Background document for stakeholder meeting on the evaluation of the Drinking Water Directive 98/83/EC – Tuesday, 26 May 2015, Brussels

Adriana Hulsmann (KWR, Watercycle Research Institute), Erik Klaassens (Ecorys, Rotterdam), Hans Kros (Alterra, Wageningen-UR), Paul Römkens (Alterra, Wageningen-UR), Wim de Vries (Alterra, Wageningen-UR)

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Introduction

This document provides background information for the stakeholder meeting on May 26. It describes the approach used by the consultants for the evaluation and it records some of the results to date. The next sections discuss the following topics: The buildings blocks of the DWD, the evaluation approach and evaluation grids (see also the Appendix), partial results of our findings regarding relevance-, effectiveness-, efficiency- and coherence of the Directive.

1 The building blocks of the DWD

The **aim of the DWD** is "to protect human health from the adverse effects of any contamination of water intended for human consumption by ensuring that it is wholesome and clean" (Article 1), limited to "water either in its original state or after treatment, intended for drinking, cooking, food preparation or other domestic purposes, excluding natural mineral waters and waters which are medicinal products" (Article 2 and 3). To achieve this, the DWD lists various actions included as articles in the Directive that form the boundary conditions that member states have to meet and, ideally will ensure that the aim of the Directive is met.

To reach the overall objective of the DWD, the Directive has defined *specific objectives* that lead to certain actions (using various inputs) at EU and Member State level. These actions are in turn expected to lead to **results (outputs)** such as good water quality, information to the public and a good monitoring system enabling remedial action to be taken based on verifiable information. These results are in turn expected to contribute to, or have **impact** on, the higher policy goal (overall objective) of protecting human health (Art. 1).

As such we identify the following 4 linked components, that together show the *intervention logic* of the DWD:

1. *Specific objectives*, i.e. set quality standards, secure monitoring, take remedial actions and inform the population;
2. *Operational objectives/Actions*: Articles in the DWD describing actions that need to be taken to attain the specific objectives and thereby the overall objective (see details below);
3. *Outputs (Results)*: indicators that give insight in the water quality status and public information on water quality, based on the compliance with operational objectives and/or specific objectives; and
4. *Impacts (Outcome):* human health not affected by consumption of drinking water.

Ideally **actions** are defined such that the desired outcome in view of the scope of the Directive is achieved through realization of the required output. As far as actions at the highest level are concerned, 4 distinct actions have been identified/addressed by the DWD. Each of these actions is listed in articles of the DWD itself (numbers between brackets):

1. Member States shall set scientifically based quality standards (values) for microbial, chemical and indicator parameters applicable to water intended for human consumption (Articles 5, 6 and 9) to be updated every 5 years (Article 11 and 12)
2. Member States implement effective monitoring to check whether drinking water meets the quality standards (Article 7);
3. Member States take proactive actions to avoid contamination by substances or materials from preparation or distribution of water or take remedial actions, possibly including water use restrictions in case of an exceedance of quality standards, including an investigation of causes (Articles 4, 8, 10, 14 and 15)

4. Member States shall provide consumers with adequate, timely and appropriately information on the water quality (Article 13).

2 Evaluation approach and evaluation grids

Evaluation approach

Although there is a widely shared opinion that the majority of drinking water available within the EU is of high quality, to date there has been no formal attempt to determine that the articles listed in the DWD have resulted in achieving this aim. The main aim of **the present evaluation** is therefore to assess whether the actions as described by the DWD in various articles have in fact resulted in the expected aim and provide evidence for this. Table 1 below illustrates the various evaluation criteria and the type of questions we are seeking to provide answers for.

Table 1 *Criteria and examples of questions to evaluate the DWD*

Evaluation criteria	Evaluation questions
Relevance should determine to what extent the objectives of the Directive (still) correspond to the needs within the EU?	Are the overall objectives of the Directive still relevant and what is the relevance of (each of) the Directive's articles?
Effectiveness considers to what extent the DWD achieved its objectives. The analysis of effectiveness looks at changes to outputs, results and impacts.[1]	To what extent has the Directive achieved its objectives? What have been the (unintended) effects of the DWD beyond protecting human health?
Efficiency looks at the relationship between the resources used to implement the DWD and the changes it has generated. The analysis includes an assessment of administrative and regulatory burden.	To what extent are the costs involved with implementing the DWD justified given the changes which have been achieved? Which factors influenced the efficiency of the DWD?
Coherence considers to what extent the DWD shares common objectives with other Directives or policies. It also looks at the internal coherences of the DWD .	To what extent is the Directive coherent with other interventions in the same policy area? To what extent is the Directive internally coherent?
EU-added value analyses the additional value resulting from the DWD, compared to what could be achieved by MS?	What has been the EU added value of the Directive?

In Figure 1 below, the building blocks of the DWD are placed in the context of the evaluation criteria described above. As such, each action in itself has its specific outputs (not shown in figure 1) and outcome. In addition, there is a number of *external factors* which are outside the scope of the DWD that can affect the drinking water quality (including other policies), such as changes in land use for production of livestock or energy crops, intensified use of fertilizers etc.

[1] *Outputs* are what is directly produced or supplied through the EU intervention. They relate to the expected deliverables of the intervention and are identified based on its operational objectives. *Results* capture the immediate/short term changes in a situation and are defined based on the specific objectives of the intervention. *Impacts* broadly define the changes over a longer period of time and are defined based on the general objectives of the intervention. (Source: *Public consultation on Commission Guidelines for Evaluation.* EC, November 2013)

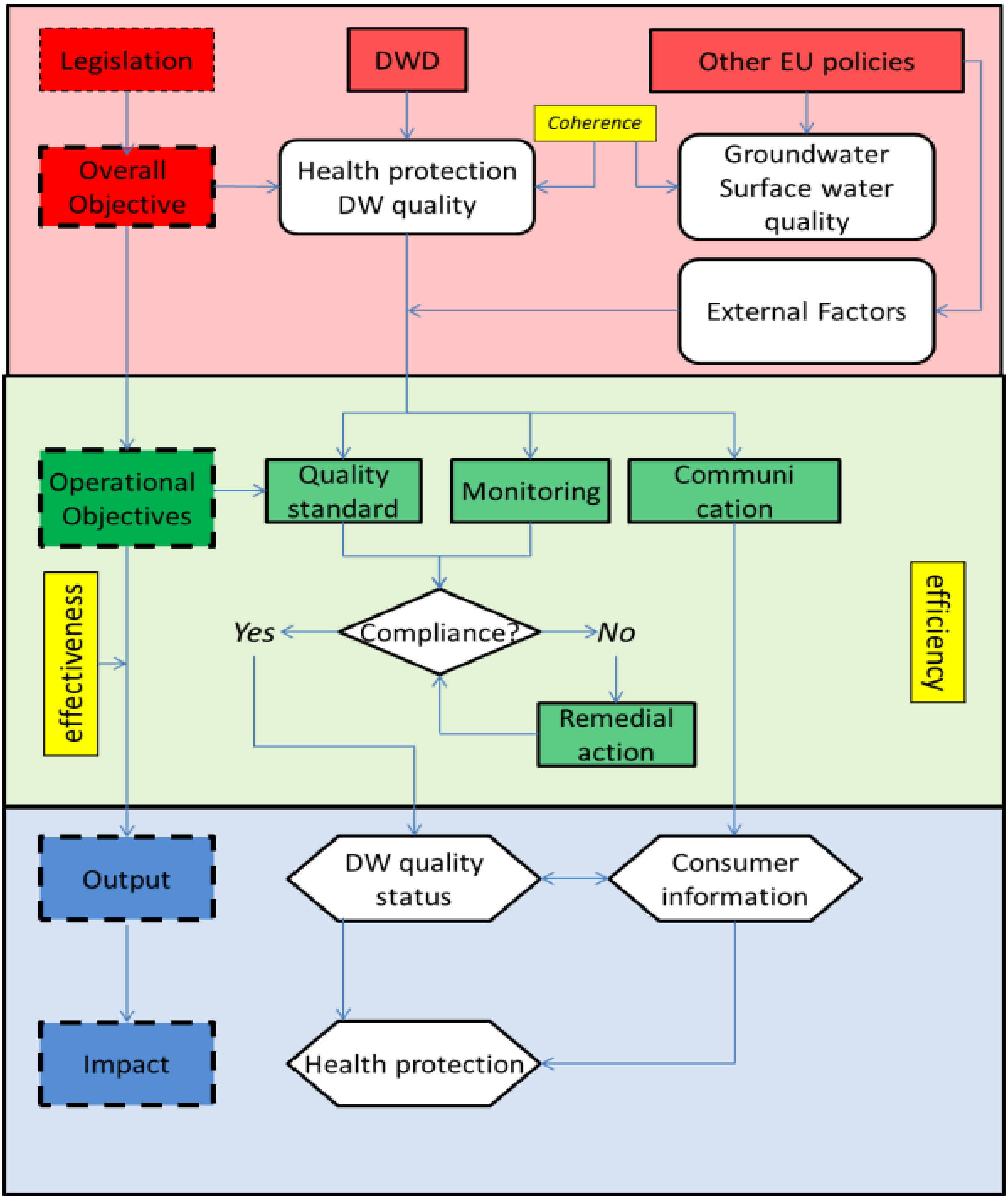

Figure 1. *Conceptual design of the intervention logic showing the various components/steps in terms of scope, actions, output and outcome*[2].

Evaluation grids

Subsequently, sub-questions have been developed and for each of these, we define the:

- Judgement criteria for assessing the answer to each question (where needed);
- Specific indicators that capture (quantified) information about results achieved;

[2] Please note that at the 'action' level (green fields), each action can be expressed in terms of output, outcome, coherence as well. Note: in addition to remedial actions also pro-active measures can be defined/distinguished, not shown here but included in the analysis.

- Evaluation methods used to answer the question; and
- Sources of information, including the result from public consultation, expert judgement, country reports, MS excel sheets on observed parametric values in drinking water, model assessments on the relation between parameter concentrations and health effects, and interviews with relevant stakeholders

Interviews with stakeholders (distinguishing EU institutions, regulating authorities, industries, consumer associations etc.) are only done for those questions where other sources do not provide (sufficient) information. In the appendix to this background document, we present the evaluation grids which show the defined questions, judgement criteria, evaluation method, indicators and sources of information with which we intend to carry out the evaluation, indicating how we intend to get results.

3 Relevance of monitored parameters under the DWD

Rationale and approach

Whether the DWD is relevant is related to the question whether the distinguished microbiological, chemical and indicator parameters, and their related parametric values (quality standards), are relevant for the protection of drinking water quality. If this is not the case for a given parameter, it is irrelevant and of course also not effective nor efficient to monitor their concentrations. To answer this main question, the following sub-questions need to be answered:

- Which parameters and related parametric values are relevant to protect drinking water quality?
- Which other parameters should be monitored (now missing in Annex I of the DWD) that are important for human health?

Relevance of included parameters and related parametric values

The judgement criterion to assess the relevance of each of the distinguished parameters and related parametric values listed in the Annexes of the DWD is to assess whether a health effect is to be expected. The relevance of parameters in the DWD depends on how we define 'being relevant'. During the design of the DWD the relevance of the various parameters played a decisive role. First of all parameters were selected for inclusion on the basis of their relevance for (many parts) of the EU. The aim was to provide a minimum level of protection of consumers over the whole EU. Parameters were therefore selected that were relevant for a large part of or the whole EU. Now we have to evaluate whether or not the parameters then selected are still relevant e.g. in the case they are never or hardly ever exceeded or only in a relatively small part of the EU reason for non-compliance with the standards for wholesome and clean drinking water.

The relevance of the parameters is mirrored in the DWD through the three categories of parameters that have been defined.

The two **microbiological parameters** have a parametric value that is a substitute for zero, in other words these parameters should be absent from drinking water to guarantee its quality.

The **indicator parameters**, including some microbiological indicator parameters, have been decided upon not for their direct relevance to the quality of water, but to warn or as their name says to indicate that something has changed in the source water, the treatment or the distribution of the water. This needs to be investigated and when urgent needs to be adjusted. Even though most indicator parameters do not pose a direct threat to human health, they might impact indirectly through the appearance, taste or odour of the water (and impact on the acceptability by the consumer) or they might interfere with proper treatment e.g. inadequate disinfection through presence of organic matter.

The **chemical parameters** are in principle selected for their potential impact on human health and their EU relevance. Here we might have to re-evaluate their relevance. Chemical parameters are besides accidents almost never present in drinking water in concentrations that cause acute health effects. Furthermore the impact of any exceedance or non-compliance of chemicals depends on the way they affect the human body. Mostly the parametric values are based on lifelong exposure and an average drinking water intake of 2 litres per person per day. Here we distinguish threshold and non-threshold substances. In the case of threshold chemicals there will be no impact on human health when the concentrations are below the threshold. In the case of non-compliance the impact depends on the level of non-compliance, the duration of exposure and the safety factor that has been used in setting the parametric value. This differs per parameter, based not only on health impacts, but also on technological capability and analytical possibilities. This is a case to case assessment where we have the added problem that in the case of non-compliance we do not always know how long the exposure has occurred.

In case of non-thresholds chemicals such as pesticides there is no threshold below which there is no potential effect on human health. Here we use a risk approach that mostly accepts one additional death through drinking water in one million people; this is more strict than the value currently used by WHO (1 in 100.000 people). When we know the level of non-compliance and the duration it is then possible to try to estimate the potential impact on human health in a particular Member State or water supply zone.

For some chemical parameters it is known that the safety margin between no effect and effect is rather small e.g. in case of Cadmium when assessing exposure for smokers and nitrite impacts on babies and infants. This implies that a relatively small exceedance of the parametric value might potentially have unwanted impacts on human health, where other chemical parameters offer more flexibility in the level of non-compliance before impacts on human health might occur. This 'room' for non-compliance will be assessed for all chemical parameters and potential implications for human health will be derived from that.

4 Assessment of the Effectiveness of the DWD

Assessment of trends and spatial variation in water quality

In this section our attention is focused largely on the quantification of changes in the quality of water in the time period 1993 – 2013. During this period data have been collected although both quality (including raw data of measured parameters versus percentages of non-compliance for example) and quantity of available, reported data vary considerably which forced us to distinguish some of the analyses in separate periods. In this chapter both temporal trends, i.e. documented changes in non-compliances at MS level and expressed as the number of water supply zones are documented as well as changes in the absolute quality of water as documented for a limited number of parameters.

Trends in compliance in water quality between 1993-2013

Based on summary reports at MS level (1993 up to 2005) and excel sheets (2005-2013), scatter plots are given of trends of the water quality at EU/MS for the period 1993 - 2013 in terms compliance of parameters that have been monitored during that whole period (this was only the case for 9 parameters in 2 to 4 countries). We took the mean for all MS (each value represents a parameter). Results are presented in Figure 2. All results show an increase in compliance with time

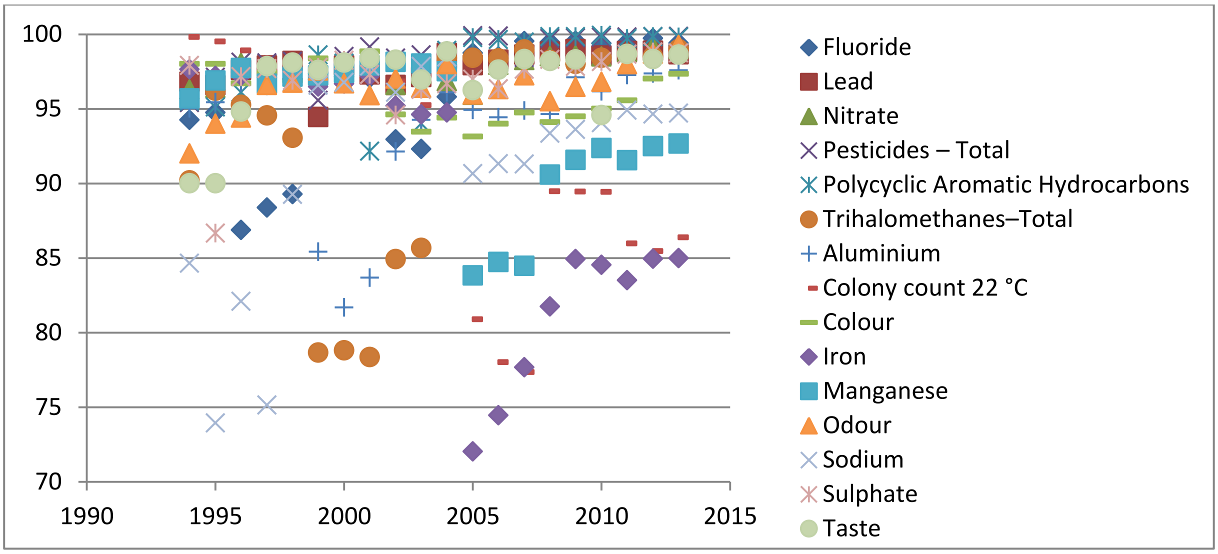

***Figure 2** Mean compliance of nine parameters over the period 1993 - 2013*

Based on excel sheets, scatter plots are given of trends of the water quality at MS level (each value represents a member state) by presenting for 2005-2013 trends in:

- mean compliance of all parameters
- mean compliance of ten selected candidate parameters

Results are shown in Figures 3 and 4.

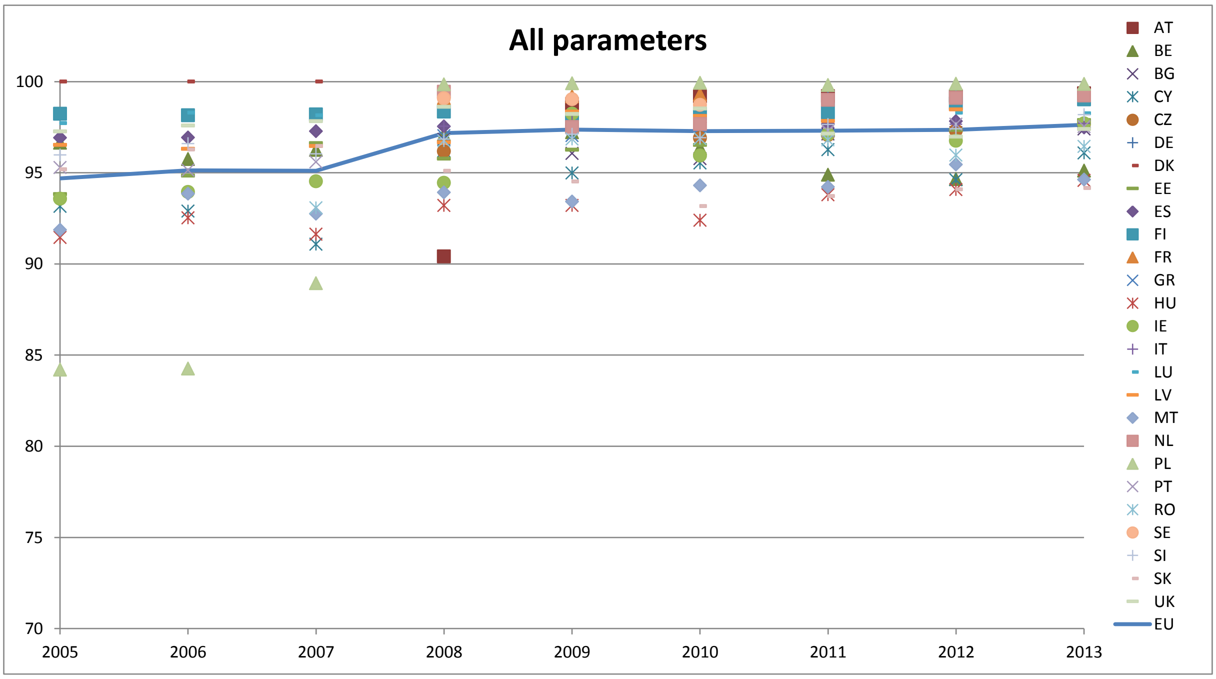

***Figure3** Mean compliance of all parameters over period 2005 – 2013*

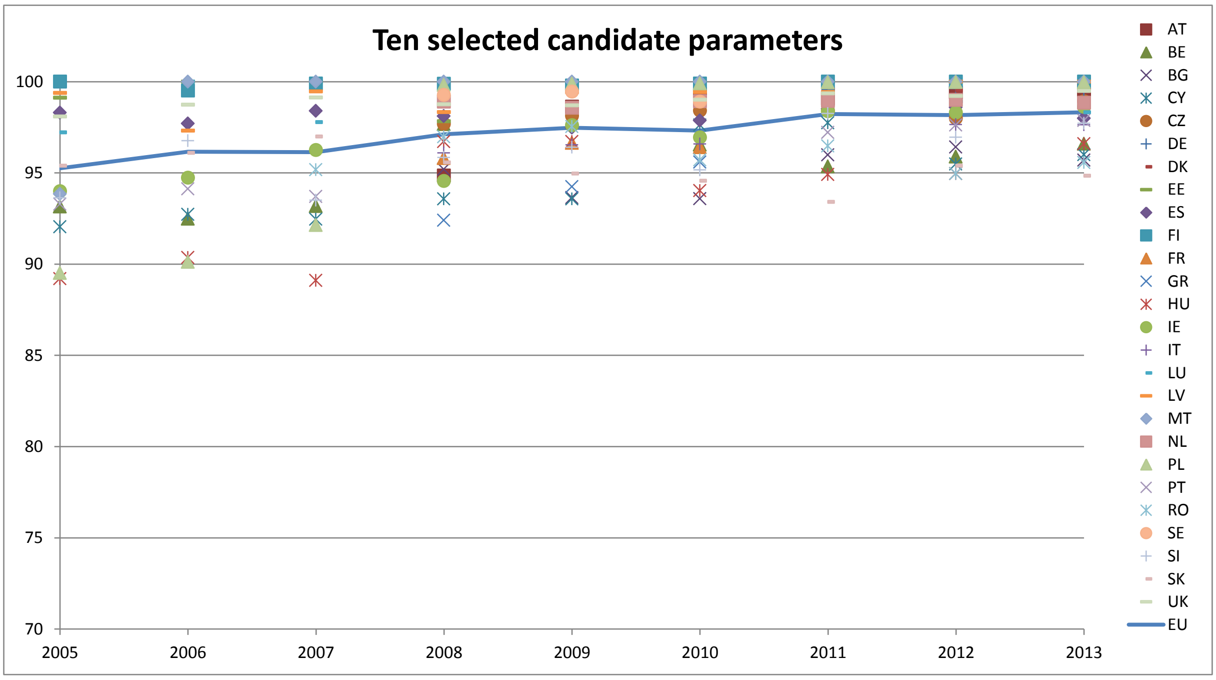

Figure 4 *Mean compliance of ten selected candidate parameters over period 2005 - 2013*

As with the mean compliance of nine parameters over the period 1993 – 2013 (Figure 2), the mean compliance of all parameters (Figure 3) and the ten candidate parameters (Figure 4) show an increasing compliance with time.

The selected ten candidate parameters for study are:

- E.*coli*
- Cl. *perfringens*
- Arsenic
- Nitrate
- Atrazin,
- Desethylatrazine
- Terbutylatrazine
- Bentazon
- Lead
- Copper

Changes in numbers of water supply zones in EU with exceedances per parameter
Based on excel sheets, a table is given of trends in water quality at EU level for 2005-2013 by presenting the number of water supply zones (WSZ) with water quality concentrations that exceed the parametric value for all distinguished DWD parameters. Overall, the number of exceedances decreased between 2005 and 2013 for the sum of all microbial parameters, chemical parameters and indicator parameters. For some parameters there are no clear trends, i.e. large fluctuations over the years, but some show clear trends, including cadmium, nitrate, clostridium perfringens, colour, iron, manganese and turbidity.

In Table 2, results are given of trends in the number of WSZs between 2005 -2013 at MS level with water quality concentrations that exceed the parametric value for the selected 10 candidate parameters. Overall, there is an improvement, especially in countries with initial large (IE, PT, UK) or very large (PL) exceedances. In many countries with small exceedances in 2005, there is hardly any trend. In ES, exceedances are comparatively high and they remain so.

***Table 2** Number of WSZ at MS level with water quality concentrations that exceed the parametric value for all the selected 10 candidate parameters.*

MS	2005	2006	2007	2008	2009	2010	2011	2012	2013
AT					9	15	16	13	10
BE	16	29	25	46	44	74	108	95	80
BG				83	81	97	58	53	62
CY	7	8	8	1	1	5	3	6	7
CZ				41	26	25	36	21	25
DE							72	63	79
DK	9	9	9				6	6	6
EE	1			4		1			
ES	113	153	143	111	141	118	107	116	177
FI		2	1	2	3	1			
FR				121	105	86			
GR				22	20	18			
HU	11	103	122	80	80	144	74	73	52
IE	90	77	57	80	51	43	23	24	20
IT							128	138	140
LU							2	3	3
LV	1	5	1	3	1	1	1		
MT	4								
NL	29	50	48	17	25	19	18	17	19
PL[1]	**686**	**593**	**535**	8	5	9	3	2	3
MS	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
PT	142	136	140				101	87	74
RO			82	68	61	81	55	101	101
SE				4	1	2			
SI	39	17	38	32	28	24	12	17	11
SK	26	22	17	25	27	31	35	25	30
UK	161	159	118	122	102	83	80	84	77
Grand Total	**1335**	**1363**	**1344**	**870**	**811**	**877**	**938**	**944**	**976**

[1] These numbers for PL could be an artefact due to data quality

Trends in concentrations of selected candidate parameters

Below, we present some *graphs* at EU level with trends in annual minimum, median and maximum concentrations plus the median of non-compliance values over the period 2005-2013 for a selection of the ten candidate parameters (Figure 5).

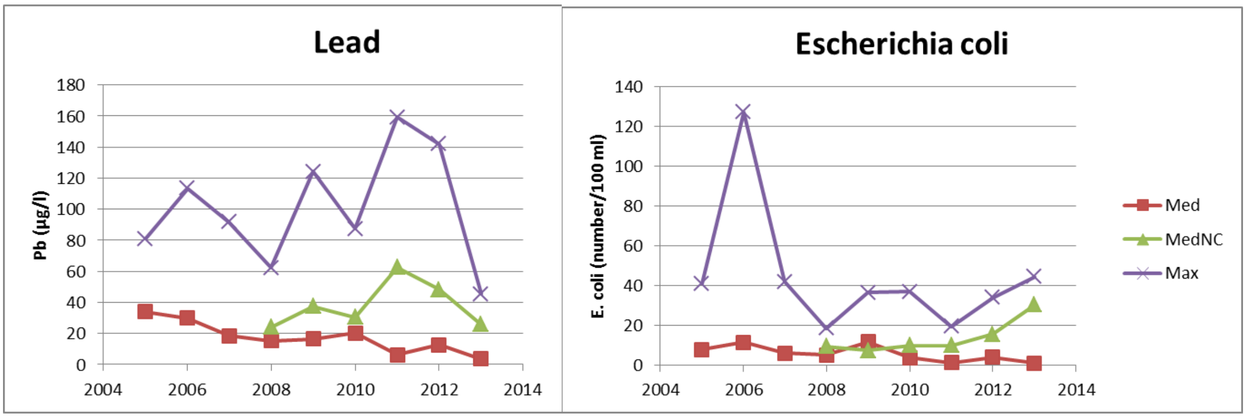

Figure 5. *Mean concentration at EU level for lead and Escherichia coli compliance of ten selected parameters over the period 2005 - 2013*

Results show a decrease in the median concentration of both lead and Escherichia coli. The mean non-compliance values for lead in the period 2008-2013 is about 40 µg/l, a fourfold exceedance of the standard (10 µg/l).

Variation in current water quality (mean 2010-2013)

For the period 2010-2013, we will present results based on an analyses of all individual water supply zones (WSZs) at EU level for the ten candidate parameters:

- Mean and standard deviations of annual average concentrations using data of all individual WSZs at EU level: 3 bars in one histogram: 10 graphs, for each parameter one
  - all WSZs
  - small WSZs
  - large WSZs
- Inverse frequency distributions of water use and annual average concentrations (plus standard in the graph to show % exceedance) using data of all individual WSZs at EU level: 3 frequencies in one graphs: 10 graphs, one for each parameter:
  - all WSZs
  - small WSZs
  - large WSZs
- Scatterplots of concentrations against water use, using data of all individual WSZs at EU level: 10 graphs, one for each parameter:
  - small WSZs with a different marker
  - large WSZs with a different marker

5 Assessment of the efficiency of the DWD

Rationale and approach

Whether the DWD is efficient is related to the question whether there are other approaches (e.g. risk based approaches) than drinking water monitoring that are more relevant and cost effective to protect human health. The question is then whether the same objective (protect human health) can be achieved (with comparable or lower risk) at lower costs than the combination of monitoring, followed by remedial action in case of exceedances

Below, the principle of the risk based approach is given and related costs and risk factors are presented based on expertise within the consultant team. In a later stage we will present the view of countries who are opting for alternative approaches (both within and outside EU) based on interviews with regulators /administrators.

Principles of the risk based approach (water safety plans)

The Water Safety Plan is a risk assessment/risk management based approach that was originally designed in Australia and was quickly embraced by WHO. The risk-based approach to ensure the quality of drinking water can be compared to the HACCP (Hazard Analysis and Critical Control Point) of the food industry and is based on the development and understanding of the water supply system from source to tap, identification and prioritisation of potential risks of contamination and putting in place adequate control measures to reduce the risks to an acceptable level. WHO states that 'The most cost-effective and protective means of consistently assuring a supply of acceptable drinking water is the application of some form of risk assessment based on sound science and supported by appropriate monitoring. It is important that risk management is inclusive and, therefore, needs to cover the whole system from catchment to consumer' [WHO 2004]. In Table 3, the key components of a water safety plan approach are given.

Table 3 *Key components of a water safety plan approach*

Key components of a water safety plan approach
Setting *health based targets* (based on an evaluation of health concerns).
System assessment to determine whether the water supply chain -from source through treatment to the point of consumption- as a whole can deliver water of a quality that meets the health-based targets.
Operational *monitoring of the control measures* in the supply chain, which are of particular importance in securing drinking-water safety
Management plans (documenting the system assessment and monitoring; describing actions to be taken in normal operation and incident conditions – including upgrade and improvement), documentation and communication
A system of independent surveillance that verifies that the above are operating properly. [Source WHO 2004]

Comparison of the risk based approach with the current approach (pros and cons)[3]

The primary goal of RA/RM for drinking water supply is the prevention of health risks and to achieve a safe and wholesome drinking water supply, to achieve an increased and reliable level of compliance with the requirements of the DWD, a lower incidence (non-compliance) rate and an increased awareness and targeted management of possible risks to water supply. Pros and contras of the current monitoring based approach and risk based approach (water safety plans) are given in Table 4.

Table 4 *Pros and contras of the current monitoring based approach and risk based approach (water safety plans)*

Aspect	Monitoring based (current approach)	Risk based approach
Environmental impact/ Control water quality		
• large WSZs	+	+
• small WSZs	-	+
Coverage (WSZs included)	-	+
Internal cooperation water suppliers/agencies	-	+
Costs		
• Investment	+	-
• Operational	-	+
Audit/control	+	-
Consumer confidence	0	+/-?

[3] Sources: WHO website documents and fact sheets on water safety planning; KWR Towards a Guidance Document for the implementation of a Risk Assessment for small water supplies in the European Union. November 2011. Adriana Hulsmann and Patrick Smeets.

Benefits of the risk-based approach are the following: The methodology is based on prevention and management of contamination and will address any problems before they arise. The traditional methodology of sampling at the tap is a check afterwards and could potentially only identify a health risks when the water has already been supplied and drunk [too little too late]. In practice this is not a general problem as good housekeeping and robust multiple barrier systems are part of most water suppliers operational practice. But in some, especially smaller water supplies a risk-based approach based on prevention has a significant added value. Once a WSP has been put in place the potential risks are known and a more intelligent monitoring program can be designed focusing on key parameters that need to be checked and not as is the case in the current approach a list of parameters that mostly do not cause non-compliance. This will safe costs for analytical work. A risk based approach will offer a better way to control the quality of water and therefore lower the risk of illness through water and will have related economic advantages. It has shown in practice that the cooperation of various departments within a water supply company work more efficiently through the joint process of water safety planning. Involvement of more stakeholders in water safety planning (e.g. the general public) will increase awareness on water supply and potential adverse impacts on the quality of drinking water (sources).

Some points of attention are:

- Water Safety Planning should be *a continuous process* and not be considered as a 'one of' exercise.
- It will *take time and money* to design and put a WSP in place, especially the first time a WSP is designed.
- There is a *need for a regulatory structure* within the Member States to assess and evaluate the Water Safety Plans (mostly inspectorates will get different tasks from the past)

6 Assessment of the coherence of the DWD

Relation between regulating mechanisms in EU Directives to improve water quality

The main aim of the DWD is to protect human health by setting standards (denoted as parametric values) for compounds (denoted as parameters) in drinking water known to be harmful either on a short (acute) or long (chronic) term. This means that water quality as expressed by the concentration of the selected microbiological, chemical (and indicator) parameters is the key controlling factor. To some extent water quality, including both ground- and surface water is regulated directly and indirectly by various other EU Directives and by National Policies. National policies will not be considered here.

In order to identify the coherence with other EU legislation we evaluated the current DWD in view of (i) gaps where further or different EU legislation is required and (ii) overlaps, discrepancies and contradictions.

In general, quality of water bodies is regulated on the basis of (i) protection principles (to maintain or achieve a desired quality related mostly to ecological targets, often not related to specific emissions), (ii) emission control principles (to avoid unwanted excessive levels in water, mostly related to emissions from industry, agriculture and households) and (iii) accident related policies. Here we distinguish the following five main types of legislation that directly or indirectly regulates water quality via EU-Directives outside the DWD:

1. Legislation *targeting water quality* as such, e.g. by setting standards *in* the water bodies itself, which includes both surface water systems as well as ground water bodies or even bottled water.
2. Legislation *targeting emissions to the water system*, e.g. existing legislation that limits emission of compounds from industry directly to the water bodies (mostly surface water)
3. Legislation targeting *emission to adjacent terrestrial systems* that are linked to water bodies via leaching and runoff. This includes among others all legislation related to emission to soil or air in agriculture (use of fertilizers, pesticides)
4. Legislation that *indirectly regulates the emission to soil or water via e.g. control of food quality*.

5. General legislation concerning the *use of dangerous substances,* in construction or otherwise, that are being used in technical provisions related to the extraction or preparation of drinking water

When assessing the impact of the five main categories listed here, the direct control or influence on the actual quality of drinking water decreases from 1 to 5 where legislation in group 1 has a comparable impact on the regulation of the water quality as the DWD itself, through the setting of standards in the water body itself. Legislation in group 2 and 3 also has a direct (emission to water) or indirect (emission to soil) effect on the ultimate quality of water in its (natural) environment, but the final concentrations, i.e. at the tap as affected by this type of legislation is as such not addressed.

Approaches to assess impacts of adjacent policies regulating water quality

In order to compare the DWD with other Directives targeting, directly or indirectly, several options are available depending on how adjacent policies regulate the ultimate water quality:

1. *A direct comparison of standards* set by the DWD and EU Directives from group 1. This obviously is the most consistent since it allows for the assessment to what extent the DWD poses more stringent or more lenient targets to the water quality.
2. *An indirect comparison to compare water quality standards set by the DWD and emission related standards.* To assess the relation between quality standards set by the DWD and emission control oriented Directives from group 2 and 3 additional assessments need to be made to relate the allowed emission concentrations to final concentrations in the water bodies to be used for drinking water purposes. This involves mixing models in case of emission to (surface) water systems but can include combined emission and transport models in case of emission to soils
3. An *indirect comparison* of allowed levels of substances in food and other consumable products via *exposure modelling* (group 4). The level of specific substances in the DWD is related partially also to a maximum daily intake (e.g. Cd).

In this context *coherence* can be defined in two ways which can be complementary:

1. Based on *what substances are regulated*. This requires an analysis of substances regulated by adjacent policies compared to that of the DWD. This then illustrates to what extent the DWD regulates substances not covered by other Directives (if any), and subsequently
2. Based on *a comparison of the absolute value* of the standards set for various water bodies. Coherence (of adjacent policies relative to the DWD) would then imply that standards set by adjacent policies are at least equal to or more strict that those set by the DWD.

In this case basically 2 situations can occur:

1. Quality standards in water set in policies are similar or use a more strict standard setting (group 1) or emission regulations to air, water and soil (group 2, 3 and 5) and product standards (group 4) are such that resulting concentrations in water are expected to be equal or below the criteria as set by the DWD. In this case, the EU directives are coherent. Standards set by the DWD are theoretically not limiting or do not require additional actions in so far it concerns the water quality prior to treatment and transport.
2. The criteria set by the DWD are more strict than those set by adjacent policies, either directly (group1) or indirectly (group 2 and 3). In this case, the DWD is the ultimate directive in control of drinking water quality and for these substances additional measures may be required to achieve the desired quality before water can be supplied to consumers.

What needs to be kept in mind is that the adjacent policies addressed here primarily address the quality of the water *prior to treatment*, i.e. the water quality as it would be observed in the different water bodies (surface, groundwater) and do not target the impact of the treatment. For substances particularly related to the presence in drinking water *during or after treatment* (e.g. during transport from the treatment facility to the tap, like lead), the DWD will be the main driving instrument even though concentrations prior to treatment can be regulated at less stringent standards than those set by the DWD itself.

Here we will first list the most relevant EU Directives that either directly or indirectly control the quality of water bodies used for drinking water purposes (Table 5). In table 1 we also indicate to which group (1-5) the Directives belong. In a separate file (yet to be completed) a quantitative comparison of the substances regulated as well as a qualitative analysis of the coherence based on the absolute value of the compound regulated by these Directives relative to the DWD is given. This will be done for Directives from group 1 only i.e. those that have standards for water quality as such. An assessment of the quantitative impact of Directives from group 2 to 5 as far as the final concentrations in water bodies would require extensive modelling approaches and or assumptions with a limited generic value (due to variation) and is therefore not included.

Table 5 *Overview of relevant EU Directives and modes of action (group 1 – 5)*

Directive	Code	Group
Nitrate Directive	1991/676/EEC	1
Water Framework Directive	2000/60/EC 2008/105/EC	1
Waste Directive	2008/98/EC	
Sewage Sludge Directive	86/278/EEC	
Plant Protection Products Directive		
Industrial Emissions Directive	2010/75/EU	
Landfill of Waste Directive	1999/31/EC	
Sewage Sludge Directive	86/278/EEC	3
Urban Waste Water Treatment Directive	91/271/EEC	2
Undesirable products in animal nutrition	2001/102/EC	
Technical requirements inland waterway vessels	82/714/EEC	
National emission ceilings for atmospheric pollutants	2001/81/EC	
Classification, packaging and labelling dangerous substances	67/548/EEC	
Integrated pollution prevention and control	96/91/EC 2008/1/EC	
Hazardous Waste	91/698/EEC	
Radioactive substances in water intended for human consumption	CD 2013/51/Euratom	1
Exploitation and marketing of natural mineral waters	2009/54/EC	1
Constituents of natural waters and the conditions for ozone-enriched air for treatment of natural mineral waters and spring waters	2003/40/EC	1
Groundwater Directive	2006/118/EC	1