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Guidelines for developing national strategies to use water quality monitoring as an environmental policy tool for the countries of Eastern Europe, the Caucasus and Central Asia, as well as interested South-Eastern European countries

Note by the secretariat

Summary

The Working Group on Environmental Monitoring and Assessment prepared the present document, in consultation with the Bureau of the Water Convention, in pursuance to sub-task 1.1 “Review of developments in environmental monitoring and assessment at the national and international levels” of its work programme (ECE/CEP/AC.10/2008/2, annex I). The document is submitted to the Committee on Environmental Policy, at its special session, for approval.

Contents

I. Introduction

1. The present guidelines were prepared in response to the invitation of the Sixth "Environment for Europe" Ministerial Conference (Belgrade, October 2007) to the United Nations Economic Commission for Europe (UNECE) "to continue its efforts, in cooperation with EEA[1] and other partners, to make monitoring an effective instrument in environmental policymaking in countries of Eastern Europe, the Caucasus and Central Asia and South-Eastern Europe".[2]

2. The format and structure of the present guidelines are the same as those of the Guidelines for Developing National Strategies to Use Air Quality Monitoring as an Environmental Policy Tool for the countries of Eastern Europe, the Caucasus and Central Asia, and of South-Eastern Europe, prepared by the Working Group on Environmental Monitoring and Assessment and approved by the Extended Bureau of the Committee on Environmental Policy in March 2010.[3]

3. The aim of the present guidelines is to provide guidance to the countries of Eastern Europe, the Caucasus, Central Asia and interested countries of South-Eastern Europe (hereinafter "the target countries") so as to help make monitoring a practical tool for environmental policy especially in the development of water pollution abatement strategies and in assessing progress in achieving policy targets and the effectiveness of abatement measures. Minimization of health and environmental risks of water pollution is a main objective.

4. The present guidelines deal not only with the quality of water in the natural environment — surface water and groundwater — but also with the quantity of water. Wherever necessary, monitoring of drinking water quality is taken into account as well.

5. While the present guidelines focus on target countries as a group they also recommend to take into account country specific issues such as geographic conditions, the diversity of national economies and established practices for setting water quality monitoring networks, practices and procedures.

6. The guidelines are based on the assessment and evaluation of the situation with regard to water quality monitoring in the target countries contained in those countries' environmental performance reviews (EPRs) prepared under the UNECE Environmental Performance Reviews Programme[4], as well as in the report, "Europe's Environment: The fourth assessment"[5]. The document reflects relevant experiences gained in the European Union and other countries where coherent systems of water quality assessment and management have been developed and implemented. They also take into account relevant international activities, requirements, guidance documents and recommendations, especially those developed under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) and its Protocol on Water and Health; under the World Health Organization (WHO), the World Meteorological Organization (WMO) and the International Organization for Standardization (ISO).

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[1] European Environment Agency.

[2] See ECE/BELGRADE.CONF/2007/8, para.7 (available at: www.unece.org/env/documents/2007/ece/ece.belgrade.conf.2007.8.e.pdf)

[3] http://www.unece.org/env/documents/2009/ECE/CEP/ece.cep.2009.10.e.pdf.

[4] http://www.unece.org/env/epr/welcome.htm.

[5] Published by the European Environment Agency, Copenhagen, 2007. The report is available at: http://www.eea.europa.eu/publications/state_of_environment_report_2007_1.

II. Linking water quality monitoring to environmental policy development

7. To minimize the negative health and environmental effects of water pollution, those target countries that have not yet done so are recommended to develop strategies to establish comprehensive water management systems (see box 1) including appropriate policy setting (objectives, priorities and targets). Within it, a realistic step-by-step approach to enhancing water quality monitoring (focusing on both surface water and groundwater quality monitoring and emission/discharge monitoring) is recommended to be developed, taking into account technical and economic conditions in a particular target country. Where such systems exist, their revision and step-by-step update is recommended with respect to the present state of the art.

8. It is recommended that water management systems include a clearly defined institutional setting, including one central competent authority responsible for the coordination of all activities within that system. Institutions responsible for permitting and for enforcement should be independent from each other.

9. The main message of the present guidelines is that water quality monitoring systems should become an integral part of national water management systems and should therefore be designed, developed and interpreted in a broader policy, economic, technical and scientific context (see box 1). When developing or upgrading national water management systems, the river-basin approach is strongly recommended, especially with regard to the institutional setting. In addition, the concept of integrated water resources management (IWRM) should be taken into account. Finally, water quality monitoring systems should provide data on transboundary rivers and other international water bodies and should therefore be coordinated with relevant international programmes.

A. Integrating water quality monitoring with water quantity monitoring

10. As water quantity and availability is an important issue for all countries, water quality monitoring has to be linked with monitoring of both groundwater and surface water quantity. In addition to water quality, national water management systems should deal with the protection of water resources in terms of quantity and availability (water quantity assessment and management), including protection against floods and other emergency situations (flood management; drought management, climate change adaptation).

11. In this respect, the balance between groundwater consumption and intake should be monitored, as well as fluctuations in river flows due to hydropower plants and other water-related infrastructure.

B. Integrating water quality and quantity monitoring with climate change mitigation and adaptation policies

12. Water quality and quantity monitoring should also be coordinated with national climate policies, especially in linking hydrological scenarios with climate scenarios and in the field of adaptation to the impacts of climate change.

Box 1
Basic elements of water management systems

Institutional framework

(a) Central competent state/public administration authority which coordinates activities of all relevant authorities and institutions with regard to water quality and quantity issues;

(b) Relevant public administration institutions at the national, regional and local levels (e.g., river basin authorities, water agencies, sanitary and hygienic services, environmental inspectorates);

(c) Supporting institutions (mainly hydrometeorological services, research institutes, etc.).

Policy-level document setting

(a) Objectives;

(b) Priorities;

(c) Targets.

Regulatory and other instruments

(a) Standards (water quality limit values, emission/discharge limit values, product standards, best available techniques, good agricultural practices) and, where appropriate, compliance deadlines;

(b) Technical requirements (operation of water related infrastructure, operation of emission/discharge sources, measurement of emissions by operators, monitoring protocols, etc.);

(c) Economic and market-based instruments (water abstraction charges, water pollution charges, product charges, taxation, incentives, etc.);

(d) Financial instruments (e.g., environmental funds);

(e) Voluntary instruments (ISO 14 000, eco-labelling, codes of conduct, voluntary agreements, etc.);

(f) Information instruments (public information and awareness-raising, environmental education).

Monitoring and information management

(a) Operation of a core national water (quality and quantity) monitoring system (including its coordination with local and specialized monitoring networks and supporting activities);

(b) Development of emission/discharge inventories and projections;

(c) Water quality and quantity modelling;

(d) Scenario analysis;

(e) Assessment of effects on human health and the environment;

(f) Operation of water information system (including public information);

(g) Reporting.

Operational level setting

(a) Permitting, including environmental impact assessment (EIA)/environmental expertise, hygienic-epidemiologic expertise, strategic environmental assessment (SEA) and life-cycle assessment (LCA);

(b) Regional approach (river basins, planning);

(c) Application of instruments/implementation of measures;

(d) Enforcement (inspection);

(e) Feedback mechanisms (mechanisms to update policy and technical levels).

C. Integrating surface water and groundwater quality monitoring with drinking water quality monitoring

13. Groundwater and surface water quality monitoring systems are recommended to be integrated with monitoring of drinking water quality, taking into account the structure of drinking water sources (direct use of groundwater, treated groundwater or treated surface water).

14. Integration of monitoring systems should take into account not only the localization and capacity of particular bodies of water intended for use for production of drinking water, but also the drinking water quality standards and standards set for water sources intended for drinking water production.

D. Integrating water quality monitoring data with emission/ discharge inventories

15. Monitoring activities should take into account the relationship model known as DPSIR (driving force-pressure-state-impact-response), which represents the conceptual model for development and implementation of water management systems. The relation between emissions/discharges from both point and diffuse sources (pressure) and surface and groundwater quality (state) is of utmost importance. Emission/discharge monitoring helps to find important sources of emissions/discharges and, when combined with water quality monitoring, it allows proposing effective and feasible measures to improve water quality. In order to integrate surface water quality monitoring with discharges monitoring, it is recommended to coordinate sampling of discharged waters with sampling of water in recipients downstream of points of discharges.

16. Target countries that have not yet done so are recommended to:

(a) Prepare a preliminary assessment of available data on emissions/discharges (including data quality assessment);

(b) Update the mechanisms to create and operate national emission/discharge inventories[6] on a regular basis; it is recommended that these inventories cover those priority pollutants (see paragraph 41) which are being regulated by national legislation

[6] Emission/discharge inventories should include not only the amounts of pollutants discharged, but also the volumes of polluted water discharged into recipients.

(using emission/discharge limit values) or reported under the Pollutant Release and Transfer Register (PRTR) framework;

(c) Include the assessment of emissions/discharges from small stationary sources (mainly households and small businesses not connected to public sewers) and from diffuse sources (mainly agriculture or contaminated land) into emission/discharge inventories;

(d) Arrange for the preparation of emission/discharge projections for selected pollutants on a regular basis (these projections should at least cover those priority pollutants which are being regulated using emission/discharge limit values).

E. Integrating water quality monitoring data with modelling activities

17. It is recommended that target countries that have not yet done so develop and verify or implement, in a step-by-step way, existing modelling tools extrapolating the monitoring data to cover all water bodies where compliance with standards is required and correlating water quality monitoring data with emissions/discharges from specific sources.

18. As a first step, past and actual situations should be assessed by appropriate models (e.g., processing of time series of monitoring data) to define the background for setting targets. Suitable policies and measures should be proposed to achieve them. As a second step, modelling should be carried out to predict future developments in water quality (and quantity) and to check both whether the proposed targets are technically and economically achievable, and whether the existing policies and measures are likely to achieve them.

19. This model-based approach is useful in the case of flow (quantity) and of diffuse pollution assessment, where the effect of prescribed measures is long term and not easy to measure or calculate in a simple way. Nevertheless, emission/discharge and water quality data and their correlation should also be taken into account in the case of routine point sources permit issuing where such a decision can be made on the basis of ordinary calculation.

F. Integrating water quality monitoring data with the assessment of health and environmental effects

20. Poor quality of both surface water and groundwater may have serious impacts on human health and/or on the environment. Direct use of polluted surface or groundwater as drinking water or use of insufficiently treated surface water is the most serious direct health effect, while the consumption of fish and shellfish from polluted surface waters represents one of serious indirect impacts on human health. In addition, bathing in polluted water may lead to negative health effects. Pollution of surface waters causes direct deterioration of aquatic ecosystems (acidification, eutrophication).

21. Water quality monitoring data, together with information on pollution sources and various types of adverse impacts (disasters, technical accidents, secondary pollution), is the only way to assess the risk of the negative effects of polluted water on human health and the environment. Water quality monitoring systems should therefore be designed to provide sufficient information on potential risks. Special attention should be given to those water bodies which are being used for drinking water production (taking into account the number of people served) and/or represent important aquatic ecosystems.

G. Integrating water quality monitoring with other monitoring networks, including international networks

22. It is recommended that the target countries consider preparing and implementing integrated environmental monitoring strategies which would create a framework for coordination of specialized monitoring networks (e.g., water, air, soil, forests, biodiversity, noise and waste). The experience of those target countries that have prepared and are implementing such integrated environmental monitoring strategies should be made available to other target countries.

23. It is also important to give particular attention in integrated environmental monitoring strategies to monitoring water quality and quantity in transboundary watercourses and international lakes. Where such international networks do not exist, the relevant target countries are recommended to consider their establishment.

H. Revising water quality standards and harmonizing them with international standards and guidelines

24. A specific problem for the assessment of waters in countries of Eastern Europe, the Caucasus and Central Asia arises from the widely used "maximum allowable concentrations of pollutants for a specific water use" (MACs)[7] formula, which seem to be more stringent than water quality criteria and objectives often used in other parts of the UNECE region. It is frequently impossible to comply with MACs, partly due to the lack of appropriate measuring devices and partly because financial and human resources or feasible technical solutions are lacking.

25. Current surface water and groundwater quality standards are recommended to be reviewed and, thereafter, revised, discontinued or set anew, where necessary. Where the ministry of health is responsible for setting national water quality standards, the central-level competent environmental authority should participate actively in the process of water quality standards updating and setting. When developing water quality standards for hazardous substances, the form in which these substances are present in water should be taken into account. For instance, as heavy metals and pesticides are present in water in the organo-mineral form and as suspensions, standards and targets should be developed also for a total content of these substances.

26. While revising groundwater and surface water quality standards, it is recommended to take into account relevant internationally agreed guiding documents. For instance, WHO has developed the Guidelines for Drinking-water Quality and the Guidelines for Safe Recreational Water Environments[8].

27. The European Union (EU) has developed and implemented a comprehensive system of water quality assessment and management with the Water Framework Directive[9] (WFD) as its background. Annex VIII of the WFD established a first indicative list of main pollutants (dangerous substances). The hazardous substances are the substances already

[7] MACs had been introduced based on hygiene standards for many hundreds of pollutants. MACs represent a background for issuing permits for discharges from particular pollution sources (using calculations).

[8] www.who.int/water_sanitation_health/dwq/gdwq3rev/en/ http://www.who.int/water_sanitation_health/bathing/en/.

[9] Directive 2000/60/EC of the European Parliament and of the Council of 23 October establishing a framework for Community actions in the field of water policy (as amended).

indicated in the list I and II of the Directive 76/464/EEC (codified by 2006/11/EC)[10] and are included as substances and classes of substances in Annex VIII of the WFD. The priority substances are all those which present a significant risk both directly or via an aquatic environment, including risks to waters used for the abstraction of drinking water. Among them, hazardous substances are identified in order to set up interventions to eliminate their emission and loss in the aquatic environment. The first step of this EU strategy is a list of priority substances and hazardous priority substances, adopted by Decision 2455/2001/EC, which identifies 33 substances of priority concern.[11] It is evident that with the WFD and Decision 2455/2001/EEC the number of substances to be controlled grows remarkably, because the criteria for toxicity, persistence and potential bioaccumulation are combined with the criterion of risk for the aquatic environment.

28. Besides the requirements for the quality of groundwater[12] and surface water, EU legislation includes special provisions for the quality of drinking water,[13] bathing water,[14] water for fish[15] and water for shellfish.[16] In addition, the requirements related to the reduction of emissions/discharges should be taken into account (e.g., directives concerning urban waste water treatment,[17] water pollution from agricultural sources[18] and integrated pollution prevention and control[19]). In addition, certain "specialized directives" establish requirements for groundwater monitoring.[20]

29. In the United States of America, the water quality assessment and management system is based on the 1972 Clean Water Act[21] (last update 2002). According to this act, the U.S Environment Protection Agency (EPA) is responsible for the development of criteria for water quality. The current EPA's compilation of national recommended water quality criteria contains water quality criteria for the protection of aquatic life and human health in surface water for approximately 150 pollutants[22]. These criteria provide guidance for states to use in adopting water quality standards. .

30. The target countries are recommended to apply a step-by-step approach in harmonizing their water quality standards with the international ones. The assessment of an existing set of national groundwater and surface water quality standards should be carried

[10] Directive 2006/11/EC of the European Parliament and of the Council of 15 February 2006 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community.

[11] Decision No. 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC.

[12] Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration.

[13] Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption.

[14] Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality.

[15] Directive 2006/44/EC of the European Parliament and of the Council on the quality of fresh waters needing protection or improvement in order to support fish life.

[16] Directive 2006/113/EC of the European Parliament and of the Council of 12 December 2006 on the quality required of shellfish waters.

[17] European Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment.

[18] European Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources.

[19] European Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control (IPPC).

[20] E.g., European Council Directive 99/31/EC of 26 April 1999 on the landfill of waste.

[21] http://epw.senate.gov/water.pdf.

[22] http://water.epa.gov/scitech/swguidance/waterquality/standards/current/index.cfm.

out to decide which ones should remain in place (taking into account their role in permitting procedures like environmental expertise and setting emission/discharge limits) and which ones should be updated and or replaced. It is recommended that water pollutants be divided among, at least, two categories: priority pollutants (see para. 31) and important pollutants (those which are not listed as priority ones but are considered to have an impact on water quality in the country or in part of its territory).

31. It is recommended that surface water quality standards be updated or introduced for the following priority pollutants: substances having unfavourable effects on oxygen balance (measured as Biochemical Oxygen Demand (BOD) or Chemical Oxygen Demand (COD); soluble substances; insoluble substances; total nitrogen; ammonia, nitrates; total phosphorus; phosphates; cadmium; mercury; lead; nickel; aromatic/polyaromatic hydrocarbons; and halogenated hydrocarbons). Nevertheless, the target countries can be flexible in developing their lists of priority pollutants, taking into account country-specific situations.

32. In the case of groundwater, quality standards should be introduced and/or updated for the following priority pollutants — arsenic, cadmium, lead, mercury, ammonium, chloride, sulphate, trichloroethylene and tetrachlorethylene — as well as for conductivity. However, the target countries can be flexible in developing their lists of priority pollutants, taking into account country-specific situations.

33. Revised standards or new standards for important pollutants could be set and existing standards for other pollutants could either be abolished or retained if considered necessary for permitting procedures.

34. In updating their current groundwater and surface water quality standards and developing new ones, the target countries may use relevant background information (e.g., health impact studies and cost-benefit analyses) available at the international level (e.g., developed by UNECE,[23] the European Commission,[24] WHO,[25] EEA[26] or the U.S. EPA[27]).

35. It is recommended that target countries consider the introduction of special water quality standards at the subnational level (e.g., for particular rivers, lakes or river basins) wherever reasonable.

36. The target countries are also recommended to decide on compliance deadlines for their updated or newly introduced groundwater and surface water quality standards for priority and important pollutants. Without compliance deadlines, these new or updated standards would remain at the level of statements without any real power.

I. Target setting

37. Detailed analysis of available water quality monitoring data (supported by modelling as far as possible) and of available emission/discharge data is a necessary precondition for sound target-setting (setting the baseline).

38. Targets are recommended to be structured as main targets (e.g., water-quality objectives and discharge reduction targets) and complementary technical targets (e.g., development of water quality and quantity monitoring networks, institutional settings,

[23] See, e.g. http://www.unece.org/env/water/publications/pub74.htm.
[24] See http://ec.europa.eu/environment/water/index_en.htm.
[25] See http://www.who.int/topics/water.
[26] See http://www.eea.europa.eu/themes/water.
[27] See http://www.epa.gov/epahome/learn.htm#water.

mechanisms for preparation of emission/discharge inventories, development of emission/discharge projections, etc.). The application of the Specific, Measurable, Achievable, Realistic, Timely (SMART) concept will be useful for the purpose.

39. Water-quality objectives are generally considered to be numerical values or descriptive statements that must be met within a specified period of time to protect human health and to protect or restore a set of environmental values (e.g. aquatic ecosystem protection, recreation and aquaculture). Water-quality objectives established should be considered as the ultimate goal, that is, as a target value which indicates a negligible risk of adverse effects on water uses and the ecological functions of waters.

Box 2
Guidelines for developing water quality objectives and criteria

Water quality objectives and criteria shall:

(a) Take into account the aim of maintaining and, where necessary, improving the existing water quality;

(b) Aim at the reduction of average pollution loads (in particular hazardous substances) to a certain degree within a certain period of time;

(c) Take into account specific water quality requirements (raw water for drinking-water purposes, irrigation, etc.);

(d) Take into account specific requirements regarding sensitive and specially protected waters and their environment, e.g., lakes and groundwater resources;

(e) Be based on the application of ecological classification methods and chemical indices for the medium- and long-term review of water quality maintenance and improvement;

(f) Take into account the degree to which objectives are reached and the additional protective measures, based on emission limits, which may be required in individual cases.

Source: Annex 3 to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

40. Water-quality objectives should be set, taking into account specific physico-chemical, biological and other characteristics of water bodies and their catchment area. In setting water-quality objectives, the application of the Guidelines for developing water quality objectives and criteria is recommended, as presented in Annex 3 to the Water Convention (see Box 2). Water-quality objectives should always include the priority pollutants (see para. 31). Important pollutants should be added taking into account specific conditions in a particular country.

41. When setting emission/discharge targets the following priority water pollutants are recommended to be covered (taking into account different sources of emissions/discharges — wastewater treatment plants, households, industrial installations and diffused sources like agriculture or contaminated sites):

(a) Substances having an unfavourable effect on oxygen balance (measured as BOD or COD);

(b) Total Phosphorus;

(c) Phosphates;

(d) Total Nitrogen;

(e) ammonium-N (NH4-N);

(f) Nitrates;

(g) Soluble inorganic substances;

(h) Insoluble substances;

(i) Microbiological pollution;

(j) Hazardous substances (e.g., mercury, cadmium, nickel, lead, aromatic/ polyaromatic hydrocarbons, halogenated hydrocarbons).

42. A particular target country may add other pollutants based on its specific conditions (e.g. specific hazardous substances), both countrywide and local ones. Particular attention should be given to water bodies used for the withdrawal of water for the purposes of drinking water production.

43. Water quality objectives and emission/discharge reduction targets should be mutually coordinated and focused on minimization of adverse health and environmental effects. It is recommended that coordination of water-quality objectives and emission/discharge reduction targets be carried out using relevant modelling techniques.

44. Complementary technical targets should be coordinated with the main targets (especially as regards timing) to create conditions both for setting the main targets and for the assessment of compliance.

45. In setting the targets, both country-specific issues (e.g., geographic conditions, the state of the environment, environmental commitments at the international level and general policy trends) and technical and economic assessment of achievability should be taken into account.

46. Reasonable timing of targets is strongly recommended following a prioritization of problems based on a detailed analysis. A stepwise and flexible approach to the timing of compliance with targets is recommended as well.

47. For the assessment of compliance with the targets, the role of water quality and quantity monitoring and control is crucial.

J. Better use of water quality monitoring data

1. Permitting

48. All target countries have introduced permitting procedures for activities which may have an impact on surface water and groundwater quality and quantity. In this respect, results of water quality and quantity monitoring, preferably in combination with modelling (or at least expert assessment), are necessary to decide on the location of a new potentially polluting activity or in the case of a substantial change in existing activity which may cause an increase in emissions/discharges. Results of water quality and quantity monitoring are used during the process of environmental impact assessment (EIA) or environmental expertise as a baseline against which the estimate of the incremental concentration of pollutants caused by the implementation of the project is assessed.

49. An integrated permitting approach, as applied in the IPPC Directive,[28] is recommended to be applied to prevent and control pollution in all recipients (air, water, soil). This directive uses the combined approach to any pollution source (wastes, emissions, discharges, energy and material use), which means that the discharge permit in any environment recipient can only be authorized if the limits of emissions for all other recipients are respected.

50. The target countries are recommended to extend the use of water quality and quantity monitoring data in combination with modelling tools in permitting processes. In the case that modelling is not available, simple calculation of consequent concentration in stream could be used.

2. Compliance with water quality standards

51. Once groundwater and surface water quality standards are adopted, reliable water quality monitoring data are the most relevant way to monitor compliance.[29] In any case, priority pollutants should be monitored in surface and ground waters for which water quality standards have been set or updated, taking into account the technical and economic conditions in the particular target countries. National legislation should clearly impose responsibilities on the actors responsible for monitoring specific standards, as well as set out the technical requirements for monitoring networks.

3. Reporting

52. Target countries which do not yet include water quality and quantity data in their national state-of-the-environment reports are recommended to do so. As national environmental reports are produced for policymakers as well as for the public, the data on water quality should be accompanied by detailed interpretation of that data. Such interpretation should cover at least the following issues:

(a) Populations living in areas with increased concentrations of pollutants in surface water and groundwater;

(b) Areas of environmental importance with increased water-pollution levels;

(c) Potential risks for human health and for the environment;

(d) The origin of water pollution (both sectoral and territorial distribution of point and diffuse sources of pollution);

(e) The impact of hydrological and meteorological conditions;

(f) Trends in water quantity;

(g) Trends in water pollution;

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[28] The 96/61/EC Directive on Integrated Pollution Prevention and Control (consolidated text in Directive 2008/1/EC) has the objective of preventing, reducing and as long as possible eliminating pollution produced into production sectors. The goal will be reached with an “integrated approach” both with regard to the coordination of competent authorities and with regard to the control of emissions, in undertaking the analysis of any environmental effects and the assessment of techniques adopted in the production processes. It is worthwhile to remark that techniques mean not only the process technologies but also their design, construction, maintenance, implementation, management and closure. Among others, the best available techniques (BATs) for optimizing efficiency and minimizing environmental impacts should be used, provided they are economically and technically viable.

[29] In the case of lower concentrations, the results of monitoring may be supplemented or even replaced by modelling or expert assessment.

(h) Policies applied and measures taken or proposed.

53. This information cannot be made available in full without monitoring, modelling and emission/discharge inventory results.

54. When preparing state-of-the-environment reports, the application of indicators[30] is strongly recommended for the target countries.

55. Besides state-of-the-environment reports, those target countries that do not do so as yet are recommended to regularly prepare and publish easily accessible specialized reports on water quality and quantity. These reports should include not only water quality monitoring data together with their detailed interpretation, but also data on water quantity and relevant emission/discharge data. International developments in water quality and quantity reporting are recommended to be taken into account.

4. International targets

56. Target countries are recommended to cooperate with other riparian countries in the case of specific transboundary waters and to work towards agreeing upon explicit quantitative targets for water quality. In the framework of bilateral or multilateral agreements on transboundary water protection and use, target countries should also establish joint monitoring networks and agree on conditions of their operation, including water quality and quantity standards.

III. Modernizing and upgrading national water quality and quantity monitoring and information systems

57. Within the framework of the development of national water management systems, the target countries are recommended to prepare and implement their national programmes for modernization and upgrading of their water quality and quantity monitoring systems (including monitoring networks, data quality management and information systems). The main objective of these programmes is to create modern systems that respond to the information and policymaking needs of the target countries and operate on the basis of best available techniques, methodologies and good practices available in the UNECE region.

58. Development of a complete national core water monitoring network as a part of water management systems should be the main specific target of these programmes. National core water monitoring networks could become a part of international networks/systems.

59. Water (quality and quantity) monitoring networks (as well as the whole water monitoring system) should be evaluated on a regular basis.

60. Surface water quality and quantity monitoring network should also be designed for particular river basins and should cover both its ecological and chemical status, namely:

(a) Quantitative issues;

(b) Parameters indicative of all biological and microbiological quality elements;

[30] *Environmental Indicators and Indicator-based Assessment Reports — Eastern Europe, Caucasus and Central Asia* (United Nations publication, Sales No. E 07.II.E.9). The English version is available online at http://www.unece.org/env/documents/2007/ece/ece.belgrade.conf.2007.inf.6.e.pdf and the Russian version at http://www.unece.org/env/documents/2007/ece/ece.belgrade.conf.2007.inf.6.r.pdf.

(c) Parameters indicative of all hydromorphological quality elements;

(d) Parameters indicative of all physico-chemical elements;

(e) Priority and important pollutants discharged into the river basin;

(f) Other pollutants discharged into the river basin in significant amounts.

61. Groundwater quality and quantity monitoring networks should be designed for particular groundwater bodies to cover:

(a) Quantitative issues (groundwater level, drawing-off and recharge);

(b) Parameters indicative of all physico-chemical and biological (and microbiological) elements;

(c) Possible sources of pollution (mostly diffuse).

62. The following issues should be covered by the programmes provided for in paragraphs 57 and 58:

(a) Objectives and targets;

(b) Monitoring points, their location and densities;

(c) Frequency of monitoring;

(d) Parameters measured (for surface water, groundwater and sediments);

(e) Sampling and analytical methods;

(f) Technical capacities, particularly automated measurements;

(g) Reliability of measurements and analyses (quality assurance (QA)/quality control (QC) including control of laboratory performance);

(h) Data management, validation and presentation;

(i) Cost estimates;

(j) Mobilization of funds from various domestic and external sources.

63. A stepwise approach is recommended for the development of networks as set out in the preceding paragraphs, taking into account the financial and technical resources of particular target countries.

A. Monitoring points, their location and densities

64. In the case of surface water, monitoring is recommended to be carried out at points, where:

(a) the volume of water flow is significant within the river basin district as a whole, including points of large rivers where the catchment area is great (depending on the country's area — e.g., in smaller countries, greater than 2,500 km^2);

(b) the volume of water present is significant within the river basin district, including large lakes and reservoirs;

(c) there is a risk of significant pressure from point sources;

(d) there is a risk of significant pressure from diffuse sources;

(e) there is a risk of significant hydromorphological pressure;

as well as at the upstream confluences (of two rivers or a river and a lake or sea) and the upstream drinking water abstraction points. Monitoring points should be located with respect not only to water abstraction points, but also to protected areas, areas used for bathing, areas with important fish populations as well as in the areas with considerable discharges of pollutants.

65. In the case of groundwater, the monitoring points are recommended to be established in order to:

(a) Provide a reliable assessment of quantitative status of all groundwater bodies, including the assessment of available groundwater resources (taking into account abstraction and recharge of groundwater);

(b) Provide a coherent and comprehensive overview of the chemical, biological and microbiological status of each groundwater body;

(c) Detect the presence of long-term anthropogenically induced upward trends in pollutants.

Monitoring points should be located with respect to vulnerability of groundwater bodies (e.g., karst aquifers).

B. Frequency of monitoring

66. In the case of surface waters, the frequency of monitoring should distinguish among types of water bodies (rivers, lakes, transitional bodies or coastal zones) and types of parameters measured (biological, hydromorphological and physico-chemical). Frequency of physic-chemical monitoring should be coordinated with hydrological and vegetation cycles. The values applied by WFD are recommended as a basic guidance, presented in Table 3. Nevertheless, target countries may decide on different frequencies, taking into account their natural, technical and economic possibilities.

Table 3
Frequency of Monitoring

Quality Element	*Rivers*	*Lakes*	*Transitional*	*Coastal*
		Biological		
Phytoplankton	6 months	6 months	6 months	6 months
Other aquatic flora	3 years	3 years	3 years	3 years
Macro invertebrates	3 years	3 years	3 years	3 years
Fish	3 years	3 years	3 years	
		Hydromorphological		
Continuity	6 years			
Hydrology	continuous	1 month		
Morphology	6 years	6 years	6 years	6 years
		Physico-chemical		
Thermal conditions	3 months	3 months	3 months	3 months
Oxygenation	3 months	3 months	3 months	3 months
Salinity	3 months	3 months	3 months	
Nutrient status	3 months	3 months	3 months	3 months

Acidification status	3 months	3 months		
Other pollutants	3 months	3 months	3 months	3 months
Priority substances	1 months	1 months	1 months	1 months

Source: Water Framework Directive (2000/60/EC), Annex V
(see htpp://eur-lex.europa.eu/en/legis/20100101/chap15102020.htm)

67. Additional monitoring of surface water is recommended to be carried out in drinking water abstraction points (4 times to 12 times per year depending on the number of persons served) and in habitat and species protection areas.

68. In the case of groundwater, monitoring should be carried with a frequency sufficient to assess the impact of abstractions and discharges on the groundwater level and to detect the impact of relevant pressures on chemical status, but at a minimum of once per year.

C. Parameters measured

69. In the case of surface water, the following parameters are recommended to be monitored:

(a) Biological and microbiological parameters (bacteria, zooplankton, phytoplankton, other aquatic flora, macroinvertebrates, fish);

(b) Hydromorphological parameters (continuity, hydrology, morphology);

(c) Physico-chemical parameters (thermal conditions, oxygenation, salinity, nutrient status, acidification status, priority pollutants, important pollutants).

70. In the case of groundwater, the following parameters should be monitored:

(a) Groundwater level;

(b) Conductivity

(c) pH;

(d) Concentration of nitrates;

(e) Concentration of ammonium;

(f) Concentrations of other pollutants including microbiological/organic parameters.

D. Technical capacities, particularly automated measurements

71. Step-by-step introduction of advanced monitoring techniques is recommended, starting with the most important water bodies which are being used for drinking water production (taking into account the amount of the population served) and including important aquatic ecosystems.

72. Automatic gauging stations are recommended rather than automatic stations for water quality measurement, as the latter stations can measure only a restricted choice of parameters and the results are not reliable. Therefore, in the case of water quality monitoring manual sampling and chemical analysis are recommended. Regular assessment of the laboratories control is mandatory. Automatic chemical status measurement can be useful in the case of accidental pollution for a quick rough estimate of the pollution level.

E. Reliability of measurements and analyses

73. The target countries are recommended to apply internationally recognized reference sampling and measurement methods (CEN/ISO standards). All methods of analysis, including laboratory, field and online methods used for the purposes of chemical monitoring, are recommended to be validated on a regular basis (including laboratory performance assessment) and documented in accordance with the EN ISO/IEC-17025 standard (General requirements for the competence of testing and calibration laboratories).[31].

F. Data management

74. It is recommended that a national water information system, as a subsystem of the national water management system (see box 1), should be updated or established to implement the following main tasks:

(a) Collection of data on water quality and quantity (e.g., core network, and specialized networks);

(b) Processing of the data (quality control);

(c) Modelling of concentration fields of pollutants and of hydrological conditions;

(d) Assessment and modelling of trends in water quality and quantity;

(e) Assessment of health and environmental effects;

(f) Emergency and warning in case of accidental pollution, possible health threat and in case of extraordinary weather events accompanied by floods or droughts;

(g) Reporting (both national and international);

(h) Providing information to the public.

Relevant international guidelines like those developed under the WMO World Hydrological Cycle Observing System (WHYCOS) should be used for the purpose.[32]

75. The water information system should be closely linked operationally with:

(a) Compliance assessment (exceedances of limit values or other relevant standards);

(b) Collection of data on emissions/discharges (cadastre/inventory);

(c) Preparation of emission/discharge projections.

76. National water information systems are recommended to be established preferably within those authorized institutions that operate the national core water quality and quantity monitoring network (often hydrometeorological services). If other arrangements are made they should promote data exchange based on an inter-agency agreement.

[31] http://www.iso.org/iso/catalogue_detail.htm?csnumber=39883.
[32] Available online at: http://www.whycos.org/IMG/pdf/WHYCOSGuidelines_E.pdf.

G. Cost estimates

77. The recommended stepwise top-down approach to upgrading water quality and quantity monitoring systems (starting with the most vulnerable areas) will allow for the target countries to optimize the needs of water quality assessment and management in accordance with their various economic conditions.

78. Additional costs (analytical laboratories and staff) must be expected for monitoring data management and the operation of the whole water information system (see Box 4).

Box 4
Costs of water- monitoring system

(a) Network administration, including design and revision;

(b) Capital costs of monitoring and sampling equipment, automatic measuring stations and data transmission systems, construction of observation boreholes or surface water sampling sites and gauging stations, transport equipment, data processing hardware and software;

(c) Labour and other operating costs of sampling, field analysis of water quality determinants and field measurements of water levels and discharge characteristics;

(d) Operating costs of online data transmission systems (e.g., water levels, accidental water pollution);

(e) Labour and other operating costs of laboratory analyses;

(f) Labour and associated operating costs of data storage and processing;

(g) Assessment and reporting (including joint work for transboundary waters);

(h) Production of outputs, including geographic information systems (GIS) or presentation software and report printing costs.

Source: *Strategies on Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters* (United Nations, Sales Publication No. E.06.II.E.15).

H. Mobilization of funds from various domestic and external sources

79. The expenditures related to modernizing and upgrading national water quality and quantity monitoring systems (core systems) as well as for national water information systems should be funded from the State budget.

80. Additional sources could be found in public (regional and municipal) budgets to support supplementary monitoring activities (regional or municipal networks).

81. Optionally, private companies could bear a part of the costs related to the modernizing and upgrading of water quality monitoring systems, either voluntarily (promoting their corporate social responsibility) or through legal requirements (mandatory self-monitoring stations according to monitoring legislation).

82. It is also recommended that the target countries actively participate in certain international activities in order to qualify for financial support from external sources (e.g., resources from trust funds under the UNECE Water Convention).

IV. Improving coordination of national water quality monitoring programmes

83. Water quality and quantity monitoring networks and/or individual monitoring stations (groups of stations) may be operated by different institutions, e.g., hydrometeorological services, environmental inspectorates, sanitary/health inspection services, river basin authorities, water agencies, territorial authorities, municipal authorities, enterprises or specialized companies. Owing to different reasons (e.g., location of monitoring stations and monitoring frequencies), the results often differ in the scope of pollutants monitored, in the parameters of measurements, in the timing of measurements and in data treatments, as well as in the quality of the data and information obtained.

84. It is recommended that the authorized institution (preferably the one which operates the national core water quality and quantity monitoring network) have the power to coordinate all water quality and quantity monitoring and data collection activities in the country. This power should be accompanied by certain rights and responsibilities with regard to data management (e.g., data flow, data validation and comparison) and support services, including the operation of reference laboratories, the organization of inter-calibration exercises, training of staff, the publication of manuals and the organization of expert training.

85. Where such an authorized institution does not report to the central competent authority, the coordination power should be given to that central competent authority.