Climate Change and the EU Water Policy

Including Climate Change in River Basin Planning

Support to the CIS working group on Climate change and Water

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Ecologic Vienna

Thomas Dworak
thomas.dworak@ecologic.eu
Hütteldorferstr 247c/3/24, A-1140 Vienna, Tel. +43 6991 813 64 88

Ecologic Berlin

Anna Leipprand
leipprand@ecologic.de
Pfalzburger Str. 43-44, D-10717 Berlin, Tel. +49 30 86 88 00

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The paper will be further developed on the basis of the outcomes of the CIS Workshop on November 21-22. The information compiled in this paper is subject to rapid change. The information presented is the status as of **November 2007**.

Contents

1 Introduction and background

1.1 Rationale: Why climate change is an issue when implementing the WFD

The scientific evidence conveys the clear message that climate is changing and that this change will impact the water cycle and water resources in Europe and world-wide. Although the impacts of climate change on water resources vary strongly between European regions, three main challenges to the management of water resources can be identified: an increase in the risk of floods along coastal zones and in river beds, a decrease in the availability of water, and a deterioration of water quality.

Currently European water managers are implementing the Water Framework Directive, the main instrument in EU water protection. Climate change impacts will affect and interact with WFD implementation activities at different stages in the process. Climatic variables are the root of many of the parameters that influence water resources and therefore it is important to consider climate change when aiming to achieve the WFD objectives (good status of all waters).

Adapting to changing conditions has always been an integral part of water management, and climate change impacts should be considered in WFD river basin management planning in order to ensure that today's decisions will still be viable in the future. Climate change impacts may not be felt strongly during the first cycle(s) of WFD management. However, in designing measures decisions and investments may be made that have a long-term outreach into the future. It is important that likely or possible future changes in climate conditions are taken into account when planning measures today. In order to take appropriate decisions on the design of the programs of measures an estimation of the distance between the set environmental objectives and the current water status is needed. Baseline scenarios should consider future trends, including those caused by climate change, which could reduce or widen the distance to target if no WFD measure is taken. This would also reduce the risk of higher cost due to the implementation of measures that are not needed when pressures might

decrease due to climate change. So adapting to climate change when implementing the WFD should be seen as an opportunity to mitigate more costly impacts in the future

Although the WFD does not explicitly mention risks posed by climate change to the achievement of environmental objectives, several articles provide good arguments for including climate change impacts into the planning process. :

1. The Directive requires in Annex II that

   "Member States shall collect and maintain information on the type and magnitude of the significant anthropogenic pressures to which the surface water bodies in each river basin district are liable to be subject in particular the following:..[…]

   … Estimation and identification of other significant anthropogenic impacts on the status of surface waters."

   There is far-reaching consensus among scientists that climate change is at least to a certain extent caused by human activities. In the terminology of the WFD, direct climate change impacts on water resources could not be classified as an "anthropogenic pressure" in the narrower sense, since they cannot be mitigated by water managers' action. However, climate change impacts interact with and potentially aggravate other anthropogenic pressures and could therefore be considered. For example, changes in precipitation and hotter/drier summer periods alter both the availability of water and the demand for water for uses such as agriculture. Lower water levels as a result of climate change can lead to an increase in the concentration of pollutants (less dilution).

   In addition, pressures on water from human activities may change as a result of climate change mitigation efforts. EU climate policy sets targets and provides incentives to reduce CO_2 emissions. This will also have an impact on future human activities and can increase or decrease pressures on water. For example the newly set targets for bioenergy production to reduce C02 emission from burning oil tend to increase pressures on water in several places (Dworak, et al, 2007). On the other hand, the requirement of cleaner production techniques to reduce $C0_2$ emission might also support the development of more water protective technologies.

2. In order to calculate the level of cost recovery the WFD requires some forecasts of future. According to Annex III of the Directive:

   "The economic analysis shall contain enough information in sufficient detail (…) to:

   (a) make the relevant calculations necessary for taking into account under Article 9 the principle of the cost recovery of water services, taking account of long term forecasts of supply and demand for water in the RBD and, where necessary:

   - estimates of the volume, prices and costs associated with water services;

   - estimates of relevant investment including forecasts of such investments".

   Therefore, the two "forecast elements" that can be found in the WFD are:

   - Long-term forecasts of supply and demand for water in the RBD;
   - Forecasts (estimates) of "relevant investments" regarding water services.

   Following the idea of the WFD, that a forward thinking, systematic approach is needed to achieve the requirements/objectives of the WFD the "forecast elements" have been developed further under the CIS process and the idea of base line scenarios was developed

in the WATECO guidance document. In this guidance document the issue of climate change as part of the baseline scenario has been also addressed.

1.2 Integrating climate change in WFD planning: limitations and opportunities

While climate change and climate change impacts research are progressing fast, there is still a lot of **uncertainty**, in particular with regard to water-related changes. There is also large uncertainty about future projections of climate change for Europe during the first three cycles of the WFD (i.e., 2009-2015, 2015-2021 and 2021-2027). Over this timeframe mean temperatures are expected to continue to rise, but large year-to-year variations in precipitation will mask underlying regional trends for several decades. This implies that temperature-dependent processes (such as seasonal snowmelt, species' distribution and phenology, etc) will manifest change in the first instance. Climate change is likely to lead an increase of extreme events (floods and droughts). Uncertainties stem from different sources:

- Uncertainty about the extent of future climate change due to the difficulty in predicting future socio-economic development (scenario uncertainty) and due to unsatisfactory model resolution and mathematical description of all global circulation processes (model uncertainty, especially for precipitation).
- Lack of local hydrological localised models: While for some river basins over the last years a set of detailed hydrological models with link to climate change have been developed (e.g. Elbe, Danube) for other river basins no models exist. This makes it difficult to forecast the detailed effects climate change might have on water quality and quantity on the water body level, which is the basic unit under the WFD.
- With regard to flooding, the uncertainties in the prediction of extreme precipitation remain high (IPCC, 2007). The attribution of these extremes to climate change is still uncertain because of a lack of accurate data and full scientific understanding of the functioning of the climate system.

Thus, limitations to adaptation exist in the sense that forecasts of changes will never be exact, and that adapting to climate change will in many cases be equivalent to preparing for a range of potential scenarios. However, there are sufficient indications concerning potential impacts on relevant water management issues and trend changes to justify starting work on adaptation. In the first cycle the focus might be placed on "climate-proofing" the planning for the future, and an outlook on future steps may be provided. For the second and third plan efforts should be made to reduce uncertainties. In summary, current knowledge about climate change impacts calls for robust strategies and win-win solutions that will be functional under different possible scenarios and generally support sustainable management of water resources.

1.3 Aim of this note

The design of the WFD provides scope to adapt to climate change through the cyclical river basin planning process. However, further clarification is needed as to how and at what stages climate change can be considered in river basin management planning.

According to its mandate, the CIS activity on "Climate Change and the EU Water Policy" aims to, among other things, "identify what can and should be done in the different upcoming River Basin Management planning cycles" in relation to climate change impacts and adaptation.

The aim of this note is to provide input to this activity and to serve as a basis for discussion at the First Workshop of the CIS Working Group on November 21-22, 2007. Two elements are proposed:

- A checklist that includes a list of points of decision in the overall **planning process** where implementers could consider climate change.
- A structure for **reporting** the issue of climate change in the River Basin Management Plans.

The main aim of the checklist is to compile all stages in WFD implementation where climate change impacts may play a role. For each implementation stage (setting objectives, status assessment, identifying measures), an attempt is made to pinpoint the questions that could be asked in order to make sure that relevant interactions between climate change and river basin planning are taken into account. Based on the Working Group discussions, the checklist could be developed further to provide a tool for water managers implementing the WFD to take account of climate change risks.

The proposed outline for reporting on climate change impacts in the RBMPs (section 3) makes suggestions as to which aspects of climate change could be reported in what format, and should equally serve as a basis for discussion during the Workshop. Reporting on climate change impacts and how they are taken into account in the planning process might ultimately also be helpful for public information and participation processes.

2 Checklist to assess the impacts of climate change in the WFD implementation process

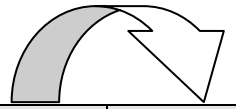
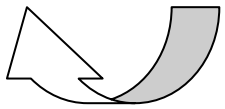


Table 1: Cyclic approach of the WFD and the points where climate change could be considered

WFD implementation step	Checklist	WFD legal basis
Defining good status	➢ Will climate change influence the definition of reference conditions? ➢ Will climate change influence the typology of a water body?	Art. 4
Setting environmental objectives	➢ Are measures for adaptation to climate change impacts being implemented that could be classified as new modifications (Art. 4.7) lowering the objectives? ➢ How does climate change affect Art 4.6 to 4.8 of the WFD	Art. 4
Status assessment: characterisation	➢ What information is available on climate change impacts in the river basin? What changes in water quantity and water quality are to be expected? ➢ Could climate change affect the rate of recharge of groundwater bodies?	Art. 5 Annex II 1.3 (surface water) Annex II 2.2 (groundwater)
Status assessment (Art. 5): environmental impact of human activity	➢ Could climate change impacts interact with pressures on water quantity or/and quality? For instance, will water abstraction by different sectoral users be changed? Could demand for groundwater abstraction increase? ➢ Could climate change directly influence pollution? (e.g. Increased erosion and diffuse pollution, more frequent flushing of combined sewer outflows) ➢ Could climate change impacts indirectly influence pollution sources (e.g. changes in land use or agricultural activities?)	Art. 5 Annex II 1.4
Status assessment: risk assessment	➢ Could the achievement of objectives be compromised by climate change? Could climate change impacts affect the likelihood of achieving the environmental objectives?	Art. 5 Annex II 1.5
Status assessment (Art. 5): Economic analysis (Art. 9)	➢ Could climate change impacts affect the baseline scenario for the river basin? Are they taken into account in long-term forecasts of supply and demand for water in the RBD? ➢ Are estimates of relevant investments and their potential costs still valid under changing climate conditions and under different climate scenarios?	Art. 5, Art. 9 Annex III/

WFD implementation step	Checklist	WFD legal basis
	➢ Do climate change impacts influence the costs of water services and the level of cost recovery?	
Monitoring	➢ Are monitoring systems able to capture long-term changes in natural conditions due to climate change? Will they capture climate-induced changes in anthropogenic pressures?	Art. 8
Programmes of Measures	➢ Could climate change impacts affect the cost-effectiveness of measures? ➢ Consider climate change in options appraisal, e.g. assess effectiveness under changing climate in the long term. ➢ Are there specific measures for climate change adaptation? If yes, how do they interact with other measures to achieve WFD objectives ➢ Could climate change impacts influence technical feasibility? ➢ Are measures climate-proof, i.e. is it ensured that they will support adaptation to climate change or at least not run counter to adaptation? ➢ Are potential adaptation measures in different sectors sufficiently integrated to ensure that synergies are exploited and conflicts avoided? ➢ Is priority given to no-regret measures which are viable under different climate change scenarios and reduce vulnerability to climate change impacts or climate-induced risks (e.g. flood risk management)?	Art. 11
Programmes of Measures: protected areas	➢ Are particular measures needed for protected areas due to climate change?	Art. 11, Art. 6
Public participation	➢ Climate change impacts and their relevance for river basin management planning could be an issue in stakeholder consultation processes. Adequate information on potential climate change impacts including uncertainties could be made available to the public. ➢ Find out if national or regional stakeholder processes on adaptation exist (e.g. sectoral adaptation initiatives, regional or national projects or strategies), explore scope for linking activities and co-operation with such processes.	Art. 14



3 Reporting on climate change in the River basin management plans

This section provides proposals for addressing climate change in RBMP reporting. Climate change impacts may be relevant at different stages of WFD implementation. In reporting, references to climate change aspects could either be included as subchapters in each of the relevant chapters (Table 2 provides an overview of the RBMP chapters as required by Annex VII WFD, and indicates in which chapters climate change impacts could be taken into account), or they could be summarised in an additional chapter. Here, the latter approach is suggested, especially for the first planning cycle. The additional chapter on climate change would present all relevant information regarding how climate change is taken into account in river basin planning, and include cross-references to other chapters where appropriate.

The following sections make suggestions which aspects might be included in the reporting.

Table 2: Basic outline for the RBMP 2009 (based on Annex VII WFD)

No.	Chapter title	Relevant for reporting on climate change and adaptation
1.	Characteristics of the River Basin	x
2.	Significant pressures and impacts from human activity	x
3.	Identification and mapping of protected areas	
4.	Monitoring networks and monitoring results	?
5.	Environmental objectives and exemptions	if appropriate
6.	Economic analysis of water use	x
7.	Programme of measures	x
8.	Register of more detailed programmes or management plans	
9.	Public information and consultation measures	?
10.	Competent authorities and international coordination arrangements	
11.	Contact points for obtaining background documentation	

It is suggested that climate change could be mentioned at least in relation to the following issues:

- Characteristics and significant human pressures
- Environmental objectives and exemptions
- Economics
- Programs of measures

First, the basis for dealing with climate change impacts needs to be laid by summarising the expected climate change impacts for the river basin assessments can then be made of the effects these impacts have on different planning stages.

The following section will identify some of the buildings blocks to account for climate change in the RBMP and will also address how to deal with gaps and uncertainty.

3.1 Characterisation of the River Basin

The analysis needs to complement the characterisation of the river basin today by an assessment of its future likely trends. This assessment is the basis for analysing the gap between likely water status and good water status (risk of non-compliance) and for undertaking the subsequent cost-effectiveness analysis of measures. Complemented by analysis of changes in the hydrological cycle, e.g. for accounting for climate change, this analysis could feed into an overall assessment of changes in key pressures, including water demand, and resulting impact on water status. This summary of changes could consider both changes in annual averages (e.g. increase of precipitation by x% in 2020) and seasonal changes (e.g. increase of flow rates during the summer period).

This section could first summarise briefly the available information and scientific evidence on climate change on water resources in the region or river basin. It could address expected changes in temperature and precipitation and, where available, in runoff and in the risk of extreme events. This section could also provide information about confidence levels and uncertainty. Where the available data basis is not sufficient to make reasonable statements on relevant climate change impacts in the gap assessment. The gap assessment could identify: data gaps (observational and monitoring) and outline future approaches to close these gaps for the next RBMPs.

Based on this summary those climate change impacts relevant for characterisation of water bodies under the WFD could be identified. The assessment might address the following issues:

1. Direct climate change impacts on water resources

- Expected changes in the main factors for characterisation. Table 3 provides a first assessment of factors that will be affected by climate change for surface waters. To the extent possible, an assessment could be made of climate change impacts on groundwater status and quantity.

Table 3: Obligatory and optional factors for characterisation of surface water body types given in Annex II of the WFD. Factors sensitive to climate variability/climate change are marked in red colour (EC-JRC, 2004)

	Rivers	Lakes
Obligatory factors	latitude longitude geology size	altitude latitude longitude depth geology size
Optional factors	distance from river source energy of flow mean water width mean water depth mean water slope form and shape of main river bed	mean water depth lake shape residence time mean air temperature air temperature range mixing characteristics acid neutralising capacity

	river flow category valley shape transport of solids acid neutralising capacity mean substratum composition chloride air temperature range mean air temperature precipitation	background nutrient status mean substratum composition water level fluctuation

- Frequency and intensity of extreme events (increase/decrease of floods and droughts)
- Effects in aquatic ecosystems in particular protected areas (e.g. loss of wetlands)
- Changes in eco-regions
- Impacts on water quality
- Effects on HMWB and artificial water bodies

2. **Indirect impacts of climate change through interaction with existing anthropogenic pressures and activities**
   - Impacts on human activities such as shipping, hydropower, water supply and wastewater treatment. This could provide the basis for the detailed assessment in chapter 6 on economics.
   - Changes in impacts from existing pressures (increased relevance of pollution source due to lower water flow levels)
   - Feedbacks between climate change impacts and human pressures (e.g. higher temperatures leading to increased demand for cooling water and thus again to higher water temperatures)
   - Changes in human activities as a result of mitigation (e.g. increasing bio energy cropping or increasing hydro-power) and adaptation efforts (e.g. new desalination plants or modifications). If negative impact can not be avoided the basis for arguing for exemptions should be made.
3. **Uncertainties related to the characterisation and gap assessment**
   - Uncertainties related to the issues stated above might also be addressed.
   - Gaps related to the characterisation and approaches to close these gaps.

?	**Questions for discussion at Working Group meeting** Which issues mentioned above can be realistically expected in the 1st cycle? Is support to the MS required to achieve basic results? For instance, could a common reference source be recommended where data on climate change impacts at relevant spatial scales are provided (e.g. ETC work on climate change indicators, WISE maps)?

3.2 Environmental objectives and exemptions

The overall objective for water bodies under the WFD is to achieve "good status" (GS) or "good ecological potential" (GEP) for heavily modified water bodies, respectively. GS and GEP are defined on the basis of reference conditions for different water body types.

Climate change impacts do not affect these overall quality objectives for water bodies. However, in some cases water bodies, especially those located near the boundary of the type range, may change their type as a result of climate change (see EC-JRC, 2004). In such cases, the reference conditions of the new type and accordingly the good status definition for this type would have to be applied.

In most cases, however, climate change impacts will not lead to clear-cut changes in water body type, but lead to weaker trend changes in parameters such as water temperatures or water flow levels. Such changes might interact with pressures from human activities present in the river basin and might change the impacts of such pressures. For instance, if river flow levels decrease, this could increase the concentration of pollutants from point or diffuse sources, and make it more difficult or costly to achieve good status. Conversely, if there is an increase in precipitation and water flow levels, the impact of pollution might be alleviated, and less action might be necessary to reach good status. Another example might be a cold monomictic lake that under a warming climate may stratify in summer and become dimictic. In such a case waste water disposal might have a different impact on the newly dimictic lake.

In practice it is likely that such trends and impacts will play a minor role at least in the first WFD management cycle, since trends caused by climate change are likely to be less important than those caused by other factors and will remain shaded and overridden by natural seasonal and year-to-year variability. As the principle issues for the WFD implementation related to typology of water bodies, Owen et al. (2001) pointed out the following questions:

- how much natural variation can be accommodated within types?
- how can we differentiate between natural variation and impact?
- should we update the natural range of values to accommodate "natural" changes, such as climate change?
- How much of these changes will take part in the time period covered by the first RBMP?

However, in theory and in a more long-term perspective, there might be cases where climate change impacts may influence proportionality of costs of measures necessary to reach good status, and may thus play a role with respect to exemptions (extended deadlines or less stringent objectives).

Member States should outline the methodology how they have set the environmental objectives for each water body. If climate change is considered when setting objectives and has influenced the process, this should be reported in the RBMP chapter on climate change

3.3 Economics

In order to make appropriate forecasts on supply and demand for water in the RBD and of "relevant investments" regarding water services as stated in Annex III of the WFD the analysis needs to complement the characterisation of the river basin today (chapter 1and 2) by an assessment of its future likely trends with regard to water quantity. Climate change could be included in the assessment as one of several factors that may influence the balance of supply and demand in the future. The section on economic analysis in the RBMPs could include

- Prospective analyses of likely development of key (economic) sectors and their water demand under a changing climate to estimate future supply and demand. For example, climate change may alter water demand of certain sectoral users (e.g. increase of irrigation needs due to drier and hotter summers).
- Projections on climate change-induced changes in water balance (see analysis in chapter 1+2) in order to estimate to which extend the demands identified above can be fulfilled.

- Identification of technological developments in the water sector (e.g. water saving technologies).

Estimations on future relevant investments regarding water services (e.g. new desalination plant, new irrigation channels) need to take account of climate change impacts in order to ensure that investments will still be viable and cost-effective under future climate conditions.

There is no doubt that in such a forecast it is difficult to differentiate between changes that will take place due to socio-economic developments and those driven by climate change. However, the section on economics could at least address these issues. If a detailed assessment is not possible due to lack of information, the gaps and potential solutions to close these gaps could be indicated.

3.4 Programs of measures (chapter 7)

The programmes of measures can be considered as the principal mechanism for the implementation of the environmental objectives of the WFD and have to be developed for each river basin district. As mentioned in the CIS guidance document 11 (planning process) a RBMP is a strategic planning document and an operational guide to implement programmes of measures that will form the basis for integrated, technically, environmentally and economically sound and sustainable water management within a River Basin District for a period of six years. Therefore it could contain from the second RBMP onwards also information on adaptation to climate change in order to avoid contradicting effects between implementing the WFD and adapting to climate change.

WFD objectives overlap with many of the aims of adaptation measures there is a large potential for synergies. On the other hand, it is important to ensure that measures identified and implemented in the PoMs do not run counter to adaptation objectives, and that they accommodate possible changes in behaviour ahead of climate change, such as adaptation measures in spatial strategies.

Ensuring compatibility between PoMs and adaptation concerns is particularly important in the case of measures that are expensive and involve long-term investments, such as large infrastructure projects. For such measures it needs to be ensured that they do not compound the risks/impacts of climate change, and that they will still be viable and cost-effective under changing climate conditions.

In cases where it is not possible to reconcile WFD objectives and adaptation, exemptions based on Art. 4.7 of the WFD might be applied (no achievement of good status as a result of new modifications or as a result of new sustainable human development activities).

In the RBMP chapter on climate change, Member States could be asked to report on the following issues:

- Have climate change impacts been taken into account in the identification and appraisal of measures? If yes, what aspects were considered most important, and what methodologies were used?

- Has a “climate-proofing” been conducted for measures?
- Do (any of) the measures in the programme provide for synergies with adaptation?
- Do PoMs include specific adaptation measures? If yes, what do they look like and how do they interact with other measures and objectives?
- If cost-benefit analyses were undertaken, did they consider the benefits of measures with respect to adaptation objectives?
- Was climate change taken into account with respect to measures related to protected areas? If yes, in what way?
- Has Art. 4.7 been used in relation to climate change impacts and adaptation?

4 References

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