Effective practices in monitoring, assessing and ensuring compliance with water reuse standards in Poland and selected European Union countries

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Introduction

This report aims to identify and describe the water reuse practice and standards in the selected Member States of European Union. The investigated countries are: Cyprus, France, Portugal, the United Kingdom, Ireland, Luxembourg, Belgium, the Netherlands, Sweden, Finland, Denmark, Slovakia, Lithuania, Estonia, Hungary, Bulgaria, Romania, Croatia and Austria. The analysed issues refer to the monitoring, assessment and ensuring compliance with the standards in the field of water reuse in the scrutinized areas.

First of all, the general landscape of water reuse, i.e. the number of sewage treatment plants, sectors and entities using them, etc. is presented. Secondly, the overview of standards and guidelines regulating water reuse is delivered. Finally, the reference to supporting elements that highly affect the waste water treatment procedures (personnel and laboratory equipment) is made.

In addition, similar information was also collected for Poland - the results are presented in the Data Collection Tool (annex).

The study was prepared mainly based on the desk research technique (analysis of existing data). The information to be determined in the case of Poland was supplemented with knowledge obtained from experts in the field of reused water. As part of the work, a few of conversations and consultations were conducted with representatives of the entity POLISH WATER, which is responsible for national water management, as well as with employees of sewage treatment plants or industrial plants that reuse water for their own needs.

General landscape of water reuse in the selected Member States

The first table shows the numbers of wastewater treatment plants according to the sewage treatment conventional processes applied in, within selected EU Member States. The process of treating sewage is broadly classified as primary; secondary and tertiary. Physical, chemical, and biological processes are used within different degrees of treatment to remove contaminants and produce treated wastewater that is safe enough for release into the environment. Primary treatment consists of removing floating and suspended solids by mechanical means. Secondary treatment of waste involves the biological degradation of organic material by micro-organisms under controlled conditions. Tertiary treatment aims at further purification of waste water (deep nitrogen and phosphorus removal) and also for its recycling.

Three countries stand out the most positively when the shares of different degrees of treatment are analysed: in the Netherlands, Cyprus and Finland the number of treatment plants with the most stringent and advanced tertiary treatment is the highest, and primary as well as secondary treatment plants hardly exist or there are very few in the mentioned countries. On the opposite side there are Croatia and Luxembourg, where the proportion of tertiary treatment plants is the lowest and where primary (mechanical) treatment of waste water is the most common (the highest share of primary treatment plants). Also Belgium, Portugal and Romania are characterised by the lowest shares of tertiary treatment plants in the total number of plants, however their highest proportion is constituted by those with secondary, not the primary, treatment degree.

The next table presents the percentages of the population connected to primary, secondary and tertiary urban waste water treatment facilities in the selected EU Member States the report is focused on. In majority of countries (except Portugal) the vast majority of the population is connected to the most stringent treatment plants (tertiary level). The Netherlands, Austria and Denmark are characterised by the highest percentage shares of population connected to the tertiary treatment (98,4; 93,8; 89,00 respectively). On the other hand, there are a few countries where the used water is collected without any treatment, among which Bulgaria (13,2%), Portugal (10,7%), Belgium (7,2%), Ireland (3%), Hungary (2%), Romania (1,9%), Croatia (1,7%) and Luxembourg (1,5%). There are countries like the Great Britain, Luxembourg and the Netherlands where the sum of presented shares is equal (or nearly equal) to 100% - it means that the whole country population is served by a sewer system (incl. each treatment levels as well as collection without any treatment).

Table 1 Number of treatment plants in selected EU Member States

Type of wastewater treatment plant	Country (ISO 3166 codes) / year																		
	BE 2012	BG 2013	DK 2013	EE 2013	IE 2013	FR 2013	HR 2013	CY 2011	LT 2012	LU 2013	HU 2013	NL 2013	AT 2012	PT 2009	RO 2014	SK 2012	FI 2012	SE 2012	GB 2008
Urban wastewater treatment plants - primary treatment	412	10	177	18	217	23	72	0	48	130	10	0	0	1384	86	5	:	0	740
Urban wastewater treatment plants – secondary treatment	485	54	273	319	536	647	36	3	457	97	278	4	791	1617	321	165	:	325	5151
Urban wastewater treatment plants - tertiary treatment	325	26	456	251	310	2605	4	32	56	24	451	337	1051	116	74	84	202	918	2156
Urban wastewater treatment plants - total	1222	90	906	588	1063	3275	112	35	561	251	739	341	1842	4287	481	254	202	1243	8047
Other wastewater treatment plants - total	:	:	:	456	:	:	204	156	156	:	:	214	:	:	345	:	:	:	:

Source: ASM-Market Research and Analysis Centre on the basis of EUROSTAT

Table 2 The percentages of the population connected to primary, secondary and tertiary urban waste water treatment facilities (2017) in selected EU Member States[1]

Level of waste water treatment	Country (ISO 3166 codes)																		
	BE	BG	DK	EE	IE	FR	HR	CY (2015)	LT	LU	HU	NL	AT (2016)	PT	RO	SK	FI (2015)	SE	GB (2015)
Primary treatment	0	0,23	0,2	0,03	0,79	0	16	0	0,1	1,6	0,07	0	0	6,97	3,2	2,2	0	0	0
Secondary treatment	8,37	16,15	1,4	3,3	40,24	11	35,9	11,5	6,67	21,8	7,12	0,8	1,2	46,66	6,2	63,2	0	4	43
Tertiary treatment	74,59	47,04	90,4	79,57	20,91	69	1	18,3	67,11	75,2	72,08	98,7	94	37,98	40,2	1,8	83	83	57
Collected without treatment	5,02	12,61	0	0	1,6	0	1,7	0	0,027	1,4	2,18	0	0	0,14	1,4	0,5	0	0	0

Source: ASM-Market Research and Analysis Centre on the basis of EUROSTAT

[1] https://www.eea.europa.eu/data-and-maps/indicators/urban-waste-water-treatment/urban-waste-water-treatment-assessment-4

Table no 3 indicates the volumes of water used by beneficiaries (businesses as well as individuals) across various sectors in countries being described within this report (symbol ':' means that data is not available). On the basis of available data, it seems that the biggest consumers of water are households – this type of end users accounts for at least 65 % (Romania) up to 98% (Cyprus) of total water use within all activities. Apart from households also industry and services sectors interchangeably consume high shares of water in selected Member States. It is important to mention, that while treated waste water is reused predominantly for agricultural irrigation[2], the use of water from public supply for this purpose is rather low when compared with other sectors (e.g. industry). It shows how small the scale of water reuse is in its global demand and how much more needs to be done.

An important addition to the overview of the status of water supply system in particular countries will be the water productivity indicator that informs how much economic output is produced per cubic meter of fresh water abstracted (in PPS per m3). It serves as a measure of the efficiency of water use. A lower water productivity primarily means that the economic and industrial structure of the country is water use intensive. A less water-consuming economy shows a relatively high water productivity. For the calculation of water productivity the unit PPS (Purchasing Power Standard) is used to enable the comparison between countries in the same year. The most favourable values of water productivity are observed in Luxembourg, Denmark, the United Kingdom and Lithuania (from above 200 up to 1011,2 PPS per cubic metre). On the opposite side Belgium and Estonia are located - the values of water productivity indicator are the lowest in the mentioned countries (17,4 and 18,5 PPS per cubic metre) and a lot of effort should be made there to make the water consumption more efficient (e.g. to introduce water reuse policy framework).

[2] Monte M.H.F.M. (2007) Guidelines for Good Practice of Water Reuse for Irrigation: Portuguese Standard NP 4434. In: Zaidi M.K. (eds) Wastewater Reuse–Risk Assessment, Decision-Making and Environmental Security. NATO Science for Peace and Security Series. Springer, Dordrecht

Table 3 Water use by economical sector (public water supply), in million cubic metres

Economical sector	Country (ISO 3166 codes) / year																		
	BE 2013	**BG 2015**	**DK**	**EE 2013**	**IE 2011**	**FR 2013**	**HR 2015**	**CY 2014**	**LT 2015**	**LU 2015**	**HU 2015**	**NL 2014**	**AT 2010**	**PT**	**RO 2015**	**SK 2015**	**FI**	**SE**	**GB 2011**
Agriculture, forestry and fishing	8,93	3,51	-	0,3	-	-	-	-	0,091	-	1,207	41,9	-	-	1,6	-	-	-	120
Industry	93,47	74,1	-	-	-	-	91,115	2,02	9,622	-	58,774	141,3	-	-	203,2	-	-	-	345
Mining and quarrying	0,1	1,57	-	-	-	-	-	0,07	0	-	-	2,4	-	-	-	-	-	-	37
Manufacturing	-	31,45	-	7,9	-	-	-	1,91	9,204	-	6,335	130,8	-	-	-	-	-	-	263
Production and distribution of electricity	-	1,09	-	0,1	-	-	-	0,032	0,046	-	0,022	3,1	-	-	4,2	-	-	-	26
Construction	-	1,53	-	-	-	-	-	-	0	-	-	2,5	-	-	-	-	-	-	9
Services	-	44,61	-	-	-	-	-	-	22,833	-	47,516	101,4	-	-	70,5	-	-	-	601
Households	-	258,64	-	-	-	3388	179,59	77,69	68,615	42,169	335,893	783,3	381	-	498,9	-	-	-	2902
All activities (incl. households)	**567,9**	**380,86**	**-**	**51,6**	**669**	**3622**	**-**	**79,71**	**101,161**	**-**	**443,389**	**1067,9**	**587**	**-**	**774,2**	**288,13**	**-**	**-**	**3968**

Source: ASM-Market Research and Analysis Centre on the basis of EUROSTAT

Table 4 Water productivity, Purchasing power standard (PPS) per cubic metre

Water productivity	Country (ISO 3166 codes) / year																		
	BE 2017	**BG 2017**	**DK 2016**	**EE 2017**	**IE**	**FR 2016**	**HR 2017**	**CY 2017**	**LT 2017**	**LU 2016**	**HU 2016**	**NL 2014**	**AT**	**PT 2017**	**RO 2017**	**SK 2017**	**FI**	**SE 2015**	**GB 2014**
Purchasing power standard (PPS) per cubic metre	18,5	174,4	285,1	17,4	-	77,1	113,8	101,4	227,7	1011,2	48,4	68,6	-	49	54,4	214,9	-	150,2	267,2

Source: ASM-Market Research and Analysis Centre on the basis of EUROSTAT

Overview of standards and guidelines regulating water reuse in selected Member States

Although there are regions where water reuse is commonly and successfully used for several years (e.g. USA), in Europe there is an absence of effective wide standards and guidelines to regulate water reuse. Even though the EU has developed a portfolio of directives of major importance for water reuse (e.g. to protect the environment and human health, regulate the water cycle, etc.), there is not a coherent EU framework for water reuse. The most recent regulatory initiative is the Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on minimum requirements for water reuse. Nonetheless, there are policies and regulatory tools developed nationally for specific water reuse applications in six of the 28 EU member states: Cyprus, France, Greece, Italy, Portugal, Spain. This report will describe the standards and practices deployed in Cyprus, France and Portugal. Also the most important findings with regard to the water reuse practice in the rest of selected Member States are presented.

Water reuse standards in Cyprus, France and Portugal

There are limited water resources in **Cyprus** – they depend mainly on rainfall that is unevenly distributed temporally and geographically. What is more, statistical analysis reveals a stepped drop of 15% in precipitation since the early 70's. Taking into account the negative impact of climate change on fresh water availability and the fact that the agricultural sector is the largest water user in Cyprus there is a strong pressure to increase the effluent reuse for irrigation and other uses. The volumes of treated effluent is systematically increasing (from 14.413.954 m3 in 2004 to 22.210.543 m3 in 2012) and the future quantity of 86Mm3 of treated effluent is expected in 2025. In 2012 effluent reuse satisfied 9 % of the irrigation needs and the objective is the replacement of fresh water used in agriculture by treated effluent up to 40 %.

The relevant documents for water reuse in Cyprus are as follows[3]:

2005 – Standards for the reuse of treated wastewater for irrigation, Decree no. 296/03.06.05 adopted in 2005 along with a Code of Good Agricultural Practice (P.I. 263/2007); issuing institutions: Ministry of Agriculture, Natural resources and Environment and Water Development Department

2002-2013 – The Water Pollution Control Laws. The basic legislative instrument on which the control of water and soil pollution control is regulated is Law No. 106 (I)/2002. This Law together with its amendments (No. (I)/2005, 76 (I)/2006, 22 (I)/2007, 11 (I)/2008, 53 (I)/2008, 68 (I)/2009, 78 is known as **"**The Control of Water Pollution Laws 2002 to 2013"

- The Water Pollution Control (Discharge of Urban Waste Water) Regulations of 2003 (No. 772/2003).
- The Water Pollution Control (Sensitive Areas for Disposal of Urban Waste Water) Ministerial Decree of 2013 (No. 280/2013).

[3] https://www.water-reuse-europe.org/about-water-reuse/policy-and-regulations/#page-content (access:20.08.2019)

- The Ministerial Decree of small – scale wastewater treatment plants < 2000 p.e (No. 379/2015).

- The Code of Good Agriculture Practice Decree (No. 263/2007).

- The Environmental Impact Assessment Law (No. 127 (I)/2018) for discharge to water bodies and for the management of the effluent for new UWWTPs.

The following description of the situation in Cypriot is mainly made on the basis of document *Reuse of Treated Effluent in Cyprus* prepared by the Water Development Department of Ministry of Agriculture, Natural Resources and Environment of the Republic of Cyprus.[4] According to the Cyprus law, sewage treatment is of Tertiary Degree, which is higher than the requirements of Directive 91/271/EEC concerning urban waste-water treatment.

Importantingly, tertiary treatment is mandatory irrespective of its use in irrigation, recharge of aquifers or disposal to the sea. Such a rule was established in order to eliminate the possibility of any health or environment incidents. An equally important motivation for such a provision was to reduce farmers scepticism and barriers to reusing as well as encourage public acceptance for it and enhance marketability of crops in this way.

The Code of Good Agricultural Practice provides mandatory guidelines to make the use of treated effluent safe for irrigation. The Code's main provisions include:

- restriction on the type of crops irrigated (irrigation of all crops is allowed except for leafy vegetables, bulbs and condyles that are eaten raw (e.g. lettuce, carrot, celery, parsley),
- safety precautions for the proper use of water >>> the use is prohibited by unauthorized persons, marking pipes with red line, clear signalling to alert the public that the water is undrinkable, ensuring protection for hydrants and distribution systems, etc.),
- irrigation practices according to the methods of irrigation (subsurface /drip / sprinklers) and to the kind of crops,
- main uses: forest trees, fodder crops, fruit- tree orchards, green areas, vegetables.

Also the quality control of the treated effluent is specified in the Cyprus law. In urban and rural agglomerations above 2.000 p.e.[5] sampling and analysis are being executed by Urban Sewerage Boards and Water Development Department that is responsible of the disposal of the treated effluent produced by the Urban Sewerage – their role is to follow the quality of treated effluent according to the requirements of their Discharge Permits. Also Department of Environment is involved in the quality control system – it is responsible of issuing the Discharge Permits and its role is to follow up whether every plant meets the requirements of granted Discharge Permits. In rural agglomerations less than 2.000p.e. sampling and analysis are being executed by Water Development Department.

On the basis of the Control of Water Pollution Laws 2002 to 2013, water and soil protection is ensured with the granting of permits for waste disposal to specific establishments by the Minister of

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[4] https://circabc.europa.eu/sd/a/3708002d-9f5c-469f-a773-c2dbaefa49d5/CYPRUS_Water%20Reuse.pdf (access:20.08.2019)

[5] **Population equivalent or unit per capita loading, (PE)**, in waste-water treatment is the number expressing the ratio of the sum of the pollution load produced during 24 hours by industrial facilities and services to the individual pollution load in household sewage produced by one person in the same time

Agriculture, Natural Resources and Environment. Environmental permits contain specific conditions, depending on the type of each establishment, for the sound management of liquid and solid waste and its controlled disposal in the environment. Inspectors of the Department of Environment carry out inspections to check the degree of compliance with environmental conditions. In cases of violations appropriate measures are taken such as letters of compliance, performance tuning and preparation for reporting to the Attorney General for taking criminal measures.[6]

A lot of negative reaction and scepticism from farmers at the early days of implementing water reuse projects in Cyprus were observed mainly due to concerns about the safety of using treated wastewater in agriculture. Acceptance issues were addressed through:

- information / consultation campaigns,
- education of the farmers in small groups,
- regulating effluent reuse through the Code,
- making recycled water much cheaper than freshwater,
- demonstrating benefits in practice (pilot irrigation area were established to demonstrate that recycled water enhances agricultural productivity and is safe to use by the farmers).

The Cyprus government bears the cost of tertiary treatment and the cost of infrastructure to take reclaimed water to agricultural areas (pipelines, pumping and storage ponds for winter), while the farmers bear the cost of transferring water from the distribution pipeline up to their farm outlet in the case of new irrigation networks.

In order to make the treated effluent more competitive economic incentives are provided in Cyprus. Water pricing system promotes Tertiary Treated Effluent for irrigation purposes – the selling rates per m3 are much lower than the price of fresh water, for example the price of tertiary treated effluent for irrigation of hotels green areas and gardens was 15 EURO Cent/m3 in 2014 while the price for fresh water was 34 EURO Cent/m3.

In contrast to Cyprus, one of the richest European countries in water resources is **France**. In France, almost the entire population is connected to a water distribution system (99 percent). A slightly smaller number is connected to a wastewater collection system (80 percent), as on-site sanitation solutions tend to be used in low density rural areas. The French model for the management of water services is characterized by decentralized relationships between public authorities and private operators, with multilevel financial mechanisms of redistribution to mutualise costs.[7]

Although the water scarcity can occur only locally or seasonally in France, the country has been one of the first in Europe that planned and implemented water reuse projects since 1890.[8] What is more, France was the second European country, after Italy, to set criteria for water reuse (Circular no. 51 of July 22, 1991, of the Ministry of Health).[9] The criteria were mainly influenced by the WHO guidelines but additional requirements were included (irrigation method, timing, distance, and other preventive

[6] http://www.moa.gov.cy/moa/environment/environmentnew.nsf/page17_en/page17_en?OpenDocument (access: 20.08.2019)
[7] WATER SECTOR REGULATION IN FRANCE, https://www.ifo.de/DocDL/dicereport207-forum2.pdf
[8] N. V. Paranychianakis, M. Salgot, S. A. Snyder & A. N. Angelakis (2015), Water Reuse in EU States: Necessity for Uniform Criteria to Mitigate Human and Environmental Risks, Critical Reviews in Environmental Science and Technology, 45:13, 1409-1468, p.1425
[9] Ibidiem, p.1434

measures) to eliminate health risks. In 2010, updated criteria in the form of regulations were released (Journal Officiel de la Republique ´ Franc'aise, 2010). They follow the philosophy of the revised guidelines of WHO (2006) but they describe additional requirements for monitoring fecal Enterococci, F-specific RNA phages, and spores of anaerobic bacteria in addition to limits for E. coli. The regulation introduced quality standards for treated wastewater based on four quality levels (from A – high quality, through B and C up to D). These four categories of treated effluent are defined based on their chemical and microbiological properties and its potential use for crop or green areas irrigation as well as monitoring requirements. The higher the risk of human exposure (valorisation of the crops, type of irrigation), the higher the treatment level needed. As a result, the irrigation of fresh vegetable crops in particular is governed by the most stringent standards while the irrigation of forests is governed by the least stringent standards. The stricter the standards, the more complicated the treatment processes required and the higher the cost of production. Additional issues mentioned in regulation are setback distances, soil water content, soil properties and parent material, and irrigation method. The newest update of regulation for water reuse for agricultural and green areas irrigation was published in 2014 in Official Journal of the French Republic: *Decree n◦0153 du 4 of July 2014 Page 11059 Text No. 29.*. The issuing institutions were: Ministry of Ecology, sustainable development and energy, Ministry for Social Affairs and Public Health, Ministry of Agriculture, Agri-Food and forests.

The French standards on wastewater reuse describe water reuse for the irrigation of agricultural lands and green areas, and exclude industrial uses, urban uses, and aquifer recharging. Although the reuse of treated effluent for crop irrigation is permitted by law in France, this practice is still seldom used (October 2015) – according to the Institut Franc¸ais de l'Environnement, the implementation of water reuse projects is growing significantly slower compared to what was predicted in past years.[10] The reuse of wastewater is restricted to particular regions, and only about 40 treated wastewater reuse projects have been identified, essentially for golf courses, turf production, and gardens or agricultural irrigation. The average daily volume of treated wastewater reused in France was estimated at 19,200 m3 (about 7 000 000 m3 per year) in 2014 representing about 0.1% of the produced treated wastewater and less than 0.3% of the total water used in irrigation.[11]

[10] Ibidiem, p. 1426

[11] The reuse of reclaimed water for irrigation around the Mediterranean Rim: a step towards a more virtuous cycle?, https://irrigationeurope.eu/sites/default/files/the_reuse_of_reclaimed_water_for_irrigation_around_the_mediterranean_rim_a_step_towards_a_more_virtuous_cycle.pdf (access: 23.08.2019)

Table 5 Water reuse criteria for agricultural and landscape irrigation in France

Water category	A	B	C	D
TSS (mg/l)	<15	In accordance with wastewater treatment standards		
COD (mg/l)	<60			
Enterococci (logs)	≥4	≥3	≥2	≥2
Bacteriophages ARN F-(logs)	≥4	≥3	≥2	≥2
Anaerobic sulforeducing bacteria spores (logs)	≥4	≥3	≥2	≥2
E. coli, cfu/100ml	≤250 1/week	≤10 000 1/15 days	≤100 000 1/month	-

The classification by categories depends on health risk:
A: restricted irrigation of all crops including these accessed by the public
B: all crops except those consumed raw or green areas with public access
C: other ornamental crops, shrubs, cereals; horticultural crops drip irrigated, forests with controlled access
D: forests with no access.

Source: ASM-Market Research and Analysis Centre on the basis of Water Reuse in EU States…

Portugal can not be classified as short in water resources compared with the mean values of Europe or the world. However, the actually available water resources are not as high as they potentially could be, due to the Mediterranean feature of the Portuguese climate: about 66% of the annual rainfall occurs during half of the year, and in some cases about 30% falls in one month. In addition to the uneven time distribution of rainfall there is a clear spatial heterogeneity: in general terms the half of the country located north of the river Tagus basin receives about 1065 mm of rainfall per year, while the southern part receives 641 mm. The result is that 57.5% of the country mainland suffers a water deficit.[12]

The volume of treated urban wastewater available in Portugal has been increasing significantly along the last decade in order to comply with the requirements imposed by the Directive 91/271/EEC of the Council of the European Communities regarding urban wastewater treatment. Water reuse for irrigation is a growing practice in Portugal due to the pressure of water needs. Therefore, guidelines for water reuse for irrigation were found to be a priority among other purposes of water reuse. A committee was appointed to produce Portuguese guidelines, which were published in January 2006 as Portuguese Standard NP 4434[13]. Although the Portuguese standards on water reuse are only guidelines (they are not included in water reuse legislation), they are enforced through the permitting requirements (the national government takes them into account when issuing any water reuse permits in the country). It is important to mention, that NP 4434 refers only to urban wastewater, not to the

[12] Monte M.H.F.M. (2007) Guidelines for Good Practice of Water Reuse for Irrigation: Portuguese Standard NP 4434. In: Zaidi M.K. (eds) Wastewater Reuse–Risk Assessment, Decision-Making and Environmental Security. NATO Science for Peace and Security Series. Springer, Dordrecht
[13] Ibidiem

industrial wastewater effluents and it applies to agricultural and landscape irrigation (crops, forest, plant nurseries, parks, gardens, sport lawns such as golf courses). The regulation presents not only quality criteria for treated urban wastewater for irrigation but also provides guidance on other important aspects to ensure safe practice, e.g. for selection of irrigation equipment and methods, guidelines for environmental protection and includes environmental impact monitoring in areas irrigated with treated urban wastewater.

As the water reuse for irrigation is concerned, the principal areas of regulation are the agronomic aspects (the maximisation of crop yields and soil and groundwater preservation) and the sanitary aspects (i.e. public health protection). In NP 4434 the required microbiological characteristics of irrigation water and the type of irrigation methods are established taking into consideration the use of the irrigated plant (e.g. if the food is eaten raw by humans and animals, etc.). Although every irrigation method is acceptable for treated urban wastewater with the exception of overflow, the preference is given to irrigation methods that limit contact between irrigation water and the plant, especially with the edible parts of the plant, and reduce the risk of runoff and spray generation and transportation by the wind. According to NP 4434 the following characteristics of the irrigation site should be considered when the treated waste water is used: chemical properties, especially the soil heavy metal content; topography; hydrogeological vulnerability; distance to dwellings. The mentioned characteristics should be taken into account in order to prevent adverse environmental impact.

Four classes of crops are defined in NP 4434 according to the level of risk of microbiological contamination generated by irrigation with treated urban wastewater:

- Class A - vegetables to be eaten raw (those whose edible parts are in close contact with the irrigated soil are not included in Class A, irrigation of such crops with treated wastewater is not permitted in NP 4434; only drip irrigation is allowed within this class),
- Class B - public parks and gardens, sport lawns, forest with public easy access,
- Class C - vegetables to be cooked, forage crops, vineyards, orchards,
- Class D - cereals (except rice), vegetables for industrial process prior to consumption, crops for textile industry, crops for oil extraction, forest and lawns located in places of difficult or controlled public access.

The NP 4434 indicates measures aimed to reduce to a minimum the risks of contamination of groundwater and surface water, the contact of people and animals with the irrigation water, the transportation of droplets by wind, the inhalation of aerosols. The established procedures to minimize such risks concern the irrigation installation as well as the irrigation site and they provide guidance on signalling the irrigation installation layout of piping, time schedule of irrigation sessions, protection equipment for irrigation operators, animal access to irrigation field, wind speed for spray irrigation.

The safe water reuse for irrigation requires also procedures for monitoring of the amount of applied nutrients and heavy metals. NP 4434 equips the irrigation operator with a table where the volume of treated wastewater applied during every irrigation session is recorded and based upon the water analysis the amount of nutrients (N, P2O5 and K2O) and heavy metals (Cd, Cu, Cr, Pb, Hg, Ni and Zn) are possible to be calculated. The most common situation is that nutrients applied to the biosystem soil-plant together with treated urban wastewater do not match completely the needs of crops and the addition of artificial fertilisers is needed. The standard NP 4434 provides assistance to the irrigation operator to calculate the amount of fertilisers to be added in order to complement the fertilisation carried by the treated wastewater - a table with a fertilisation programme including targets and guidance of how to make the necessary calculation is provided. The table is based on a balance between crop needs, soil chemical analysis and the estimated nutrient amounts to be applied together with the estimated irrigation volumes. In addition, guidelines on the frequency of soil analysis are also provided. Another table for the irrigation operator included in the standard is used to record the real amount of applied fertilisers (both the irrigation water and the complementary artificial fertilisers) as it is extremely important to monitor the impact of the use of treated urban wastewater for irrigation on groundwater quality. Monitoring details are given in the NP 4434 and it provides a table to record the results of analysis of samples of groundwater taken from piezometers.

In addition to the NP 4434 standard, Portugal has been introduced a Technical Guide on wastewater reuse. The Technical Guide has been issued by the Portuguese Regulating Authority for Water and Sanitation Services to support the implementation of water reuse projects. The Guide focuses on wastewater quality aspects of the proposed reuse applications, includes additional uses to those described in NP 4434, (i.e. urban uses), and considers the economic viability and public acceptance of water reuse projects.[14]

The Cypriot, French and Portuguese standards described above confirm there is no homogeneity between the aspects covered by each EU Member State regulation. In general, the regulations involve the following criteria: intended uses of treated wastewater, analytical parameters, maximum limit value permitted for each parameter, monitoring protocols and additional preventive measures for health and environment protection.

The intended uses of the standards evaluated are summarised in table 6. The Cypriot, French and Portuguese standards are mainly intended for agricultural applications, to a small extent to the urban areas and not for the industrial applications (e.g. street cleaning, fire hydrants). In particular:

- the Portuguese guidelines only refer to irrigation of urban areas and agriculture, although the Technical Guide issued in 2010 does include other uses such as street cleaning, industrial water process and cooling towers,
- the French standards on wastewater reuse describe water reuse for the irrigation of agricultural lands and green areas, and exclude industrial uses, urban uses, and aquifer recharging,
- Cypriot regulation does not allow for any industrial or urban use of reclaimed water.

[14] Alcalde Sanz L., Gawlik B.M. ,(2014), Water Reuse in Europe Relevant guidelines, needs for and barriers to innovation, p.23

Table 6 Intended uses for water reuse included in the standards of Cyprus, France, Portugal

Intended use of reclaimed water	Cyprus	France	Portugal
Irrigation of private gardens			
Supply to sanitary appliances			
Landscape irrigation of urban areas (parks, sports grounds and similar)	★	★	★
Street cleaning			
Soil compaction			
Fire hydrants			
Industrial washing of vehicles			
Irrigation of crops eaten raw	★	★	★
Irrigation of crops not eaten raw	★	★	★
Irrigation of pastures for milk or meat producing animals		★	★
Irrigation of trees without contact of reclaimed water with fruit for human consumption	★	★	★
Irrigation of ornamental flowers without contact of reclaimed water with the product		★	
Irrigation of industrial non-food crops, fodder, cereals	★	★	★
Water process, and cleaning in industry other than the food industry			
Water process and cleaning in the food industry			
Cooling towers and evaporative condensers			
Golf course irrigation	★	★	★
Ornamental ponds without public access			
Aquifer recharge by localised percolation	★		
Aquifer recharge by direct injection	★		
Irrigation of woodland and green areas not accessible to the public		★	★
Silviculture			
Environmental uses (maintenance of wetlands, minimum stream flows and similar)			

Source: ASM-Market Research and Analysis Centre on the basis of Water Reuse in Europe

The analytical parameters included in the evaluated standards for wastewater reuse are summarised in table 7. The standards comprise microbiological and physical-chemical parameters. Also the maximum limit values permitted for most of the parameters included in the standards evaluated are shown in table 7. Regarding microbiological parameters, all the standards include a bacterial indicator to monitor reclaimed water quality, but the selected indicator is not always the same; the regulations of Cyprus and France have selected E. coli as a surrogate for pathogenic bacteria, while the Portuguese standards only include faecal coliforms as a bacterial indicator. In addition to E. coli, the French regulation includes faecal enterococci as a supplementary bacterial indicator (because of their high resistance to wastewater treatment). Moreover, only French regulations consider the risk of pathogenic viruses and protozoan parasites in the use of reclaimed water by including renowned viral and protozoan parasites indicators, F-specific bacteriophages and sulphate-reducing bacteria, to be analysed in all the intended uses.

Cyprus and Portugal include the determination of helminth eggs as a compulsory parameter for most of the intended uses. Helminth eggs, or intestinal nematode eggs, are a parameter recommended by the WHO guidelines for developing countries for agricultural irrigation with reclaimed water, however this parameter does not appear in any of the most relevant standards such as California regulations, and USEPA and Australian guidelines. This is due to the fact that these pathogens are very rare in developed countries, and so they are not a significant health risk in these countries.

Regarding physical-chemical parameters, all the standards reflect the requirements of several European Directives such as Directive 91/271/EEC on the quality of treated effluent disposal, Directive 2008/105/EC on environmental quality standards and emission limits, and Directive 91/676/EEC on water pollution from nitrates. In addition to this, some standards include additional parameters or stricter limit values.

Table 7 Analytical parameters included in the evaluated standards for water reuse and their maximum limit values

Intended use of reclaimed water	Cyprus	France	Portugal
Microbiological parameters			
Escherichia coli (cfu/100ml)	$5\text{-}10^3$	$250\text{-}10^5$	
Faecal coliforms (cfu/100ml)			$100\text{-}10^4$
Total coliforms (cfu/100ml)			
Faecal enterococci (log reduction)		2-4	
Legionella sp. (cfu/l.)			
Salmonella sp.			
Sulphate-reducing bacteria (log reduction)		2-4	
Helminth eggs (Intestinal nematodes) (eggs/l)	0		1
F-specific Bacteriophages (log reduction)		2-4	
Physical-chemical parameters			
Total suspended solids (TSS) (mg/l)	10-30	15	60
Turbidity (NTU)			
Biochemical oxygen demand (BOD_5) (mg/l)	10-70		
Chemical oxygen demand (COD) (mg/l)	70	60	
pH	6.5 - 8.5		6.5 - 8.4
Heavy metals and metalloids			
Electrical conductivity (EC) (dS/m)	1.7 – 2.9		1.0
Total dissolved solids (TDS) (mg/l)			640
Sodium adsorption ratio (SAR)			8
Chlorine (Cl, Chlorides) (mg/l)	300		70
Nitrogen forms (Total, N-NO_3, NNH_4) (mg/l)	15		
Total phosphorus (mg/l)	2-10		
Bicarbonate (HCO_3)			

Source: ASM-Market Research and Analysis Centre on the basis of Water Reuse in Europe

Table 8 presents the frequency of analysis with regard to the parameters and the types of treatment wastewater use. As it can be seen, Portuguese standards do not provide any precise frequency of analysis (mark 'x') - it should be established by those in charge of the facility, in accordance with the responsible authorities and always taking into account the variability of water characteristics. The French regulations stipulate three types of frequency, not according to the parameter but to the desired level of quality (A, B, C and D).

Table 8 Frequency of analysis according to the parameter and intended use of the evaluated water reuse standards

Analytical parameters	Cyprus	France	Portugal
Escherichia coli (cfu/100ml)	1/15 days	1/week; 1/two weeks; 1/month	
Faecal coliforms (cfu/100ml)			
Total coliforms (cfu/100ml)			
Faecal enterococci (log reduction)		1/week; 1/two weeks; 1/month	
Legionella sp. (cfu/l.)			
Salmonella sp.			
Sulphate-reducing bacteria (log reduction)		1/week; 1/two weeks; 1/month	
Helminth eggs (Intestinal nematodes) (eggs/l)	4/year		x
F-specific bacteriophages (log reduction)		1/week; 1/two weeks; 1/month	
Total suspended solids (TSS) (mg/l)	1/15 days	1/week; 1/two weeks; 1/month	
Turbidity (NTU)			
Biochemical oxygen demand (BOD_5) (mg/l)	1/15 days		
Chemical oxygen demand (COD) (mg/l)	1/15 days	1/week; 1/two weeks; 1/month	
pH	3/week		x
Heavy metals and metalloids	2/year		x
Electrical conductivity (EC) (dS/m)	1/15 days		x
Total dissolved solids (TDS) (mg/l)			x
Sodium adsorption ratio (SAR)			x
Chlorine (Cl, Chlorides) (mg/l)	1/month		x
Nitrogen forms (Total, N-NO_3, NH_4) (mg/l)	1/15days		x
Total phosphorus (mg/l)	1/15days		x

Source: ASM-Market Research and Analysis Centre on the basis of Water Reuse in Europe

Water reuse standards in the rest of the selected Member States

Despite Cyprus, France and Portugal there are no general legislative criteria for water reuse in other countries being analysed within this report: the United Kingdom, Ireland, Luxembourg, Belgium, the Netherlands, Sweden, Finland, Denmark, Slovakia, Lithuania, Estonia, Hungary, Bulgaria, Romania, Croatia and Austria. In some Member States, guidelines for the reuse of water exist or are being prepared even though there is no binding legislation or quality standards for the moment (e.g. Belgium, Denmark). Although the majority of Member States do not have legislation or guidelines on water reuse yet, water reuse might be governed by other legislation e.g. permitting procedures on wastewater discharge or drinking water requirements. Table below provides a complete catalogue of the existing and, in a few cases planned, legislation and guidelines that directly address water reuse.[15]

[15] Gancheva M., McNeill A. and Muro M. (Milieu Ltd, Belgium), Water Reuse – Legislative Framework in EU Regions (2018), p. 29-32

Table 9 Catalogue of legislation on water reuse in the selected Member States (2018)

Member state	Water reuse legislation	Guidelines	Standard s	Other relevant measures or incentives
AT	No	No	No	None identified
BE	No	Proposal for guidelines on water quality in the Flemish region but there is no information about the progress so far	No	Water reuse measures for some River Basin Management Plans
BG	No	Consideration of guidelines for the water reuse implementation but there is no information about the progress so far	No	Water reuse measures for some River Basin Management Plans
DK	No	The Danish government issued guidelines on water use in food businesses in 2014 (Vejledning nr. 9236 af 29. april 2014 om fødevarehygiejne, kap. 10 or 'Guidelines on hygiene') in order to provide clarity concerning the current water-related regulations that are considered as relatively complex	No	None identified
EE	No	No	No	None identified
FI	No	No	No	None identified
HR	No	No	No	None identified
HU	No	No	No	The Environmental Programme and the River Basin Management Plan promote the local reuse of treated wastewater for irrigation where lands are affected by water scarcity
IE	No	No	No	None identified
LT	No	No	No	None identified
LU	No	No	No	None identified
NL	No	No	No	Taxes and limits on aquifer abstraction make industrial wastewater reuse attractive
RO	No	No	No	Indirectly water reuse is covered by Government Decision no. 188/20.03.2002 approving norms for discharging into aquatic environment of used waters and Law no. 241/2006 regarding the water supply and sewage services6
SE	No	No	No	None identified
SK	No	No	No	None identified
GB	No	No	No	Water reuse with membranes is part of the Enhanced Capital Allowances (ECA) scheme that provides financial incentives for the industry to reuse wastewater through tax incentives

Source: ASM-Market Research and Analysis Centre on the basis of Water Reuse – Legislative Framework in EU Regions (2018)

The most important and interesting findings regarding the water reuse current state of art among the remaining countries of the group selected for this report are taken from Updated Report on Wastewater Reuse in the European Union[16] and briefly presented below. Countries where no regulations nor standards are identified (table 9) have been omitted.

The **Belgian** Government wishes to reduce groundwater abstraction and stimulate water reuse. Presently, almost all the urban wastewater is treated. There is a growing interest about recycle and reuse namely for industrial water supply (cooling water in power plants, food processing plants, textile industry), agriculture and groundwater recharge although the percentage of treated effluent that is currently reused remains very limited.

Back in 2003, the Flemish Regional Water Authority proposed the Government, based on Australian EPA Guidelines, a water reuse criteria, but no outcome has been registered to the day. So far, the incentives to reuse wastewater have been lacking in Belgium. Nevertheless, in some situations, the reuse of treated wastewater could become increasingly attractive in areas of dropping water tables or high summer water demand such as the coastal regions during the tourist season. The elimination of discharges in environmentally sensitive areas is also a reason for developing wastewater reuse projects.

Due to the high water stress index, **Bulgaria** is currently contemplating Guidelines over the water reuse implementations. It needs to be said, that such Guidelines, still lack a lot of precision and accuracy. Specifically, Bulgaria's Water Act is criticized because of too high a level of generality. The Water Act indicates its goals (ensuring integrated water management for the general interest of the public and protecting public health, as well as creating conditions that avoid water pollution, including through multifunctional and efficient use and reuse of water resources), but does not provide clear tools for achieving and enforcing the stated goals.

The issue of wastewater reuse has so far been considered insufficiently in **Denmark.** During the 1990s there were several initiatives financially supported by the Ministry of Environment to introduce in-house grey water recycling for domestic uses. But due to the inconsistency of political acting and several operational set-backs the practice was almost abandoned. No regulations nor direct guidelines have been done about the water reuse patterns implementation. High water prices encourage industries to recycle process and cooling water. One of the best known examples is the industrial symbiosis of Kalundborg where several companies mutually provide and recycle wastewater.

Nowadays, there's still no legislation regarding water reuse in **Hungary.** However, the Environmental Programme and the River Basin Management Plan promote sustainable water use and water recycling through policy objectives in order to protect and preserve water quality and quantity. These programmes advocate the reuse of water locally through the use of treated wastewater for irrigation where lands are affected by water scarcity.

So far, the total amount of wastewater recycling and reuse in **the Netherlands** is small. In few cases, recycled water is used for maintenance of the aquifer water level, water for fire-fighting and other urban uses. The long range perspective also foresees reuse as fire extinguishing water and industrial water. The infiltration and the use for irrigation are additional options. Water boards are also considering an additional treatment after tertiary treatment if the wastewater can be used for groundwater recharge in forest areas or other natural areas. For industries, the reuse of wastewater will be an option if it is cost-efficient. With the Dutch Government imposing taxes and limits on aquifer abstraction to reinstate original groundwater level, industrial wastewater reuse is becoming increasingly

[16] Raso J., Updated Report on Wastewater Reuse in the European Union (2013), https://ec.europa.eu/environment/water/blueprint/pdf/Final%20Report_Water%20Reuse_April%202013.pdf

interesting. The installation of constructed wetlands as an option to realize environmental benefits by reusing wastewater was demonstrated for several locations in the Netherlands.

In **the United Kingdom**, the guidance notes on the installation, modification and maintenance of reclaimed water systems and pipe work was published by the organization Water Regulations Advisory Scheme (WRAS) gathering water suppliers in August 1999. (WRAS). The UK government added water reuse with membranes in 2006 to the Enhanced Capital Allowances (ECA) scheme providing financial incentive for industry to reuse wastewater through tax reductions. United Kingdom Water Industry Research group (UKWIR) together with American Water Works Association (AWWA) and Water Reuse Foundation published in 2005 a " Framework for developing water reuse criteria with reference to drinking water supplies" – document identifies the factors that need to be taken into account when planning and implementing any water reuse projects.

Supporting elements affecting the waste water treatment procedures

Within the context of water reuse, the key aspect is to safeguard the quality of the water and to ensure that there are adequate mechanisms for mitigating the health, environmental and biological risks involved. This is the task of water reuse legislation / guidelines / standards defining adequate monitoring rules. There are also additional supporting elements that are not directly involved in monitoring issues, however, they highly affect the waste water treatment procedures: the quality of personnel and laboratory equipment. No information was identified regarding the quality of these two supporting elements in the countries analysed within this report. In general, there is very limited, and often dated information on the quality and quantity of resources in water treatment services.[17] Data gaps include the condition of the existing wastewater infrastructure as well as quality of human resources. The World Water Development Report 2017 notes that investments in water treatment and control technologies in European Union are increasing. The Member States have far more extensive, and advanced, treatment systems than developing countries do, but they also contend with an aging infrastructure and concerns about rising pressure on facilities from rising wastewater volumes. At the same time, there is concern over staff quality and quantity in EU.[18]

The literature is clear on the need for greater investment in municipal wastewater infrastructure, incl. investment in new infrastructure, but also maintenance and upgrading of old facilities.

According to the document *Wastewater and jobs: The Decent Work approach to reducing untreated wastewater* issued by International Labour Office, many countries already face significant staff shortages in the water treatment industry.[19] OECD countries confront the problem of staff attrition due to an aging workforce. Many lower- and middle-income countries have failed to match investments in sanitation infrastructure with an expansion of the human resource base. An adequate technical and vocational education and training efforts are needed. In many countries, there is also a lack of coordination between the wastewater sector and training institutions, resulting in a mismatch between the numbers and skills of workers trained and actual sector needs. Improved collaboration is essential for any expansion of wastewater reuse.

[17] Wastewater and jobs / International Labour Office, Sectoral Policies Department. - Geneva: ILO, 2017. (SECTOR working paper ; No. 314), p.3
[18] Ibidiem, p.6
[19] Ibidiem, p.7

Conclusions

Factors such as population growth, urbanization, environmental pollution and the effects of climate change (e.g. drought) place a huge burden on European water resources and their quality. While Europe's water resources seem to be sufficient enough, water demand has increased steadily throughout Europe over the past 50 years, which has in turn led to an overall reduction of 24% per capita in renewable water resources across Europe. It is estimated that around one third of EU territory is exposed to permanent or temporary water shortages. The most threatened areas are agricultural areas that require intensive irrigation, islands of southern Europe popular with tourists, and large urban agglomerations.[20]

In response to the water deficit problem a few water conservation strategies have been described, of which a water reuse is certainly a very important component together with water savings (e.g. suppressing the leakage of supply networks, using more efficient irrigation techniques such as drip irrigation and small flush systems), tapping other resources (e.g. desalinating seawater or brackish water) or reducing demand through pricing. Reuse of treated wastewater can be considered a reliable water supply, quite independent from seasonal drought and weather variability and able to cover peaks of water demand. Therefore, the maximisation of water reuse is a top priority objective of the European Union policy. At present, about 1 billion cubic metres of treated urban wastewater is reused annually, which accounts for approximately 2.4% of the treated urban wastewater effluents and less than 0.5% of annual EU freshwater withdrawals. But the EU potential is much higher, estimated in the order of 6 billion cubic metres – six times the current volume.[21] For these reasons the Commission is working on legislative or other instruments to boost water reuse when it is cost-efficient and safe for health and the environment.

[20] https://www.eea.europa.eu/pl/sygna142y/sygnaly-2018/artykuly/zuzycie-wody-w-europie-2014 (access: 24.08.2019)
[21] https://ec.europa.eu/environment/water/reuse.htm (access:24.08.2019)

Annex - Data Collection Tool

<table>
<tr><td colspan="4">AQUARES – Activity 1.4</td></tr>
<tr><td colspan="4">Documentation form</td></tr>
<tr><td>A.</td><td colspan="3">General information</td></tr>
<tr><td>1)</td><td>Partner</td><td colspan="2"></td></tr>
<tr><td>2)</td><td>Country*
*where [country], hereafter [region] for MURCIA-GDW</td><td colspan="2">PL</td></tr>
<tr><td rowspan="2">3)</td><td rowspan="2">Does your country implement water reuse standards?</td><td>☐</td><td>Yes</td></tr>
<tr><td>☒</td><td>No*
*If your country does not implement water reuse standards, please use the policy framework most relevant to water reuse to fill-in the rest of the form (e.g. risk management framework for wastewater treatment).</td></tr>
<tr><td>4)</td><td>Name of the standard (or most relevant framework)</td><td colspan="2">1. KPOŚK - National Urban Waste Water Treatment Program (2003),
2. The Act of 20 July 2017. - Water law,
3. Legislative proposal - REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on minimum requirements for water reuse (2018).</td></tr>
<tr><td>5)</td><td>Developed by</td><td colspan="2">1. KPOŚK was approved by the Council of Ministers in 2003, its provisions are a consequence of the need to adapt Polish wastewater management to the requirements of Directive 91/271 / EEC of May 21, 1991 regarding urban wastewater treatment.
2. The Water Law Act, issuing authority: SEJM (lower house of parliament), obligated authorities: PRESIDIUM OF THE COUNCIL OF MINISTERS, minister competent for health, competent minister for fisheries, competent minister for agriculture, minister competent for justice, minister competent for planning and spatial management and housing, Council of Ministers.
3. Proposal - REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on minimum requirements for water reuse (2018) - the document issued by the European Parliament was the result of organized public consultations (including via the Internet); A wide range of stakeholders took part in the consultations: representatives of private enterprises, the drinking water sector, sanitary infrastructure, the food industry and the environment from EU Member States.</td></tr>
</table>

6)	Implementing authority / (-ies)	• Polish Water - the main entity responsible for water management in Poland and its organizational units:
		  ○ National Water Management Authority,
		  ○ Regional Water Management Boards,
		• Entities that purify and reuse water or discharge it into the environment, including sewage treatment plants or other units with closed water circulation, e.g. industrial plants.	

7)	Geographical coverage	☒	National
		☐	Regional
8)	Purpose/use of the standard	☒	Agricultural
		☒	Industrial
		☐	Urban
		☒	Recreational
		☐	Other (please specify):
9)	a) Please briefly describe the main aspects of the standard. *(No more than 15 lines)*	**Act of 20 July 2017. Water law** The Act regulates water management in accordance with the principle of sustainable development, in particular the shaping and protection of water resources, water use and management of water resources. The Act also describes water management while maintaining a rational and comprehensive treatment of surface and groundwater resources, including their quantity and quality. **KPOŚK** The objective of the Program, by implementing the investments included in it, is to reduce discharges of insufficiently treated wastewater, and thus to protect the aquatic environment. KPOŚK is a strategic document which estimates the needs and specifies activities for equipping the agglomeration, with RLM greater than 2000, with sewage systems and municipal sewage treatment plants. Pursuant to the Water Law Act, KPOŚK is periodically updated at least once every four years. The last and fourth update of the Program was approved by the Council of Ministers on April 21, 2016. **Proposal for a Regulation of the European Parliament and of the Council on minimum requirements for the reuse of water:** The overall goal is to contribute to reducing water scarcity across the EU, primarily by increasing the use of reclaimed water, in particular for agricultural irrigation. The establishment of harmonized minimum requirements (in particular key parameters of pathogens) regarding the quality of recovered water and	

		monitoring, combined with harmonized risk management tasks, will ensure a level playing field for those who have an impact. Article I lays down minimum requirements for water quality and monitoring, along with the establishment of key risk management tasks to ensure the safe use of purified waters. Article II specifies the standards for specific applications. Article IV speaks of the minimum requirements that must be met for agricultural irrigation. Article V sets out risk management procedures that should be carried out by the purification plant operator or in cooperation with relevant parties. Article VI sets out the procedure for the submission of applications for permits for the supply of recovered water (including list of documents). Article VII deals with procedures and conditions for authorization. Article VIII deals with checking compliance of the recovered water with the conditions set out in the permit (sets out the obligations of the competent authorities together with the rules to be followed in the event of non-compliance).	
	b) Is it standalone or part of a wider policy framework for water reuse?	☒	Standalone (regarding the Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on minimum requirements for water reuse)
		☒	Part of a wider policy framework (please specify which): (regarding KPOŚK and the Water Law Act); framework documents: Directive 91/271 / EEC of 21 May 1991 concerning urban waste-water treatment, Directive 2000/60 / EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, Directive 2006/118 / EC Of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and the deterioration of their status
		☐	Other (please specify):
	c) What types of stakeholders are involved in providing feedback and implementing the standard?	☒	Public authorities
		☒	Water supplier company / organisation
		☒	Operator/owner of the reuse plant and system
		☒	End-users (e.g. farmers)

		☐	Public health organisations	
		☒	Consumer representatives	
		☒	NGOs (e.g. environmental)	
		☒	Local communities / citizen initiatives	
		☐	Other (please specify):	
	d) How intensely are stakeholders involved in the implementation of the standard?	☐	1	The standard is implemented without any stakeholder involvement.
		☒	2	Stakeholders are informed about the implementation process of the standard, without providing their opinion.
		☐	3	Stakeholders are consulted in the process of implementing the standard, providing opinions and information.
		☐	4	Stakeholders are involved in the implementation of the standard, providing (further to option 3) resources and data.
		☐	5	Stakeholders collaborate with public authorities in the implementation of the standard, having (further to option 4) increased managerial responsibilities and co-shaping the policy direction of the standard.
10)	Please provide data on the number of treatment facilities that implement the standard, including data (if available) on the type and number of end users served by those facilities. *(No more than 10 lines)*	According to data from the Central Statistical Office of Poland, in 2018 there were a total of 4,139 industrial and municipal sewage treatment plants. Among all sewage treatment plants in 2018, there were 853 entities where the tertiary treatment takes place. The number of people using urban and rural sewage treatment plants in 2018 was 28,410 645 in Poland. Importantly, the total number of people connected to tertiary treatment plants was 23,044,623. Water used in Poland by all sectors in 2015 (including households) was equal to 1 595.1 million m3. Households constitute the largest group among end users served by wastewater treatment plants - based on EUROSTAT data in 2015, they consumed 1,236.5 million m3 of water. The services sector came second in terms of water consumption - services consumed 160.8 million m3 in 2015. Next were: industry (31.4 million m3), production (18.7 million m3), mining and quarrying (6.4 million m3), generation and supply of electricity (5.4 million m3), construction (less than 1 million m3). Due to		

		the lack of data, EUROSTAT does not present water consumption for the Agriculture, forestry and fisheries section.	
11)	Is the water reuse standard embedded in or accompanied by a risk management framework?	☒	Yes
		☐	No
12)	Which of the following elements comprise the water reuse standard?	☒	Operation of a (risk) management team
		☒	Description of the water reuse system
		☐	Processes to identify hazards and hazardous events, and risk assessment
		☒	Determination of preventive measures to limit risks
		☒	Operational procedures for monitoring
		☒	Verification procedures of the water quality and the receiving environment
		☒	Validation of processes and procedures
		☒	Procedures to manage incidents and emergencies
		☐	Other(s) (please describe):
13)	a) Does the water reuse standard define:	☒	Provisions for granting permits to treatment plants
		☒	Steps for managing non-compliance
		☒	Regulations defining compliance checks procedures
	b) If existing, please briefly describe the steps followed for 1) granting permits, 2) coping with non-compliance issues, and 3) compliance checks. *(No more than 15 lines)*	1	In Poland, water law permits require, in particular, special use of water and construction of water facilities, as well as other activities that may affect the status of waters. A person interested in such a permit, referred to in the Water Law as a plant, should submit an application for its granting to the competent public administration body. Water-law permits are granted by the competent authorities with respect to the place of use of the applied permit: starosts, presidents of cities with poviat rights, marshals of voivodships, and from 15 November 2008 also directors of regional water management boards. A person applying for a water law permit should submit an application for its issuing, containing a brief description of the subject of the application (the basic document is a water law document consisting of two parts: descriptive and graphic)

				and outline the purpose of the intended activity in a non-technical language).
		2		• Correspondence with the superior (supervisory) body so that it returns to its initial state (meeting all standards before failure). • Take all necessary measures for the operation of the plant to meet all the requirements obtained in the permit. • Correspondence on the line: director of the plant granted with permission - Polish Waters - Chief Inspectorate for Environmental Protection and the State Sanitary Inspection.
		3		• The competent authorities check compliance of the recovered water with the conditions set out in the permit. The authorities competent to control water law permits are the authorities that issued them (point 12.1). • Checks are carried out on the spot. • Verification of compliance of the values of the analyzed water parameters (permission obtained VS. results of subsequent tests).
	c) How effective do you consider the processes of:	1) Granting permits to treatment plants		
		☐	1	Not effective: There are a lot of delays and bureaucratic drawbacks for granting permits.
		☐	2	Moderately effective: There are some delays and bureaucratic drawbacks, sometimes hindering the process of granting permits, but it is overall operational.
		☒	3	Very effective: The process of granting permits does not have any delays or administrative setbacks.
		2) Managing non-compliance issues		
		☐	1	Not effective: Most non-compliance issues are not treated in time and are not resolved.
		☐	2	Moderately effective: Around half of the non-compliance issues are treated in time and resolved.

		☒	3	Very effective: Most non-compliance issues are treated in time and resolved.
		3) Compliance checks procedures		
		☐	1	Not effective: Compliance checks rely solely on on-spot checks.
		☐	2	Moderately effective: Compliance checks use both on-spot checks and monitoring checks defined in EU regulations (Directives 91/271/EEC and 2000/60/EC)
		☒	3	Very effective: Compliance checks use on-spot checks, monitoring checks defined in EU regulations (Directives 91/271/EEC and 2000/60/EC), and include additional physio-chemical parameters (e.g. micro-pollutants, trace residues from medicine).
B.	Monitoring water reuse			
1)	Are monitoring procedures defined within the water reuse standard?	☐	Yes	
		☒	No (please describe the framework under which they are defined): Monitoring procedures are indirectly defined in the following documents: • Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on minimum requirements for the reuse of water, • Act of 20 July 2017 - Water law.	
2)	Do the monitoring procedures follow / are based on an established approach?	☐	No	
		☒	World Health Organisation approach (WHO)	
		☒	ISO 16075:2016	
		☐	Other (please describe below):	
3)	Does the monitoring procedures include one of the following (select all that apply):	☒	Identification of critical control points (or similar monitoring points)	
		☒	Definition of water quality parameters & indicators	☒ Health ☒ Biological ☒ Physical
		☒	Definition of critical limits for parameters & indicators	
		☐	On-line real-time monitoring	

		☒	Manual monitoring
		☐	Other type(s) of monitoring method (please specify):
		☒	Procedures for initiating corrective actions
		☒	Verification monitoring
		☒	Validation monitoring
		☒	Audits on the overall monitoring procedures
4)	In documenting monitoring data, do you (select all that apply):	☒	Release the data to the public / regular public reports
		☐	Use ICT methods to document data
		☐	Other(s) (please describe below):
5)	Please provide information regarding the implementation of the monitoring procedures. Does the implementation run into any kind of <u>problems</u>? (For example, is there a frequent need to take corrective actions?) *(No more than 20 lines)*		• The most common problem encountered when implementing monitoring procedures is incomplete understanding. Ambiguous understanding of issues leads to confusion on the implementation-controlling line. • If there is a necessity / need to refer to documents originally prepared in a language other than Polish, interpretation problems also arise - specialists in a water industry are often not responsible for translation, the translations are made by people who have too little knowledge in this area. • Another problem mentioned is the short time in which standards need to be implemented.

6)	With 1 being not effective at all and 5 being absolutely effective, how good (overall) do you assess (according to your own judgement) the quality of monitoring?	1	2	3	4	5
		☐	☐	☐	☒	☐

C.	Elements supporting monitoring			
1)	How would you assess the quality of the personnel that implements the monitoring?	☐	1	Not adequately qualified: The personnel does not include specialised chemists, engineers or technicians.
		☐	2	Qualified: The personnel includes specialised chemists, engineers or technicians.
		☒	3	Qualified and up-to-date: The personnel includes specialised chemists, engineers or

				technicians, who undergo additional training regularly.
2)	How would you assess the lab equipment used for monitoring?	☐	1	Basic equipment: Can measure microorganisms, pathogens.
		☐	2	Adequate equipment: Can measure microorganisms, pathogens, water quality parameters (e.g. BOD5, TSS).
		☒	3	Advanced: Can measure microorganisms, pathogens, water quality parameters (e.g. BOD5, TSS), and additional parameters such as micro-pollutants, trace residues, heavy metals, and/or other physio-chemical parameters.