box 1-3 Ongoing evaluations of EU Water Policy

As part of the EU Better Regulation initiative, the UWWTD is currently subject to a REFIT evaluation (European Commission, 2019b).

In the 28 years of the Directive's existence many changes have occurred, amongst others: increased and new pressures on the environment, depletion of key resources, visible impacts of climate change, changing socio-economic situations, continued scientific and technological progress, increased societal demands for "cleaner waters" and the increasing importance of tourism (European Commission, 2019b). Furthermore, the legal context has changed: new and interrelated water directives have come into force, the WFD and the Marine Strategy Framework Directive. Furthermore, reviews of implementation have shown that certain provisions could be clarified (European Commission, 2019b).

Alongside the evaluation of the UWWTD, the Commission is also in the process of undertaking a Fitness Check covering other parts of EU Water policy, specifically:

- the WFD and its daughter Directives (Groundwater Directive 2006/118/EC and Environmental Quality Standards Directive 2009/105/EC); and
- the Floods Directive 2007/60/EC.

The purpose of both evaluations is to determine if the current regulatory framework is "fit for purpose" as per the Better Regulation Guidelines and assess effectiveness, efficiency, coherence, relevance and EU added value of EU Water Legislation (European Commission, 2019b).

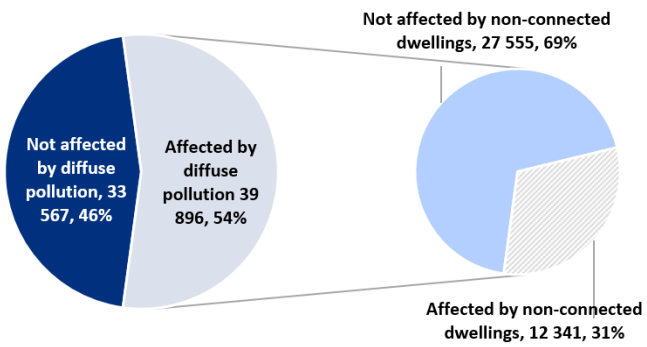
The results of the evaluation of the UWWTD are expected to feed into the other Fitness Check, given the important role of urban waste water treatment in achieving the objectives of the WFD (European Commission, 2019b).

1.3 Pollution from non-connected dwellings

With the development and improvement of urban waste water collection and treatment systems which reduce pressures on the environment, discharges from non-connected dwellings could represent a (more) significant pressure on water bodies. For instance, it is estimated that in 2017, approximately 11 % (55 million out of 512 million) of the EU population was not connected to waste water collection (Eurostat, 2019)[12]. Furthermore, the reporting under the 2nd RBMPs of the WFD showed that in 19 of the reporting countries **pressures from non-connected dwellings are a significant diffuse pollution pressure**[13] (EEA, 2019). As illustrated in Figure 1-1, 31 % of surface water bodies affected by diffuse pollution were reported to be under pressure from diffuse pollution pressure (8.5 % of all surface water bodies in Europe) (EEA, 2019). Comparatively and as shown in Figure 1-2, **20 % of the groundwater bodies area** (km^2) affected by diffuse pollution pressures from discharges not connected to sewerage network (or 4 % of groundwater bodies in the country) (EEA, 2019). Further information on how these figures have been derived is available in **Annex 1.**

The precise reasons for the significance of these pressures and the approaches to addressing them are poorly understood at this stage.

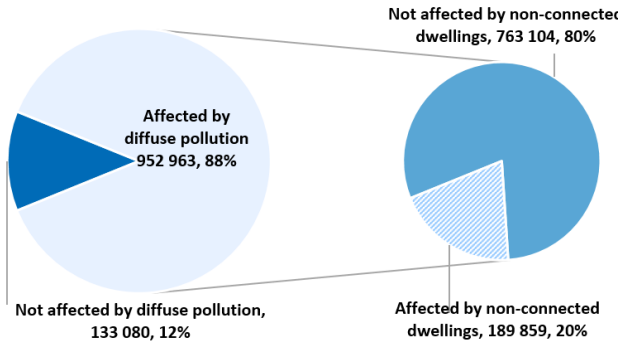
Figure 1-1 Surface water bodies affected by pressures in Europe: Number affected by diffuse pollution; Number with diffuse pollution from non-connected dwellings[14]



Source: Own compilation based on EEA (2019)

[12] Data for Italy, Cyprus and the United Kingdom was not available. Furthermore, data for Austria, Germany, Greece, was extrapolated from 2016 and data for Finland and Spain was extrapolated from 2014 due to data gaps.
[13] Meaning more than 10 % of the diffuse pollution pressures originate from non-connected dwellings.
[14] EU-28 and Norway. Water bodies may be affected by more than one pressure.

Figure 1-2 Ground water body area (km²) affected by pressures in Europe: Area affected by diffuse pollution; Area with diffuse pollution from non-connected dwellings[15]



Source: Own compilation based on EEA (2019)

In general, the most common reasons for diffuse pollution from non-connected dwellings relate to the lack of on-site waste water treatment or the improper operation and maintenance of an existing IAS. Table 1-1 introduces the most common types of IAS applied in Europe. A more detailed description of these and other types of IAS is provided in **Annex 2.**

Table 1-1 Common IAS technologies

IAS	Description
Cesspool	Cesspools (also known as cesspits) are holding tanks that store waste water but do not provide treatment (Vorne and Silvenius, 2017). They should be periodically emptied, with waste water and sewage sludge[16] being transferred to WWTPs (Vorne and Silvenius, 2017). Infrequently emptied or improperly maintained cesspools are a source of contamination of soil, groundwater and surface water (Vorne and Silvenius, 2017).
Septic tank	Septic tanks provide primary[17] waste water treatment. They are used for accumulation, sedimentation, and subsequent withdrawal of partially treated waste water without suspended particles (Vorne and Silvenius, 2017). The process in septic tanks is anaerobic. The term "septic" refers to the anaerobic bacterial environment that develops in the tank which degrades organic contaminants (Vorne and Silvenius, 2017).Sewage sludge forms into the bottom of the tank (Vorne and Silvenius, 2017). The septic tank needs to be regularly[18] de-sludged, with the collected sludge being disposed to a WWTP for further treatment (Vorne and Silvenius, 2017). Septic tanks could be used together with an infiltration system for further treatment (Vorne and Silvenius, 2017).
Sand filter (type of infiltration)	In a sand filter, effluent is filtered down a large ditch filled with several layers of stone and sand, as well as a water-resistant lower and outer plastic layer to keep substances within the filter (Vorne and Silvenius, 2017). A series of filters can be applied and customised to suit property needs (Vorne and Silvenius, 2017).
Drain field (type of infiltration)	The drain field consists of drain pipes, laid under layers of sand and crushed stone. The waste water is filtered through the sand, gets to the crushed stone layers and then soaks into the ground (Vorne and Silvenius, 2017). The

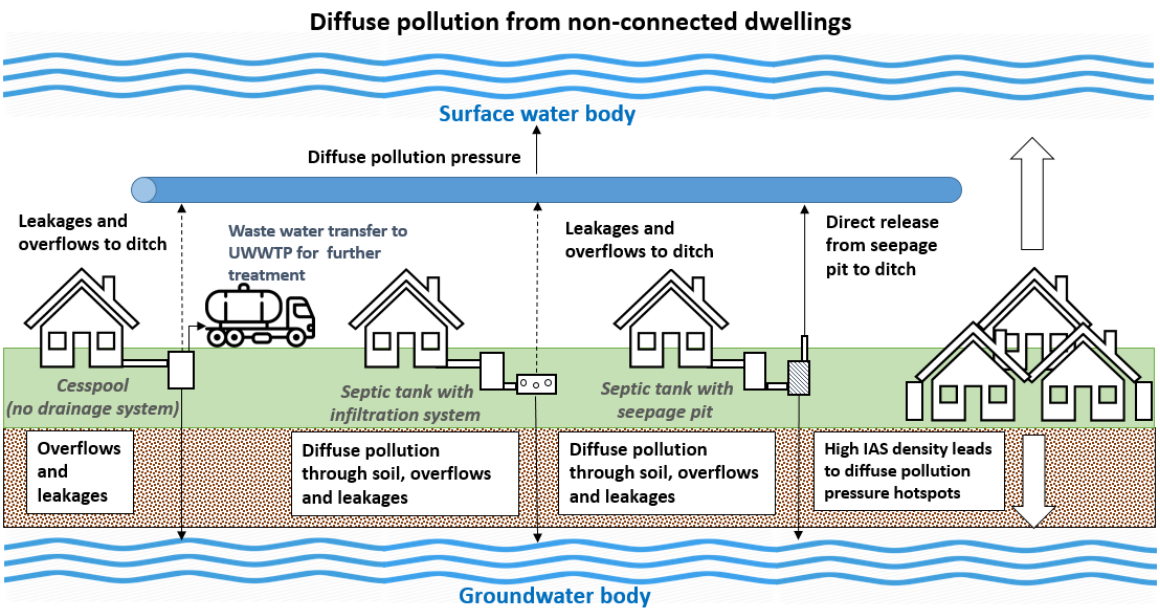
[15] EU-28 and Norway. Water bodies may be affected by more than one pressure.
[16] Semi-solid slurry composing of different kind of organic substances and nutrients.
[17] Removal of heavy solids.
[18] The frequency depends on the size of the septic tank. De-sludging once a year is appropriate for small septic tanks.

IAS	Description
	absorption area is a pipeline made of perforated material (Vorne and Silvenius, 2017). The drain field is usually applied after a septic tank.
Seepage pit	Seepage pits are vertical wells lined with a porous masonry in which discharges from a septic tank are collected and gradually seeped into the soil, the ground surface or a ditch (Ispectapedia, 2019).
Constructed wetlands	Constructed wetlands are artificial wetlands designed to treat waste water. These are often used after a septic tank for further treatment separating solid from liquid effluent. Constructed wetlands usually provide mechanical, chemical and biological treatment of waste water (Vorne and Silvenius, 2017).

Figure 1-3 illustrates the pathways of diffuse pollution to water bodies from three common types of IAS, i.e. cesspools, septic tanks with sand filter system and septic tanks with seepage pit.

Cesspools do not have an outlet, and therefore when not regularly emptied of waste water and sewage sludge, their contents build up and can leak or overflow into surrounding soil or ditches. With respect to septic tanks, these can be a source of diffuse pollution where they are improperly maintained or operated. For instance, if septic tanks are not regularly de-sludged, they can become blocked and overflow. Furthermore, septic tanks may be subject to leakages, or alternatively drains between a house and septic tank can become clogged, causing leakages of waste water before it has entered the septic tank. (Vorne and Silvenius, 2017). Septic tanks are often applied in a combination with infiltration system or seepage pit (Vorne and Silvenius, 2017). Infiltration systems provide secondary treatment whereas seepage pits are simply a method of gradually disposing of effluent from septic tanks into the soil or in a ditch on surface level (Vorne and Silvenius, 2017). Solids from septic tanks could enter infiltration systems or seepage pits and cause blockages (Ispectapedia, 2019). Therefore, these need to be regularly inspected to limit leakages and overflows. Finally, it is noteworthy that a high density of IAS could lead to diffuse pollution pressure hotspots.

Figure 1-3 Pathways of diffuse pollution from IAS



Source: Own compilation

It is noteworthy that unsafe sanitation of waste water resulting from IAS leakages and overflows can lead to the exposure of humans to pathogens and could therefore represent a significant health hazard (WHO, 2019).

1.4 Methodology

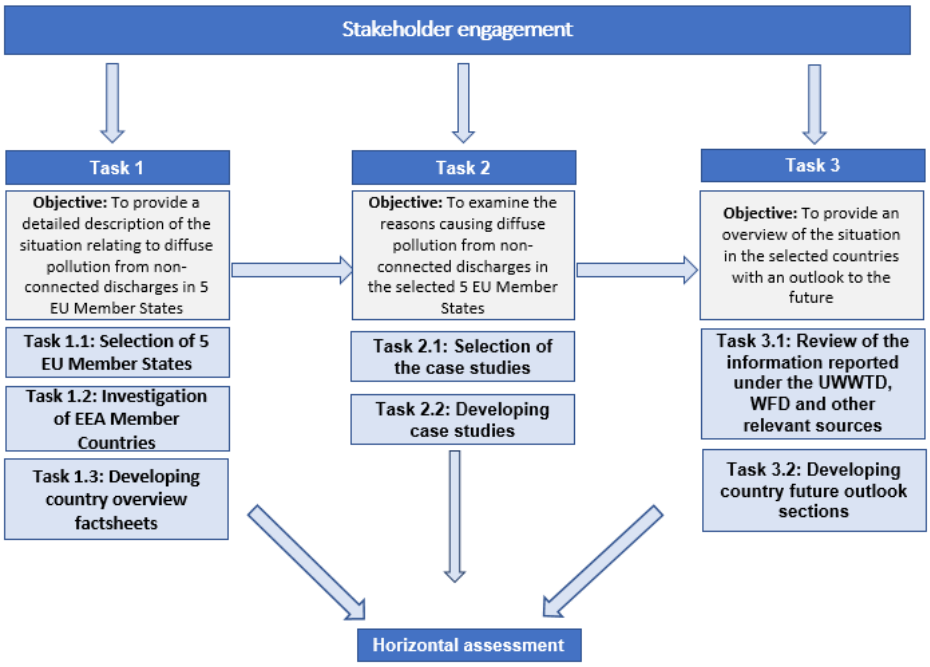
1.4.1 Overview

To achieve the objectives of this study, three distinct but related tasks were carried out, with the following objectives:

- To **develop country factsheets** which describe the situation with respect to pollution pressures from non-connected dwellings in five selected European countries;
- To **develop case studies** which examine specific reasons causing diffuse pollution from non-connected discharges in the five selected countries;
- To describe **future investments or current policies** that may change the situation in the five countries.

Furthermore, a horizontal assessment was undertaken in order to identify the common issues and differences, as well as examples of best practice. Figure 1-4 presents an overview of the methodology and the associated tasks.

Figure 1-4 Methodology overview



Source: Own compilation

1.4.2 Selection of the five countries

Countries reporting under the WFD have been considered separately from those that do not report, owing to the better information available for the former.

Non-connected dwellings in EEA Member countries reporting under the WFD

In the most recent reporting under the WFD, the EU Member States, as well as Norway, reported pressures to water bodies and the proportion of water bodies affected by these pressures within the Member State. The selection of five countries of interest for this study was performed based

on the reported information on the pressure of diffuse pollution from non-connected dwellings. The selection criteria included:

- Share of water bodies affected;
- Geographical representation, targeting countries from different European regions; and
- Information availability.

Table 1-2 presents all **countries where more than 10 % of the groundwater bodies (by area) and/or surface water bodies (by number) affected by diffuse pollution sources were under pressure from non-connected dwellings.** This relates only to surface water bodies which failed to achieve high or good ecological status and groundwater bodies which failed to achieve good chemical status. The Red-Amber-Blue rating has been used to underline the countries where the diffuse pollution pressures from non-connected dwellings are the most significant. The ratings have been assigned in the following manner:

- Red – where pressures from non-connected dwellings affect more than 50 % of all water bodies under pressure from diffuse pollution;
- Amber - where pressures from non-connected dwellings affect more than 20 % of all water bodies under pressure from diffuse pollution;
- Blue - where pressures from non-connected dwellings affect more than 10 % of all water bodies under pressure from diffuse pollution.
- Peach - where pressures from non-connected dwellings affect below 10 % of all water bodies under pressure from diffuse pollution.
- White - where no pressures from non-connected dwellings were reported.

Table 1-2 Countries where more than 10% of ground or surface water bodies are affected by diffuse pollution and non-connected dwellings are identified as one of the pressures[19]

EEA Member countries reporting under the WFD	Groundwater	Surface water
BE	<10 %	47 %
BG	99.9 %	39 %
CZ	-	52 %
CY	81 %	<10 %
DE	-	14 %
DK	-	87 %
EE	58 %	42 %
ES	<10 %	13 %
FI	35 %	52 %
FR	<10 %	13 %
HR	-	92 %
HU	100%	-
IE	< 10 %	14 %
LV	-	25 %
NO	-	58 %
PL	-	67 %
RO	100 %	79 %
SE	61 %	29 %
SK	93 %	-

Source: EEA (2019)

To select the five countries of interest, an initial screening of information availability was performed. This included the screening of the countries' RBMPs and national policies, national reports and other relevant literature sources. The countries selected were:

- **Bulgaria** – to represent the Southeastern European region, and to investigate the barriers to sanitation in this region;
- **Finland** – to represent the North European region, and to investigate the operation of individual and other appropriate systems in cold climates;
- **France** – to represent the Southwestern European region, and to investigate the prioritisation of action on areas of environmental and health concern[20];

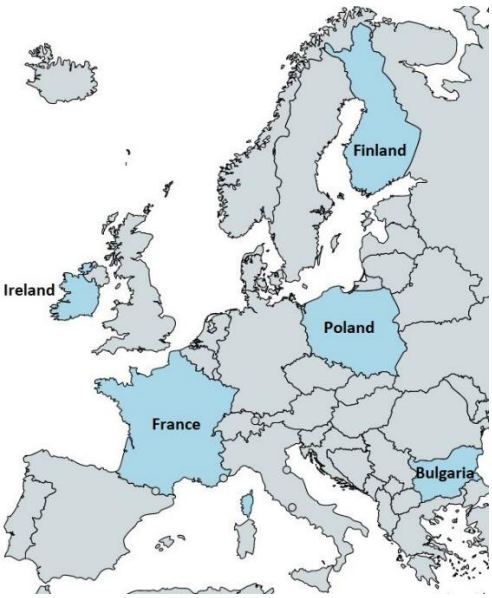
[19] The figures consider only surface water bodies with moderate, poor or bad ecological status and groundwater bodies failing to achieve good chemical status.

[20] The concept is described in **Section 4.2**.

- **Ireland** – to represent the Western European region and to investigate the issue of operation and maintenance of individual and other appropriate systems;
- **Poland** – to represent the Central European region, and to investigate the operation of individual and other appropriate systems in mountainous areas;

Figure 1-5 presents an overview of the selected countries and their location.

Figure 1-5 Overview of the geographical location of the selected countries



Source: Own compilation using Map Generator (2019)

Non-connected dwellings in EEA Member countries not reporting under the WFD

Given the limited information for EEA Member countries which do not report under the WFD[21], these were not considered in the selection of the five countries. However, desk-based research was performed to examine the situation in these countries with respect to waste water treatment in non-connected dwellings, and associated pressures. The findings from this task are presented in Chapter 7.

It is noteworthy that Norway usually reports under the UWWTD and WFD and was therefore considered together with the EU Member States in the selection of the five countries of interest for this study (see above). Liechtenstein is outside the scope of the study due to the lack of scattered dwellings and use of IAS. Therefore, Chapter 7 considers only Iceland, Switzerland and Turkey.

1.4.3 Stakeholder engagement

As illustrated in Figure 1-4, stakeholder consultation has informed all three tasks. The stakeholder engagement process took place in two key stages:

- **Stage 1**: In stage 1, draft country factsheets were shared with the Member State authorities for feedback, together with a questionnaire seeking information on the selected case study topic and on future outlook. The feedback received was implemented in the country factsheets. The information acquired from the questionnaire fed into the development of the case studies and sections on future outlook.

[21] Iceland, Liechtenstein, Switzerland, Turkey

- **Stage 2**: Following the finalisation of the draft final report, a copy of it was shared with the Member States together with a list of country-specific information gaps. Stakeholders were required to provide feedback on the developed case studies, as well as to fill in the information gaps. This second stage took place after the submission of the draft final report and the feedback received has been incorporated into this final report.

1.4.4 Deliverables

The tasks undertaken fed into the development of individual country chapters consisting of:

- Country factsheets: these provide a broad overview of the situation in the country;
- Case studies: these examine country-specific topics, which build on the research conducted for the country factsheets and showcase a variety of different problem types experienced in different European countries;
- Future outlook sections: these include information on plans to reduce diffuse pollution from non-connected dwellings and investments to deliver improvement in water quality.

A country overview table is included in each country chapter summarising the key findings, as presented in Table 1-3.

Table 1-3 Key to country overview tables

Legend	Explanation
	This field provides a summary of the identified information on **environmental impacts from non-connected dwellings.**
	This field provides a summary of the information identified **on the proportion of non-connected dwellings in the Member State.**
	This field provides a summary of **the legal framework regulating non-connected dwellings in the Member State.**

The findings for the five Member States were then brought together in a horizontal assessment.

1.5 Structure of the report

This report has the following structure:

- **Chapters 2 - 6 present country chapters for Bulgaria, Finland, France, Ireland and Poland -** these include country factsheets, case studies and sections examining potential future developments.
- **Chapter 7 EEA Member countries not reporting under the Water Framework Directive** – this chapter presents an overview of the situation with respect to non-connected dwellings in EEA countries not reporting under the WFD, namely Iceland, Switzerland, and Turkey.
- **Chapter 8 Horizontal assessment and conclusions** – this chapter brings together the information for all countries, considering the key similarities and differences with respect to the underlying reasons for the pressure(s) from non-connected dwellings and the adopted approaches to mitigate the problem.

- **Annex 1 WISE database calculations** – this Annex includes the WISE database information used as the basis for figures presented in the country chapters in tabular format.
- **Annex 2 Overview of the most common IAS** – this Annex describes some of the most commonly used IAS.

2 Bulgaria

2.1 Country factsheet

2.1.1 Overview

Bulgaria	
	Environmental impacts from non-connected dwellings • **39 %** of all surface water bodies affected by diffuse pollution pressure (81 out of 210) are under pressure from discharges not connected to sewerage network (EEA, 2019). This is equivalent to 8 % of all surface water bodies (955) in the country. • Almost all (**99.9 %)** of the area of groundwater bodies that is under pressure from diffuse pollution (59 318 km^2 out of 59 417 km^2) is affected by non-connected dwellings (EEA, 2019). This is the equivalent of 37 % of the area of groundwater bodies (158 602 km^2) in the country.
	Proportion of non-connected dwellings: • In 2017, 24 % of the population was not connected to waste water collection or treatment and was assumed to apply IAS (NSI, 2019). • Approximately 16 % of the population in agglomerations of more than 2 000 p.e. (or 1.3 million p.e.) is not connected to sewerage and 12 % (1.05 million p.e.) is connected to sewerage but the collected waste water is not treated (EEA, 2019c).
	Legal framework regulating non-connected dwellings: • The EN 12566 standards have been implemented as national standards (UBA and BOKU-SIG, 2011). • In settlements without a developed sewer network or those having only a partially developed network, the national legislation requires that the water is collected and treated within watertight cesspools which meet the national technical and sanitary requirements (Bulgarian Government, 2001). The waste water and sludge accumulated in these facilities are transported through licensed companies to the closest functioning waste water treatment plant for subsequent treatment (Ministry of Environment and Water, 2019). • A permit is required for the releases of all waste water. All permits require waste water to be treated prior to release and specify the level of treatment that should be applied (Ministry of Environment and Water, 2019). • Bulgaria has introduced plans to reassess the boundaries of agglomerations larger than 2 000 p.e. and exclude areas below certain population density threshold from these agglomerations. The aim is to narrow down the scope of the Urban Waste Water Treatment Directive and ensure cost-effective compliance with the Directive (Ministry of Regional Development and Public Works, 2019). • Bulgaria is discussing a mechanism to support customers to pay the expenses for waste water treatment services (Ministry of Regional Development, 2014). Currently, homeowners are responsible for the expenses of connection to waste water network.

2.1.2 Non-connected dwellings

Bulgaria has a very high proportion of non-connected dwellings in agglomerations of all sizes. **In agglomerations larger than 2 000 p.e.,** 84 % of the waste water is collected at UWWTP (EEA,

2019c)**, 0.01 % (equivalent to 8 117 p.e.) is addressed through IAS and a further 16 % (equivalent to 1.3 million p.e.) are not treated at all** (EEA, 2019c). Most collection systems are very old and therefore subject to technical problems and frequent leaks (Ministry of Environment and Water, 2016). Finally, 12 % (equivalent to 1.05 million p.e.) of the collected waste water does not undergo any treatment (EEA, 2019c).

There is no publicly available information on the proportion of population in agglomerations of less than 2 000 p.e. applying IAS. However, according to a study investigating IAS use in Central and Eastern Europe, agglomerations of less than 2 000 p.e. represented 92 % of all agglomerations in Bulgaria in 2005[22] (4 941 out of 5 332) (Bodrik and Ridderstolpe, 2007) and accommodated a quarter of the population (1.88 million) (UBA and BOKU-SIG, 2011). The Bulgarian Statistical Institute reported that a total of 59 waste water treatment plants (WWTPs) existed in agglomerations of less than 2 000 p.e. in Bulgaria in 2007 (out of 169 WWTPs overall) (NSI, 2019). The institute also reported that in 2017, **63.4 % of the total Bulgarian population was connected to waste water collection and treatment, 12.6 % of the population was connected to waste water collection but not to UWWTP and 24 % of the population used IAS** (NSI, 2019). However, the use of IAS has been estimated based on the population connected to sewerage in relation to the total population (NSI, 2019).

The predominant type of IAS applied in Bulgaria are cesspools (80 %), followed by activated sludge or other secondary treatment systems (15 %) and other systems[23] (5 %) (UBA and BOKU-SIG, 2011). In general, techniques applied for on-site treatment should be compliant with the EN 12566 standards which have been implemented as national standards (UBA and BOKU-SIG, 2011). A permit is required for the release of all waste waters into the surface water bodies (Ministry of Environment and Water, 2019). All permits require that waste water is treated in advance and specify the level of treatment that should be applied (Ministry of Environment and Water, 2019).

It is noteworthy that the Bulgarian transposition of the UWWTD does not provide the alternative of applying IAS where waste water collection is not available (Ministry of Environment and Water, 2000). Furthermore, the Spatial Development Act 2001 requires that waste water from non-connected dwellings in sparsely populated areas is discharged to a watertight cesspool that is regularly emptied but does not provide the alternative of applying IAS with better environmental performance (Bulgarian Government, 2001) (World Bank, 2015). Additionally, no clear definition of "sparsely populated" is provided (World Bank, 2015). Therefore, the wording of the regulation could mean that sufficiently aggregated areas with less than 2 000 p.e. and no connection to waste water collection are not required to apply IAS (World Bank, 2015).

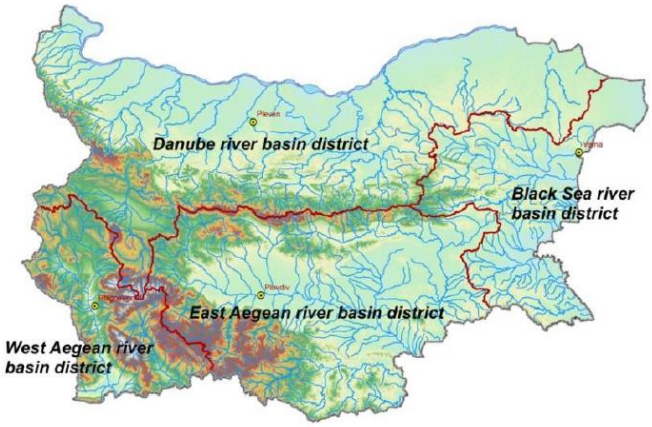
[22] It is unclear what is the underlying source of this information since the number and size of agglomeration is not reported on national level.

[23] The study does not specify what are "other systems".

2.1.3 River Basin Districts affected by diffuse pollution from non-connected discharges

Bulgaria has four RBDs as illustrated in Figure 2-1.

Figure 2-1 Map of Bulgaria and the Bulgarian RBDs

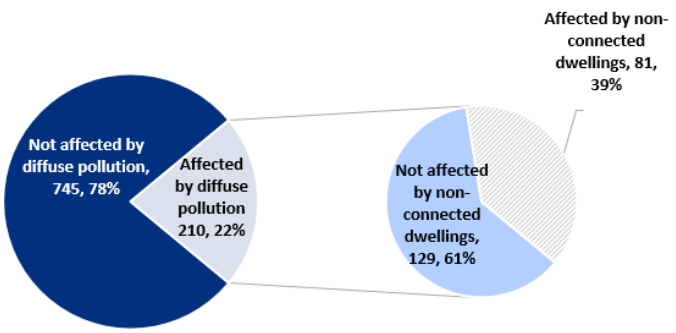


Source: Ministry of Environment and Water (2016)

In the 2nd RBMP submitted in 2016, **56 % of the surface waters in Bulgaria achieved good or high ecological status, and only 33 % achieved good chemical status** (Ministry of Environment and Water, 2016). Similarly, only 34 % of the groundwater bodies achieved good chemical status. One of the key pressures reported with respect to both surface and groundwater bodies was diffuse pollution from discharges not connected to sewerage network (Ministry of Environment and Water, 2016).

As illustrated in Figure 2-2, Bulgaria reported that **39 % of the surface water bodies** affected by diffuse pollution pressures are under pressure from discharges not connected to sewerage network (or 8 % of all surface water bodies in the country) (EEA, 2019). Comparatively and as shown in Figure 2-3, **99.9 % of the groundwater bodies area** (km^2) affected by diffuse pollution pressures from discharges not connected to sewerage network (or 37 % of groundwater bodies in the country) (EEA, 2019). The pressure has been reported to affect surface and groundwater bodies in all four RBDs and is associated with excessive loads of nitrogen (N), phosphorus (P) and organic matter (Ministry of Environment and Water, 2016). Further information on how these figures have been derived is available in **Annex 1.**

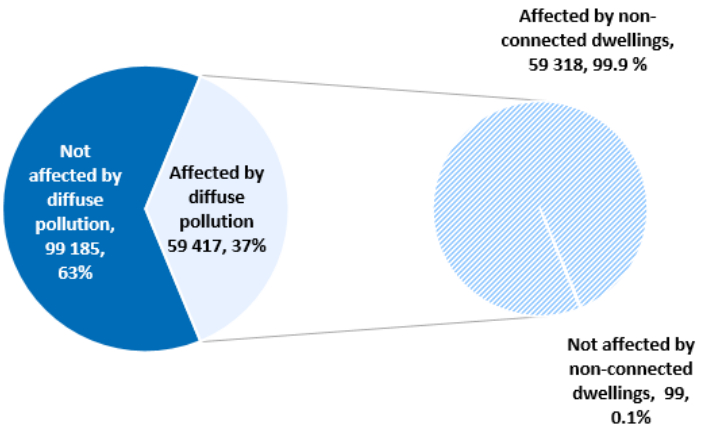
Figure 2-2 Surface water bodies affected by pressures in Bulgaria: Number affected by diffuse pollution; Number with diffuse pollution from non-connected dwellings[24]



Source: Own compilation based on EEA (2019)

[24] Water bodies may be affected by more than one pressure.

Figure 2-3 Ground water body area (km²) affected by pressures in Bulgaria: Area affected by diffuse pollution; Area with diffuse pollution from non-connected dwellings[25]



Source: Own compilation based on EEA (2019)

In the West Aegean RBD, nutrient pollution from agglomerations of less than 2 000 p.e. not connected to sewerage was found to have a significant cumulative effect due to the large number of such agglomerations (Ministry of Environment and Water, 2016). Another factor contributing to diffuse pollution is the deterioration of the old sewage network, which leads to a significant percentage of leakage (Ministry of Environment and Water, 2016).

In the East Aegean RBD, it was reported that:

- Cesspools used in non-connected dwellings were improperly maintained and as a result, 14 surface water bodies were under significant pressure from nutrient pollution.
- Six surface water bodies were impacted by untreated urban waste water from large agglomerations. Under the operational programme 'Environment', investments are foreseen to mitigate the problem in two of the agglomerations (Yambol and Chirpan), larger than 10 000 p.e. (Ministry of Environment and Water, 2019).
- Overall, 47 % of the diffuse pollution pressures in this RBD were linked to non-connected dwellings (Ministry of Environment and Water, 2016).

In the Black Sea RBD:

- There are 12 agglomerations which discharged untreated waste water into water bodies, some of which are larger than 10 000 p.e.
- One agglomeration larger than 10 000 p.e. (Aytos) does not have a UWWTP (Ministry of Environment and Water, 2019).
- In the agglomerations Balchik and Tsarevo, operational waste water collection and treatment systems exist, however not all water collected is linked to the UWWTPs (Ministry of Environment and Water, 2019).

In the Danube RBD, 35 % of the collection system in agglomerations of more than 2 000 p.e. was reported to be either lacking or unsuitable for use (Ministry of Environment and Water, 2016). As a result, nine groundwater bodies had 90 % of their area affected by diffuse pollution (Ministry of Environment and Water, 2016).

[25] Water bodies may be affected by more than one pressure.

2.1.4 Underlying reasons for the problem

The potential reasons underlying the problem of diffuse pollution from non-connected dwellings in Bulgaria include:

- Bulgaria has a high proportion of population not connected to waste water collection and central waste water treatment, in agglomerations of all sizes. In many instances, IAS is not applied (EEA, 2019c). The National Statistics Institute of Bulgaria reported that in 2017, 24 % of the population was not connected to waste water collection and was assumed to apply IAS (NSI, 2019).
- The Bulgarian transposition of the UWWTD does not provide the alternative of applying IAS where waste water collection infrastructure is not available (Ministry of Environment and Water, 2000)
- Bulgaria has a high number of agglomerations of less than 2 000 p.e. (Bodrik and Ridderstolpe, 2007) which accommodates a quarter of the population. Therefore, a large proportion of the population is not subject to the UWWTD requirements.
- The Spatial Development Act 2001 does not permit the use of IAS other than cesspools which limits the use of IAS with better environmental performance (World Bank, 2015). Furthermore, the Act only applies to non-connected dwellings in sparsely populated areas, thus leaving a legislative gap for non-connected dwellings in areas that are not sparsely populated but also not covered by the UWWTD (World Bank, 2015).
- According to the Strategy for Development and Management of the Water Supply and Sanitation Sector in the Republic of Bulgaria 2014 – 2023, the requirement for non-connected dwellings to discharge household waste water in cesspools that are regularly emptied is not enforced in practice (Ministry of Regional Development, 2014). A key obstacle to the enforcement of the requirement are the economic costs associated with installation, maintenance and emptying of cesspools which is borne by homeowners (Ministry of Regional Development, 2014).
- The poor maintenance of cesspools could be a cause of pollution to groundwater bodies. It is unclear what proportion of non-connected dwellings have installed a cesspool.
- Some of the planned measures related to the development of the waste water collection network from the 1st RBMP did not take place in the first cycle due to delays in funding. They have been transferred to the 2nd RBMP cycle (Ministry of Environment and Water, 2016). Currently, 90 % of funding obtained by water supply and sanitation operators is invested into water supply infrastructure, and 10 % is invested in the maintenance of the existing sewerage network (Ministry of Environment and Water, 2019).
- Finally, existing WWTPs in agglomerations of less than 2 000 p.e. are not in operation due to having insufficient influent loads, which does not enable them to operate properly (Ministry of Environment and Water, 2019). The collection systems in place in some agglomerations are also a source of diffuse pollution as they are subject to frequent leaks (Ministry of Environment and Water, 2016).

2.1.5 Approaches to mitigating the problem

Bulgaria has implemented several approaches to mitigate the pressures from non-connected dwellings on ground and surface water bodies. These include:

- Under the Strategy for the Development and Management of the Water Supply and Sanitation Sector in the Republic of Bulgaria 2014 – 2023, an obligation has been imposed on non-connected dwellings to connect to existing sewers (Ministry of Regional Development, 2014)[26].

[26] According to national authorities, there is no information to indicate that connectivity rates have improved as a result (Ministry of Environment and Water, 2019).

The key aim is to improve compliance rates under the UWWTD. A mechanism is discussed to support customers with the payment of the initial expenses of connection and IAS will be considered as an alternative cost-effective treatment option (Ministry of Regional Development, 2014).

- The same strategy specified that the boundaries of the agglomerations will be also reconsidered to ensure that only densely populated areas are within the scope of agglomerations of more than 2 000 p.e. (Ministry of Environment and Water, 2016). The aim is to ensure cost-efficient compliance with the UWWTD and prioritise infrastructure development in densely populated, non-connected areas. These goals will be promoted through the revision of the national legal framework to promote the wider use of IAS, as well as through the publication of guidance documents on what constitutes "excessive costs" when developing sewage infrastructure and how to re-delineate the spatial scope of "agglomerations" (Ministry of Regional Development, 2014). The guidelines on excessive costs is developed by a World Bank team and is applied in development of Regional Feasibility studies (Ministry of Environment and Water, 2019).
- The packages of measures introduced as a part of the 2nd RBMP include measures concentrating on the development and reconstruction of waste water collection systems in agglomerations in all RBDs (Ministry of Environment and Water, 2016). For instance, in the East Aegean RBD, there are 41 projects related to waste water collection development which should alleviate pressures on 26 water bodies.
- In 2019, Bulgaria has announced planned investment of BGN 1.2 billion (EUR 0.6 billion) for reconstruction and renovation of the existing water supply and sewage network, development of waste water collection systems, reconstruction of the existing UWWTP and the development of new UWWTPs for agglomerations with more than 10 000 p.e. (Ministry of Environment and Water, 2019).
- Finally, Bulgaria is also reconsidering waste water release permits as part of future updates to the RBMPs (Ministry of Environment and Water, 2016). This means that stricter permit requirements could be included in the revised permits. The permits relate to all waste water sources, including IAS.

2.2 Case study: Barriers to access to sanitation

The case study for Bulgaria focuses on the current barriers to compliance with waste water collection requirements of the UWWTD and access to sanitation to all.

Bulgaria: Barriers to access to sanitation

Overview

Bulgaria is an Eastern European country with an area of 110 990 km^2 and a population of approximately 6.9 million people, of which 25 % live in rural settlements (World Bank, 2016). *In areas with no sewerage infrastructure, most of the waste water is discharged without treatment or collected in cesspits or other treatment systems* (UBA and BOKU-SIG, 2011). *The operation of individual and other appropriate systems is not influenced by climatic factors, Bulgaria being characterised by temperate climate.*

Description of the issue	Bulgaria has not achieved full compliance with EU water policy, and particularly the requirements of waste water collection and treatment imposed by Article 3 of the Urban Waste Water Treatment Directive (UWWTD)[27] (European Commission, 2017). Approximately 16 % of the waste water produced in agglomerations of more than 2 000 population equivalents (p.e.) is not collected, of which less than 1 % is addressed through individual and other appropriate systems (EEA, 2019c). The issue extends to agglomerations of more than 10 000 p.e. (Ministry of Environment and Water, 2019) As a consequence, Bulgaria has reported significant diffuse pollution pressure from non-connected dwellings on surface and groundwater bodies (See *Country factsheet* in **Section 2.1**). In the context of the Sustainable Development Goals (SDGs), SDG6 calls for ensuring universal access to safe and affordable drinking water, sanitation and hygiene, and ending open defecation. At present, approximately 10 % of the Bulgarian population does not have access to basic sanitary facilities within their households (Eurostat, 2019). The lack of proper sanitation could pose a risk to human health due to exposure to pathogens (WHO, 2019). The issue is common to other countries on the Balkan peninsula including Romania (Eurostat, 2019) and may be experienced in the Western Balkans EU accession countries[28]. This case study looks at the barriers to meeting the EU policy requirements related to waste water collection and sanitation, and the fulfilment of SDG6.
Geographies affected	Discharges from non-connected dwellings affect all four RBDs in Bulgaria. Therefore, this case study examines the problem nationwide rather than on RBD level.
Reasons	One of the main reasons for the high number of non-connected dwellings in Bulgaria is the lack of sufficient investment for waste water treatment infrastructure (Ministry of Environment and Water, 2019). To implement compliance measures of UWWTD, funds of EUR 3 billion[29] are required (Ministry of Environment and Water, 2019). Under the Operational Programme Environment 2014-2020, funding of EUR 993 million was secured to achieve compliance in 85 agglomerations with more than 10 000 p.e. (Ministry of Environment and Water, 2019). Nevertheless, a significant number of measures remain with unsecured funding (Ministry of Environment and Water, 2019). In some agglomerations, sewerage network is constructed but not all of the dwellings are connected due to the need of additional investments from every user for connecting to the sewage (Ministry of Environment and Water, 2019). The legal obligation imposed on non-connected dwellings to connect to existing sewers is in force but there is no information if this regulation has succeeded in raising the connection rate (Ministry of Environment and Water, 2019).

[27] Bulgaria's transition period to comply with the UWWTD ended on 31 December 2014 (European Commission, 2017a).

Bulgaria: Barriers to access to sanitation	
Status of the receiving water body	A significant proportion of the Bulgarian territory has been designated as sensitive catchment for nitrogen and phosphorus, with very small exceptions of catchments in the North East that have been designated as normal area under the UWWTD (EEA, 2019c).
Is the entire RBD affected	Most agglomerations across all River Basin Districts (RBDs) were reported to be affected in the 2nd River Basin Management Plans (RBMP) (Ministry of Environment and Water, 2016).
Type of treatment unit	Domestic and industrial waste water in non-connected agglomerations are collected in septic tanks or cesspools. These tanks are often not water-tight and isolated, and there is probability that waste water could pollute groundwaters with pollutants of domestic and agricultural origin (organic pollutants and nutrients) (Ministry of Environment and Water, 2019).
Response to the challenge	In response to the challenges with access to sanitation, Bulgaria has implemented a prioritisation approach to target the most densely populated areas with no connectivity to waste water treatment. For instance, the Operational Programme Environment (2016-2020) is focussed on investments of getting full compliance with the requirements of the UWWTD and the Drinking Water Directive (DWD) for the agglomerations above 10 000 p.e. (Ministry of Environment and Water, 2019). However, the progress in agglomerations of less than 2 000 p.e. is rather small due to the trend of population decrease (Ministry of Environment and Water, 2019). To address gaps in funding, funds collected by the Enterprise for the Management of Environmental Protection Activities from water fees are provided to municipalities in the form of grants to be used for waste water infrastructure development (Ministry of Environment and Water, 2019). All agglomerations within the scope of the UWWTD which have not achieved full compliance are prioritised. Furthermore, similar prioritisation is applied in measures introduced as a part of the RBMP (Ministry of Environment and Water, 2019). With respect to best practice, in agglomeration Vratsa there are several pilot IAS installed to demonstrate different appropriate systems for urban waste water treatment (Ministry of Environment and Water, 2019).
Costs of the solution	The overall cost of the measures currently in place to improve waste water collection and treatment rates in agglomerations of more than 2 000 p.e. are EUR 3 billion (Ministry of Environment and Water, 2019). The figure concerns the entire territory of Bulgaria.
Benefits of the solution	The benefits of these measures include improving access to sanitation and improving water quality of surface and groundwater bodies. The latter point is illustrated in the East Aegean RBD, where most water bodies where collection systems and UWWTPs were developed in the 1st RBMP period improved in quality (Ministry of Environment and Water, 2016).

2.3 Outlook for the future

Bulgaria is making significant investments in the area of urban waste water treatment, prioritising agglomerations of more than 10 000 p.e., followed by agglomerations of more than

[28]Albania, Macedonia, Montenegro, Serbia

[29] The figure accounts for the development of sewerage infrastructure and the development and upgrade of UWWTPs.

2 000 p.e. Between 2014 and 2020, a budget of EUR 993 710 is invested as a part of Operational Programme Environment (OPE, 2019)**.**

Furthermore, Bulgaria is in the process of making several revisions to its legal framework to ensure quick and cost-efficient compliance with the UWWTD as presented in **sub-section 2.1.5.**

Regarding IAS, Bulgaria is considering a revision of the legal framework to enable the use of IAS other than watertight cesspools (Ministry of Environment and Water, 2019). Furthermore, the revision will aim to address the existing legal gap with respect to non-connected dwellings in areas that are not sparsely populated (Ministry of Environment and Water, 2019). The possible revision will be informed by the recommendations of the 2015 World Bank report on IAS use in Bulgaria (World Bank, 2015). Overall, the rates of connectivity to waste water collection and treatment in agglomerations of more than 2 000 p.e. are expected to grow in Bulgaria, with densely populated areas being prioritised. The agglomerations of less than 2 000 p.e. are likely to increase in number Funding for action in smaller agglomerations is available under the Rural Development Programme, however no assessment of the funding needs with respect to waste water has been performed at this stage (Ministry of Environment and Water, 2019). Furthermore, no imminent policy interventions have been planned.

2.4 Abbreviations used in the country chapter

IAS	Individual and other Appropriate Systems
p.e.	Population equivalents
RBD	River Basin District
RBMP	River Basin Management Plan
UWWTD	Urban Waste Water Treatment Directive
WFD	Water Framework Directive
WWTPs	Waste Water Treatment Plants

3 Finland

3.1 Country factsheet

3.1.1 Overview

Finland	
	Environmental impacts from non-connected dwellings • 52 % of surface water bodies under pressure from diffuse pollution sources (838 out of 1 624) are affected by discharges not connected to the sewerage system. This is the equivalent of 12 % of all surface water bodies (6 806) in the country (EEA, 2019). • 35 % of the groundwater bodies area that is under pressure from diffuse pollution sources (147 km^2 out of 417 km^2) is affected by discharges not connected to sewerage network. This is the equivalent of 1 % of the groundwater body area (9 969 km^2) in the country.
	Proportion of non-connected dwellings: • Approximately 1 million people in Finland live in agglomerations of less than 2 000 population equivalent (p.e.) (around 18 % of the total population). An additional 1 million vacationers have a seasonal presence in these agglomerations (Ruokojärvi, 2007). All agglomerations of more than 2 000 p.e. have full compliance with waste water collection and treatment requirements of the UWWTD (EEA, 2019c).
	Legal framework regulating non-connected dwellings: • Finland has extensive legislation regulating the operation of IAS. All non-connected dwellings located less than 100 m from surface water bodies or in a groundwater area are required to apply IAS systems that remove at least 80 % of organic matter, at least 70 % of the total phosphorus, and at least 30 % of total nitrogen. The requirement is still in its implementation stage, with deadlines falling in October 2019.

3.1.2 Non-connected dwellings

While Finland achieves **full compliance with respect to waste water collection and treatment in agglomerations of more than 2 000 p.e., it also has a high percentage of remote and rural areas which are not regulated by the UWWTD** (EEA, 2019a). Finland is the eighth-largest country in Europe in terms of area, and the most sparsely populated country in the European Union (Vorne and Silvenius, 2017)**. It has been estimated that 1 million people live in agglomerations of less than 2 000 p.e. and are not connected to waste water collection and central treatment (around 18 % of the total population) and an additional 1 million vacationers have a seasonal presence** (Ruokojärvi, 2007). At least 286 000 dwellings apply IAS in rural areas[30] (Ruokojärvi, 2007) with an additional 500 000 holiday homes (Kallio & Suikkanen, 2019).

As a party to the Helsinki Convention (Box 3-1), Finland is required to take actions to minimise pollution to the Baltic Sea from on-land activities and to apply Best Available Techniques together with the 'Precautionary' and 'Polluter pays' principles to ensure the highest level of environmental protection (HELCOM, 2019). Finnish water regulations embed these principles and place focus on

[30] It is unclear what is the definition of "rural" used in this analysis. However, since no IAS application has been reported in agglomerations of more than 2 000 p.e., it could be inferred that rural areas are smaller than 2 000 p.e. (EEA, 2019a).

treatment of waste water treatment from rural areas, which has been identified as one of the contributors to eutrophication in the Baltic Sea (HELCOM, 2019). For instance, the Finnish Environmental Protection Act (527/2014, as amended 19/2017) states that domestic discharges not connected to a waste water collection system should be treated prior to release in water bodies (Ministry of Environment, 2017). Owners are required to choose and install IAS that would provide sufficient treatment considering the load size and the environmental impacts (Ministry of Environment, 2017). As for the general treatment specifications, the Environmental Protection Act 2017 requires that all onsite owners must fulfil the requirement of removing from influent a minimum of 80 % of organic matter, at least 70 % of the total P, and at least 30 % of N, however, the local authority has the right to set stricter requirements for sensitive areas (Ministry of Environment, 2017).

Box 3-1 The Helsinki Convention

The 1992 Helsinki Convention entered into force on 17 January 2000. Its parties include Germany, Denmark, Latvia, Lithuania, Poland, Russia, Sweden and the European Community (HELCOM, 2019)

The State-Parties to the Convention agreed to take actions individually and collectively to promote the ecological restoration of the Baltic Sea area, including inland waters as well as the water of the sea itself, the sea-bed and the Baltic Sea catchment (HELCOM, 2019). The parties are required to implement:

- Precautionary principle, that is, to take preventive measures when there is reason to assume that substances or energy introduced, directly or indirectly, into the marine environment may create hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea;
- Best Environmental Practice and Best Available Technology (criteria set out in Annex II of the Convention);
- Polluter pays principle, that is, make the party responsible for producing pollution responsible for paying for the damage done to the environment (HELCOM, 2019).

In 2007, the parties to the Convention introduced the ambitious HELCOM (Baltic Marine Environment Protection Commission, known as the Helsinki Commission) Baltic Sea Action Plan (BSAP) with the aim to achieve a good environmental status of the marine environment by 2021 (HELCOM, 2007). The main sections of the action plan tackle four themes: eutrophication, hazardous substances, the protection of biodiversity, and marine traffic (HELCOM, 2007). The parties to the convention are required to introduce national implementation programmes through various national policies, including relevant EU Directives such as the WFD (HELCOM, 2007).

It is noteworthy that sparsely populated areas are the third-largest source of diffuse nutrient loads into the Baltic Sea, considering all Baltic countries (Vorne and Silvenius, 2017).

Owners are required to maintain the IAS (i.e. emptying the sludge) while the municipality is responsible for organising waste management for the sludge generated in waste water systems for residents (i.e. the transportation and treatment of the sludge). However, there is some variation between municipalities with regards to how this is organised. Discharge intervals for sludge are specified in the waste management regulations of the municipalities. A common requirement is that septic tank sludge must be emptied if necessary, but at least once a year. The requirement also applies to summer cottages. Cesspools and their filling must be monitored regularly and emptied if necessary. The owner must keep a record of the cesspool de-sludging. Before

undertaking renovation of IAS to meet regulatory requirements, homeowners are required to apply for a permit and produce a waste water treatment plan (Finnish Environmental Institute, 2019).

The requirements must be implemented during the construction phase in all new dwellings built after 2004 and are embedded in the building permit. Old dwellings are required to implement them when they undertake other major renovations. Exception are properties located in transitional areas, i.e. areas less than 100 m from water systems or in a groundwater area which must fulfil requirements by the end of the transition period in October 2019 (Ministry of Environment, 2017). A 2019 study by SYKE concluded that 16 % (45 000 out of 286 000) of permanent dwellings with IAS constructed before 2004 are in transitional areas and required renovation (Kallio & Suikkanen, 2019). Similarly, 16 % (69 000 out of 441 000) of holiday homes with IAS constructed before 2004 are in transitional areas and require renovation (Kallio & Suikkanen, 2019). The figures are based on results from water advice visits in sparsely populated areas (Kallio & Suikkanen, 2019).

Owners could apply for derogations in instances where the waste water load is insignificant and compliance with the regulation will be associated with disproportionate costs (Ministry of Environment, 2017). The implementation of the regulation is monitored by regional authorities prioritising inspections of areas where non-compliant IAS could lead to environmental or health damage (Finnish Environmental Institute, 2019).

Furthermore, IAS are also regulated by the Government Decree on Treating Domestic Waste Water in Areas Outside Sewer Networks (157/2017) which provides standards for planning, construction, use and maintenance of IAS and sets the normative standard for the treatment of waste water in areas sensitive to pollution (Ministry of Environment, 2017a). It is unclear how these standards relate to the standards imposed in the Environmental Protection Act (527/2014, as amended 19/2017).

The cost of the IAS is mainly covered by the owner, as financial aid from the Finnish Ministry of Environment is no longer available (Finnish Environmental Institute, 2019). However, owners can request tax credits for household expenses, which include the share of work in the construction and installation costs of the IAS (Finnish Environmental Institute, 2019). The maximum amount of tax credit that can be claimed by each person in a household is EUR 2 400 per year (Finnish Environmental Institute, 2019). The Housing Finance and Development Centre of Finland (ARA) - acting under the Finnish State - also provides grants for those on low incomes intended to support for pensioners, disabled, war veterans and widows (Finnish Environmental Institute, 2019).

IAS types applied in Finland include (Ruokojärvi, 2007):

- Small WWTPs serving agglomerations > 50 p.e.;
- Cluster systems, i.e. all waste water from on-site IAS is collected and transferred to a central WWTP;
- Two-stage septic tanks for greywater and dry/composting toilet for black water[31];
- Two-stage septic tanks for greywater and cesspool for water;
- Small on-site treatment plants;
- Three-stage septic tanks and sand filtration; and
- Three-stage septic tanks and infiltration into ground.

In addition, in houses not equipped with water pipes where only minor amounts of water are handled, waste water is directly released to the ground through a concrete sink ring (Ruokojärvi, 2007).

The Finnish Environment Institute (SYKE) collects data regarding the extent to which each IAS type is used in Finland. According to their estimates, one-quarter of all properties treat black water and

[31] The term “greywater” refers to all waste water from a household apart from toilet water. The term “black water” refers to toilet water.

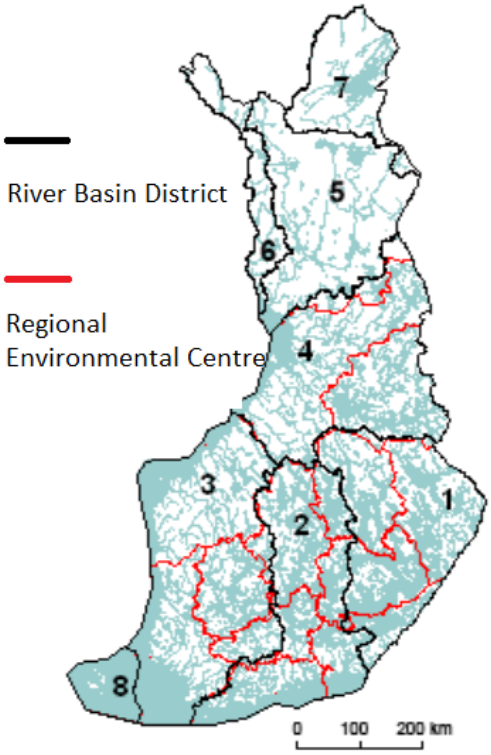
greywater separately. The remaining three quarters treat all waste water in a single system, with septic tanks being applied in 80 % of the cases (Ministry of Environment, 2019a). Less than 15 % of the single system users apply small on-site WWTPs, sand filtration systems and infiltration systems. 2 % of them collected their waste water into cesspools, with the effluent being emptied and transported to a WWTP for further treatment, and in a further 2 % of the cases the produced waste water is negligible and therefore not treated (Finnish Environmental Institute, 2019). The remaining 25 % of households have separate systems (mostly septic tanks) for black water and grey water.

The Finnish Water Association has released guides on domestic waste water treatment for households and holiday homes which encourage the use of the techniques specified above and suggest that different levels of treatment should be applied for black and greywater (The Finnish Water Association, 2019).

3.1.3 River Basin Districts affected by diffuse pollution from non-connected discharges

Finland has eight RBDs, as presented in Figure 3-1. Of these, one is shared with Sweden (RBD 6), one with Norway (RBD 7) and one has been defined to cover the autonomous Åland Islands province (RBD 8), where the WFD is being implemented by the provincial government.

Figure 3-1 Map of Finland and the Finnish RBDs[32]



Source: Ministry of Environment (2019)

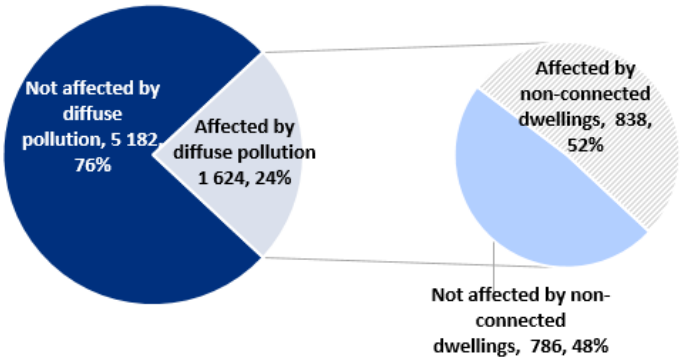
Overall, 24 % of the surface water bodies in Finland achieved high ecological status and 56 % good ecological status (EEA, 2019). Furthermore, 88 % of the surface water bodies achieved good chemical status (EEA, 2019). In comparison, 93 % of all groundwater bodies achieved good chemical status (4 % failed to achieve good chemical status and for 3 % the status was unknown) (European Commission, 2019a). Chemical and nutrient pollution were reported to be significant pollutant

[32] 1. Vuoksi River Basin District 2. Kymijoki-Gulf of Finland River Basin District 3. Kokemäenjoki-Archipelago Sea-Bothnian Sea River Basin District 4. Oulujoki-Iijoki River Basin District 5. Kemijoki River Basin District 6. Tornionjoki IRBD (shared with Sweden) 7. Teno, Näätämöjoki and Paatsjoki IRBD (shared with Norway) 8. The autonomous Åland Islands province.

groups, with 51 % of surface water bodies reporting pressures from chemical pollution and 29 % pressure from nutrient pollution (European Commission, 2019a).

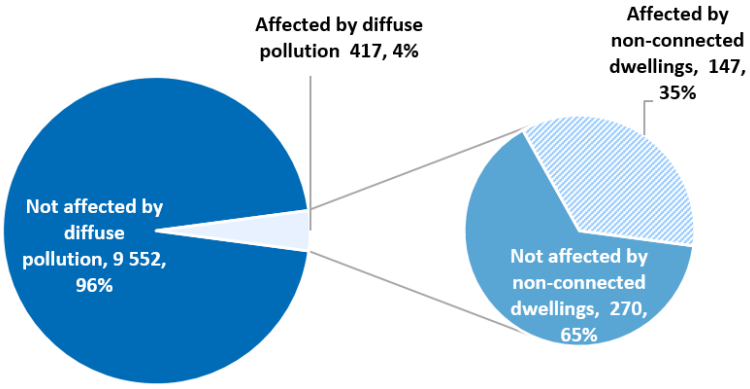
As illustrated in Figure 3-2, **52 % of surface water bodies** under pressure from diffuse pollution sources are affected by discharges not connected to sewerage network (or 12 % of all surface water bodies in the country) (EEA, 2019). In comparison, and as shown in Figure 3-3, **35 % of the groundwater body area** that is under pressure from diffuse pollution sources is affected by discharges not connected to sewerage network (or 1 % of all groundwater bodies in the country) (EEA, 2019). Overall, pressures from non-connected dwellings were reported to be the 4th most significant pressure source for surface water bodies and the 9th most significant source for groundwater bodies in Finland (European Commission, 2019). Finally, the issue of diffuse pollution from non-connected discharges was reported in all Finnish RBDs, with the most common pollutants being nutrients such as N and P (Ministry of Environment, 2016). Further information on how these figures have been derived is available in **Annex 1.**

Figure 3-2 Surface water bodies affected by pressures in Finland: Number affected by diffuse pollution; Number with diffuse pollution from non-connected dwellings[33]



Source: Own compilation based on EEA (2019)

Figure 3-3 Ground water body area (km²) affected by pressures in Finland: Area affected by diffuse pollution; Area with diffuse pollution from non-connected dwellings[34]



Source: Own compilation based on EEA (2019)

Finally, it has been estimated that in rural areas the discharge of phosphorus to water is 50 % higher than in urban areas (Ruokojärvi, 2007).

[33] Water bodies may be affected by more than one pressure.
[34] Water bodies may be affected by more than one pressure.

3.1.4 Underlying reasons for the problem

The potential reasons underlying the problem of diffuse pollution from non-connected dwellings in Finland are listed below:

- Finland is the most sparsely populated country in Europe, with many properties using IAS (Vorne and Silvenius, 2017). In addition, the number of non-connected holiday houses is high (approximately half a million) and continues to grow as more holiday homes are in development (Ministry of Environment, 2016).
- According to the information reported in the 2nd RBMP, many IAS in Finland do not meet the required national standards (Ministry of Environment, 2016). One reason for the high number of non-compliant properties is the constant changes in legislation over the past 15 years. When the Environmental Protection Act first came into force in 2004, it was heavily criticized and considered unreasonably expensive for the people living in sparsely populated areas (Finnish Environmental Institute, 2019). Therefore, several revisions have been introduce to lessen the requirements of the Act (Finnish Environmental Institute, 2019). If more stringent requirements are introduced again, it is likely that similar reactions could follow as a result (Finnish Environmental Institute, 2019).
- Different IAS technologies have different emission reduction efficiencies, and as a result, the inappropriate choice of IAS could contribute to the pressures from non-connected dwellings. A study by Lehtoranta et al. focusing on Finland showed that applying separate treatment for greywater in infiltration system and dry toilet[35] for blackwater is the most sustainable choice (Lehtoranta et al., 2014). By contrast, the application of dry toilet for black water and greywater filters, sand filters, biofilters or sequencing batch reactors for greywater were associated with higher environmental impact and contributions to eutrophication of water bodies (Lehtoranta et al., 2014).
- Cold climates reduce the nutrient removal efficiency of biological waste water treatment. Studies examining the performance of IAS in Finland concluded that the options such as sand filters or septic tanks are highly influenced by temperature variability (Luostarinen et al., 2007; Ahmed at al., 2005; Kauppinen et al., 2014). As stated in **sub-section 3.1.2**, 80 % of the single treatment systems applied in Finland are septic tanks and approximately 15 % are small on-site WWTPs, sand filtration systems or other infiltration systems (Finnish Environmental Institute, 2019). Furthermore, single treatment systems are applied in 75 % of the non-connected dwellings in Finland (Finnish Environmental Institute, 2019).

3.1.5 Approaches to mitigating the problem

The approaches taken in Finland to mitigate the problem are listed below:

- At the national level, in 2017, Finland has introduced an extensive policy package regulating the performance of IAS (Ministry of Environment, 2017; Ministry of Environment, 2017a). The Finnish Environmental Protection Act 19/2017 is still in the implementation phase. Finland has also developed detailed guidelines on selecting suitable IAS taking into consideration characteristics of discharge (The Finnish Water Association, 2019).
- At RBD level, improving IAS in permanent and holiday homes and monitoring of the impacts of the measures have been listed in the packages of measures for the Kymijoki and Vuoksi RBD (Ministry of Environment, 2016). No information on similar measures has been included in the rest of the RBMPs. Some RBDs such as Kymijoki and Teno, Näätämöjoki and Paatsjoki have also listed measures focusing on improving the water use efficiency with the aim to reduce waste water from non-connected dwellings (Ministry of Environment, 2016).

[35] Type of composting toilet. Further information about the system is available in **Annex 2.**

- While there are no grants to cover IAS, support for installation or renovation of the IAS is provided through a system of tax credits for household expenses (Finnish Environmental Institute, 2019).
- Finland has been working on increasing the levels of connectivity to waste water treatment in agglomerations of less than 2 000 p.e. by developing waste water collection infrastructure (Ministry of Environment, 2016).
- Finland is a part of the Interreg project "VillageWaters"[36] which aims to determine the most effective waste water treatment solutions for households in sparsely populated area that use IAS. As a part of the project, an information tool has been developed to assist homeowners to select the most cost-efficient IAS for their area and household size (VillageWaters Project, 2019). The project concentrates on countries which are parties to the Helsinki Convention (HELCOM, 2019).

3.2 Case study: Operation of individual and other appropriate systems in cold climates

The case study for Finland focuses on the operation of IAS in cold climates and is presented below.

[36] https://www.villagewaters.eu/

Finland: Operation of individual or other appropriate systems in cold climates

Overview

Finland is a northern European country spread over 338 145 km^2 between lowlands and archipelagos to the south and mountainous areas to the north. Finland is home to 5.5 million inhabitants and is the country with the most sparsely populated areas in Europe. 85 % of the population is concentrated in urban areas along the southern coast. The rest of the population is spread across numerous small agglomerations, especially in the south and central regions, where the use of individual and other appropriate systems is prevalent. One-third of Finland's territory lies north of the Arctic Circle hence the country is dominated by a subarctic climate in the northern and central regions and a more temperate humid climate in the southernmost areas. Mean temperatures in July are between 13 °C and 17 °C and in February, between -3 °C and -22 °C.

Description of the issue	The operation of several types of individual and other appropriate systems (IAS) is hampered by cold climates. Several studies examining the situation in Finland established that IAS such as sand filters are significantly impaired under cold climatic conditions due to reduced biological activity or freezing (Luostarinen et al., 2007; Ahmed at al., 2005; Kauppinen et al., 2014). The specific temperature associated with reduced efficiency of IAS in Finland is below 12 °C (Finnish Environmental Institute, 2019).
Geographies affected	The entire territory of Finland has non-connected dwellings and is affected by cold climates. However, average temperatures are lower in northern Finland (Finnish Environmental Institute, 2019). There is no specific information on what river basin districts (RBDs) are affected the most.
Reasons	Cold climates reduce treatment efficiencies of biological treatment techniques such as sand filters (Luostarinen et al., 2007; Ahmed at al., 2005; Kauppinen et al., 2014). For them to operate properly, the incoming organic load should be reduced. The results from the reduced biological activity include higher level of pathogens and nutrients in the treated effluent. Septic tanks do not apply biological treatment, however where these have not been well insulated, they often freeze which leads to improper treatment of the load (Finnish Environmental Institute, 2019).
Status of the receiving water body	The entirety of Finland is designated as a nutrient sensitive area under the Urban Waste Water Treatment Directive (UWWTD) (EEA, 2019c). The catchments in the southern area and south coastal waters are sensitive to both nitrogen (N) and phosphorus (P) pollution, while the catchments in the central and northern region are sensitive only to P (EEA, 2019c)
Is the entire RBD affected?	No information is available with respect to the issue on sub-RBD level.
Type of treatment unit	As discussed in **sub-section 3.1.4**, septic tanks are the most common type of single treatment IAS applied in Finland, followed by small waste water treatment plans (WWTPs), sand filters and other infiltration systems (Finnish Environmental Institute, 2019). In addition, small WWTPs are applied mostly in agglomerations > 50 population equivalents (p.e.) (Ruokojärvi, 2007). This suggest that the issue of impaired IAS performance is widespread across Finland, especially in agglomerations of more than 50 p.e.

Finland: Operation of individual or other appropriate systems in cold climates	
Response to the challenge	Finnish legislation for IAS operation takes into account the temperature regime and requires IAS to comply with requirements based on an annual average (Finnish Environmental Institute, 2019). It is the responsibility of the property owner to select an IAS that has been found to be able to meet the requirements and it is strongly recommended to use a qualified waste water planner to support the selection process (Finnish Environmental Institute, 2019). The Finnish Environment Institute SYKE has a legal obligation to monitor IAS (Finnish Environmental Institute, 2019). The collected information is made publicly available (Finnish Environmental Institute, 2019). Monitoring is not usually performed systematically. Instead, a risk-based approach is taken prioritising properties in sensitive areas or where a complaint has been issued about the operation of IAS. Furthermore, municipalities provide in-depth advice to owners, regarding the choice of IAS available to them, maintenance plans and financing options (Finnish Environmental Institute, 2019). Finally, freezing problems are normally addressed by installing the IAS below the frost level and using insulation around pipes and chambers (Finnish Environmental Institute, 2019).
Costs of the solution	No specific costs are associated with the policy approach taken to address IAS operation in cold weather. The insulation of IAS to protect them from freezing is associated with less than 10 % of the total cost of IAS (Finnish Environmental Institute, 2019).
Benefits of the solution	The policy-based approach ensures that the reduced efficiency of IAS during the winter is compensated for in the summer. The specific IAS installation and insulation approaches reduce the risk of environmental impacts due to freezing. Furthermore, they reduce costs associated with thawing and repairing frozen IAS.

3.3 Outlook for the future

As discussed in **sub-section 3.1.2**, the **revised Finnish Environmental Protection Act (527/2014, as amended 19/2017)** imposes stricter requirements on IAS removal efficiencies. As a result, homeowners may need to install new IAS or rehabilitate their old IAS to comply with the regulation. Dwellings located within 100 m from water systems or in groundwater areas are required to comply with the regulation by October 2019. Therefore, renovations of IAS may occur in some dwellings by the end of the year.

No further information on future policies or investment plans for IAS infrastructure was provided by Finland during the consultation period or identified from the Finnish RBMP and the information reported under the UWWTD.

3.4 Abbreviations used in the country chapter

IAS	Individual and other Appropriate Systems
N	Nitrogen
P	Phosphorus
p.e.	Population equivalents

RBD	River Basin District
RBMP	River Basin Management Plan
SYKE	Finnish Environment Institute (Suomen ympäristökeskus)
UWWTD	Urban Waste Water Treatment Directive
WFD	Water Framework Directive
WWTP	Waste Water Treatment Plants

4 France

4.1 Country factsheet

4.1.1 Overview

France	
	Environmental impacts from non-connected dwellings: • **13 %** of all surface water bodies affected by diffuse pollution are under pressure from discharges not connected to the sewerage network (489 out of 3 887 water bodies). This is the equivalent of 4 % of all surface water bodies (11 414) in France. • **5 %** of the groundwater bodies area affected by diffuse pollution are under pressure from discharges not connected to the sewerage network (15 759 km^2 out of 313 056 km^2). This is the equivalent of 1% the total groundwater bodies area (1 235 075 km^2) in France as shown in the 2nd RBMP (EEA, 2019).
	Proportion of non-connected dwellings: • 13 million people are connected to IAS[37]. The total number of IAS nationwide in 2009 was 5 million and this number is likely still to be similar (Ministry for the Ecological and Solidary Transition, 2009a). • In 2017, only 7.8 million people applying IAS were covered by inspection services (ONEMA, Communes, EPCI, Directions Départementales des Territoires, 2017).
	Legal framework regulating non-connected dwellings: • Under the Water Law, areas, where IAS should be used, are determined by local authorities. The recommended type of IAS is septic tank with infiltration system, however, homeowners can choose alternative treatment options from a list of accredited IAS published on the Ministry of Environment and Solidary Transition website (Ministry for the Ecological and Solidary Transition, 2019a). • A public service responsible for inspections of IAS has to be set up in all municipalities. • Since 2012, the RBD authorities have to define 'area of environmental concern' (AEC) and national authorities have to define 'area of health concern' (AHC) to prioritise actions on IAS and minimise environmental and public health pressures from non-connected dwellings (JORF, 2012).

4.1.2 Non-connected dwellings

In the context of waste water management, France has the following classification of urban areas:

- **Agglomerations of more than 2 000 p.e.** where waste water is collected and treated in UWWTPs. These accommodate 77 % of the French population (approximately 46 million) (INSEE, 2018). **IAS is not applied in such agglomerations** (European Commission, 2017).

[37] France adopts the definition "non-collective waste water treatment systems" instead of IAS. The definition refers to systems treating waste water from single houses i.e. houses not connected to a public sewer system.

This results from the strict interpretation of the definition of "agglomeration" adopted in France, which excludes smaller settlements that are remote to the densely populated economic centres.

- **Settlements of less than 2 000 p.e. where dwellings are sufficiently aggregated**[38], and waste water must be collected and treated in a smaller WWTPs. These settlements accommodate 23 % of the French population (8 million people) (INSEE, 2018) and are served by 17 766 small WWTPs[39] (with the total treatment capacity of 9.4 million p.e., 10 % of the treatment capacity installed in France) (Ministry for Ecological and Solidary Transition, 2017)**.** This type of unit is not common to the other countries examined in this study**.**
- **Scattered dwellings of less than 2 000 p.e.** where non-connected waste water treatment systems (NCWWTSs)[40] are applied. In 2009, there were approximately 13 million inhabitants connected to 5 million NCWWTS installations (Ministry for the Ecological and Solidary Transition, 2009a)**.**[41] Out of these, only about 4.2 million inhabitants are connected to NCWWTS compliant with the national standards (Ministry for the Ecological and Solidary Transition, 2009a)**.**

The classification of urban areas has been implemented following UWWTD transposition in the Water Law 1992 (JORF, 1992). To ensure that NCWWTS provide an equivalent level of environmental protection as UWWTPs and are maintained and operated properly, all municipalities have to define the area where a collection system is or will be put in place **and the area where NWWTS have to be used, maintained and de-sludged on a regular basis.**

The overall policy framework determining the operation of NCWWTS has been systematically reviewed, and currently consists of the Water Law 2006 (JORF, 2006), the Law on Territorial Organisation (JORF, 2015). and four additional Decrees, aiming at:

- **The establishment of NCWWTS public services –** these are responsible for the 4-yearly NCWWTS inspections. The inspections ensure systematic data collection and the identification of any operational issues. NCWWTS which do not conform with national standards should be corrected within four years, or within one year if the house has been sold. Furthermore, the public services are responsible for NCWWTS reports submitted by new homeowners.
- **Recommendation for the type of NCWWTS applied** - the recommended NCWWTS is a septic tank with infiltration system. If the soil does not have the appropriate infiltration properties, a reconstituted soil with gravel, sand or zeolite can be used instead (Ministry for the Ecological and Solidary Transition, 2019a). Where a septic tank could not be used, the homeowner can choose to apply another nationally accredited NCWWTS. The list of nationally accredited systems has been published on the Ministry of Environment website and in the Official Journal of the French Republic (Ministry for the Ecological and Solidary Transition, 2019a). Where this approach is taken, the public authority needs to approve compliance of the selected NCWWTS (Ministry for the Ecological and Solidary Transition, 2019a).
- **Guidelines on the use of NCWWTSs** - A dedicated national website is available providing relevant information, documentation, guidelines and explaining the legal framework which applies to IAS (The Ministry for the Ecological and Solidary Transition, 2019b).

[38] The area has more than 50 inhabitants with distance between houses of no more than 200 m.
[39] A large proportion of these are constructed wetlands (Morvannou et al., 2015).
[40] The definition used in France instead of IAS.
[41] No important urbanisation movements occurred since 2009 in France (World Bank, 2019), and therefore it is assumed that the figure is still accurate.

- **Accreditation scheme for de-sludging activities** - An accreditation scheme has been introduced for private companies responsible for de-sludging of NCWWTS and sludge transportation (JORF, 2009).

Furthermore, the Law on Territorial Organisation will introduce a territorial restructure to transfer public services from communal to inter-communal public bodies by 2026 (JORF, 2015). As a result, the service and its associated costs should become more harmonized and the data collection process is expected to improve (Ministry for Ecological and Solidary Transition, 2019).

In 2012, to further support actions on NCWWTS and ensure compliance with national standards, a Decree introduced two new concepts, called **'area of environmental concern' (AEC) and 'area of health concern' (AHC)** (JORF, 2012)**.** AEC have to be defined by the RBMP with the support of the NCWWTS public service. There is no nationally applied criteria or definition of AEC (Ministry for Ecological and Solidary Transition, 2019). AHC are defined by the State on the basis of the following considerations (Ministry for Ecological and Solidary Transition, 2019):

- Proximity to areas for abstraction of drinking water;
- Proximity to bathing area;
- Proximity to shellfish waters and marine protected areas.

The criteria for determining AHC is similar to the criteria used for sensitive areas under the UWWTD. However, its scope is extended under the WFD to cover local issues in areas of less than 2 000 p.e.

The Water Management Plans on sub-RBD level (SAGE) are often involved in the definition of AEC and AHC (JORF, 2015a).

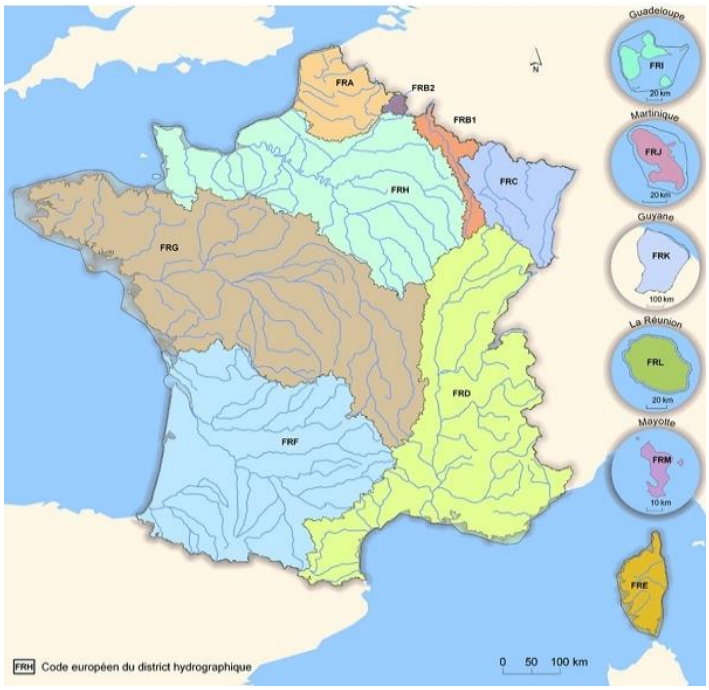
Finally, **two action plans (PANANC) were put in place** to support the implementation of the NCWWTS legal framework. These covered the periods 2009-2013 and 2014-2019 (Ministry for the Ecological and Solidary Transition, 2009a; 2015) and broadly had the following aims:

- To enhance the NCWWTS suppliers and improve design and control of the treatment units;
- To support NCWWWTS public services;
- To support homeowners applying NCWWTSs with information on relevant procedures;
- To train all NCWWTS owners and regulators.

4.1.3 River Basin Districts affected by diffuse pollution from non-connected discharges

France has identified 14 RBDs[42], as shown in Figure 4-1. This includes six overseas RBDs which have been included within all statistics presented in the chapter.

Figure 4-1 French River Basin Districts



Source: OIEau (2011)

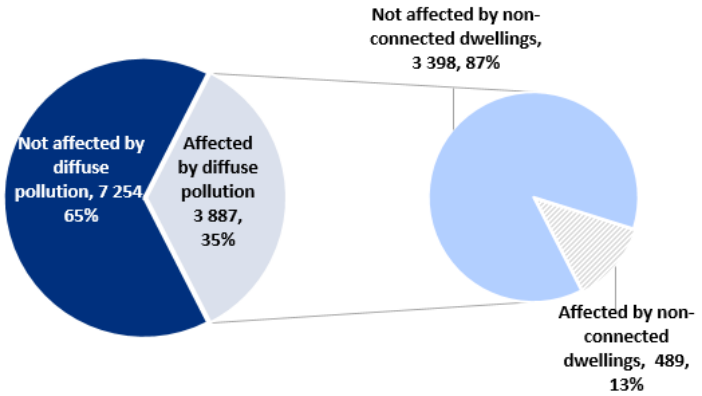
The second RBMP shows that **46 % of rivers and lakes, 23 % of artificial or heavily modified water bodies, 69% of groundwater had achieved good or high status** (OIEau, 2019). According to France's 2nd RBMP, there are 7 RBDs (Rhine, Meuse, Seine-Normandie, Guadeloupe, Martinique, Reunion, Mayotte) with surface water bodies affected by pressures from non-connected dwellings, and 2 RBDs (Seine-Normandie, Reunion) with groundwater bodies affected (EEA, 2019).

As illustrated in Figure 4-2, **13 % of surface water bodies** under pressure from diffuse pollution were affected by discharges not connected to sewerage network (or 0.3 % of all surface water bodies in the country) (EEA, 2019). In comparison, and as illustrated in Figure 4-3, **5 % of the groundwater body area** under pressure from diffuse pollution is affected by discharges not connected to sewerage network (or 1 % of the total groundwater body area) (EEA, 2019). In most RBDs, the pressure from non-connected dwellings is relatively limited compared to other types of pressures (OIEau, 2019). Further information on how these figures have been derived is available in **Annex 1.**

Overall, the pressure from discharges not connected to the sewerage network is of a smaller scale in France when compared to other countries examined in this study. However, as noted in **Section 4.1.2**, NCWWTS in France have been subject to extensive regulations which date back to 1992.

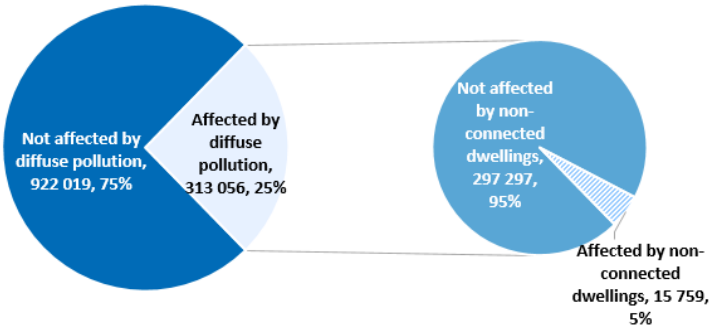
[42] Scheldt, Somme and coastal waters of the Channel and the North Sea, Meuse, Sambre, Rhine, Rhone and Coastal Mediterranean, Corsica, Adour, Garonne, Dordogne, Charente and coastal waters of Aquitania, Loire, Brittany and Vendee coastal waters, Seine and Normandy coastal waters, Guadeloupe, Martinique, Guyana), Reunion Island, Mayotte.

Figure 4-2 Surface water bodies affected by pressures in France: Number affected by diffuse pollution; Number with diffuse pollution from non-connected dwellings[43]



Source: Own compilation based on EEA (2019)

Figure 4-3 Ground water body area (km^2) affected by pressures in France: Area affected by diffuse pollution; Area with diffuse pollution from non-connected dwellings[44]



Source: Own compilation based on EEA (2019)

Pressures from non-connected dwellings were reported to be significant in the case of 4 overseas RBMPs (Guyana, Réunion, Guadeloupe and Martinique) where 40 to 50 % of the population applies NCWWTS, and a large proportion - up to 90 % in the case of Martinique - are considered non-compliant with national standards (JORF, 2015a). The respective RBMPs identify that the issue is also related to local climates and there is a need to develop NCWWTSs adapted to tropical areas. In the case of Guyana and Réunion, where the cultural diversity of population is wider, a need has been identified to develop technically simple but robust solutions for scattered non-connected dwellings (JORF, 2015a).

It is recognised in the RBMPs for these RBDs that pollution pressures from non-connected dwellings could relate to pollution from the following:

- The operation of small economic activities like farms or other SMEs not connected to sewers (JORF, 2015a);
- The release of domestic waste waters from households with non-compliant NCWWT systems, from non-connected dwellings (Guyana, Réunion, Guadeloupe and Martinique), from absence of a sub-soil drainage system or direct discharge of grey waste water into the receiving environment (Martinique and Réunion) (JORF, 2015a);

[43] Water bodies may be affected by more than one pressure.
[44] Water bodies may be affected by more than one pressure.

- Waste water discharged with no prior treatment from mobile-homes, camping cars and boats used by tourists in Loire-Bretagne) (JORF, 2015a).

It is noteworthy that some RBMPs recommend the application of NCWWTS as an alternative to small WWTPs which are reported to have higher environmental impact on water bodies (AESN, 2015).

4.1.4 Underlying reasons for the problem

Even though France has implemented an extensive policy package to regulate NCWWTS, 13.5 % of the diffuse pollution pressures on surface water bodies originate from discharges not connected to the sewerage network. The potential reasons underlying the problem in France are listed below:

- The standard NCWWTS used in France, i.e. a septic tank with infiltration using the natural soil, does not operate well in shallow groundwater, insufficiently permeable soil or soil with unsuitable biophysical characteristics (Comité de bassin de la Guadeloupe, 2015) (Ministry for the Ecological and Solidary Transition, 2019c). Owners of septic tanks which experience such issues often do not adjust or change their systems. Less than 50 % of the inspected IAS were compliant with national requirements (ONEMA, Communes, EPCI, Directions Départementales des Territoires, 2017)
- There are several accredited NCWWTSs in France but not all of these provide sufficient treatment. For instance, a study examining 246 real installations in mainland France concluded that from 21 possible technical combinations of IAS equipment, only five reached the acceptable level for N, BOD and TSS removal and were sufficiently well maintained (excluding de-sludging and standard maintenance (Boutin et al., 2017).
- All French municipalities (including in overseas territories) had to implement a NCWWTS public service by 2005. However, in 2017, only 60 % of the population applying NCWWTS[45] has reported (ONEMA, Communes, EPCI, Directions Départementales des Territoires, 2017). For small municipalities, reporting is not an easy task and even if the service is in place, the reporting is not fully operational. In some of these areas, the service is not in place and no advice or inspections are available to NCWWTSs owners. The lack of monitoring means that issues with NCWWTSs could not be identified and resolved in a timely manner (Ministry of the Ecological and Solidary Transition, 2019). All RBMPs identify a specific action to support the implementation of this public service in the next period, in particular in AECs, where the rehabilitation of NCWWTS will be subsidised. Despite the requirement for all households using NCWWTS to maintain their system in good working conditions, and have it inspected every four years, the systems are located on private ground and hence the public service has limited power when it comes to enforcement of the identified actions (Ministry for the Ecological and Solidary Transition, 2019c).

4.1.5 Approaches to mitigating the problem

France has implemented several actions to mitigate pollution from non-connected dwellings, including:

- It introduced national action plans (PANANC 2009-2013 and 2014-2019) with a set of actions aiming at the overall improvement of NCWWTSs operation. Integral to the national action plans is the engagement and awareness strategy, which aims to inform all actors of their rights, obligations as well as the technical solutions available via a public national website (Ministry for the Ecological and Solidary Transition, 2015a) (Ministry for the Ecological and Solidary Transition, 2019c).

[45] Estimation based on following assumptions: 13 million inhabitants are connected to NCWWTS and 7.8 million are covered by an active public service reporting information in the national system. Most of the remaining population have a service, not currently reporting in national system but 3 300 settlements had no service in 2015.

- The NCWWTS public services conduct inspections of existing installations every four years as well as assess new NCWWTS installations (Ministry for the Ecological and Solidary Transition, 2019c).
- The Law on Territorial Organisation 2015 restructures the way water and waste water services operate, reducing the number of public services but expanding their scope and geographical coverage (JORF, 2015). The regulation should be implemented by 2026 in all municipalities (JORF, 2015).
- Since 2009, a grant scheme has been made available to assist owners with associated costs for house renovations, by allowing them a zero-interest loan. Under the scheme, loans can be acquired for the installation or rehabilitation of NCWWTS. IAS consuming energy for the purpose of treatment are not eligible for funding (JORF, 2009).
- In 2019, a separate grant scheme has been made available to finance new or rehabilitate existing NCWWTS (Ministry of Housing, 2019). Both grant schemes are still available and there are no plans of discontinuing them (Ministry for Ecological and Solidary Transition, 2019).
- The RBD authorities are progressively implementing AHC and AEC in RBMPs with associated financing grants to minimise pollution from non-connected dwellings in these areas. They also support research to develop techniques which will perform better in tropical climates (JORF, 2012).

4.2 Case study: Prioritising action on sensitive areas

This section discusses France's approach to reducing pollution from non-connected dwellings by prioritising action on sensitive areas.

France: Prioritising action on sensitive areas

Overview

France is a large country with an area of 643 801 km² and has a very diversified climate, soil, population density and landscape. France is home to 67 million inhabitants of which 13 million are using non-collective waste water treatment systems. The environmental policy is managed at the national level with rules defined for the whole territory of France. Non-collective waste water treatment systems are managed at the local level. Detailed data on status of the systems is therefore not collected at national level. Acknowledging diffuse pollution pressures from non-connected dwellings, the Ministry of Environment published a decree according to which pollution hotspots could be defined as 'area of environmental concern' and 'area of health concern'. Once an area is designated as area of environmental or health concern, authorities develop sets of measures aiming at mitigating the issue and assign funding to them. The measures could include the inspection and rehabilitation of non-collective waste water treatment systems.

Description	Despite a well-established legal and technical framework for non-collective waste water treatment systems (NCWWTS), non-connected dwellings are still identified as one of the pressures preventing good status of waters (OIEau, 2019). The issue can have an impact on public health through a microbiological contamination of abstraction wells, bathing and other waters used for recreational activities, and fishing areas. It can also have an impact on the quality of the environment, and on protected areas, by creating oxygen depletion or through excessive input of nutrients (SAGE Sambre, 2017)
Geographies affected	NCWWTs are spread across France and therefore all river basin districts (RBDs) are or can be affected. The case study focusses on the Sambre RBD (SAGE Sambre, 2017) which is part of a transboundary RBD shared with Belgium. Sambre RBD is one of the most advanced in defining its areas of environmental concern, and the pragmatic method they used to develop it can be applied elsewhere. All RBD and/or sub-units in France are required to define their AEC alone or with support from the NCWWTS public services. However, most RBDs are still only undertaking preliminary studies. The Sambre RBD encompasses 655 river water bodies and a wide set of wetlands and protected areas. The RBD has a dual character, urban and rural with a big agglomeration, Maubeuge, and an average population density of 165 inhabitants/km². 66 % of the RBD territory is used for agriculture and 22 % is covered by natural areas (Région Nord–Pas de Calais – Direction du Développement Durable, 2014). It is covered by 5 NCWWTS public services which together are responsible for the control of 8 096 individual NCWWTSs. Information on geographical location of each NCWWTS is available, but the knowledge about the systems (e.g. compliance with standards, type of systems, size) is limited and there is no information on the extent to which they impact different rivers in the RBD.
Reasons	The main problem is that design of NCWWTS often does not meet nationally defined standard rules, there are issues with appropriate operation and maintenance of NCWWTS. Risks for water quality also arise where there is no NCWWTS or alternative treatment in place (ONEMA, Communes, EPCI, Directions Départementales des Territoires, 2017). This leads to untreated or insufficiently treated waste water entering the aquatic environment.

France: Prioritising action on sensitive areas	
Status of the receiving water body	France identified 106 "sensitive areas" in which nitrogen (N) and/or phosphorus (P) must be treated, but approximately 70-80 % of the territory is considered normal area under the UWWTD (Ministry for Ecological and Solidary Transition, 2019). The Sambre is an international river, and the French part is a sensitive area requiring mitigation of N and P pollution. It is unclear what level of N and P removal is provided by the NCWWTS applied in the RBD.
Is the entire RBD affected	The most affected parts of the RBD will be designated as areas of environmental and health concern.
Type of treatment unit	The most widespread NCWWTS are septic tanks connected to low-depth underground drainage systems using the local soil as a secondary treatment with either simple drainage or infiltration trenches. Other nationally accredited systems include compact filters, planted filters and microstations (Ministry for the Ecological and Solidary Transition, 2019).
Response to the challenge	In the Sambre RBD, areas of environmental concern were defined with the support of NCWWTS public services and local representatives from the Ministry of Environment, inter-ministerial departments, RBD authority (Agence de l'Eau Artois Picardie) and regional natural park authorities. The approach to identifying areas of the greatest concern was based on apportioning the waste water effluent from NCWWTS (estimated at 315 l/day per NCWWT) to rivers with ecological hotspots (e.g. wetlands, nature parks, rivers, Natura 2000 areas) during low flows (5-year low water flow)[46]. Areas of environmental concern were those where a waste water flow from NCWWTS was greater than 2% of the overall river flow. This exercise identified 6 sub-basins within the Sambre RBD that were designated as areas of environmental concern. Subsequently, the relative contribution of NCWWTS discharges to the total flow in individual catchments was evaluated. This identified a further 2 areas of environmental concern. It is noteworthy that while there is no uniform national process for the selection of areas of environmental concern, most public services follow the approach described here (Ministry of the Ecological and Solidary Transition, 2019).
Costs of the solution	The measures implemented in areas of environmental concern and areas of health concern often include the installation or rehabilitation of NCWWTS. The estimated cost of installing a new NCWWTS is EUR 10 -12 000 (EUR 10 241-12 289 in 2019[47]) (SAGE Sambre, 2017). The rehabilitation of existing installations bears similar costs to the implementation of a new installation (GreenGalileo Media, 2019).
Benefits of the solution	With the areas of environmental concern defined, each NCWWTS public service develops coordinated rehabilitation programme and offers financial support to owners to improve the operation of their NCWWTS (Ministry for Ecological and Solidary Transition, 2019). Further support is provided with the project management of the rehabilitation (Ministry for Ecological and Solidary Transition, 2019). It is expected that the rehabilitation will improve the operation of NCWWTS in the Sage Sambre. The method adopted is simple to apply and easy to discuss with local stakeholders. It can be revised and updated with new research and improved data availability.

4.3 Outlook for the future

As detailed in the previous sections, the implementation of AEC and AHC in the current RBMP period will increase the investment in rehabilitation or implementation of new NCWWTS. This will allow targeted actions to the most prominent areas where NCWWTS affect water body status.

For example, in the most recent Loire-Bretagne RBMP (2016-2021), the following were financed:

- **The rehabilitation of 1 % of installations included in an area where a NCWWTS public service is in place. The subsidy will cover 50 % of the necessary work, limited to EUR 8 000;**
- **For installations located in an AEC, an unlimited number of installations can apply and receive a subsidy of 60 % of the necessary work limited to EUR 8 000. It is, therefore, an incentive to local authorities to gather the necessary information and define AEC** (Agence de l'Eau Loire Bretagne, 2013)**.**

Similar investments are available for all RBDs where AECs and AHCs are identified but the funds may differ.

The recent reduction of the overall budget of the water agencies in France will lead to a reduction in funds available for actions on NCWWTS in the next financing period 2019-2024 (Ministry of the Ecological and Solidary Transition, 2019). Two RBD authorities have already decided not to finance NCWWTS rehabilitation and the others have reduced the budgets allocated for rehabilitation of NCWWTS for the 3rd RBMPs (Ministry of the Ecological and Solidary Transition, 2019).

Besides the investments, the French Ministry of Environment will introduce the next implementation plan to support NCWWTS (PANANC) (Boulch, 2019).

The limited detail of the nationally collected data on NCWWTS via the public services has been identified as an important issue. It has been agreed in 2017 to extend the data collection to 61 additional information covering organisation of the services, NCWWTS, conformity, financial aspects and services (Ministry for the Ecological and Solidary Transition, 2017).

Overall, the situation with respect to NCWWTSs in France is evolving. While budget cuts are likely to slow down the mitigation efforts, positive developments are to be expected considering current investments and the full implementation of NCWWTS public services for each region.

4.4 Abbreviations used in the country chapter

AEC	Area of Environmental Concern
AHC	Area of Health Concern
NCWWT	Non-collective Waste Water Treatment
PANANC	National action plan on NCWWT (Plan d'Actions National sur l'Assainissement Non Collectif)
p.e.	Population equivalent
RBD	River Basin District
RBMP	River Basin Management Plan
SAGE	Water Management Plan (Schéma d'Aménagement et de Gestion des Eaux)

[46] France uses for low flow the mean monthly annual minimum discharges.
[47] On the basis of the Eurostat GDP deflators for France 2017 (P1) and 2019 (p1), see https://ec.europa.eu/eurostat/databrowser/view/teina110/default/table?lang=en

5 Ireland

5.1 Country factsheet

5.1.1 Overview

Ireland	
	Environmental impacts from non-connected dwellings: • 14 % of all surface water bodies affected by diffuse pollution are under pressure from non-connected discharges (135 out of 939 water bodies). This is the equivalent of 3 % of all surface water bodies (4 310) in Ireland. • 9 % of the groundwater bodies area affected by diffuse pollution are under pressure from non-connected discharges (46 km^2 out of 526 km^2). This is 0.0006 % of the total groundwater bodies area (71 593 km^2) in Ireland.
	Proportion of non-connected dwellings • Ireland has a high proportion of rural population[48] (37 %, or 1.77 million people) when compared to other European countries (Central Statistics Office, 2019). Approximately 30 % of all dwellings (490 000) in Ireland are not connected to public waste water collection and apply individual systems or other appropriate systems (Government of Ireland, 2018).
	Legal framework regulating non-connected dwellings: • Installation of IAS requires planning permission at which point the site and DWWTS must be demonstrated to be suitable and comply with EN Standards, the Code of Practice and Building Regulations. • The operation and maintenance of IAS is governed by the Water Services (Amendment) Act 2012 (Republic of Ireland, 2012). The provision defines these units as domestic waste water treatment systems and requires owners to maintain and de-sludge them, and report to relevant authorities. • Ireland introduced National Inspection Plans in 2013. Approximately 1 000 (out of 490 000) domestic waste water treatment systems are inspected each year.

5.1.2 Non-connected dwellings

Ireland has a high proportion of non-connected dwellings, with approximately 30 % of all dwellings (490 000) in Ireland not connected to public sewage collection systems and having private, on-site, domestic waste water treatment systems (DWWTS)[49] (Government of Ireland, 2018). The figure accounts for agglomerations of all sizes, with an estimated 1.4 million people in houses using individual septic tank systems or treatment systems in 2016. With respect to agglomerations regulated under UWWTD (> 2 000 p.e.), it has been reported that 5 % of the waste water load is treated via IAS (or 262 788 p.e.) (European Commission, 2017). Furthermore, it is reported that untreated sewage from 88 000 p.e. flows into Irish water ways daily (EPA, 2017).

[48] The Central Statistics Office defines the term *Aggregate Rural Area* as the area that includes the population of settlements with a population of less than 1 500 persons.

[49] Domestic waste water treatment systems in Ireland are systems treating waste water from single houses i.e. houses not connected to a public sewer system. The definition includes in scope individual and other appropriate systems as defined in the Urban Waste Water Treatment Directive.

According to national authorities, the figure relates to areas where the construction of UWWTPs is required (EPA, 2019).

In the ECJ ruling against Ireland (European Commission v Ireland, 2009), it was found that, "…by failing to adopt… all the laws, regulations and administrative provisions necessary to comply with Articles 4 and 8 of Council Directive 75/442/EEC of 15 July 1975 on waste…as regards domestic waste waters disposed of in the countryside through septic tanks… Ireland has failed to fulfil its obligations under that directive" (European Court of Justice, 2009) (European Council, 1975) (repealed by Directive 2008/98/EC). As a result, Ireland amended the Water Services Act (2007) to introduce additional provisions for IASs.

The Water Services (Amendment) Act 2012 regulates all waste water treatment activities, including the use of DWWTS (Republic of Ireland, 2012). Furthermore, it introduced the National Inspection Plans (NIP) (Republic of Ireland, 2012). The Act requires that all DWWTSs are recorded in a database that is regularly updated. The purpose of the NIP is to monitor the frequency of de-sludging and the overall maintenance of DWWTS. The onus is on DWWTS owners to register their systems with the relevant authorities. As of October 2017, 95 % of DWWTS were registered within the database (EPA, 2018). The remainder 5 % unregistered DWWTS are still inspected as part of the minimum 1 000 inspections taking place every year (EPA, 2018). Where issues are identified, owners are required to improve the operation of their DWWTS and provided with information on how to do so (EPA, 2018).

The most common type of DWWTS in Ireland are septic tank systems, covering approximately 90 % of all DWWTS (Dubber and Gill, 2014). To operate safely and efficiently, a septic tank system must be well-designed, installed at the correct depth, situated in the right soil conditions, consistently de-sludged, inspected and officially registered (Dubber and Gill, 2014). Local Authorities use a geoscientific land-use planning approach (the national Groundwater Protection Scheme and Responses for DWWTSs), in conjunction with the recommendations from the qualified assessors, to determine appropriate site selection for DWWTS. Local authority staff and environmental consultants are required to attend a certified National Framework of Qualifications Level 6 training programme (100 hours) to equip them to carry out the site assessments for DWWTS (EPA, 2019).

DWWTS are selected for inspection based on a risk assessment process that:

- are in catchments of waters that are At Risk as identified under the WFD;
- are in WFD Areas for Action;
- where DWWTS have been identified as a significant pressure;
- in areas of increased groundwater risk potential.

In the period between 2017 and 2018, 2 370 inspections were completed and 1 132 DWWTS failed to meet the required standard. The identified issues generally relate to septic tank systems, of which:

- 647 (27%) failed for operation and maintenance reasons;
- 547 (23%) failed for not being appropriately de-sludged.

The proportion of DWWTS that have failed inspection has remained relatively consistent from the period between 2014 and 2018, with an average failure rate of 47 %. The lowest failure rate occurred in 2014 (44 %) and the highest failure rates occurred during 2016 and 2017 (49 %). It should be noted that the failure rate has recently reduced from 49 % (2017) to 47 % (2018). The NIP also includes several engagement activities, such as workshops and training days for septic tank inspectors, planners, and practitioners. Engagement with the public is through media, websites, leaflets, information stands and talks.

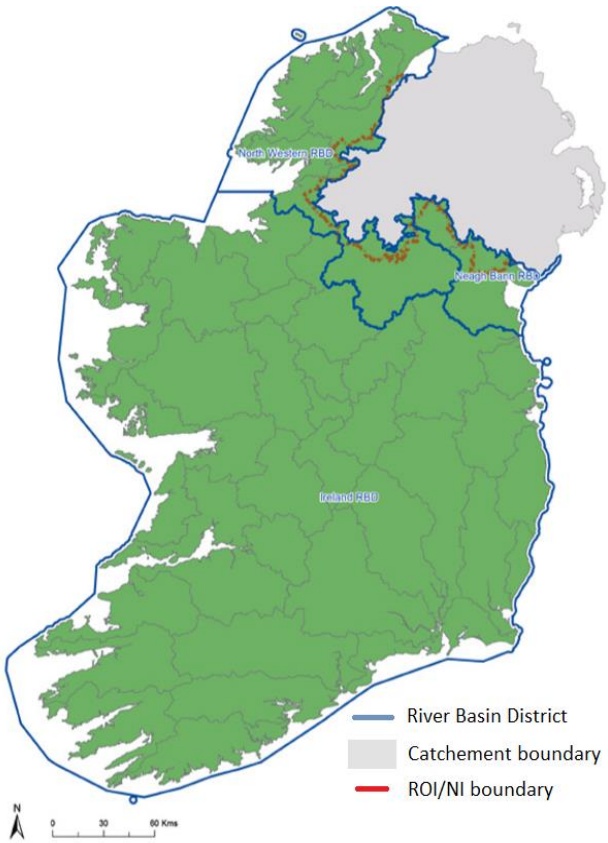
Several studies have been undertaken or funded by the Irish Environmental Protection Agency (EPA) to assist the DWWTS regulatory and inspection processes and to identify key pollutants and pathways. For instance, a risk-based methodology was developed to assess pathways between DWWTS and pollutants entering the aquatic environment (EPA, 2013). The methodology showed that molybdate reactive phosphate[50] was the main pollutant posing a threat to the environment, particularly to surface water. While the cumulative pollutant load from DWWTSs was insignificant compared to impact of UWWTPs and agriculture at river basin scale, it was shown that it can be significant in certain physical settings at small catchment scale (EPA, 2013). By contrast, pressures from nitrogen at catchment scale were low due to dilution (EPA, 2013). Another study by the Irish EPA concluded that groundwater bodies are under pressure from bacteria such as *E.Coli* and agreed that surface water bodies were more likely to be affected by phosphates (EPA, 2018a).

The EPA also funded the development of a model that predicts the annual nutrient loading from individual DWWTS at a catchment scale into rivers in Ireland. The SANICOSE model (Gill and Mockler, 2016) synthesises over a decade of field studies on on-site systems in Ireland across many different soils types and combines factors relating to the efficiency of the septic tank systems with attenuation factors for the hydrogeological flow pathways. The national results of this model have been generated to help Local Authority Waters Programme (LAWPrO) staff target the local catchment assessments to areas where the potential impact from DWWTS may be higher.

5.1.3 River Basin Districts affected by diffuse pollution from non-connected discharges

Under the 2nd RBMP, Ireland has one RBD integrating all previous RBDs, as presented in Figure 5-1.

Figure 5-1 RBD of Ireland



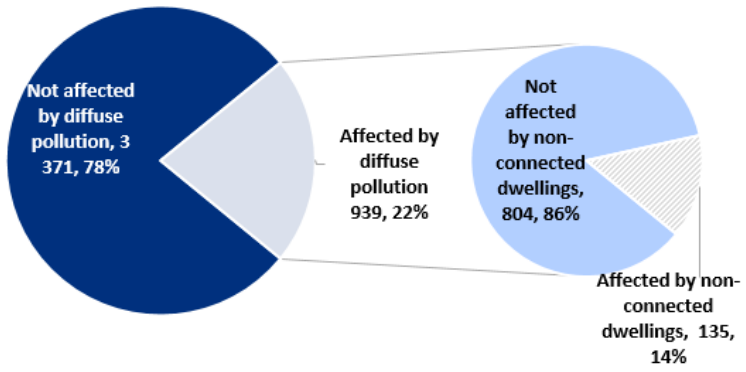
Source: Government of Ireland (2018)

[50] Includes phosphates, as well as other easily hydrolysable organic and inorganic forms of Phosphorus.

According to the most recent reporting under the WFD, 57 % of river water bodies, 46 % of lakes, 31 % of transitional waters and 79 % of coastal waters achieved good ecological and chemical status (Government of Ireland, 2018). Furthermore, 90 % of groundwater bodies achieved good chemical status.

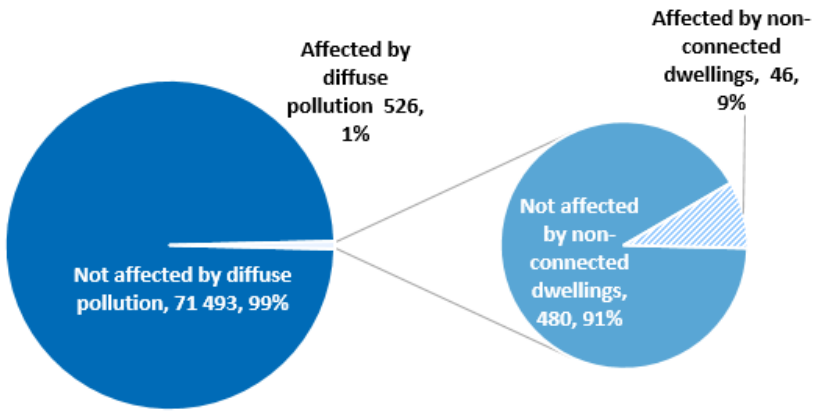
As illustrated in Figure 5-2, non-connected discharges have been identified as one of the pressures on **14 % of surface water bodies** under pressure from diffuse pollution (or 3 % of all surface water bodies in the country) (EEA, 2019)**.** Comparatively and as illustrated in Figure 5-3, non-connected discharges have been identified as one of the pressures on **9 % of the groundwater body area** (or 0.0006 % of the total groundwater body area in the country) (EEA, 2019). Further information on how these figures have been derived is available in **Annex 1**.

Figure 5-2 Surface water bodies affected by pressures in Ireland: Number affected by diffuse pollution; Number with diffuse pollution from non-connected dwellings[51]



Source: Own compilation based on EEA (2019)

Figure 5-3 Ground water body area (km^2) affected by pressures in Ireland: Area affected by diffuse pollution; Area with diffuse pollution from non-connected dwellings[52]



Source: Own compilation based on EEA (2019)

In addition, the 2nd RBMP also identified 2 coastal waters and 6 transitional waters under pressure from domestic waste water (Government of Ireland, 2018).

[51] Water bodies may be affected by more than one pressure.
[52] Water bodies may be affected by more than one pressure.

5.1.4 Underlying reasons for the problem

The potential reasons underlying the problem of diffuse pollution from non-connected dwellings in Ireland are listed below:

- The results from the first year (2013) of the national monitoring campaign revealed that 49 % of DWWTS failed their inspection due to infrastructure, de-sludging and/or operation and maintenance issues (EPA, 2016). However, it must be noted that a risk assessment methodology that prioritises higher risk scenarios is used to select the DWWTSs for inspection, so a higher rate of failure is expected than if they were selected at random.
- Surface and groundwater bodies are at risk where there is inadequate percolation or filtration in the ground for the waste water arising from DWWTSs. This can arise both from poorly constructed drain fields and from low-permeability subsoil and bedrock (EPA, 2013). The risk of pollution is particularly related to microbiological pathogens and/or nutrients Density of DWWTSs can cause localised plumes with elevated nitrate concentrations in groundwater (EPA, 2013).

5.1.5 Approaches to mitigating the problem

Ireland has been taking several actions to mitigate pollution from non-connected dwellings. These include:

- The adoption of the Water Services Act 2007/2012 (Republic of Ireland, 2012), which states that DWWTS owners are responsible for the operation and maintenance of their own DWWTS, including de-sludging.
- The establishment of the LAWPrO which provides targeted catchment management to support the programme of measures as outlined in the RBMB 2018-2021. This includes undertaking local catchment assessments to identify problematic DWWTS in areas where DWWTS have been identified as a significant pressure.
- Establishing the NIP, with the aim of identifying instances of unsatisfactory operation. Information collected via NIP helps prioritising inspections in water bodies that failed to achieve good chemical status or had poor or bad ecological status, water bodies in protected areas and those water bodies that have deteriorated since the 1st RBMP (Mooney, 2015).
- The introduction of a grant scheme in 2013 to help owners with the cost of DWWTS. The grant was only available to householders who had registered their system prior to February 2013 (EPA, 2019a), however, the grant is now being extended to all owners in priority areas.
- A €1.7 billion investment in waste water projects, programmes and asset maintenance by Irish Water, via a European Investment Bank loan (Government of Ireland, 2018).
- The engagement and awareness strategy promoted by the EPA, which aims to raise awareness of best practice in the operation and maintenance of DWWTS, as well as environmental and health risks associated with the improper operation of DWWTS. The EPA has established an engagement working group in July 2015 to disseminate information via leaflets distributed through local authorities (EPA, 2018).
- The launch of the EPA Research Programme 2014-2020, with three key pillars – climate, water and sustainability which helps building the knowledge base in the field of urban and domestic waste water treatment. EPA has published a Code of Practice for installation of DWWTSs which is currently being reviewed to incorporate new research on treatment systems in low permeability soils (EPA, 2019).

5.2 Case study: Issues related to the operation and maintenance of domestic waste water treatment systems

This section discusses Ireland's approach in reducing diffuse pollution related to the operation and maintenance of DWWTSs.

Ireland: Issues related to the operation and maintenance of domestic waste water treatment systems	
Overview *Ireland occupies 70 273 km^2 of the Irish Isle, benefiting from a mild and humid climate. Ireland boasts a population of 4.9 million people, of which approximately 1.8 million people live in areas which are not connected to public sewerage systems and therefore, rely on domestic waste water treatment systems. Much of the country's territory is dominated by the central plain underlain by limestone aquifers, which are susceptible to pollution.*	
Description	Since 2014, the Irish Environment Protection Agency (EPA) has been coordinating annual inspections by Local Authorities of a sample of DWWTS to establish whether these are operating within the required standards. On average between 2014 and 2018, 47 % of the inspected installations failed to comply with the requirements (EPA, 2019). Across all years, reasons for failure were construction defects and lack of maintenance and desludging (EPA, 2019).
Geographies affected	There are 160 surface water bodies with domestic waste water identified as one of the significant pressures, distributed across the Irish RBD (EPA, 2019).
Reasons	There is a wide variety of issues with operation and maintenance, from broken parts to replacement or installation of an entire system. In areas where the depth of unsaturated subsoil is less than 1 m, there is a higher risk of inadequate attenuation of nutrients and micro-organisms. In low permeability subsoil areas, issues can occur where there is inadequate percolation through the subsoils (EPA, 2019).
Status of the receiving water body	There are 160 surface water bodies where domestic waste water has been identified as one of the significant pressures) (EPA, 2019). It is noteworthy that significant proportion of Ireland has been designated as being sensitive for phosphorus (P), nitrogen (N) or both (EEA, 2019c). Sensitive areas cover most of the south, central and northern parts of Ireland, the western side being deemed as a normal area (EEA, 2019c).
Is the entire RBD affected	There are 160 surface water bodies (out of 4 310) with domestic waste water identified as one of the significant pressures, distributed across the entire Irish RBD (EPA, 2019).
Type of treatment unit	In Ireland, 90 % of the non-connected dwellings applying DWWTSs apply septic tank systems (EPA, 2019).

Ireland: Issues related to the operation and maintenance of domestic waste water treatment systems	
Response to the challenge	As a response to the issues identified with DWWTSs, Ireland has taken a multipronged approach, including: • Implementation of the Code of Practice for DWWTS, provisions in the Building Regulations and adoption of European Standards; • New requirements brought in from 2012-13 through the amendment of the Water Services Act, including registration requirements and associated National Inspection Plan; • Training programmes for local authorities' staff and environmental consultants who take part in on-site inspections; • The use of a geoscientific land-use planning approach in conjunction with the recommendations from the qualified assessors, to determine appropriate planning conditions for DWWTS; • The introduction of Local Authority Waters Programme (LAWPrO) for local catchment assessments to identify problematic DWWTS in areas where DWWTS have been identified as a significant pressure. • The DWWTS Grant Scheme which is to be extended to make the grant available to households with defective DWWTSs located within High Status objective catchments and to households in Areas for Action where, in the course of catchment investigations undertaken by LAWPrO staff, defective DWWTS are identified.
Costs of the solution	The total cost of all the measures implemented in Ireland to address diffuse pollution from non-connected dwellings is unknown (EPA, 2019). In the period between 2014-2017, a total of 242 DWWTS grants have been paid out by Local Authorities at a total cost of € 746 566 (EPA, 2019).
Benefits of the solution	The SANICOSE model and the data collected from yearly inspections help authorities identify areas at high-risk of contamination where renovations of DWWTS are required (EPA, 2019). The renewed grant scheme will support alleviating the problems in the identified areas (EPA, 2019).

5.3 Outlook for the future

The newly introduced grant scheme will enable homeowners using DWWTSs in priority areas to improve the operation of their DWWTSs (EPA, 2019). As a result, reduction in the diffuse pollution pressures from DWWTSs are anticipated. Work under LAWPrO and an extended grant scheme are additional measures currently identified for DWWTS.

5.4 Abbreviations used in the country chapter

DWWTS	Domestic Waste Water Treatment System
EPA	Environment Protection Agency
IAS	Individual and other Appropriate Systems
LAWPrO	Local Authority Waters Programme
NIP	National Inspection Plans
p.e.	Population equivalent
RBD	River Basin District

RBMP	River Basin Management Plan
UWWTD	Urban Waste Water Treatment Directive
WFD	Water Framework Directive

6 Poland

6.1 Country factsheet

6.1.1 Overview

Poland	
	Environmental impacts from non-connected dwellings: • 67 % of all surface water bodies affected by diffuse pollution are under pressure from non-connected discharges (1 007 out of 1 503 water bodies). This is the equivalent of 18 % of all surface water bodies (5 649) in Poland (EEA, 2019). • Groundwater bodies were not reported to be under pressure from diffuse pollution from non-connected dwellings (EEA, 2019).
	Proportion of non-connected dwellings: • In 2015, 27.3% of the population was not connected to waste water treatment plants (Central Statistical Office, 2016) with the waste being cleaned in a different way. In agglomerations of more than 2 000 p.e., 5.9% is addressed by IAS and 0.28% is not collected nor addressed by IAS (EEA, 2019c).
	Legal framework regulating non-connected dwellings: • The "Regulation on conditions for the introduction of sewage into water or soil and on the list of substances particularly harmful to water environment 2014" regulates the operation of IAS and outlines the maximum permissible pollutant values for waste water and sewage originating from IAS. • Polish Water Law 2018 requires permit for water management activities and domestic and urban waste water discharges to water or ground. • The National Programme on Municipal Waste Water Treatment (NPMWWT) has been running since 2003 to improve compliance with the UWWTD. Some of the key actions outlined in the programme include the development of additional, and upgrade of existing, waste water collection infrastructure (Polish Waters, 2019). • These regulations and programmes play a key role in mitigating the impact of non-connected dwellings on water quality.

6.1.2 Non-connected dwellings

Poland has a high proportion of rural areas[53], covering 290 759 km^2 or 93 % of the total area of the country. It accommodates 15.3 million people (40 % of the total population). With respect to waste water treatment, **in 2015, 27.3% of the population** (10.5 million out of 38.6 million inhabitants) **was not connected to waste water treatment** with the waste being cleaned in a different way

[53] It is unclear what is the definition of "rural" used in this analysis. The Polish Statistical Institute defines "rural areas" on the basis of administrative boundaries. Rural areas are therefore all areas that are not towns or cities (i.e. urban areas)

(Central Statistical Office, 2016)**. In 2017, the number of inhabitants of agglomerations over 2000 p.e. served by tankers for waste water transfer was 1.7 million**. The figure concerns agglomerations of all sizes, although only 0.28 % of the load in agglomerations larger than 2 000 p.e. is not collected or treated at all (load equivalent to 108 080 p.e.) (EEA, 2019c). National law requires holding tanks to be emptied periodically and sewage taken to waste water treatment plants (Ministerstwo Gospodarki Morskiej i Żeglugi Śródlądowej, 2019)**. 5.89 % of the waste water (load equivalent of 2 273 540 p.e.) is addressed through IAS (EEA, 2019c)**. It is unclear what proportion of the population in agglomeration of less than 2 000 p.e. applies IAS[54]. However, the Polish Statistical Institute has reported that in 2017, there were 2.2 million IAS in Poland (Polish Waters, 2019). Of these, 86 % (1.9 million) were located in rural areas (Polish Waters, 2019).

In terms of commonly applied techniques for on-site waste water management, the Central Statistical Office reports that 90 % of population not connected to WWTPs uses cesspools (Vorne and Silvenius, 2017).

However, alternative IAS solutions are growing in popularity, with septic tank with the drain field being the most predominantly used IAS (Vorne and Silvenius, 2017). Other commonly applied IAS solutions include filtering drainages, sand filters and hydrobotanic beds (Piasecki, 2019). In 2013, 15 871 IAS with a total capacity of 25 012 m^3/day have been installed (Vorne and Silvenius, 2017). The benefit of these alternative solutions over cesspools is that they provide primary (in case of septic tanks) or secondary (in case of other IAS listed above) level of waste water treatment (Vorne and Silvenius, 2017).

Despite being a primary[55] level waste water treatment system, academic studies concentrating on Poland show that septic tanks often provide inadequate treatment (Karczmarczyk, 2016). The key reasons for that relate to leakages of septic tanks (Polish Waters, 2019). The adverse environmental impact increases when septic tanks are densely located (Karczmarczyk, 2016). Small on-site waste water treatment plants may provide higher levels of environmental protection, however, when improperly maintained, they can be associated with emission levels similar to those of septic tanks (Karczmarczyk, 2016). Table 6-1 presents a comparison between the pollutant load associated with the use of septic tanks and with treatment in a central UWWTP in Poland.

Table 6-1 Pollutant loads associated with septic tanks against average pollutant load of the Krynica-Zdrój UWWTP

Pollution indicators and components	Septic tanks Mean values	Septic tanks Maximum values	Average values in UWWTPs
BOD_5 [mg/dm^3]	280 - 830	1250	197
COD [mg/dm^3]	370 - 1300	2350	393
N-NH_4 [mg/dm^3]	80 - 136	250	25
Total nitrogen N [mg dm^3]	100 - 180	270	36
P-PO_4 [mg/dm^3]	12.3 – 17.6	26	6
Suspended solids [mg/dm^3]	75 - 215	250	116

[54] This information is not collected by Statistics Poland.
[55] Physical phase separation to remove settleable solids.

Note: BOD – Biological Oxygen Demand[56]; COD – Chemical Oxygen Demand[57]; N-NH_4 – dissociated form of ammonia[58]; P-PO_4 - Orthophosphate as phosphorus[59].

Source: Jucherski (2016)

Poland has several water regulations relevant to the operation of IAS. **The Regulation on conditions for the introduction of sewage into water or soil and on the list of substances particularly harmful to water environment (2014)** defines IAS as a device with waste water flow capacity of up to 5 m^3 per day, used for a household or farm needs. Furthermore, it outlines the maximum permissible pollutant values for waste water and sewage from IAS and UWWTPs (Polish Ministry of Environment, 2014). According to the regulation, IAS should have removal efficiency of at least 20 % for BOD and at least 50 % for suspended solids but no requirements are introduced for nutrients (Polish Ministry of Environment, 2014). The place where treated waste water is discharged must be separated by a layer of soil of at least 1.5 m thickness from the highest level of groundwater aquifers (Polish Ministry of Environment, 2014). With respect to sewage from IAS entering water or land, it has to meet the same requirements as UWWTPs operating in agglomerations smaller than 2 000 p.e. The requirements relate to BOD, COD, suspended solids, N and P. According to the Sewage Regulation, only waste water from a household or farm located in agglomerations over 2000 p.e. requires treatment of these indicators to a similar standard as sewage treatment plants in the agglomeration. The requirements for household sewage treatment plants outside agglomerations in the scope of indicators apply only to the levels of BOD and suspended solids.

The revised **Polish Water Law 2017** entered into force in January 2018. It requires the regular emptying of cesspools to the nearest UWWTP by means of truck. Furthermore, it establishes the Polish Waters agency which replaces the role of local authorities and oversees all water management activities in the country (In Principle, 2017). The agency is also responsible for issuing water permits and for the inspection of water management installations (In Principle, 2017).

Finally, according to the **Act on Maintaining Cleanliness and Order in Municipalities 1996**, the owner of properties equipped with an IAS is obliged to have a signed agreement for the transport of waste water and sewage sludge with an entity which possess the proper permits to operate in such capacity (Polish Ministry of Environment, 1996). Additionally, owners are required to keep proof of payment for these services, as well as be ready to present proof during inspections[60]. If any irregularities are found, the owner of the property will be fined as stated in the Act (Polish Ministry of Environment, 1996).

6.1.3 River Basin Districts affected by diffuse pollution from non-connected discharges

As illustrated in Figure 6-1, Poland currently has a total of 10 RBDs, all of which are shared with other countries.

[56] BOD is an indicator of organic pollution to water that measures the amount of biodegradable organic matter in water;

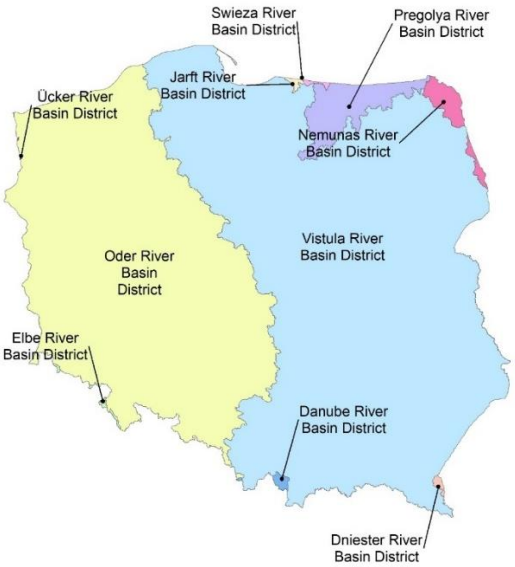
[57] COD is an indicator of organic pollution to water that measures the amount of chemicals in the water that can be oxidised;

[58] N-NH_4 is an indicator that measures the nitrogen content in water.

[59] P-PO_4 is an indicator that measures the phosphate content in water.

[60] It is unclear how frequent inspections of non-connected dwellings in Poland are.

Figure 6-1 Map of Poland and the Polish RBDs (to be revised in 2021)

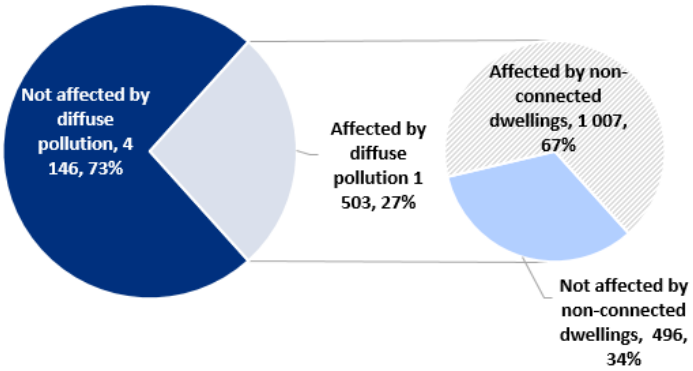


Source: Polish Waters, (2019).

In the 2nd RBMP, **70 % of surface water bodies** in Poland were reported in less than good ecological status and the level of confidence of the classification was low for most water bodies (European Commission, 2019). With respect to chemical status, **59 % of surface water bodies achieved good status**, **15 % were unknown and 26 % were failing to achieve good** status (European Commission, 2019). The **monitoring of groundwater bodies was reported to be incomplete**. Nevertheless, groundwater body area failing good status increased from 3.7 % to 7.8 % of the total groundwater body area (European Commission, 2019).

In WISE, diffuse pollution from non-connected dwellings was reported to be a significant pressure on surface water bodies only. As illustrated in Figure 6-2, **67 % of all surface water bodies** affected by diffuse pollution were reported under pressure from discharges not connected to the sewage network (1 033 out of 1 556 water bodies). This is equivalent to 18 % of all surface water bodies in Poland (EEA, 2018). Further information on how the figure has been derived is available in **Annex 1.**

Figure 6-2 Surface water bodies affected by pressures in Poland: Number affected by diffuse pollution; Number with diffuse pollution from non-connected dwellings[61]



Source: Own compilation based on EEA (2019)

[61] Water bodies may be affected by more than one pressure.

In terms of spread between RBDs, **all 10 RBDs reported non-connected dwellings as a key contributor to eutrophication of water bodies** (Polish Ministry of Environment, 2016a). In six RBMPs, the overall pressure was classed as significant (Dniester RBD, Jarft RBD, Odra RBD, Elbe RBD, Swieza RBD and Niemen RBD). Furthermore, the Ucker RBD introduced packages of measures to address the pressure despite not reporting it as significant (Polish Ministry of Environment, 2016a). Even though non-connected dwellings were not reported as a pressure on groundwater bodies in WISE, all 10 RBDs quoted that malfunctioning IAS have a negative impact on the chemical status of groundwater bodies (Polish Ministry of Environment, 2016a)

6.1.4 Underlying reasons for the problem

The potential reasons underlying the problem of diffuse pollution from non-connected dwellings in Poland are listed below:

- Many non-connected dwellings still apply cesspools. Cesspools are holding tanks that do not provide any level of waste water treatment and are associated with high levels of pollution (Vorne and Silvenius, 2017).
- Septic tanks in Poland are also associated with high environmental impacts (Karczmarczyk, 2016). Pollutant load from septic tanks is four or five times higher than this of an average UWWTP (Jucherski, 2016). This relates mainly to leakages from septic tanks (Polish Waters, 2019).
- Furthermore, illegal waste water disposal from non-connected dwellings is an ongoing problem in Poland (Polish Waters, 2019).
- The requirement to regularly empty cesspools and septic tanks and transfer of their content to UWWTPs is often not complied with in practice due to the associated costs that need to be borne by homeowners (Jucherski, 2016). This leads to the illegal disposal of untreated sewage and waste water to soil or directly to surface water bodies (Jucherski, 2016).
- Nutrient pollution problems in Poland are connected to the relatively high level of population not connected to sewerage in the catchment area (Vorne and Silvenius, 2017), and the associated high density of IAS (Karczmarczyk, 2016).
- The existing waste water collection infrastructure is old and subject to frequent leaks which further contributes to the issue (Polish Ministry of Environment, 2016a).

6.1.5 Approaches to mitigating the problem

The approaches taken in Poland to mitigate the problem are listed below:

- The National Programme on Municipal Waste Water Treatment (NPMWW) has been running since 2003 to improve compliance with the UWWTD (Polish Waters, 2019). Between 2003 and 2016, 84.8 thousand km of sewerage network were developed (Polish Waters, 2019). Some of the developed network was in agglomerations of less than 2 000 p.e. (Polish Ministry of Environment, 2016a). The Council of Ministers adopted the 5th update of the NPMWW which concerns the period between 2016 and 2021 (Polish Waters, 2019). It sets a goal for the development of 14 661 km of additional sewage network and the modernisation of 3 506 km of the existing network across 1 587 agglomerations (total size of 38.8 million p.e.) (Polish Waters, 2019).
- In response to the septic tanks' leakages and illegal disposal of waste water from non-connected dwellings, Poland has increased the number of inspections since 2018. These inspections are performed by municipal police in cities and other entities decided on municipal level (Polish Waters, 2019).

- The packages of measures introduced for 7 RBDs (Elbe, Jarft, Odra, Pregolya, Swieza, Ucker, Vistula) include extensive checks of governmental records to establish whether non-connected dwellings are compliant with legal requirements (Polish Ministry of Environment, 2016a). In particular, the checks will concentrate on whether homeowners have ensured the use of IAS in the absence of waste water collection system, frequency of IAS emptying and de-sludging and pathways of waste water and sludge disposal (Polish Ministry of Environment, 2016a). Finally, records of the type and location of existing IAS will be used to establish the hotspots where waste water collection network is required (Polish Ministry of Environment, 2016a).
- The packages of measures for the same RBDs also include the construction of new cesspools and renovation of existing ones, construction of IAS and development of an IAS register (Polish Ministry of Environment, 2016a).
- Poland is also a part of the Interreg project "VillageWaters" described in **Section 3.1.5**.

6.2 Case study: Operation of individual and other appropriate systems in mountain areas

This section discusses Poland's approach in reducing diffuse pollution from non-connected dwellings in mountainous areas.

Poland: Operation of individual and other appropriate systems in mountain areas

Overview

Poland has a territory of 312 679 km² which accommodates a population of 38.6 million. Poland is characterised with lowlands to the North with exposure to the Baltic sea, and mountainous areas to the south. Population density is greater within and nearby urban areas. Overall, 7.4 % of the population in mountainous areas is not connected to waste water infrastructure (Polish Waters, 2019).

Description	Mountainous areas in Poland are the areas elevated 350 m above sea level, with an area of about 25 000 km² (approximately 8 % of the territory of the country) (Jucherski, 2016). Depending on the terrain, installing waste water collection and treatment infrastructure could be technologically challenging and economically unattractive in mountainous areas (Polish Waters, 2019). At present, 821 127 people are not connected to the sewage network in mountainous and sub-mountainous areas (2 % of the total population) (Polish Waters, 2019). 11 136 of these people apply package waste water treatment plants (1 % of the non-connected population in mountain areas) with no information about practices by the remaining share of population (99 %) (Polish Waters, 2019). The figures may be underestimated due to poor data availability (Polish Waters, 2019).
Geographies affected	Most Polish RBDs cover mountainous areas with the exception being Ucker, Świeża, Niemno, Pregoła, Jarft river basin districts (RBDs). Since the issue is widespread, this case study does not focus on a specific RBD but considers the problem nationwide.
Reasons	The type, construction and processing of waste water treatment facilities in mountain regions are affected by difficult access to certain sites, energy supply, rationing of sites and by challenging load frequencies caused by varying seasonal and weather conditions (Rödel et al, 2019). In the National Urban Waste Water Treatment Program, the development of sewage network is justified where there are at least 120 inhabitants per km² (Polish Waters, 2019). In the remaining areas, IAS or no treatment is applied. Mountain areas are subject to high tourist influx which could further contribute to the pressures on water bodies. However, there is no information on the number of holiday goers in non-connected mountainous areas in Poland.
Status of the receiving water body	Poland applied Article 5(8) of the Urban Waste Water Treatment Directive (UWWTD), thus designating its entire area as a sensitive area for nitrogen (N) and phosphorus (P). Therefore, all water bodies affected by the operation of individual and other appropriate systems (IAS) in mountain areas are sensitive water bodies.
Is the entire RBD affected	The issue concerns only mountainous areas within the RBDs, and especially sparsely populated areas or areas with difficult terrain.

Poland: Operation of individual and other appropriate systems in mountain areas	
Type of treatment unit	Where IAS is applied, it is reported that the most common types of treatment are mechanical and/or biological treatment (Polish Waters, 2019). Literature sources show that in numerous instances septic tanks are applied, although these are associated with risks to shallow groundwaters which are often used for drinking water (Jóźwiakowski et al., 2018). Two-stage small waste water treatment systems for up to 50 p.e. are gaining popularity in mountain areas, including constructed wetland, activated sludge treatment plant and infiltration drainage systems (Jóźwiakowski et al., 2018). Infiltration drainage systems were found to be particularly common in some regions, albeit being associated with pollution to surface and groundwater bodies because they provide mechanical treatment only (Jóźwiakowski et al., 2018). According to Polish law, home sewage treatment plants should meet relevant standards, and the conditions for discharging sewage from such systems are specified in the Sewage Regulation.
Response to the challenge	Investments in the waste water infrastructure are available in mountain areas under the National Urban Waste Water Treatment Program (Polish Waters, 2019).
Costs of the solution	Unfortunately, detailed information is not available. The cost of investments planned by urban agglomerations and those included in the update of the National Program for Urban Waste Water Treatment is 27.85 billion PLN (6.5 billion EUR), which includes: - construction and modernization of the sewage network: PLN 16.67 billion (3.9 billion EUR) - investments related to sewage treatment plants: PLN 11.10 billion (2.6 billion EUR) - home sewage treatment plants as a supplement to the sewage system (IAS): PLN 79.28 million (18.5 million EUR).
Benefits of the solution	The focus of the investments in mountainous areas is unclear. No further information has been received from Member State authorities.

6.3 Outlook for the future

Poland is currently investing in waste water infrastructure under the National Urban Waste Water Treatment Program, with the 5th update to the programme having been published in 2017 (Polish Waters, 2019). The programme focuses specifically on the development and reconstruction of UWWTPs and the development of sewage collection network. Under the programme, works will be undertaken within 1 587 agglomerations between 2016 – 2021 and will be prioritised according to the importance of the investment and the urgency of providing funds (Polish Waters, 2019).

369 additional UWWTPs were developed and 1 470 were modernised or expanded before 2016 (Polish Waters, 2019). The investment plan shows that a further 116 UWWTPs will be constructed and 1 060 will be upgraded (Polish Waters, 2019). The overall cost of investments planned under National Program for Urban Waste Water Treatment between 2016 and 2021 is PLN 27.9 billion (EUR 6.5 billion) (Polish Waters, 2019). This includes:

- Investment of PLN 16.7 billion (3.9 billion EUR) in the construction and modernisation of waste water collection infrastructure;

- Investments of PLN 11.1 billion (2.6 billion EUR) in the development and modernisation of UWWTPs;
- Investment of PLN 79.3 million (18.5 million EUR) for IAS, and namely the installation of package plants to supplement UWWTPs.

Overall, the programme is likely to lead to significant improvements in waste water collection and treatment rates in agglomerations of more than 2 000 p.e., therefore alleviating pressures from non-connected dwellings in densely populated areas. Areas below 2000 p.e. receive support from the national programme for municipal waste water treatment.

6.4 Abbreviations used in the country chapter

IAS	Individual and other Appropriate Systems
p.e.	Population equivalents
RBD	River Basin District
RBMP	River Basin Management Plan
UWWTD	Urban Waste Water Treatment Directive
WFD	Water Framework Directive

7 EEA Member countries not reporting under the Water Framework Directive

This chapter provides an overview of the situation with respect to non-connected dwellings in the EEA Member countries which are not reporting under the WFD. Overall, the picture in the three examined countries is mixed, with **water bodies in Switzerland being the least likely to be under pressure from diffuse pollution from non-connected dwellings, and water bodies in Iceland and Turkey being the most likely to be impacted.**

7.1 Iceland

Iceland implemented the UWWTD at national level in 1994 (Environment Agency of Iceland, 2013), however, it does not fully report under the Directive[62]. Therefore, as in the EU, Iceland is required to establish collection and treatment systems in all agglomerations of more than 2 000 p.e., unless this is associated with disproportionate costs. In these instances, IAS could be applied instead. Furthermore, under national legislation (Environment Agency of Iceland, 2013), municipalities are required to provide and operate collection systems and UWWTPs within their boundaries, where:

- The area has more than 50 inhabitants with distances between houses of no more than 200 m.
- New development areas in rural areas have more than 20 houses in an area 10 ha in size and/or businesses discharge 50 p.e. or more from an area 10 ha in size.
- In exceptional circumstances, for instance, because of excessive costs, the boards of public health can allow the use of systems other than collection systems and UWWTPs with regard for the abilities of the recipient to receive waste water and other environmental considerations.

Iceland introduced a grant scheme for municipalities to support them in meeting requirements on connectivity to sewerage and waste water treatment (Environment Agency of Iceland, 2013).

There is no data on the use of IAS in agglomerations of less than 2 000 p.e., however, in rural areas, the Environment Agency of Iceland assumes that septic tank systems are nearly exclusively used along with sub-surface drainage fields (Environment Agency of Iceland, 2013). In rural areas, an estimated 16 000 dwellings (farms and cottages) use septic tanks in Iceland (Environment Agency of Iceland, 2013). However, because of climatic or geographical conditions, dry toilets[63] may be applied instead (Environment Agency of Iceland, 2013).

In 2010, it is estimated that about 26% of the total population was not served by UWWTP nor applied IAS (Environment Agency of Iceland, 2013).

7.2 Switzerland

In 2012, 99 % of the population in Switzerland was connected to waste water collection and treatment (all population in urban areas and 97 % of population in rural areas) (Federal Office for the Environment, 2013). 2 % of the population in rural areas use IAS (Federal Office for the Environment, 2013). The Federal Office for the Environment stated that no further improvements to the levels of connectivity will be sought since targets have been achieved (Federal Office for the

[62] Iceland provides situational reports under Article 16 of the UWWTD (Environment Agency of Iceland, 2013).
[63] Type of composting toilet. Further information about the technology is available in **Annex 2.**

Environment, 2013). IAS are not considered to be a pressure to surface or groundwater bodies in Switzerland (Federal Office for the Environment, 2013).

7.3 Turkey

According to information published by the Turkish Statistical Institute, as of 2016, 75 % (56 million people) of the municipal population[64] was served by waste water treatment systems (Turkish Statistical Institute, 2019). This includes water treated in UWWTPs and constructed wetland systems. Furthermore, 90 % (67 million) of the municipal population was served by the sewage collection network (Turkish Statistical Institute, 2019) and 10 % applied septic tanks (7.7 million) in 2016 (Turkish Environment Agency, 2019).

Baba et al. (Baba et al., 2011) showed that one of the key pressures on groundwater bodies in Turkey is diffuse pollution from septic tanks. Engin at al. (2006) suggested that implementing a centralised waste water treatment approach is not feasible in Turkey due to the high infrastructure investment costs. However, alternative decentralised approaches could be implemented to secure better environmental protection. These included:

- package waste water treatment systems: secondary treatment units that provide aerobic waste water treatment (Engin et al., 2006). These could be installed in houses and require energy inputs for the artificial oxidation within the system (Engin et al., 2006)
- cluster systems: (Engin et al., 2006). where waste water from septic tanks and cesspools is emptied and transferred to WWTP for treatment (Engin et al., 2006).

[64] The Turkish Statistical Institute does not provide definition for “municipal population”.

8 Horizontal assessment and conclusions

8.1 Horizontal assessment

This section presents the horizontal assessment performed across all countries, highlighting the key similarities and differences in the issues experienced and associated with diffuse pollution from non-connected dwellings and the solutions implemented in response. The key topics of the horizontal assessment are presented in Table 8-1.

8.1.1 Underlying reasons

Connectivity to waste water collection and UWWTP

The issues of diffuse pollution reported under the WFD could be linked to high proportions of non-connected dwellings[65] in the five considered countries. For instance, the pressure has been reported to be more significant[66] in Bulgaria, Finland and Poland. In Bulgaria and Poland, this could relate to the high proportion of non-connected dwellings in agglomerations larger than 2 000 p.e. as well as the high proportion of population in agglomerations of less than 2 000 p.e. In Finland, the issue is related to the high proportion of population living in scattered dwellings, as well as the high seasonal influx of people residing in scattered dwellings during the summer.

The situation in France and Ireland is somewhat different. A continuous policy effort has been placed in these countries to minimise the impact of non-connected dwellings, and as a result, the pressures from the large number of non-connected dwellings are reported to be less significant[67].

Enforcement of national regulations and legal gaps

Despite all five countries having introduced a legal framework to deal with non-connected dwellings, issues of non-compliance have been identified in all countries. The reasons for that include the high capital and operational costs associated with IAS that are borne by homeowners (Bulgaria, Finland, Poland), as well as specific technical issues related to the operation and maintenance of IAS (France and Ireland). Furthermore, inspections of IAS are difficult to execute since these are located on private properties. With respect to the issue of cost, Finland reported that when it first introduced a regulation on IAS, it led to significant criticism from homeowners due to the cost associated. As a result, the regulation was revised several times to lessen the standards. Similar public reaction is expected if standards are tightened again.

Furthermore, specific legislative gaps have been observed in Bulgaria, where legislation currently specifies that waste water from non-connected dwellings in sparsely populated areas should be collected in cesspools, thereby limiting the use of more sustainable and effective IAS. Furthermore, no definition of sparsely populated areas is provided and at the same time, there is no regulation dealing with non-connected dwellings in areas that are not sparsely populated.

Technology choices

The choice of IAS could have an impact on the scale of the pressure. For example, cesspools which are still common in Bulgaria and Poland are associated with higher environmental impacts than septic tanks. This is because they are watertight and as such, they require more frequent emptying which is often not conducted in practice. Since cesspools provide no waste water treatment, leakages or overflows will lead to the release of untreated effluent in the local environment. While septic tanks provide primary treatment, these can also be a subject to leakages and overflows and therefore need to be regularly inspected.

[65] Above 10 %.
[66] More than 20 % of water bodies affected by diffuse pollution pressures.
[67] Less than 10% of groundwater bodies area and less than 20% of surface water bodies are affected.

Influence of the local environment

The operation of IAS could be hampered by country-specific factors such as climate (e.g. low temperatures in Finland and high temperatures in the overseas territories of France), type of soil (as reported in Ireland and France, especially where the soil is used for additional filtration), or terrain (e.g. mountainous areas in Poland)

8.1.2 Approaches to mitigating the problem

Legislation and enforcement

All five considered countries have introduced legislation to address the issue of pollution from non-connected dwellings. For example, all countries have imposed some requirements for the use of IAS in non-connected areas and have set minimum operation requirements. Finland is the only country that has specified pollutant load requirements within its legal framework.

Furthermore, inspections of properties using IAS have been undertaken in Finland, France, Ireland and Poland[68]. The aim of these inspections is to identify properties with non-compliant IAS and order remedial actions. It is unclear whether inspections are performed in Bulgaria[69].

Finally, France has applied an additional "agglomeration" category to these of the UWWTD, requiring waste water collection and treatment in sufficiently aggregated areas in agglomerations of less than 2 000 p.e.

Financial mechanism and other support

Most countries have introduced financial mechanisms to support the implementation of the IAS national standards. Financial mechanisms for the development or rehabilitation of IAS are available in Finland, France and Ireland. A financial mechanism to support homeowners in connecting to waste water collection will be introduced in Bulgaria. No information is available on funding mechanisms in Poland.

With respect to country-specific actions, awareness campaigns have been implemented in France and Ireland to inform homeowners about the selection, maintenance, and operation of IAS. In addition, Finland and France have developed guidance materials to assist homeowners in making the most sustainable IAS choice. France has also provided a list of accredited IAS that should be applied by homeowners. Finally, Ireland has introduced a land use planning and site assessment approach applied to ensure the IAS selected are suitable to the local environment.

8.1.3 EEA member countries not reporting under the Water Framework Directive

It is unclear what is the extent of the pressures from dwellings not connected to sewerage in Iceland, Switzerland and Turkey. However, the findings from this report show that Iceland and Turkey have a substantially higher proportion of the population not connected to sewerage and UWWTP when compared to the EU Member States. The use of IAS in non-connected areas is either limited or unknown. For instance, 26 % of the population in Iceland is not connected to the sewerage network and does not apply IAS. While Turkey has indicated that the non-connected population in municipalities applies IAS, it is unclear whether this is the case in rural areas. These observations indicate that the scale of diffuse pollution pressures from non-connected dwellings in Iceland and Turkey may be far greater when compared to the five Member States examined in-depth in this report. With respect to Switzerland, it is unlikely that non-connected dwellings represent a significant source of pressure to water bodies since only 1 % of the population is not connected to UWWTP.

[68] It is unclear how frequent these are.

[69] The Member State has not provided any information regarding inspections.

Finally, regarding approaches taken to mitigate the problem, Iceland has introduced a financial mechanism to improve the rates of waste water collection and treatment in non-connected dwellings. The approach is similar to that of Finland, France and Ireland.

8.2 Conclusions and future outlook

This report has found that even though discharges from non-connected dwellings are not fully regulated at EU level, significant efforts have been made in the five countries considered to mitigate the diffuse pollution pressures that they create. All five countries considered have introduced regulations to deal with the impact of waste water from non-connected dwellings on the local environment. However, the most significant challenge that remains is the enforcement of the regulations, especially considered that all associated costs are borne by homeowners. Another challenge to addressing the situation are the data gaps which result from inconsistent or no monitoring and reporting requirements. These issues are likely to be common to the wider European region due to the lack of specific EU-level requirements in agglomerations of less than 2 000 p.e.

Specific needs to improve the situation include:

1. Improvements of central waste water collection and treatment in sufficiently populated areas;
2. Provision of more coherent national regulatory framework to address non-connected dwellings;
3. Provision of further investments, financial assistance, and awareness campaigns for homeowners to improve compliance rates;
4. Regular inspections of non-connected dwellings; and
5. Systematic data collection to improve the understanding of the problem.

These needs are particularly important in light of the health hazards represented by unsafe sanitation in non-connected dwellings (WHO, 2019).

With respect to future outlook, improvements in the five examined countries are likely since they have planned further investments and/or regulatory changes to further improve the situation.

However, in countries where full compliance with the waste water collection requirements of the UWWTD has not yet been achieved, the policy and investment focus is placed on agglomerations larger than 2 000 p.e. As such, there is a gap in the mitigation efforts in smaller agglomerations. In comparison, the planned investments in countries that have achieved full compliance with the requirements of the UWWTD relate to the rehabilitation or development of IAS.

With respect to EEA non-EU Member States, no information on planned policy interventions or investments was identified with respect to Turkey. In Iceland, some improvements may be anticipated as a result of the financial mechanism introduced in 2013 to improve the compliance with sanitation requirements, however there is no information available on the efficacy of the mechanism. Finally, no specific improvements are required in Switzerland due to the fact that 99 % of the population is connected to waste water collection and UWWTPs.

Table 8-1 Horizontal overview of the five selected countries

✓- Relevant to the Member State
x - Not relevant to Member State
Unclear – No information was identified with respect to this Member State, however, the relevance of this indicator is possible

	Bulgaria	Finland	France	Ireland	Poland
Overview					
Population in agglomerations < 2 000 p.e.	1.9 million people (25 % of total population)	1 million people (18 % of total population) 1 million people have seasonal presence	13 million people[70] (19% of total population)	1.7 million people (38 % of total population)[71]	9.6 million people (30 % of total population)[72]
IAS applied in agglomerations > 2 000 p.e.	8 117 p.e. (0.01 %)	0 %	0 %	262 788 p.e. (5 %)	2.3 million p.e. (5.9 %)
No collection/treatment > 2 000 p.e.	1.3 million p.e. (16 %)	0 %	0 %	0 %	108 080 p.e. (0.28 %)
IAS applied nationwide	1.8 million people applied IAS (24 %)	286 000 dwellings and 500 000 holiday homes (total unclear)	13 million people connected to 5 million IAS	490 000 dwellings (30 % of all dwellings)	*No information*
Water bodies under pressure from discharges not connected to sewerage system (proportion of all water bodies affected by diffuse pollution)					
Surface water bodies	39 %	52 %	13 %	14 %	67 %
Groundwater bodies	99.9 %	32 %	5 %	9 %	*Not reported*
Water bodies under pressure from discharges not connected to sewerage system (proportion of all water bodies in the country)					
Surface water bodies	8 %	12 %	4 %	3 %	18 %

[70] Population with no access to central waste water collection and treatment.
[71] The Central Statistics Office defines the term *Aggregate Rural Area* as the area that includes the population of settlements with a population of less than 1 500 persons.
[72] The figure relates to population in rural areas. It is unclear what is the definition of "rural" used in this estimate. However, the Polish Statistical Institute defines "rural areas" as all areas are all areas that are not towns or cities (i.e. urban areas) but does not specify the associated population size.

	Bulgaria	Finland	France	Ireland	Poland
			Overview		
Groundwater bodies	37 %	1 %	1 %	0.0006 %	*Not reported*
			Legal framework		
National regulation / standards	✓	✓	✓	✓	✓
Inspections	*Unclear*	✓	✓	✓	✓
Financial mechanisms	To be introduced	✓	✓	✓	*Unclear*
Awareness campaigns and user guidance	*Unclear*	✓	✓	✓	*Unclear*
			Underlying causes		
High proportion of non-connected dwellings	✓	✓	✓	✓	✓
Lack of infrastructure in agglomerations > 2 000 p.e.[73]	✓	×	×	×	✓
Poor operation, maintenance, de-sludging	✓	✓	✓	✓	✓
Implementation and enforcement issues (national regulations)	✓	✓	✓	✓	✓
Unsuitable technology choice	✓	✓	✓	✓	✓
Climate	×	✓	Only in overseas areas	×	×

[73] i.e. non-compliance with the requirements of the UWWTD

	Bulgaria	Finland	France	Ireland	Poland
Overview					
Mitigation approaches[74]					
Development of infrastructure	✓	✓	✓	✓	✓
Rehabilitation of IAS	×	✓	✓	✓	×
Future outlook					
Investments	✓	*Unclear*	✓	✓	✓
Policy interventions	✓	✓	*Unclear*	✓	*Unclear*

[74] See also *Legal framework*

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Annex 1 Data derived from WISE database

Table 9-1 and Table 9-2 present the data derived from the WISE database which informs the information presented throughout the report regarding numbers of surface water bodies and total area of groundwater bodies under pressure from non-connected dwellings **(EEA, 2019)**. The numbers presented in the report consider only surface water bodies with moderate, poor or bad ecological status and groundwater bodies failing to achieve good chemical status. Ecological status of surface water bodies is the indicator used to monitor nutrient pollution whereas chemical status is used for nutrient pollution to groundwater bodies. It is noteworthy that water bodies are normally affected by several pressures at the same time, and therefore, the status of the water bodies considered in this report is not solely a result of diffuse pollution pressures from non-connected dwellings.

Table 9-1 Data derived from WISE database underlying country chapters surface water body figures

Country	Surface water bodies (number)	Surface water bodies (moderate, poor or bad ecological status) (number)	Surface water bodies with moderate, poor or bad ecological status affected by diffuse pollution pressure (number)	Surface water bodies with moderate, poor or bad ecological status affected by diffuse pollution from non-connected dwellings (number)
Bulgaria	955	431	210	81
Finland	6 806	1 724	1 624	838
France	11 414	6 331	3 887	489
Ireland	4 309	1 288	939	135
Poland	5 649	3 882	1 503	1 007
EU-28 and Norway	143 565	73 463	39 896	12 341

Source: EEA (2019)

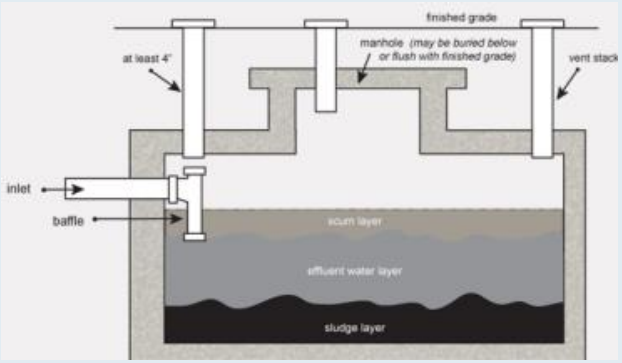
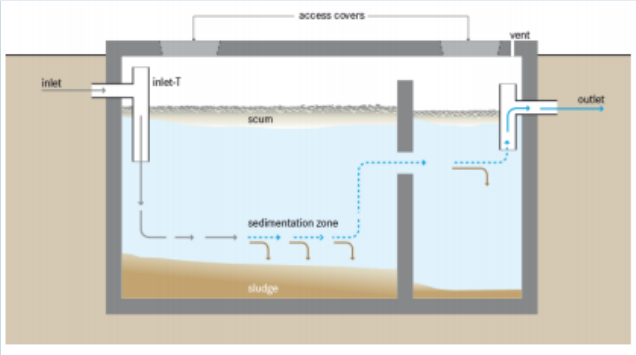
Table 9-2 Data derived from WISE database underlying country chapters groundwater body figures

Country	Groundwater body area (km^2)	Groundwater body area (failing to achieve good chemical status) (km^2)	Groundwater body areas failing to achieve good chemical status affected by diffuse pollution pressure (km^2)	Groundwater body area failing to achieve good chemical status affected by diffuse pollution from non-connected dwellings (km^2)
Bulgaria	158 602	70 939	59 417	59 318
Finland	9 969	456	417	147
France	1 235 075	313 666	313 056	15 759

Country	Groundwater body area (km^2)	Groundwater body area (failing to achieve good chemical status) (km^2)	Groundwater body areas failing to achieve good chemical status affected by diffuse pollution pressure (km^2)	Groundwater body area failing to achieve good chemical status affected by diffuse pollution from non-connected dwellings (km^2)
Ireland	71 593	667	526	46
Poland	311 978	24 228	22 949	0
EU-28 and Norway	4 284 995	133 080	763 104	189 859

Source: EEA (2019)

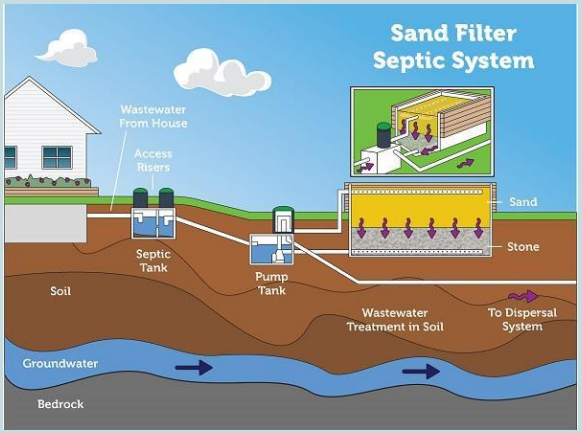
Annex 2 Overview of most common IAS technologies

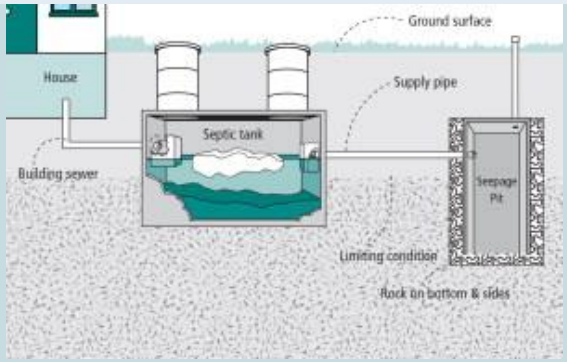
Name of Technology	Diagram	Description	Treatment level	Maintenance needs
Holding Tank / Cesspool		Closed, watertight structures with no outlet pipe where effluent accumulates. The effluent needs to be subsequently transferred to a waste water treatment plant for further treatment (Vorne and Silvenius, 2017).	No treatment	Regular removal or drainage to remove build-up of sewage and waste water. Cesspools that are not operated and maintained properly are associated with adverse environmental pollution (Vorne and Silvenius, 2017).
Septic Tanks		Septic tanks provide primary[75] waste water treatment. They are used for accumulation, sedimentation, and subsequent withdrawal of partially treated waste water without suspended particles for the final stage of treatment (Vorne and Silvenius, 2017). The process in septic tanks is anaerobic. The term "septic" refers to the anaerobic bacterial environment that develops in the tank which degrade organic contaminants (Vorne and Silvenius, 2017).	Primary treatment	Accumulated sludge must be periodically removed - varies from tank to tank (~6 months). Dependent on volume of tank relative to input solids, the volume of indigestible solids and the temperature (more efficient digestion at higher temperatures)

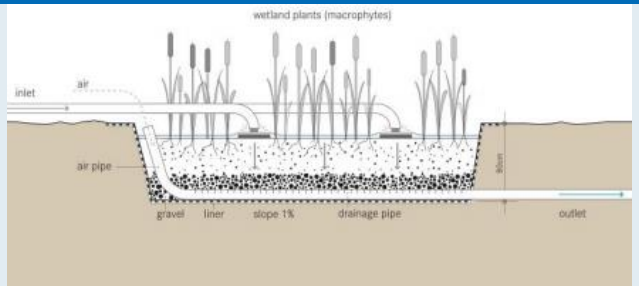
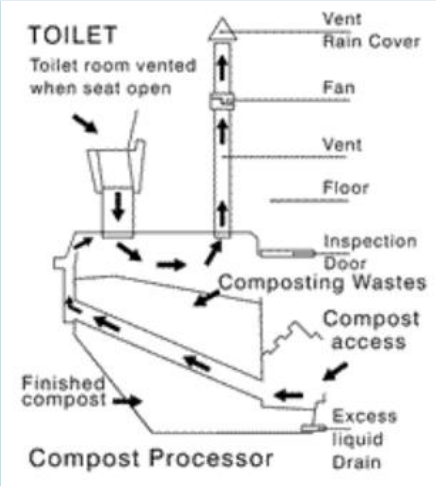
[75] Removal of heavy solids.

Name of Technology	Diagram	Description	Treatment level	Maintenance needs
		Sewage sludge forms into the bottom of the tank (Vorne and Silvenius, 2017). The septic tank needs to be regularly[76] de-sludged, with the collected sludge being disposed to a WWTP for further treatment (Vorne and Silvenius, 2017). Septic tanks could be used together with a infiltration systems to provide further treatment (Vorne and Silvenius, 2017).		(Vorne and Silvenius, 2017).
Package Plants		Packaged WWTPs are secondary and advanced secondary treatment systems which are often supplied as a ready-made package plant. The treatment system uses physical and biological processes to reduce the level of contaminants in waste water discharging it into the ground. The packaged plant treatment system is normally a type of bio-chemical treatment for domestic waste using the extended aeration process, however also completely biological processes are	Secondary treatment[77] and more stringent treatment[78]	Once installed, in theory should require minimal maintenance while still successfully cleaning waste to high standard. Aerobic digestion is sometimes applied which requires additional energy inputs. (Vorne and Silvenius, 2017).

[76] The frequency depends on the size of the septic tank. De-sludging once a year is appropriate for small septic tanks.
[77] Physical phase separation to remove settleable solids .
[78] Biological treatment to remove dissolved and suspended organic compounds.

Name of Technology	Diagram	Description	Treatment level	Maintenance needs
		developed especially for larger treatment volumes. Physical treatment processes include the gravity settlement of solids and the filtering of wastewater to remove suspended solids. Precipitation of phosphorus is frequently a chemical process. Biological treatment occurs through the digestion of wastes by bacteria. Bacterial digestion is an aerobic process (in the presence of air), such as within an aerated treatment plant (Vorne and Silvenius, 2017).		
Sand filter (Infiltration system)		In a sand filter, effluent is filtered down a large ditch filled with several layers of stone and sand, as well as a water resistant lower and outer plastic layer to keep substances within the filter (Vorne and Silvenius, 2017). A series of filters, vertical, horizontal or radial can be applied and customised to suit property needs (Vorne and Silvenius, 2017).	Secondary treatment. Lower ammonia removal compared to other systems	Low once installed. Often users require a new filter field every 3-4 years as a result of silt (Vorne and Silvenius, 2017).

Name of Technology	Diagram	Description	Treatment level	Maintenance needs
Drain field (infiltration system)		The drain field consists of drain pipes, laid under layers of sand and crushed stone. The waste water is filtered through the sand, gets to the crushed stone layers and then soaks into the ground (Vorne and Silvenius, 2017). The absorption area is a pipeline made of perforated material (Vorne and Silvenius, 2017). The drain field is usually applied after a septic tank.	Secondary treatment. BOD and N removal efficiency is high (Vorne and Silvenius, 2017).	Low once installed. Often users require a new filter field every 3-4 years as a result of silt (Vorne and Silvenius, 2017).
Seepage pit		Seepage pits are vertical wells lined with a porous masonry in which discharges from a septic tank are collected and gradually seeped into the soil, the ground surface or a ditch (Ispectapedia, 2019).	No treatment	Seepage pits may become clogged with solids entering from the septic tank. They need to be regularly inspected for blockages and to be emptied every 3-5 years (Ispectapedia, 2019). .
Constructed wetland		Constructed wetlands are artificial wetlands designed to treat waste water. These are often used after a septic tank for further treatment separating solid from liquid effluent. Constructed wetlands usually provide mechanical, chemical and biological treatment of	Secondary treatment	Hybrid designs require expert design but can be built locally using local materials usually. Highly effective - effluent can be used for irrigation or aquaculture or be

Name of Technology	Diagram	Description	Treatment level	Maintenance needs
		waste water (Vorne and Silvenius, 2017).– They incorporate physical filtration and sedimentation, biological uptake, transformation of nutrients by both aerobic and anaerobic bacteria as well as precipitation, absorption and decomposition (Vorne and Silvenius, 2017).		discharged into water bodies (Vorne and Silvenius, 2017).
Composting toilets (dry and wet)		Composting toilets use microorganisms to decompose human waste mixed with wood shavings, lawn clippings and other organic matter into humus. There are two types of composting toilets - dry and wet (WaterNSW, 2019). Dry composting toilets collect urine and faeces in a sealed chamber beneath the toilet pedestal, where microorganisms decompose the mixture of human waste and extra organic matter (WaterNSW, 2019). Excess liquids drain to a small absorption trench and may be treated with grey water from the household. Wet composting systems can be used in conjunction with flushing toilets (WaterNSW, 2019). Wet	Primary treatment	De-sludging required every 2-3 months (WaterNSW, 2019).

Name of Technology	Diagram	Description	Treatment level	Maintenance needs
		composting systems treat all the waste water from the house (WaterNSW, 2019).		

Diagram sources: Vorne and Silvenius, (2017),Louisville, (2019) and REUK (2019)