UNDP I GEF
DANUBE
REGIONAL
PROJECT

May 2006

DEVELOPMENT OF OPERATIONAL TOOLS FOR MONITORING, LABORATORY AND INFORMATION MANAGEMENT

Objective 3: Options for developing WFD type-specific quality nutrient standards in the Danube River

Draft final report

WORKING FOR THE DANUBE AND ITS PEOPLE

AUTHORS

PREPARED BY:

Environmental Institute, s.r.o.

AUTHOR:

Paul Buijs

Environmental Institute, s.r.o.,
Okruzna 784/42, 972 41 Kos,
Slovak Republic
ei@ei.sk

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS, ACRONYMS, DEFINITIONS

BLFUW	Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Federal Ministry of Agriculture, Forestry, Environment and Water Management)
DIN	dissolved inorganic nitrogen (NH_4, NO_2, NO_3)
DIP	dissolved inorganic phosphorous
EQS	Environmental Quality Standard
L	left
MZB	macrozoobenthos
N	nitrogen
NH_3	ammonia
NH_4	NH_4^+, ammonium
NL	The Netherlands
NO_2	NO_2^-, nitrite
NO_3	NO_3^-, nitrate
NOEL	No Observed Effect Level
N_{tot}	total nitrogen
P	phosphorous
PO_4	PO_4^{3-}, ortho-phosphate
P_{tot}	total phosphorous
$P_{tot(fil)}$	total phosphorous, after filtration
R	right
rkm	river kilometre
SI	Saprobic Index
TNMN	Transnational Monitoring Network
US-EPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

The EU Water Framework Directive (WFD) expects Member States to define type-specific water quality standards for quality elements like nutrients. An inventory of the current state in a number of Member States as well as in international initiatives like REBECCA showed that no 'ready and easily applicable' methods for doing so are available yet, maybe with exception of a 1st draft method developed in Austria in 2005.

This Austrian proposed 1st draft method essentially uses the following approach. The physico-chemical monitoring data of (different types of) water bodies are combined with their (WFD-compatible) quality status according to the Saprobic Index of the benthic invertebrate fauna. By pooling the actual physico-chemical monitoring data per (type of) water body and quality class ('high', 'good', 'moderate'), the resulting 90th percentile statistical values are proposed to represent the boundaries between high/good either good/moderate status. Therewith serving the purpose of providing WFD-compliant type-specific water quality standards.

The principles of the Austrian proposed 1st draft method have been applied to the mainstream of the Danube River. Several gaps were identified during this exercise, among others: benthic invertebrate fauna are not yet routinely monitored at all Transnational Monitoring Network (TNMN) stations; no WFD-compliant metrics have been agreed yet like type-specific Ecological Quality Ratios based upon benthic invertebrate fauna.

Being two important pillars of the Austrian proposed 1st draft method, a proper basis was lacking for the underlying study for extending on its results in terms of proposing actual quality standards. Statistics for instance could be associated with 'high' as well as 'good' status conditions, which of course makes quite a difference. The table below therefore merely provides an indication for the possible concentrations ranges one might be dealing with (with the TNMN data representing either high/good or good/moderate class boundaries).

90%-values calculated for the Austrian bioregion FH, ground state SI ≤ 2.00; compared with study findings

	Austrian bioregion FH high status 90%-ile	Austrian bioregion FH good status 90%-ile		TNMN 2001 min – max 90%-ile	TNMN 2004 min – max 90%-ile
NO3 [mg N/l]	4	5.5		1.3 – 3.7	1.3 – 3.8
PO4 [mg P/l]	0.1	0.2		0.03- 0.68	0.04 – 0.19
Ptot(fil) [mg P/l]	0.2	0.25	Ptot	0.1 – 0.4	0.1 – 0.3

The underlying study indicated differences for several quality elements along the mainstream of the Danube, with for instance apparently higher nitrate (NO3) concentrations in the upper half reaches (with riverkilometer 1300 -possibly: the Iron Gates- seeming to be a pivotal area). Such observations support the type-specific approach.

In order to be able to elaborate upon methods for defining type-specific quality standards, at least some basic requirements will have to be met, including:

- routine monitoring of biological quality elements at all TNMN monitoring, comprising at least: benthic invertebrate fauna and phytoplankton (minimally: chlorophyll-a)
- development of Danube Section Type metrics for biological quality elements, at least comprising indices for benthic invertebrate fauna.

Since few basin-wide data are available so far, the coming 2007 Joint Danube Survey preferably should be designed in such a way, that also data relevant for further establishing of type-specific quality standards will be obtained.

1. INTRODUCTION

Among the reports prepared under Phase 1 of the UNDP/GEF Regional Project, the report "Orientation on environmental quality standards for nutrients and other Danube specific priority substances" has been published [Buijs, 2003]. This report included a first exercise in formulating Environmental Quality Standards (EQS) for nutrients in line with the WFD. While the report adhered to the WFD denominators for "high" and "good" status, it did not apply a type-specific approach. For instance: the proposed EQS for nutrients were derived from a rather generic pool of water quality standards that also mixed standards for lakes and rivers. Not having applied the type-specific approach was considered the major comment on the study.

The underlying report pursues the issue of developing type-specific nutrient standards for the Danube. This study is part of the "Danube Regional Project - Component 2.2: Development of operational tools for monitoring, laboratory and information management": Task 4: Development of Water Quality Standards.

1.1. Departure points

In February 2006, an Interim Report has been prepared and its major findings presented during the 1st Monitoring and Assessment Expert Group (MA EG) in Prague, 2-3 March 2006. The MA EG encouraged the UNDP/GEF consultants to further elaborate on the EQS using the Austrian approach. Accordingly, the activities after issuing the Interim Report focussed on elaborating this approach. For the sake of completeness, the major findings of the Interim Report have been incorporated in the underlying report, thus making this report a stand-alone version.

1.2. Report outline

The remainder of this report is structured in the following way.

> Chapter 2 describes the conceptual framework for this study, elaborating two major components: a) an overview of relevant Water Framework Directive text relating to type-specific water quality standards and b) the more specific issues when dealing with nutrients.

> Chapter 3 includes the results as reported in the Interim Report of February 2006 with a brief synthesis.

> Chapter 4 describes the major features of the 1st proposal of the Austrian method: "Leitfaden zur typspezifischen Bewertung der allgemeinen chemisch/physikalischen Parameter in Fließgewässer. 1. Vorschlag September 2005".

> Chapter 5 contains the results of applying the 1st proposal of the Austrian method to the mainstream of the Danube. This chapter also will reflect the findings in the perspective of pollution of the Black Sea by the discharge of the Danube.

> Chapter 6 discusses and evaluates the major findings of this study.

> Chapter 7 is used for summarising the major conclusions and recommendations.

2. CONCEPTUAL FRAMEWORK

2.1. Positioning nutrients in the WFD

2.1.1. Some relevant WFD quotations

WFD Article 2.18 contains the following definition: 'Good surface water status' means the status achieved by a surface water body when both its ecological status and its chemical status are at least 'good'.

Following Article 2.21: 'Ecological status' is an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters, classified in accordance with Annex V[1].

WFD Annex V.1.4.2.(i) mentions that "For surface water categories, the ecological status classification for the body of water shall be represented by the lower of the values for the biological and physico-chemical monitoring results for the relevant quality elements classified in accordance with the first column of the table set out below." This table lists the five possible statuses (high, good, moderate, poor, bad and their corresponding colour codes).

The definition of chemical status is defined in Article 2.24: 'Good surface water chemical status' means the chemical status required to meet the environmental objectives for surface waters established in Article 4(1)(a), that is the chemical status achieved by a body of surface water in which concentrations of pollutants do not exceed the environmental quality standards established in Annex IX and under Article 16(7), and under other relevant Community legislation setting environmental quality standards at Community level.

Annex V.1.4.3 further mentions "Where a body of water achieves compliance with all the environmental quality standards established in Annex IX, Article 16 and under other relevant Community legislation setting environmental quality standards it shall be recorded as achieving good chemical status. If not, the body shall be recorded as failing to achieve good chemical status."

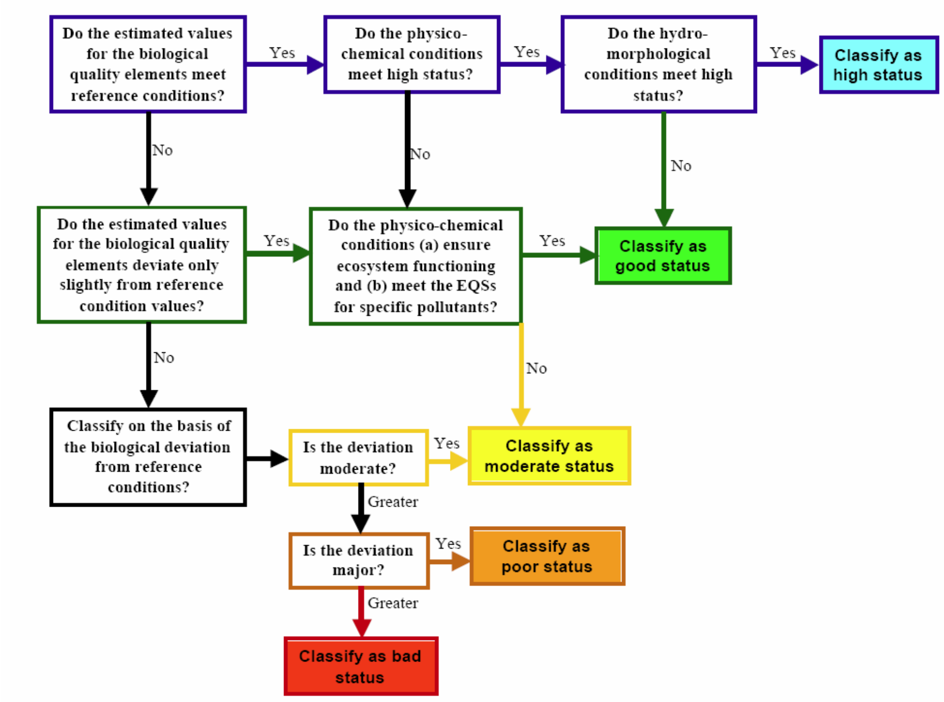
Nutrients are explicitly referred to in WFD Annex VIII.12: "Substances which contribute to eutrophication (in particular, nitrates and phosphates)".

2.1.2. Nutrients and Ecological status

A popular figure often presented when dealing with the WFD's status classification is included in the REFCOND Guidance Document [REFCOND, 2003] and shown below.

[1] When mentioning 'ecological status' in the underlying report also 'ecological potential' (in relation with Artificial Water Bodies and Heavily Modified Water Bodies) is refered to, unless mentioned otherwise.

Figure 1 **Indication of the relative roles of biological, hydromorphological and physico-chemical quality elements in ecological status classification (*REFCOND Guidance document, figure 3*)**



WFD Annex V.1 distinguishes the group of 'Chemical and physico-chemical elements supporting the biological elements', consisting of:

- General
  - Thermal conditions
  - Oxygenation conditions
  - Salinity
  - Acidification status
  - Nutrient conditions
- Specific pollutants
  - Pollution by all priority substances identified as being discharged into the body of water
  - Pollution by other substances identified as being discharged in significant quantities into the body of water

While the priority substances can be linked to the chemical status, the WFD is less explicit about where to consider the other substances of the specific pollutants (compare the boxout below). The general conditions, including nutrients, straight forwarded can be considered as belonging to the physical-chemical conditions within the ecological status.

Intermezzo: Physico-chemical quality elements, general conditions, specific synthetic pollutants, specific non-synthetic pollutants

The grouping of the physico-chemical quality elements in WFD Annex V (comprising general conditions, specific synthetic pollutants, and specific non-synthetic pollutants) easily can lead to confusion. The RECOND Guidance Document mentions the following in its section 2.6 Classification of ecological status [REFCOND, 2003]. (Author's note: figure 3 of the REFCOND Guidance document is Figure 1 of the underlying report.)

"*There is a clear distinction between the role of general physico-chemical quality elements and specific pollutants in classification of ecological status. In good ecological status, general physico-chemical quality elements should not reach levels outside the range established to ensure ecosystem functioning and the achievement of the values specified for the biological quality elements ((a) in the middle box in Figure 3) and specific pollutants should meet the Environmental Quality Standards (EQS) set in accordance with section 1.2.6 in the Directive ((b) in the middle box in Figure 3).*

Once European EQS have been established, priority substances are not included in the ecological status, but are relevant for assessment of chemical status (Article 2, Annex X and Article 16(7) dealing with priority substances). For the purpose of assessing ecological status the quality elements for specific pollutants listed in Annex V, 1.1 and 1.2 ("specific synthetic pollutants" and "specific non-synthetic pollutants") must be considered and their national quality standards must be met. Shifting of priority substances for which EU-wide quality standards have been set from ecological to chemical state assessment does not compromise the good status of a water body because for good status, both ecological and chemical status must be good."

2.1.3. WFD normative definitions for nutrients

Nutrients are addressed in the definitions of ecological status (WFD Annex V, table 1.2, physico-chemical quality status) as follows:

> **High status**: nutrient concentrations remain within range normally associated with undisturbed conditions.

> **Good status**: nutrient concentrations do not exceed the levels established as to ensure the functioning of the ecosystem and the achievement of the values specified above (*author: this is a reference to table 1.1 in WFD Annex V*) for the biological quality elements.

> **Moderate status**: Conditions consistent with the achievement of the values specified above for the biological quality elements.

2.1.4. How many classes?

The way WFD Annex V.1.4.2.(i) is formulated implies that not only for the biological quality elements, but also for the physico-chemical quality elements five status classes are to be distinguished. On the other hand, Figure 1 suggests an explicit role of the physico-chemical quality elements in the assessment for 'high' and 'good' status only.

Working Group 2 A Ecological Status (ECOSTAT) mentions the following [ECOSTAT 2003, Chapter 2, 2.6) "*The values of the physico-chemical quality elements must be taken into account when assigning water bodies to the high and good ecological status classes and to the maximum and good ecological potential classes (i.e. when downgrading from high status/maximum ecological potential to good ecological status/potential as well as from good to moderate ecological status/potential). This is discussed in detail in Section 4. For the other status/potential classes the physico-chemical elements are required to have conditions consistent with the achievement of the values specified [in Tables 1.2.1 - 1.2.5] for the biological quality elements. Therefore, the assignment of water bodies to moderate, poor or bad ecological status/ecological potential may be made on the basis of the monitoring results for the biological quality elements. This is because if the biological quality element values relevant to moderate, poor or bad status/potential are achieved, then by definition the condition of the physico-chemical quality elements must be* *consistent with that achievement and would not affect the classification of ecological status/potential.*"

Chapter 4 in [ECOSTAT, 2003] furthermore mentions "*If the monitoring results for both the biological quality elements and the general and specific physico-chemical quality elements in a water body meet the conditions required for good ecological status/potential, the overall ecological status/potential of the water body will be good. However, if one or more of the general physico-chemical quality elements or specific pollutants do not meet the conditions required for good ecological status/potential but the biological quality elements do, the overall ecological status/potential will be moderate.*"

From the above it may be assumed that when dealing with nutrients (as part of the general conditions) it suffices to establish criteria which allow for distinguishing 'high', 'good' and 'moderate' status. The latter follows when the 'good' conditions criteria are not met. So, of major interest will the values for the boundary between high and good status and the boundary between good and moderate status.

2.1.5. Type-specific criteria

The concept of type-specific conditions is introduced in WFD Annex II.1.3: Establishment of type-specific reference conditions for surface water body types: "*(i) For each surface water body type characterised in accordance with section 1.1, type-specific hydromorphological and physicochemical conditions shall be established representing the values of the hydromorphological and physicochemical quality elements specified in point 1.1 in Annex V for that surface water body type at high ecological status as defined in the relevant table in point 1.2 in Annex V. Type-specific biological reference conditions shall be established, representing the values of the biological quality elements specified in point 1.1 in Annex V for that surface water body type at high ecological status as defined in the relevant table in section 1.2 in Annex V*".

The conditions are to represent the values of a.o. physicochemical quality elements at high ecological status for each surface water body type characterised in accordance with WFD Annex II.1.1. The WFD does not explicitly mention establishing type-specific criteria for e.g. good or moderate status. However, reasons to have to do so basically follow from the context of the (type-specific) reference conditions. The "Overall Approach to the Classification of Ecological Status and Ecological Potential" ECOSTAT, 2003] describes the necessity for type-specific 'good status' levels of physico-chemical quality elements as follows: "*(4.2) The ranges and levels established for the general physico-chemical quality elements must support the achievement of the values required for the biological quality elements at good status or good potential, as relevant. Since the values for the biological quality elements at good status will be type-specific, it is reasonable to assume that the ranges and levels established for the general physico-chemical quality elements should also be type-specific. Several types may share the same ranges or levels for some or all of the general physico-chemical quality elements*".

Intermezzo: a more flexible definition for nutrients?

There seems to be an intriguing difference in the way WFD Annex 1.2.1 has formulated the normative definitions for good status of the general conditions (***bold typeface*** added by the author):

Temperature, oxygen balance, pH, acid neutralising capacity and salinity do not reach levels outside the range established so as to ensure the functioning of ***the type specific ecosystem*** *and the achievement of the values specified above for the biological quality elements.*

Nutrient concentrations do not exceed the levels established so as to ensure the functioning of ***the ecosystem*** *and the achievement of the values specified above for the biological quality elements.*

For some reason, the normative definition for nutrients does not explicitly contain the words *type specific*. This notice does not seem to imply that type specific characteristics are not to be taken into account at all when setting quality standards for nutrients. Nevertheless, it may be interpreted as implying a bit more slack for the nutrients than for the other general conditions quality elements.

2.1.6. One out, all out

The WFD expects all quality elements to comply with the criteria for good status in order for a water body indeed to be qualified as such. Implying, that if just one of the quality elements is of less than good status, the water body as such has to be qualified of no good status (hence moderate or worse).

The quotations in section 2.1.3 once more illustrate this important principle: "…*if one or more of the general physico-chemical quality elements or specific pollutants do not meet the conditions required for good ecological status/potential but the biological quality elements do, the overall ecological status/potential will be moderate*" [ECOSTAT, 2003].

The implications are obvious: setting too stringent nutrient standards might result in wrongly qualifying waters as being of not good status. On the other hand: setting the standards too loose might result in unfavourable conditions such that biological quality elements would not comply with good status.

Intermezzo: adjusting quality standards

Guidance Document 13 on the Overall Approach to the Classification of Ecological Status and Ecological Potential [ECOSTAT, 2003] addresses this topic in the following way: "*4.4 The following sections outline a checking procedure designed to ensure that the type-specific values established for the general physico-chemical quality elements are no more or no less stringent than required by the WFD, and hence do not cause water bodies to be wrongly downgraded to moderate ecological status or potential. The checking procedures apply only in relation to values for the good-moderate status/potential boundaries. They apply where Member States are confident that there is a real mismatch between the monitoring results for the biological and general physico-chemical quality elements, and not just a mismatch resulting from uncertainties from monitoring. For example, this will usually require evidence that there is a consistent mismatch from a significant number of water bodies in the type. In checking whether the physico-chemical ranges are valid, there is a balance between the scale of the discrepancy that can be demonstrated and the number of sites where the physico-chemical data and the biological data are not compatible. For example, where there are only a few sites monitored, it will be possible only to confirm large discrepancies. Even where the checking procedure applies, it may not be appropriate to revise the level or ranges using the checking procedures if the established levels or ranges are being exceeded because of temporary alterations to the values for the general physico-chemical conditions due to unusual natural conditions, such as prolonged droughts or flooding.*"

2.2. …ensure the functioning of the ecosystem…

While developing type-specific criteria for nutrients it has to be recognised that the WFD considers nutrients as quality elements supporting the biological quality elements. As described in WFD Annex V.1.2 under good status "*Nutrient concentrations do not exceed the levels established so as* *to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements*".

Levels of general conditions associated with e.g. good status are not an objective by themselves, but expected to allow for a good status of the biological quality elements. Within the context of this report, this can be converted into two (admittedly: a bit simplified) questions, looking at the same problem from two different angles:

a) It is possible to predict the (high, good, moderate, poor, bad) status of the biological quality elements from defined nutrient concentrations?
b) Is it possible to derive/predict quality standards for (high, good, moderate status for) nutrients when the conditions of (high, good, moderate status for) the biological quality elements are known?

Unfortunately, the answer to both questions is "no"; or at least "not really".

A good illustration to illustrate this situation is the notice included in one of the reports published under the REBECCA project: "*Although the impact of nutrient pressures on biological quality is relatively well understood for lakes in qualitative terms, there has been very limited development of quantitative dose response relationships, classification tools or models*" [Heiskanen et. al., 2005]. Even if for a certain lake (-type) validated quantitative relations have been established, they cannot simply be transferred to any other lake, indeed because of the type-specific (and sometimes also: site-specific) differences.

2.2.1. Eutrophication

Besides the ecotoxicological potential of ammonium (NH_3), ammonium (NH_4) and/or nitrite (NO_2), there seems to be consensus to regard nutrients under the WFD dominantly in the perspective of eutrophication [DG Environment, 2005]. For all WFD biological quality elements eutrophication phenomena can be distinguished, but often different (combinations of) conditions and mechanisms will lead to the expression of eutrophication characteristics for each of them (compare also the boxout below).

Intermezzo: eutrophication and the individual biological quality elements [in : DG Environment, 2005]

63. As a general rule, aquatic flora quality elements will have an earlier response to nutrient conditions than benthic invertebrates or fish fauna. The relative 'sensitivity' of different aquatic flora to nutrient enrichment may vary, depending on local circumstances, e.g. water category, surface water body type and the nature of the pressure and transport of nutrient loading.

64. For instance: phytoplankton, phytobenthos and macroalgae derive their nutrients from the water column and, under the right conditions, can colonise, grow and reproduce quickly. As a consequence, they tend to respond rapidly to changes in nutrient concentrations. However, these quality elements can also be characteristically highly variable. This may make reliable assessments of their condition difficult.

65. Rooted macrophytes and angiosperms derive their nutrients from sediments or from a combination of sediments and the water column. Their response to nutrient enrichment tends to be slower than that of phytoplankton, phytobenthos and macroalgae, and therefore may enable reliable assessments to be achieved more easily. On the other hand, this relative 'stability' means that assessments based solely on macrophytes and angiosperms may in some situations fail to detect the early onset of eutrophication.

For instance. A commonly used indicator for eutrophication is phytoplankton (or its proxy: chlorophyll-a). It already is a challenge by itself to establish nutrient concentrations levels (thresholds) for the different types of water bodies with respect to phytoplankton. Having defined such nutrient criteria for phytoplankton not automatically means that the conditions for the other biological quality elements are also warranted. Chapter 3 contains more examples of complications when dealing with the setting of (type-specific) water quality standards for nutrients.

3. INVENTORY OF METHODS AND APPROACHES

This chapter summarises the status as also has been reported in the Interim Report of February 2006.

3.1. Austria

Basically, only one method could be identified that deals with setting of type-specific criteria in line with WFD-requirements and in such a way that the methodology could be 'relatively easily' replicated by others. In 2005, the Bundesministerium für Land- und Fortwirtschaft, Umwelt und Wasserwirtschaft published a first proposal for guidelines for type-specific assessment of general physico-chemical parameters in running waters [Deutsch & Kreuzinger, 2005]. This method will be discussed into more detail in the next chapter.

3.2. The Netherlands

In the Netherlands, preliminary steps to setting differentiated nutrient criteria have been undertaken several years ago. The related documents concerning differentiated nutrient criteria definitely contain useful ideas and considerations for the purposes of setting WFD-compliant type-specific criteria.

For example: at low discharge and stagnant sections, high algal biomass can occur in the River Rhine. At present, these algal concentrations though are not experienced as a problem. Nevertheless, target values for the River Rhine have been calculated in order to protect vulnerable waters in downstream lakes of its delta, including coastal waters [Liere *et.al.* , 2002; several texts sections have been translated into English; CIW, 2002]. Similar considerations can be expected to be applicable for the Danube River, like in relation to the Black Sea. The type-specific context of the WFD as such would not indicate formulating standards from this point of view.

However, contrary to what has been assumed when writing the Technical Proposal, no actual method has yet been developed that already specifically deals with setting water quality standards for nutrients in line with the type-specific requirements of the WFD. A working group for this task became just operational during the last quarter of the year 2005. Outputs (made publicly available) are not expected within the first half year of 2006.

3.3. REBECCA

The objective of the EU-funded research programme named REBECCA ("Relationships between ecological and chemical status of surface waters") is to provide underpinning for one of the key scientific principles on which the Water Framework Directive (WFD) is based, i.e. that relationships between the biological state and physical and chemical properties of surface waters are sufficiently well understood to enable the management of catchments and surface waters to achieve ecological objectives. The outputs of this project are expected to present tools and/or methods supporting the formulation of type-specific nutrient criteria. The current status is summarised in the following subsections.

3.3.1. Lakes

In 2005, the report "Reference Conditions of European Lakes" has been published [Solheim, 2005]. The objective of this report is to present the state-of-the-art practice on methods used to assess reference conditions in lakes, and to give a region- and type-specific overview of typical flora and fauna for all the biological elements required in the Annex V of the Directive, as well as providing reference values for the most relevant physico-chemical elements.

Although the report still is a draft, there seems to be no ground to expect some 'ultimate solutions' from the final report. This can be illustrated by the examples in the boxout below.

Intermezzo: Regression models for reference total phosphorus and chlorophyll(*text quotes from* [Solheim, 2005])

(*section 2.4.1*)
The Morpho-Edaphic Index (MEI) model … predicts reference total phosphorus concentrations (TP) resulting from natural background loading in undisturbed watersheds, from the ratio of alkalinity or conductivity in lake water to the lake mean depth. The model was originally based on data from of 53 cool-temperate lakes of North America and Europe. However, the model has not been calibrated and tested for a wider variety of lakes. In REBECCA the model has been recalibrated and tested with large regional reference lake data sets.

(*section 4.1.4*) Conclusions

• The MEI Model results strongly depend on data used. They would suffer very much upon an inaccurate identification of reference lakes are true reference (sensu WFD) lakes.

• The data set is very much skewed towards Northern lakes. The results are probably robust only for lakes in this geographic area and not for the other regions.

• The results that different GIG regions have different MEI_{alk} models should be taken with care because of the very low number of lakes from region other than Nordic.

• A validation run on a more robust dataset, especially including Central Baltic, Atlantic and possibly Alpine lakes is needed before generalizing those conclusions.

Reference conditions for selected physicochemical elements

(*section 4.1*) Phosphorus
The analysis of the dataset (see point 2.1.5) has led to preliminary reference conditions for different GIG lake types (table 4.2). The analysis revealed that reference conditions in most countries were relatively comparable for a particular GIG lake. Some of the Central-Baltic types had substantially higher reference conditions than other GIGs (Fig. 5), highlighting probably also differences in their criteria for selecting reference sites.

(*section 4.2*) Chlorophyll
The population approach cannot be used for all European lakes. In particular, there appear to be very few deep and very shallow high alkalinity reference lakes in Europe. Of those lakes that Member States have designated as reference, most are shallow or deep low alkalinity lakes. Most Northern GIG lake types and L-CB1 Central-Baltic GIG type do, however, have sufficient data to have reasonable confidence in the results.

The analysis shows in particular that chlorophyll reference conditions appear to increase with decreasing depth, decreasing altitude and increasing alkalinity. This is readily explained in terms of increasing light availability throughout the growth season in shallower lakes, warmer waters (and less UV) in low altitude lakes and naturally higher nutrient concentrations in more alkaline lakes …

For the Northern GIG, there are sufficient data to compare reference conditions within a GIG type by country (Fig. 5). This highlights that there are country-specific differences, for example median values (reference conditions) for Finland were consistently higher than those of Norway for the same GIG type. The most likely reason for this is more stringent criteria for selection of reference lakes in Norway, rather than Finland having naturally more fertile waters within a lake type. Data from Sweden and the UK were more limited and showed no consistent pattern of being lower or higher compared with Norway and Finland, but had median and 75th percentile values broadly in agreement with each other and the other GIG countries. Ireland showed lower median values than even Norway but only had data from 3 lakes.

The quotes once more show the general problem when dealing with the definition of type-specific criteria: being that conditions indeed seem to be type-specific. Even when for a certain region and or type of lakes relationships could be developed and validated, they not simply can be transferred to other parts of Europe or other lake types. Furthermore, from the quoted examples one can infer that to develop, use and/or calibrate a model, either to derive general principles otherwise, on needs field data, either through dedicated investigations or from the routine monitoring programmes.

The report quoted above is limited to reference conditions. No outputs have yet been obtained dealing with setting class boundaries for high/good and good/moderate status. A report entitled "Current knowledge on indicators and methods for Water Framework Directive Ecological Status Assessment." has been finished by the end of the year 2005 and should be published publicly during the first half of the year 2006. When made available in time, the relevant information from this report will be incorporated in the underlying study.

3.3.2. Rivers

The boxout below contains several quotes from the "Report on existing methods and relationships linking pressures, chemistry and biology in rivers" (Andersen et. al., 2004). To a certain extent, the overall pictures share several resemblances as summarised for lakes in the previous paragraph. Notices like "*It is usually assumed that phosphorus is the limiting nutrient for autotroph growth. Now, this idea has to be reconsidered due to the number of cases where nitrogen has been found limiting.*" seem to aggravate the situation.

Intermezzo: Excerpts from "Report on existing methods and relationships linking pressures, chemistry and biology in rivers" [Andersen et. al., 2004]

4. Nutrients causing eutrophication

4.6 General conclusions

Qualitative effects of inorganic nutrient enrichment on autotrophs are well understood. … Knowledge of quantitative effects of nutrient enrichment is more variable. … Quantitative relations between inorganic concentrations and autotrophs have usually been carried out for biomass, a few times on indices. … When assessing species assemblages, nutrients may be included but their relative effect is masked by the other habitat variables also included in the analysis. … And few papers actually consider the nutrients from sediments whereas macrophytes can uptake a significant amount of nutrients from their roots and phytobenthos can be directly in contact with them.

In term of assemblages, most of the scientific efforts have focussed on diatoms and macrophytes; little work has been done on phytoplankton assemblages. From these studies, indices, and classifications based on these indices, have been developed for diatoms and macrophytes. They all have in common the fact that they integrate the relative abundance of each species and their respective tolerance to nutrients.

Phytoplankton is considered to be a good indicator of eutrophication in slow-flowing deep lowland rivers whereas phytobenthos would be a good one for all other types of rivers. The position of macrophytes is not so clear. Indeed, link between macrophytes and inorganic nutrients is not as strong as for phytoplankton and phytobenthos and macrophytes' biomass and composition would be mainly driven by the hydromorphology characteristics of each site along the river. Macroinvertebrates and fish can be influenced by nutrient enrichments. However, they are rarely directly influenced by nutrient concentrations but more through repercussion of changes in the food web and the habitat.

Modelling of biomass of phytoplankton is the most developed modelling. Some models of diatoms' and macrophytes' biomass have also been developed. However, there are very few models for the species composition, especially for phytobenthos other than diatoms and phytoplankton. And the models developed may apply only to restricted areas. Their validity when upscaling should be tested.

It is usually assumed that phosphorus is the limiting nutrient for autotroph growth. Now, this idea has to be reconsidered due to the number of cases where nitrogen has been found limiting. The effects of the different forms of nitrogen and phosphorus and the relative effects of sediments and water column on macrophytes and phytobenthos have received little attention.

When determining species preferences or when analysing the effects of water quality on biota, effects of inorganic nutrients and organic pollution are usually confounded. Distinguishing between these two pressures would be fundamental in determining what to do to achieve a good status.

Few studies have focussed on the recovery of the river after reduction in either phosphorus or nitrogen (or both) sources. This aspect should be considered fundamental in determining the measures Members of State need to implement to achieve a good status.

The report quoted in this subsection was published in the year 2004. The General conclusions mention, *"The next task of the REBECCA WP4 work on rivers is to analyse and describe these relationships based on information found in literature and especially from available monitoring results from rivers covering both biological and chemical/physical quality elements. With the very large number of possible biological quality metrics, the large number of different river types in EU and the different types of pressures this is still a very ambitious task."* Implying, that some relevant outputs can be expected from the REBECCA WP4 group. The REBECCA report on "Current knowledge on indicators and methods for Water Framework Directive Ecological Status Assessment" (expected to be published publicly during the first half of the year 2006) furthermore might contain useful additions[2].

3.4. CIS Eutrophication Guidance

Version 11 of the draft Eutrophication Guidance (DG Environment, 2005) definitely contains much useful information, from both a conceptual point of view, as well as addressing relevant points of consideration. Unfortunately, the final version of this document also is not expected to contain the 'ultimate' recipes and methods for defining type-specific nutrient criteria, like for instance, in the Danube Basin.

Nevertheless, the current version 11 of the draft document for instance contains a table, entitled: "Table 4a: Progress in the development of new WFD-compliant assessment systems for eutrophication in LAKES. Preliminary criteria and values (September 2005)". While being far from complete, already sometimes figures are included under the columns 'good' or 'moderate'. Often, reference is made to -data collected under- the REBECCA project either the GIG (Geographical Intercalibrate Groups) under the activities of the ECOSTAT WG2.A.

3.5. US-EPA

Previous text sections several times illustrated that obviously one of the big problems when dealing with the issue of defining WFD compliant type-specific criteria for nutrients indeed turns out to be the 'specific characteristics of water types'. For instance, mechanisms proven for Scandinavian lakes not just can be transferred to Danubian lakes or -reservoirs.

From this point of view, it therefore does not seem to make much sense to make an outing to the United States. However: the US-EPA has published a series of reports under the header "Ecoregional Nutrient Criteria", which at least from a title point of view implies some resemblances with the underlying settings. A first scan of the related documents[3] though seems to indicate that they contain useful material, if only from conceptual points of view.

For instance (and very in brief), one of the objectives was to define Ecoregional Nutrient Criteria, which to some extent could be compared to having to define high status/reference conditions under the WFD. In the overall approach, monitoring data formed an important basis, while acknowledging the fact that not always (monitoring data of) undisturbed lakes might be available in the ecoregion concerned. The approach can be illustrated with the following quotes (US-EPA 2000, Chapter 1): "*Candidate reference lakes can be determined from compiled data and with the help of Regional experts familiar with the lake resources of the area. There are two recommended ways to go about this. One is to select those lakes believed to be minimally impacted by human activity (e.g., with little or no riparian or watershed development). These lakes should be reviewed*

2 While preparing this report in May 2006, the documents were not yet available through the Rebecca website

3 Downloadable through the website: http://www.epa.gov/ost/standards/nutrient.html

and visited to confirm their "natural" status. When satisfied with this list, a median value (adjusted for seasonal and spatial variation) for TP, TN, chlorophyll a, Secchi depth, and other appropriate enrichment indicators can be prepared for each lake based on existing and/or new data collections. The upper 25th percentile of the frequency distribution of these reference lakes can then be selected as the reference condition for each value (because these lakes represent the best obtainable and most "natural" condition, some allowance for variation should be made) (Figure 1.4(a)).

Another option is to plot the frequency distribution of all of the lake data presently available by each variable and selecting percentiles for TP, TN, chlorophyll a, Secchi depth, and other similarly appropriate variables. The lower 25th percentile, reflecting high nutrient quality can be selected as the reference condition for each value (because in this instance the pool of information likely includes lakes of considerably less than "natural" trophic condition) (see Figure 1.4(b))."

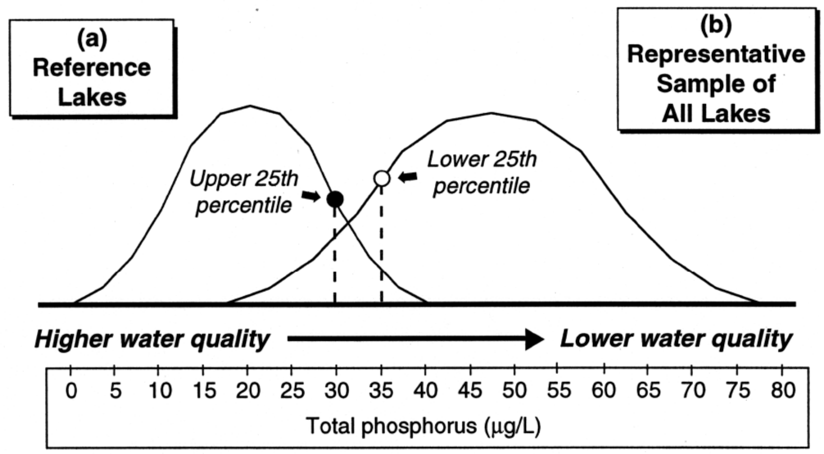


Figure 1.4. Two approaches for establishing a reference condition value using total phosphorus as the example variable.

The US-EPA documents seem to contain useful ingredients if only from a conceptual point of view. The approach has been reported in this Interim Report merely at its face value. Nevertheless, what indeed might be considered as appealing in the approach indicated above is, for instance, the option to define 'reference conditions', even when such kinds of waters actually are not available. Of course, one might have to discuss refining criteria (like using "upper 90th / lower 10th percentiles"), either argues the basic principle as such. But, considering the complexity as once more expressed in for instance the REBECCA reporting series, a pragmatic way out finally might be the only way to make progress, if only to lay a foundation …

4. SUMMARY OF THE 1ST PROPOSED AUSTRIAN GUIDELINES FOR TYPE-SPECIFIC ASSESSMENT OF GENERAL PHYSICO-CHEMICAL PARAMETERS IN RUNNING WATERS

The 1st proposal for the Austrian method for the type-specific assessment of physico-chemical quality elements in running waters has been introduced in the previous chapter. This chapter will go more into detail in the proposed guidelines and methodology. Unless otherwise mentioned, the major data and information have been derived from [Deutsch & Kreuzinger, 2005; Kreuzinger, 2005][4].

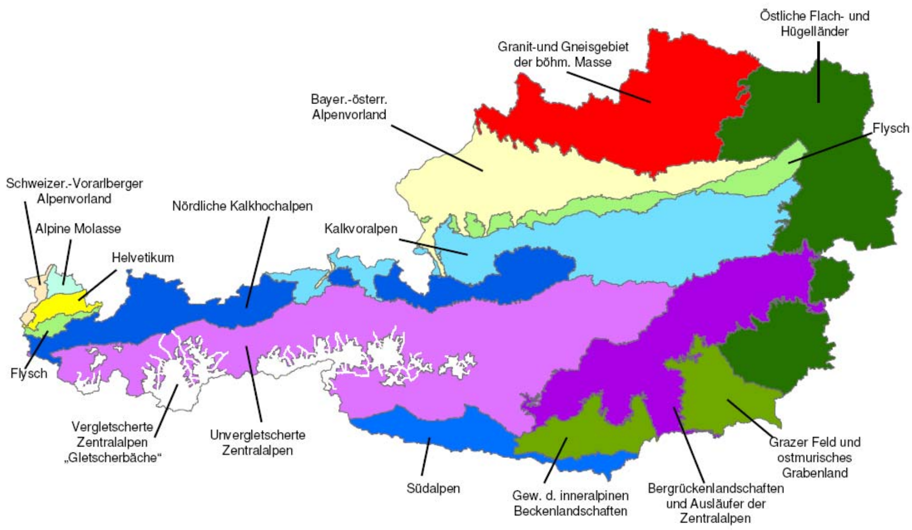
It has not been feasible to contain all details in this report, since that would have implied more or less an integrated translation of the reports [Deutsch & Kreuzinger, 2005; Kreuzinger, 2005] as well as the relevant information contained in their supporting reports. Readers who are able to read German texts are strongly advised to read the original reports in order to get the full picture.

4.1. Bioregions/ water bodies

One of the reasons to elaborate the so-called bioregions for Austria was that the areas assigned in the WFD as ecoregions were considered too large and broad [Moog, O *et. al*., 2001]. Furthermore, the concept of the bioregions has been introduced in order to be able to extend on the abiotic descriptors and physical/chemical factors underlying the typology according to the Systems A or B of the WFD (WFD, Annex II).

For Austria, 17 running water type-regions and 9 special types (called "large rivers") have been established. Building upon this division, 15 bioregions for running waters could be discriminated by their aquatic biocoenosis; the "large rivers" were summarised into four units: Donau (Danube), March/Thaya, Rhein (Rhine) and Alpenflüsse (alpine rivers).

Figure 2 Overview of the 15 bioregions in Austria



4 The text of this chapter has been screened by the authors, with their remarks being incorporated

Primarily based on macrozoobenthos data, for each of the bioregions the saprobic ground state was determined. The saprobic ground state can have four values (Saprobic Index): 1.25, 1.5, 1.75 or 2. This saprobic ground state can differ within one bioregion, when further taking into account the catchment area (size of the surface area) and the altitude. The possible subdivisions of the bioregions result into a total 45 water types for the whole of Austria[5].

It turned out, that the division of the running waters in Austria following physico-chemical characteristics matched quite well with the bioregions. Because of the more direct links with the (hydro-)biology, the bioregions with the associated saprobic ground states prevail as the smallest working units (hence are preferred over a subdivision of nature areas based upon water-chemistry) also for assessing quality standards for physico-chemical parameters.

4.2. Classification of high, good and moderate status based upon Saprobic Index

Based upon other research works, for each of the four saprobic ground states criteria have been formulated which can be used as delimiters for good- and moderate status (the saprobic ground state itself can be considered equivalent to high status). The Saprobic Indices associated with the class boundaries between high/good and good/moderate are included in the table below.

Table 1 Saprobic ground states ('high status') and corresponding definitions of good- and moderate status (in: Deutsch & Kreuzinger, 2005)

SI (saprobity index)			
High status (*saprobic ground state*)	Good status	*delta*	Moderate Status
≤ 1.25	≤ 2	+ *0.75*	> 2
≤ 1.5	≤ 2.1	+ *0.6*	> 2.1
≤ 1.75	≤ 2.25	+ *0.5*	> 2.25
≤ 2	≤ 2.4	+ *0.4*	> 2.4

4.3. Derivation of type-specific quality standards for the physico-chemical parameters

The data obtained from the monitoring in the year 2003 formed the basis for the further calculations. For the whole of Austria, this comprised about 350 measuring points, with monthly measurements for general physico-chemical parameters. In addition, saprobiological investigations were conducted at these monitoring locations.

During the data processing, a wide number of parameters were taking into consideration, for instance using ion-balances for plausibility checks, as well as for chemical verification of the typology of the bioregions. For nutrient conditions, the following parameters were used:

- nitrate (NO_3_N)
- ortho-phosphate (PO_4_P)
- total phosphorous (after filtration)

[5] The "Summary report of the characterisation, impacts and economics analyses required by Article 5" mentions that for natural water bodies in Austria, 50 types of rivers and 11 types of lakes were identified (BLFUW, 2006).

Other nutrients which have as well a toxical relevance (e.g. Ammonium and Nitrite) are regulated within the Austrian Regulation of Quality Standards[6], which stresses the precautionary principle and hence is not regulated type specific. Although these parameters were as well included in the considerations.

Based upon their position and by overlaying the type maps, the related type, i.e. the combination of bioregion and saprobic ground state, was assigned to each measurement point. The monitoring locations along the "large rivers" and "other special waters" were not taken into consideration. The exclusion of the monitoring sites along the "large rivers" is motivated by the fact that the larger rivers actually represent a mix of different bioregions.

After removing these locations, 246 measurement points remained. Based upon the measured SI for 2002/2003, the locations were assigned a status in accordance with the values mentioned in Table 1. 65 locations were of high status, 141 locations of good status, and the remaining 40 locations of moderate status.

4.4. The 'class boundary - 0.125' criterion

Since the aim was to formulate quality standards for the class boundaries (high/good, good/moderate), the remaining 246 locations were furthermore reduced. Only those locations were selected, where the measured SI deviated not more than -0.125 units (implying a better status) from the respective class boundaries:

$$\text{class boundary} - 0.125 \; < \; \text{SI measurement point} \; \leq \; \text{class boundary}$$

The data from the monitoring sites meeting this 'class boundary – 0.125' sites were pooled and general statistics were calculated like total number, minimum, maximum, mean, median, 90%-percentile and standard deviation.

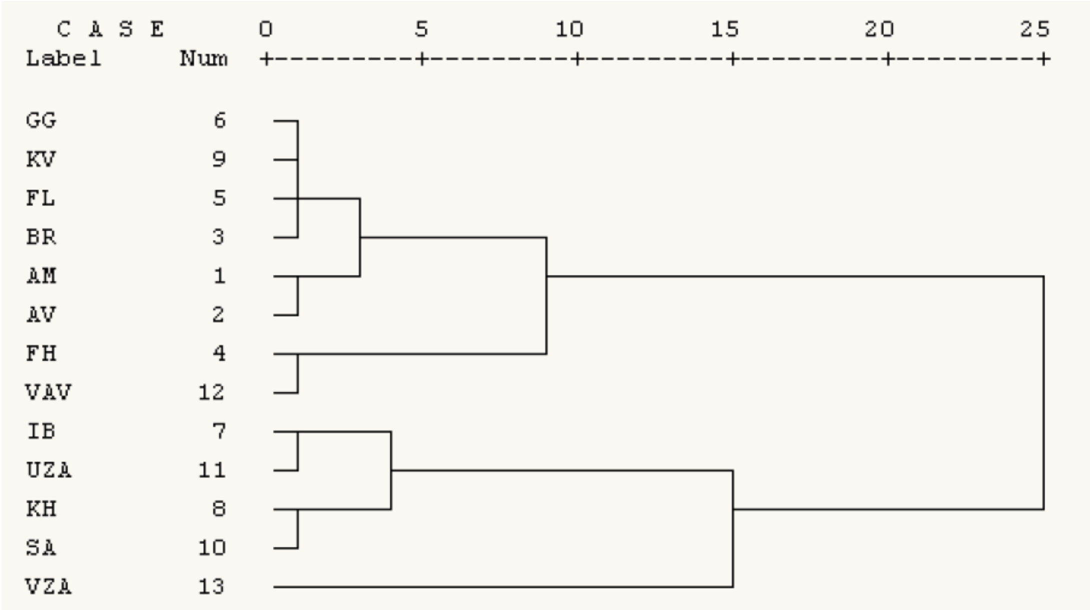
The 90%-percentile values are chosen for setting the quality standards for good and moderate status.

4.5. Cluster analysis

Not always for all types and class boundaries measurement data were available. Such gaps were tried to be solved by means of a cluster analysis. For the cluster analysis of each parameter, the data were used of those measurement locations whose corresponding quality status was "high", while taking the bioregions into account. For instance, it turned out that the BOD_5 concentrations in the bioregions GG, KV, FL and BR for the different saprobic ground states were comparable or showed similar features otherwise (compare Figure 3 below). Under the assumption that such similarities also will be the case for the other quality classes (good, moderate), then the known 90%-percentile of one bioregion might be used to derive the 90%-percentile value for another bioregion. In the Austrian study, this approach was used to complete the tables for those parameters and bioregions without –sufficient- data (without actually deriving the 90%-percentile for those types).

[6] http://ris1.bka.gv.at/authentic/index.aspx?page=hit&q_datum_von=2006-03-02&q_datum_bis=2006-03-02&sort=bgblnrup

Figure 3 Example of clustering of BOD_5 values in the different bioregions



4.6. Proposed type-specific quality standards for nutrients in Austrian running waters

The 90%-ile values are chosen for setting the quality standards for good and moderate status. The final results for the nutrients NO_3, PO_4 and $P_{tot(fil)}$ are shown in the tables below. Blank entries in the tables indicate that this water body type does not exist in Austria.

Bioregion	NO_3_N [mg N/l]							
	Saprobic ground state							
	1.25		1.5		1.75		2	
	high status 90-percentile	good status 90-percentile	high status 90-percentile	good status 90-percentile	high status 90-percentile	good status 90-percentile	high status 90-percentile	good status 90-percentile
AV			1.5	2.5	2	3.5		
AM			1.5	2.5	2	3.5		
BR	1	2.5	1.5	2.5	2	3.5		
FH			2	4	3	4.5	4	5.5
FL	0.5	2	1	2	1.5	2.5		
GF			1.5	2.5	2	3.5		
GG	1	2.5	1.5	3.5	2.5	4		
HV	0.5	1.5	1	2				
IB			1	2.5	1.5	3		
KH	0.5	1.5	1	2				
KV	0.5	1.5	1	2	1.5	2.5		
SA	0.5	1.5	1	2				
UZA	0.5	1.5	1	2	1.5	2.5		
VAV			1.5	2.5	2	3.5		
VZA	0.5	1.5	1	2	1.5	2.5		

Bioregion	PO_4_P [mg P/l] Saprobic ground state							
	1.25		1.5		1.75		2	
	high status 90-percentile	good status 90-percentile	high status 90-percentile	good status 90-percentile	high status 90-percentile	good status 90-percentile	high status 90-percentile	good status 90-percentile
AV			0.03	0.07	0.03	0.08		
AM			0.02	0.05	0.04	0.08		
BR	0.02	0.05	0.04	0.1	0.05	0.15		
FH			0.05	0.1	0.07	0.15	0.1	0.2
FL	0.01	0.04	0.02	0.05	0.03	0.08		
GF			0.04	0.1	0.05	0.1		
GG	0.02	0.05	0.03	0.07	0.05	0.1		
HV	0.01	0.04	0.02	0.05				
IB			0.05	0.1	0.07	0.15		
KH	0.01	0.04	0.02	0.05				
KV	0.01	0.04	0.02	0.05	0.04	0.08		
SA	0.01	0.04	0.02	0.05				
UZA	0.01	0.04	0.02	0.05	0.04	0.08		
VAV			0.02	0.05	0.03	0.08		
VZA	0.01	0.04	0.02	0.05	0.04	0.08		

Bioregion	$P_{tot(fil)}$ [mg P/l] Saprobic ground state							
	1.25		1.5		1.75		2	
	high status 90-percentile	good status 90-percentile	high status 90-percentile	good status 90-percentile	high status 90-percentile	good status 90-percentile	high status 90-percentile	good status 90-percentile
AV			0.04	0.1	0.05	0.15		
AM			0.03	0.08	0.05	0.1		
BR	0.03	0.07	0.05	0.08	0.07	0.15		
FH			0.07	0.15	0.1	0.25	0.2	0.25
FL	0.02	0.05	0.03	0.06	0.05	0.1		
GF			0.05	0.1	0.07	0.15		
GG	0.03	0.07	0.04	0.1	0.07	0.15		
HV	0.02	0.05	0.03	0.06				
IB			0.07	0.15	0.1	0.2		
KH	0.02	0.05	0.03	0.06				
KV	0.02	0.05	0.04	0.07	0.05	0.1		
SA	0.02	0.05	0.03	0.06				
UZA	0.02	0.05	0.03	0.06	0.05	0.1		
VAV			0.03	0.06	0.05	0.1		
VZA	0.02	0.05	0.03	0.06	0.05	0.1		

5. APPLICATION OF THE AUSTRIAN PROPOSED 1ST DRAFT METHOD

The 1st Monitoring and Assessment Expert Group meeting (Prague, 02 – 03 March 2006) encouraged the underlying study to further elaborate on the Austrian proposed 1st draft method. The mainstream of the Danube has been selected as study area.

5.1. Departure points: basic requirements

One can distinguish at least three basic requirements for applying the Austrian proposed 1st draft method:

a) Water bodies, assigned in line with WFD typology requirements.

b) WFD-compliant criteria for assigning the biological status.

c) Monitoring data, at least for:
  - benthic invertebrate fauna;
  - pshysico-chemical quality elements, notably: nutrients.

5.1.1. Typology of the Danube River Basin; water bodies

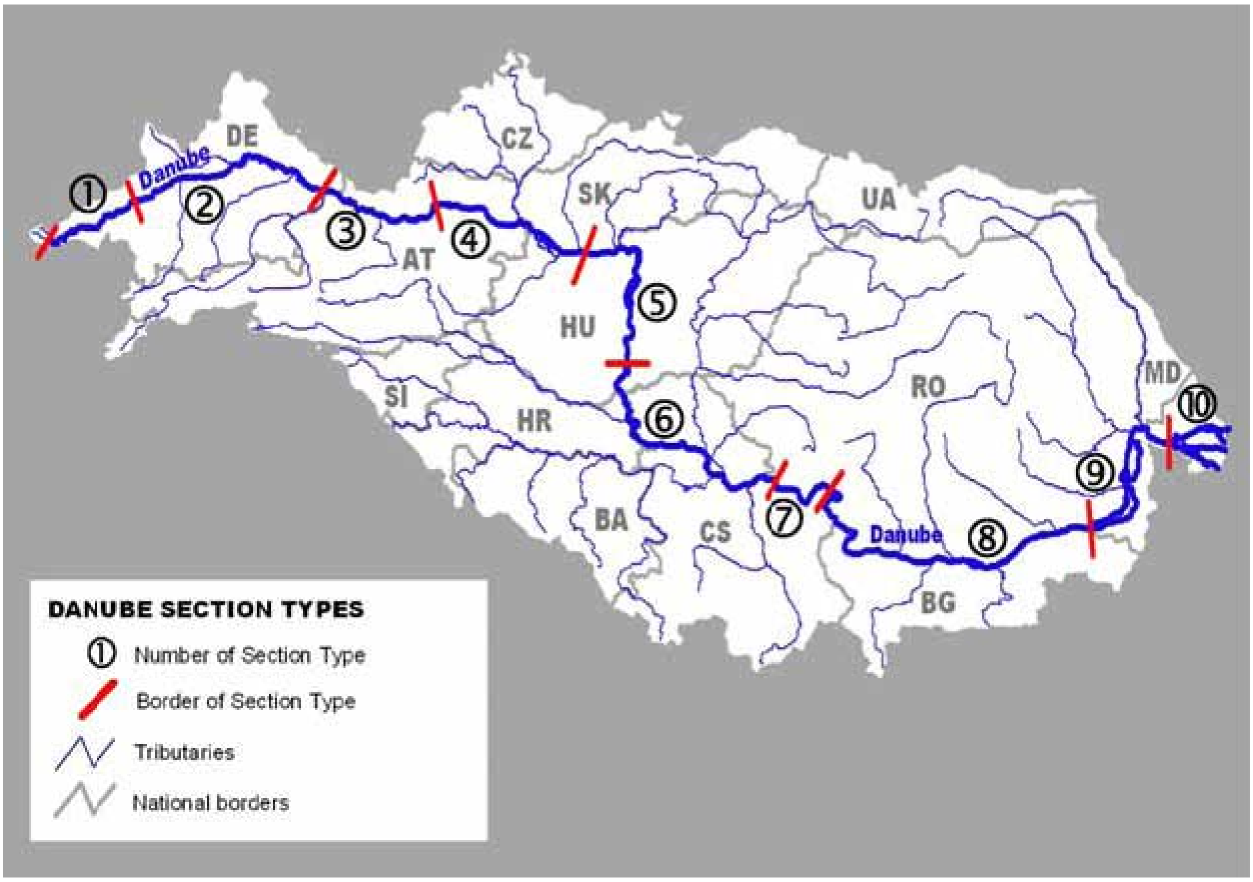
Along the mainstream of the Danube River, 10 section types have been identified. For each section type, morphological and habitat characteristics have been outlined (compare for instance [ICPDR, 2005]). Some of the relevant details are included in the table and figure below.

Table 2 Definition of Danube section types (*from Table 11 in [ICPDR, 2005]*)

Section Type №	from – to
1: Upper course of the Danube	rkm 2786: confluence of Brigach and Breg – rkm 2581: Neu Ulm
2: Western Alpine Foothills Danube	rkm 2581: Neu Ulm – rkm 2225: Passau
3: Eastern Alpine Foothills Danube	rkm 2225: Passau – rkm 2001: Krems
4: Lower Alpine Foothills Danube	rkm 2001: Krems – rkm 1789.5: Gönyű/Kližská Nemá
5: Hungarian Danube Bend	rkm 1789.5: Gönyű/ Kližská Nemá – rkm 1497: Baja
6: Pannonian Plain Danube	rkm 1497: Baja – rkm 1075 : Bazias
7: Iron Gate Danube	rkm 1075: Bazias – rkm 943: Turnu Severin
8: Western Pontic Danube	rkm 943: Turnu Severin – rkm 375.5: Chiciu/Silistra
9: Eastern Wallachian Danube	rkm 375.5: Chiciu/Silistra – rkm 100: Isaccea
10: Danube Delta[1]	rkm 100: Isaccea – rkm 20 on Chilia arm, rkm 19 on Sulina arm and rkm 7 on Sf. Gheorghe arm

[1] Within this section the Danube divides into the three main branches of the Danube Delta. Each arm also has transitional waters with the following limits: Chilia arm: rkm 20 – 0, Sulina arm: rkm 19 – 0, Sf. Georghe arm: rkm 7 – 0.

Figure 4 **Danube section types; the dividing lines refer only to the Danube River itself** (*from Figure 8 in [ICPDR, 2005]*)



Quoting [ICPDR, 2005] "*44 water bodies have been identified on the Danube River. Two of these are shared by the Slovak Republic and by Hungary. The number of water bodies on the Danube varies per country, e.g. on the German part of the Danube 15 water bodies were delineated, on the Bulgarian part only one. This means that the size of the water bodies also varies significantly. The smallest water body on the Danube is only 7 km long, the longest is 487 km.*"

Table 3 **Number of water bodies on rivers on the DRBD overview scale** *(table 20 in [ICPDR, 2005])*

DE	AT	CZ	SK	HU	SI	HR	BA	CS	BG	RO	MD	UA
15	6	-	3*	4*	-	2	-	9	1	6	na	na

* Two of these water bodies are shared by SK and HU.

No further details about the individual water bodies could be obtained while compiling this report. Therefore, the processing of data has been grouped *per section type*. As such, this approach still is in line with the type-specific requirements for this study, since the major differences in typology coincide with the section types. Therewith, the main typology of the individual water bodies would be determined by the section in which they are situated.

5.1.2. WFD-compliant criteria for the assigning the biological status

Much information already has been compiled with respect to hydrobiological (reference) conditions in the Danube basin (compare for instance 'WFD Roof Report' ANNEX 3: Typology of the Danube River and its reference conditions [ICPDR, 2005]). Nevertheless, currently no WFD-compliant metrics yet (officially) have been defined or agreed.

In order to be able to apply the Austrian methodology, the following approach has been selected for the underlying study. In their report "Integration of the Saprobic System into the Assessment Approach of the WFD – a Proposal for the Danube River", Stubauer & Moog mention the following [Sommerhäuser *et. al.*, 2003]: *"The SI of 2.0 as the highest threshold reference value seems to be a good estimate not only for the Austrian part of Danube in Ecoregion 11, but also for the Danube sections downstream. Quite similar saprobic indices around 2.1 have been observed along the entire stretch of the Danube below the borderline of Ecoregion 9 and 11. Based on these findings, a saprobic index of 2.0 is recommended as class boundary of the saprobic reference condition."* [7]

This proposed class boundary value matches with the Austrian classification system as introduced in chapter 3. In their presentation "Integration of the Saprobic System into the WFD approach - A proposal for the Danube River" for the 2nd Surface Water Workshop in Zagreb, 4-5 September 2003, Stubauer and Moog showed an extended version of the Austrian assessment scheme that also includes class boundaries for moderate/poor and poor/bad status [Stubauer & Moog, 2003].

Table 4 WFD compliant assessment scheme with Saprobic indices for benthic invertebrate fauna (*in: Stubauer & Moog, 2003*)

Ecological status class	Saprobic reference condition (range of Saprobic index)				
I – High	≤ 1.0	≤ 1.25	≤ 1.50	≤ 1.75	≤ 2.00
II – Good	1.01 – 1.75	1.26 – 2.00	1.51 – 2.10	1.76 – 2.25	2.01 – 2.40
III – Moderate	1.76 – 2.25	2.01 – 2.50	2.11 – 2.60	2.26 – 2.75	2.41 – 2.90
IV – Poor	2.26 – 2.75	2.51 – 3.00	2.61 – 3.10	2.76 – 3.25	2.91 – 3.40
V – Bad	>2.75	>3.00	>3.10	>3.25	>3.40

Following the hypothesised 'high-status' ground state of SI ≤ 2.00, the accompanying class boundaries (including the 'class boundary – 0.125' criterion) are the following.

Table 5 Definition of 'eligible SI values' with a SI ground state ≤ 2.00

Ecological status class	Range of Saprobic index	Ecological status class boundary	'Eligible ranges' for further data processing
I – High	≤ 2.00	High / Good	1.875 < SI ≤ 2.00
II – Good	2.01 – 2.40	Good / Moderate	2.275 < SI ≤ 2.40
III – Moderate	2.41 – 2.90	Moderate / Poor	2.775 < SI ≤ 2.90
IV – Poor	2.91 – 3.40	Poor / Bad	3.375 < SI ≤ 3.40
V – Bad	>3.40		

[7] ANNEX 2: 'Overview of river types in the Danube River Basin District' in the 'WFD Roof Report 2004' [ICPDR ,2005] contains the following details for Austria:

- Code: AT_ST_Large Rivers_Danube_Type d-1,75. Name of river type: River Danube, Saprobiological Basic Condition = 1,75
- Code: AT_ST_Large Rivers_Danube_Type e-2,00. Name of river type: River Danube, Saprobiological Basic Condition = 2,00

Intermezzo: differences with the classification used in the JDS reporting

In the reporting of the Joint Danube Survey of 2001, the transformation of the saprobic indices to biological water quality classes was established following the Austrian standards ÖNORM M 6232, shown below (quoted from *TABLE MZB-1 in [ICPDR, 2002]*)

Saprobity	Interval of saprobic indices	Saprobiological water quality class
oligosaprobic	< 1.25	I (unpolluted)
oligosaprobic to β-mesosaprobic	1.25 to 1.75	I-II (low polluted)
β-mesosaprobic	1.76 to 2.25	II (moderately polluted)
β-mesosaprobic to α-mesosaprobic	2.26 to 2.75	II-III (critically polluted)
α-mesosaprobic	2.76 to 3.25	III (strongly polluted)
α-mesosaprobic to polysaprobic	3.26 to 3.75	III-IV (very high polluted)
polysaprobic	> 3.75	IV (excessively polluted)

The differences with the classes used for the underlying study are substantial.

5.1.3. Monitoring data

In order to apply the Austrian proposed 1st draft method, at least two sets of monitoring data are needed:

a) benthic invertebrate fauna, in order to assign a status quality class to the water bodies concerned;

b) physico-chemical quality elements (notably nutrients) monitored at the water bodies concerned[8].

With the focus set on the Danube's mainstream, the data collected within the Transnational Monitoring Network (TNMN) prevail for the purposes of the underlying study. Unfortunately, so far only few countries have included benthic invertebrate fauna in the routine monitoring of the TNMN sites along the Danube, being: Germany, Austria, Slovakia and Hungary (status at least as up to and including 2004).

Two sets of data on macrozoobenthos exist that encompass wider stretches, being the data collected during:

> the Joint Danube Survey (JDS) of 2001, comprising data from Neu-Ulm at river kilometre (rkm) 2581, up to the Sulina arm at rkm 12;

> the Aquaterra survey of 2004, where samples have been taken between rkm 1942 (Klosterneuburg) and rkm 795 (Calafat).

Therefore, these two years of observations (2001 and 2004) have been selected for the underlying study. With the JDS and Aquaterra providing the major hydrobiological data, the TNMN data are the major source for physico-chemical data.

[8] As mentioned in the previous subsection, for the underlying study data are grouped per section type.

5.2. Applying the Austrian proposed 1st draft method: general requirements

This section is first of all dedicated to recording general experiences gathered while applying the Austrian proposed 1st draft method. The actual results will be presented and discussed in the next sections.

5.2.1. Combining data sets

Following the principles of the Austrian proposed 1st draft method, monitoring data will be used when available for the water bodies concerned. If no monitoring data are available for certain (sets of) water bodies, they might be inferred by means of cluster-analyses (compare subsection 4.5; this option has not been substantiated in the underlying study, also because the section types were selected as the basic units, instead of individual water bodies).

Data on benthic invertebrate fauna data along wider stretches of the Danube currently only are available via the Joint Danube Survey (JDS) of 2001 and the AQUATERRA survey of 2004. The reported river kilometres of the JDS and the AQATERRA sampling sites not necessarily coincide with those of the TNMN stations. In order to link the JDS/AQUATERRA biological (benthic invertebrate fauna) data with the physico-chemical TNMN data the following criteria has been used in the present study:

a) TNMN versus JDS/AQUATERRA sampling sites differ no more than 10 rkm. Ten river kilometres is a rather arbitrary criterion, but has been introduced to emphasise that data sets should somehow coincide in terms of space and distance. There seems no need to insist on an exact match. Generally, requirements for sampling sites may differ. While bridges are quite popular for taking water samples for physico-chemical quality elements, they are not favourable sites for sampling benthic invertebrate fauna.

b) In case locations were sampled both within 10 rkm upstream and downstream sites, the upstream sampling/monitoring data are selected. For example: for TNMN L2370, rkm 1258, Novi Sad, two JDS sampling sites are within a reach of 10 rkm, being: JDS51, rkm 1259, upstream Novi Sad and JDS52: rkm 1252, downstream Novi-Sad. In this case, the data of JDS51 prevailed. Although these also distance-wise are closest, the major underlying reason has been that the JDS52 site might be impacted by local sources from Novi Sad (see also below).

c) 'Expert judgement'. One set of data that would comply with the criteria above has been omitted, being the combination TNMN L2170, rkm 1874, Wolfsthal and JDS15: rkm 1881, upstream Morava (Hainburg) / ADS 3: rkm 1881, upstream Morava (Hainburg). The reason for doing so is that the tributary Morava discharges in between the JDS/AQUATERRA sites and the TNMN monitoring station. The TNMN samples at Wolfstahl are taken at the right bank, so basically no influence of the Morava can be expected in these samples. Since the overall approach has been to use the average of the left and right bank samples for benthic invertebrate fauna, nevertheless this combination has been skipped, mainly as an example for future considerations when elaborating on the underlying study. The underlying idea is that when selecting combinations of data, it should be verified that there are no local influences (e.g. discharges of waste water or tributaries) that may affect one of the data sets (benthic invertebrate fauna or physico-chemical quality elements).

In one case, is has been decided to deviate from the (basically: arbitrary) 10 rkm criterion, namely for the combination TNMN L0480: rkm 0, Sulina - Sulina arm with JDS97: rkm 12, Sulina arm. Otherwise, there would have not been 'eligible' data for evaluating section type 10.

Intermezzo: 'borderline syndrome'

The following case could act as an example of possible complications when combining various monitoring / sampling locations. According to the Danube's typology, the following river kilometres apply to the Section Types 8 respectively 9:

8: Western Pontic Danube	rkm 943: Turnu Severin – rkm 375.5: Chiciu/Silistra
9: Eastern Wallachian Danube	rkm 375.5: Chiciu/Silistra – rkm 100: Isaccea

When for instance using the MS Excel INT() function straightforwardly, =INT(375.5) would return the number 375, which would position the location Chiciu/Silistra inside Type Stretch 9. When using conventional math conventions, rounding the rkm 375.5 to its nearest integer would become 376, being the nearest even number. Rkm 376 is 'more upstream' than rkm 375.5, so would qualify as belonging to Type Section 8.

In the DANUBIS TNMN station information, the location TNMN L0280 (RO), L0850 (BG): Chiciu/Silistra is situated at rkm 375, which implies that is has to be positioned in Section Type 9. The nearest Joint Danube Survey location JDS89: rkm 378, Chiciu/Silistra, would have to be assigned to Type Section 8.

For the underlying study, TNMN Chiciu/Silistra has been put inside Section Type 9, if only that otherwise for this section only one site would remain downstream at Reni, around rkm 130). Furthermore, section 8 is rather 'overcrowded' anyway (compare Annex 1). No possible significant impacts are known to exist between rkm 378 and 375, so from this point of view the TNMN Chiciu/Silistra and JDS89 can be combined.

While seemingly quite trivial, this example underlines the importance of expert judgements prior to organising and processing the actual data.

Annex1 contains an overview of the TNMN, JDS and AQUATERRA sites, including the suggested matching combinations.

5.2.2. Averaging data per cross section

During both the JDS and the AQUATERRA surveys, in most occasions benthic invertebrate fauna samples have been taken separately at the left and the right bank of the Danube River. In the TNMN, samples often are taken at three positions: left bank, middle of the river, right bank.

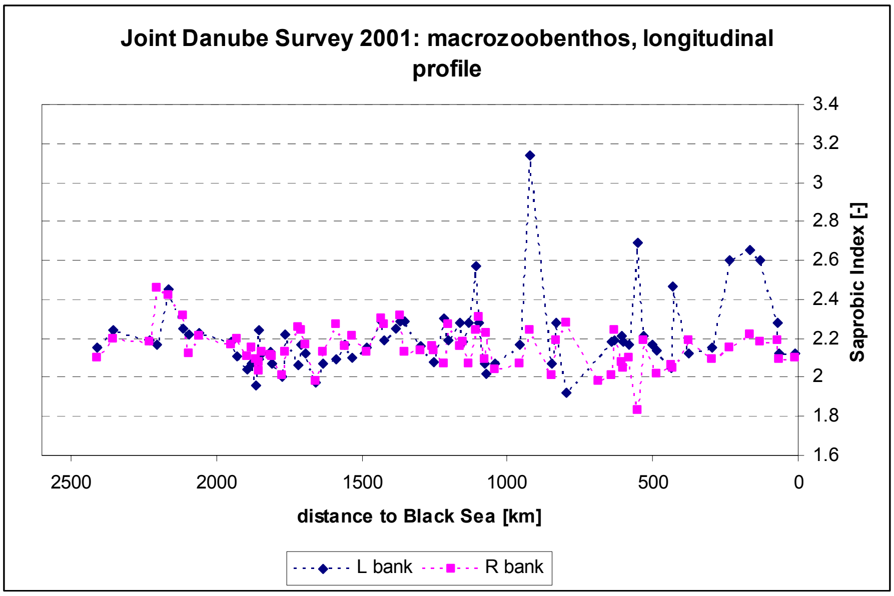
For the underlying study, averaged data per cross section were used. Meaning that TNMN data firstly were pooled per cross-section before calculating statistics. Please notice that for this reason statistics in this report can be different from those reported in the TNMN year books, where the statistics are shown per individual sampling site per cross-section.

5.3. Applying the Austrian proposed 1st draft method for the year 2001 (Joint Danube Survey)

5.3.1. Descriptive findings: benthic invertebrate fauna

A graphic representation of the macrozoobenthos results of the Joint Danube Survey are shown in the graph below.

Figure 5 Longitudinal profile of the macrozoobenthos findings of the Joint Danube Survey



Several observations can be derived from the figure above.

a) The SI generally is larger than 2, being the class boundary between 'high' and 'good' status as defined for the underlying study (compare subsection 5.1.2).

b) The highest values (SI >2.4) are found in several left bank samples starting from rkm 1107 and further downstream. In the upper reaches, the SI in samples at two cross sections is higher than 2.4: JDS06, Jochenstein and JDS07, Upstream dam Aschach. Nevertheless, there does not seem to be a systematic difference overall between left and right bank samples.

5.3.1.1. Comparison of TNMN macrozoobenthos data with JDS

Some countries have included monitoring macrozoobenthos in their TNMN sites. As shown in the table below, the JDS and the TNMN data generally compare relatively well. Most intriguing difference is Neu-Ulm that can be qualified as 'high status' with the JDS data, while it would qualify as 'good status' according to the TNMN data[9].

Table 6 Comparison of TNMN[10] versus JDS macozoobenthos results

Section №	Type	rkm	name	TNMN Mean SI	JDS SI L-bank	SI middle	SI R-bank
2		2581	Neu-Ulm L	2.11	1.89		
3		2204	Jochenstein M (AU)	2.15	2.17	2.46	2.17
		2204	Jochenstein M (DE)	2.22	2.17	2.46	2.17
		2120	Abwinden-Asten R	2.08	2.25		2.32
4		1935	Wien-Nussdorf R	2.10	2.11	2.2	
		1874	Wolfsthal R	2.01			
		1869	Bratislava M	2.16	1.96		2.09

[9] Compare the footnote for section 5.1.2, indicating that at least one Austrian water body in the Danube has a saprobic ground state of SI ≤ 1.75. Assuming that this can be applied to upstream locations, then Neu-Ulm would have to be qualified as being of 'good' status.

[10] Data derived from the TNMN Yearbook 2001.

Section №	Type	rkm	name	TNMN Mean SI	JDS SI L-bank	SI middle	SI R-bank
		1806	Medvedov/Medve M (SK)	2.11	2.07		2.11
5		1768	Komarno/Komarom M (SK)	2.00	2.00		2.01
6		1429	Batina M	2.33	2.19		2.27
		1337	Borovo R	2.03			

5.3.2. Combining data sets

Following the principles introduced in section 5.2.1, JDS and TNMN sites have been selected. An overview of these selected sites is included in Annex 2.

5.3.3. Selecting locations in accordance with the 'class boundary - 0.125' criterion

For compilation of the table below, the more restrictive 'combine data sets' and 'class boundary – 0.125' criteria have been applied.

Table 7 Overview of selected sites: quality status according to the SI of the JDS

JDS code	TNMN code	Name	Section Type №	rkm	SI L-bank	SI R-bank	SI average	status	complies with class boundary
JDS01	L2140	Neu-Ulm	2	2581	1.89	-	1.89	high	high/ good
JDS06	L2130 (DE) / L2220 (AU)	Jochenstein	3	2204	2.17	2.46	2.315	good	good/ moderate
JDS08	L2200	Upstream dam Abwinden-Asten		2120	2.25	2.32	2.285	good	good/ moderate
JDS12	L2180	Wien-Nussdorf (Klosterneuburg)	4	1935	2.11	2.2	2.155	good	*no*
JDS17	L1840	Bratislava		1865	1.96	2.09	2.025	good	*no*
JDS23	L1470 (HU) / L1860 (SK)	Medvedov/Medve		1806	2.07	2.11	2.09	good	*no*
JDS25	L1475 (HU) / L1870 (SK)	Komarno/Komarom	5	1768	2	2.01	2.005	good	*no*
JDS31	L1490	Szob		1708	2.17	2.24	2.205	good	*no*
JDS40	L1520	Dunafoldvar		1560	2.17	2.16	2.165	good	*no*
JDS44	L1540	Hercegszanto	6	1435	2.29	2.3	2.295	good	good/ moderate
JDS45	L1315	Batina		1429	2.19	2.27	2.23	good	*no*
JDS48	L2360	Downstream Drava (Erdut/Bogojevo)		1367	2.29	2.32	2.305	good	good/ moderate
JDS51	L2370	Upstream Novi Sad		1258	-	2.16	2.16	good	*no*
JDS58	L2390	Downstream Pancevo		1155	2.18	2.18	2.18	good	*no*
JDS63	L2400	Starapalanka - Ram		1077	2.07	2.09	2.08	good	*no*
JDS64	L0020	Banatska Palanka/Bazias	7	1077	2.02	2.23	2.125	good	*no*

JDS code	TNMN code	Name	Section Type №	rkm	SI L-bank	SI R-bank	SI average	status	complies with class boundary
JDS66	L2410	Tekija		955	2.17	2.07	2.12	good	*no*
JDS68	L2420	Upstream Timok (Rudujevac/Gruia)	8	851	2.07	2.01	2.04	good	*no*
JDS70	L009 (RO) / L0730 (BG)	Pristol/Novo Selo Harbour		834	2.28	2.19	2.235	good	*no*
JDS73	L0780	Upstream Iskar (Bajkal)		642	2.18	2.01	2.095	good	*no*
JDS80	***L0810***	***Downstream Zimnicea/Svishtov***	***8***	***554***	***2.69***	***1.83***	***2.26***	***??***	***??***
JDS83	L0820	Upstream Ruse		503	2.17	-	2.17	good	*no*
JDS86	L0240	Upstream Arges		432	2.05	2.06	2.055	good	*no*
JDS89	L0280 (RO) / L0850 (BG)	Chiciu/Silistra	9	375	2.12	2.19	2.155	good	*no*
JDS95	***L0430***	***Reni - Chilia/Kilia arm***		***132***	***2.6***	***2.18***	***2.39***	***??***	***??***
JDS97	L0480	Sulina arm	10	12	2.12	2.1	2.11	good	*no*

Several observations can be derived from the table above, among others:

> There are two sites with relatively big differences between the SI's at their left and right bank: downstream Zimnicea/Svishtov at rkm 554 and Reni - Chilia/Kilia arm at rkm 132. As for Zimnicea/Svishtov, the left bank sample indicates a 'moderate' status, while the right bank sample would indicate a 'high' status. For the time being, these two sites are omitted for further specific assessments in the underlying study. The criterion in section 5.2.1c) has been introduced to avoid such situations where there seem to be apparent differences between left and right bank.

Intermezzo: Downstream Zimnicea/Svishtov

The author has no knowledge about left bank emissions that might explain the relatively high SI. For the sake of completeness, the SI's at the left bank of the JDS sampling sites that were not selected (because of no overlapping TNMN site) are mentioned.

JDS_code	rkm	name	bank	SI
JDS75	629	Downstream Iskar	L	2.19
JDS76	606	Upstream Olt	L	2.21
JDS78	602	Downstream Olt	L	2.18
JDS79	579	Downstream Turnu-Magurele/Nikopol	L	2.17

One reasonably may assume that the difference in SI at Zimnicea/Svishtov somehow must be due to the sampling (site) and not so much to some local stress factors.

> Out of the remaining 24 locations, only one site qualifies as being of 'high' status: Neu-Ulm at rkm 2581. The remaining sites would qualify as being of 'good' status (based on average SI from left and right bank samples).

> The 'class boundary - 0.125' criterion reduces the number of 'eligible' sites considerably. Out of the 24 remaining selected sites, only 5 sites meet the 'class-boundary criterion'. For the following section types, none of the sites meets this criterion: 4, 5, 7, 8, 9 and 10, implying that for these sites no estimates for type-

specific quality standards could be made. Leaving only the section types 2, 3, and 6 (please notice that there is no TNMN station situated in Section Type 1).

> For the sake of completeness, calculations nevertheless have been carried out for all TNMN monitoring stations along the mainstream of the Danube (compare Annex 3 for results).

5.3.4. Nitrate (NO_3)

5.3.4.1. Applying the method

An overview of all results can be found in annex 3. The table below contains the results of those sites complying with the methodological criteria.

Table 8 NO_3 concentrations (90%-ile values) at TNMN stations meeting the 'class boundary – 0.125' criterion in 2001

Section	Rkm	Country	Location	**Class boundary: high/good** NO3, 90%-ile [mg N/l]	**Class boundary: good/moderate** NO3, 90%-ile [mg N/l]
2	2581	DE	Neu-Ulm/Boefinger Halde	3.7	
3	2204	AT	Jochenstein		3.3
		DE	Jochenstein		3.1
	2120	AT	Abwinden-Asten		2.9
6	1435	HU	Hercegszanto		2.9
	1367	SC	Bogojevo		3.1

Too few stations (which furthermore are situated in the upper half reach only) comply with the class boundary criterion in order to be able to draw some more substantiated conclusions. While acknowledging these limitations, the table above nevertheless implies several interesting observations, like:

> The highest 90%-ile nitrate concentration has been found at the only station being qualified as 'high' status according the SI of the Joint Danube Survey: Neu-Ulm / Boefinger Halde.

> Within the two remaining section types 3 and 6, the 90%-ile values can differ up to 0.4 mg N/l. Introducing yet another methodological consideration: which data set to use for representing the associated Section Type?

> The two data-sets at Jochenstein (from Austria and Germany) furthermore illustrate that at one location different results can be obtained. Several factors could be underlying such differences: date, place and/or method of sampling, laboratory analysis, sampling frequency, et cetera. In this case the difference is minor, but the boxout below show examples where differences are more substantial. Adding to the consideration mentioned just above: which data set to use for representing the associated Section Type?

Intermezzo: differences between results of countries sampling at the same TNMN site

In the example above, the differences between the Austrian and the German nitrate data at Jochenstein are rather modest. There are several locations, where differences appear to be more substantially (compare also Annex 3 for details).

For example in the results at Pristol/Novo Selo at rkm 874 and Chiciu/Silistra at rkm 375, where samples are taken both by Bulgaria and Romania.

NO3 concentration (90%-ile values), [mg N/l]

	rkm 384	rkm 384	rkm 375	rkm 375
country	2001	2004	2001	2004
BG	2.3	**2.3**	**1.9**	2.2
RO	2.0	**1.3**	**2.4**	2.4

In 2004, the differences between the Bulgarian and Romanian 90%-ile values at Pristol/Novo Selo are 1 mg N/l, almost one order of magnitude at these levels. At Chiciu/Silistra in 2001 the difference was 0.5 mg N/l.

Similar observations can be made for NH_4, although in this case only at Chiciu/Silistra, as shown below.

NH_4 concentration (90%-ile values) [mg N/l]

	rkm 384	rkm 384	rkm 375	rkm 375
country	2001	2004	2001	2004
BG	0.31	0.29	**0.13**	**0.15**
RO	0.40	0.32	**1.00**	**0.79**

Another example is the TNMN site at rkm 18, Vilkova-Chilia arm/Kilia arm, where in the year 2004 samples were taken by both Romania and Ukraine.

NO_3 and NH_4 concentrations (90%-ile values) in 2004 [mg N/l]

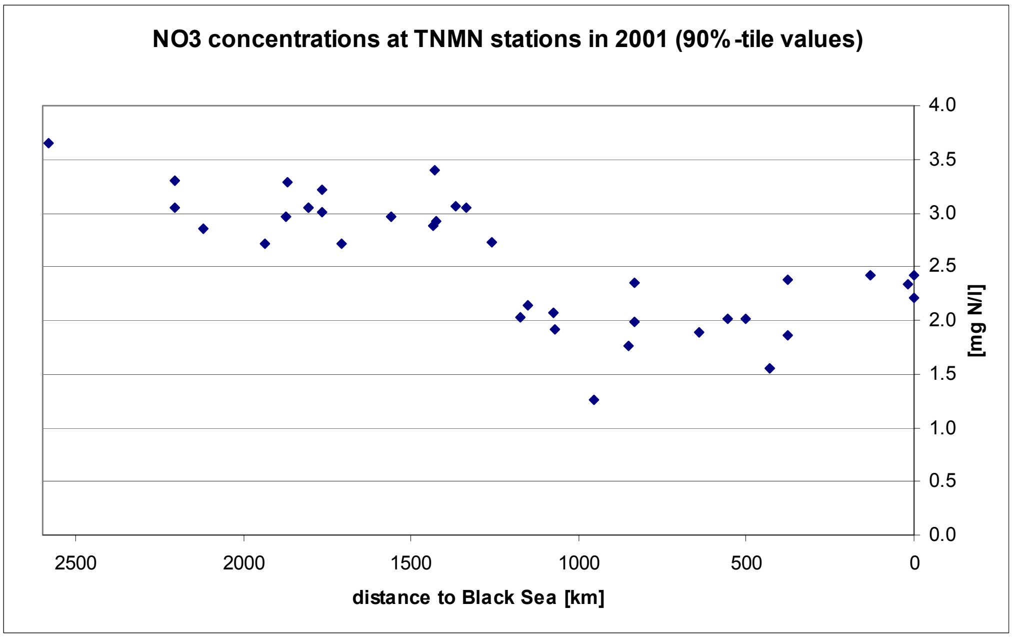
	NO_3	NH_4
RO	**2.3**	**0.86**
UA	**1.4**	**0.30**

These examples show the importance of general screening of the monitoring data and the derived results prior to their actual use as like in the exercises of the underlying study.

5.3.4.2. Additional observations

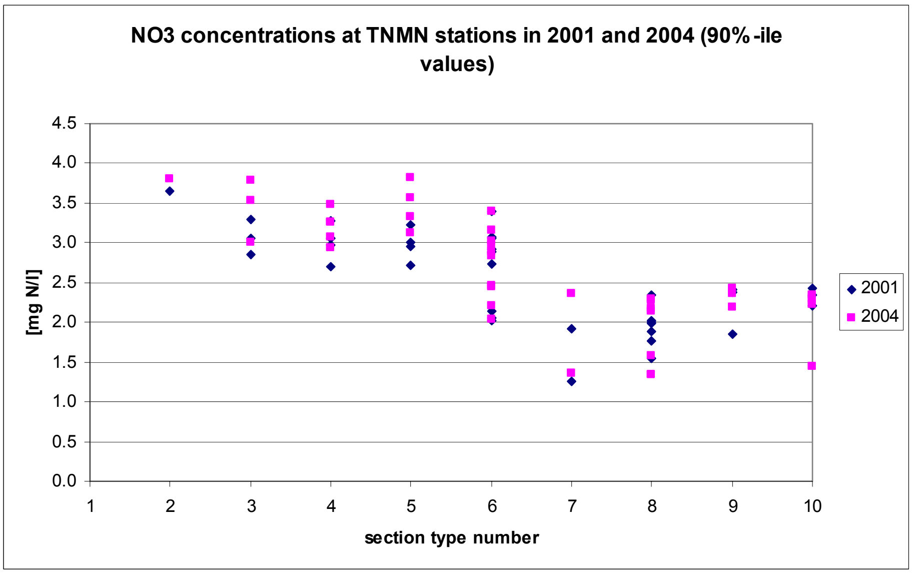
Unfortunately, the 2001 data resulted in a limited number of matching locations when applying the principles of the Austrian proposed 1st draft method. These locations cannot be considered as representative for the whole Danube mainstream. As an example, the 90%-ile nitrate concentrations at all TNMN stations for the year 2001 are shown in the graph below.

Figure 6 90%-ile nitrate concentrations at all TNMN stations in the year 2001



The graph indicates a tendency of decreasing NO_3 concentrations in the upstream – downstream direction, implying a rather distinct drop somewhere near rkm 1300. A similar tendency can be observed in 2004. In the graph below, the nitrate concentrations are pooled in each section type for the years 2001 and 2004. There seem to be substantial differences between the sections 2-5 versus 7-10. The highest 90%-ile values in the section types 7-10 are lower than the lowest 90%-ile values in the section types 2-5.

Figure 7 90%-ile nitrate concentrations in the various section types for 2001 and 2004



5.3.5. P_{tot} and PO_4

An overview of all results can be found in annex 3. The tables below contain the results of those sites complying with the methodological criteria. The few available results do not allow for substantiated conclusions. The 90%-ile concentrations at the only location being qualified as 'high status' (Neu-Ulm) are not lower than at the other ones.

Table 9 P_{tot} **concentrations (90%-ile values) at TNMN stations meeting the 'class boundary – 0.125' criterion (2001)**

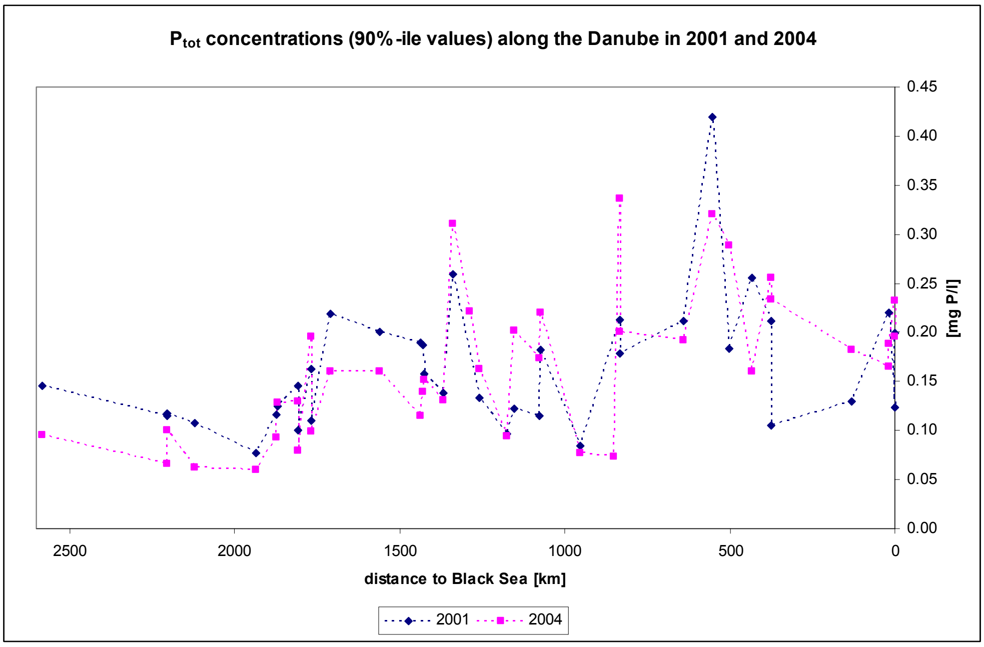
Section	Rkm	Country	Location	Class boundary: high/good P_{tot}, 90%-ile [mg P/l]	Class boundary: good/moderate P_{tot}, 90%-ile [mg P/l]
2	2581	DE	Neu-Ulm/Boefinger Halde	0.15	
3	2204	AT	Jochenstein		0.12
		DE	Jochenstein		0.12
	2120	AT	Abwinden-Asten		0.11
6	1435	HU	Hercegszanto		0.19
	1367	SC	Bogojevo		0.14

Table 10 PO_4 **concentrations (90%-ile values) at TNMN stations meeting the 'class boundary – 0.125' criterion (2001)**

Section	Rkm	Country	Location	Class boundary: high/good PO4, 90%-ile [mg P/l]	Class boundary: good/moderate PO4, 90%-ile [mg P/l]
2	2581	DE	Neu-Ulm/Boefinger Halde	0.06	
3	2204	AT	Jochenstein		0.07
		DE	Jochenstein		0.05
	2120	AT	Abwinden-Asten		0.05
6	1435	HU	Hercegszanto		0.09
	1367	SC	Bogojevo		0.07

Whether there is a tendency in the longitudinal direction is not so obvious for the year 2001, but in combination with the 2004 data phosphorous concentration seem to be increasing in a downstream direction, as indicated in the figure below.

Figure 8 P_{tot} **concentrations (90%-ile values) along the Danube in 2001 and 2004**

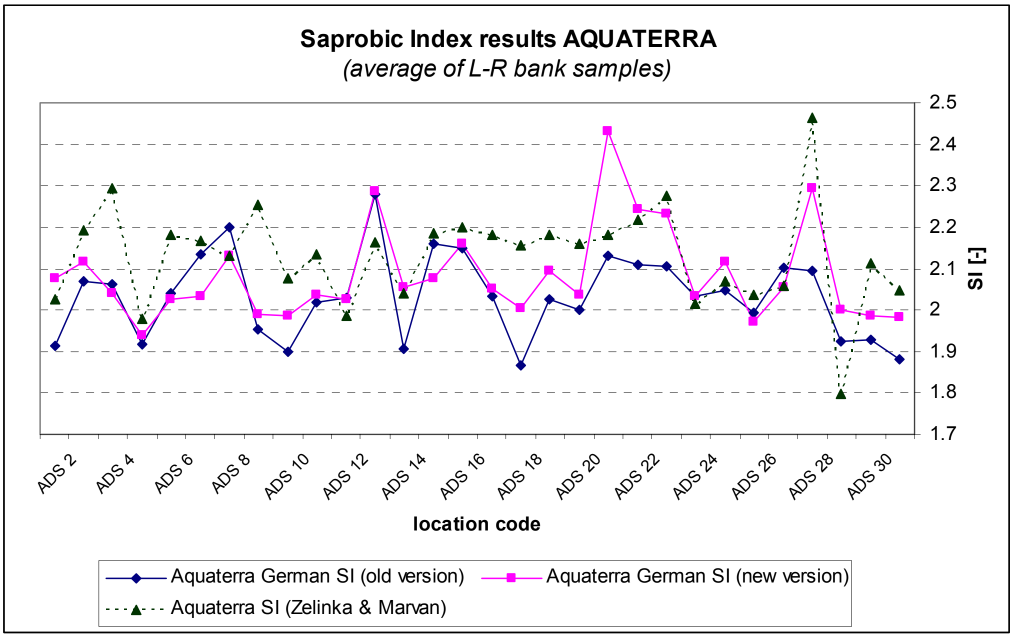


5.4. Applying the Austrian proposed 1st draft method for the year 2004 (Aquaterra)

5.4.1. Descriptive findings: benthic invertebrate fauna

For the Aquaterra survey Saprobic Indices were calculated through several methods, the results of three of them shown in the graph below.

Figure 9 SI results of the AQUATERRA survey



With calculating the SI by several different methods, AQUATERRA has introduced a new element in the exercise. Since the resulting SI's are different, it raises the question; which one to use for a status assessment?

When comparing the results of the three calculation methods as shown in Figure 9, the following observations can be made:

> the results of the SI's calculated with the new version of the German method for the majority of the sites are higher than the old version (the differences are not systematic);

> the results of the SI's calculated with the Zelinka & Marvan method for the majority of the sites are higher than the new version of the German method (the differences are not systematic).

The implications are obvious: the SI's calculated with the Zelinka & Marvan method and the new German method result in a lower quality status than when using the old German method, as illustrated in the table below.

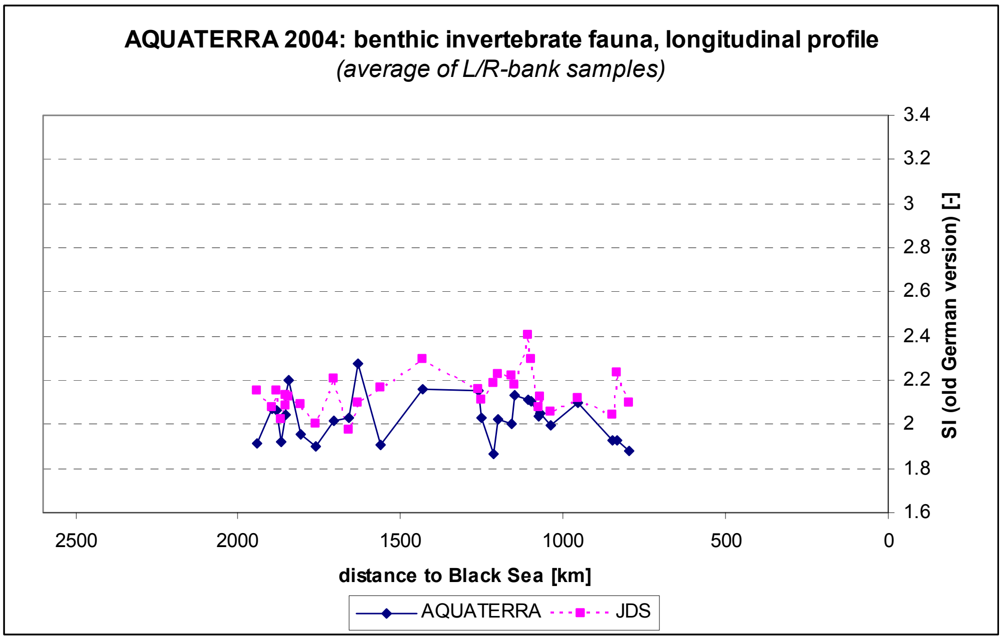
Table 11 Quality status of AQUATERRA sites according to different calculation methods [total = 30]

status	German SI (old version) [n]	German SI (new version) [n]	SI (Zelinka & Marvan) [n]
high	10	6	3
good	20	23	26
moderate	0	1	1

In order to be able to compare the results of using the AQUATERRA data with those obtained on basis of the JDS data, the SI's resulting from the old version of the German method have been selected for further processing.

The longitudinal profile is shown in the figure below. The (averaged) saprobic indices range between 1.87 to 2.28 and in most cases are lower than at the matching JDS sites.

Figure 10 Overview of average SI's in the overlapping stretch of Aquaterra and JDS



5.4.1.1. Comparison of TNMN 2004 macrozoobenthos data with Aquaterra

The table below contains the average SI from the TNMN 2004 data, together with the ones measured at matching Aquaterra sites. In most matching cases, the TNMN saprobic indices tend to be a bit higher; none the sites according to the SI of the TNMN would qualify as 'high status' (contrary to several Aquaterra sites).

Table 12 Comparison of TNMN 2004 versus Aquaterra macozoobenthos results

Section	Rkm	Code	Location	TNMN saprobic index	Aquaterra SI old German index	Aquaterra SI new German index
2	-2581	L2140	Neu-Ulm/Boefinger Halde	2.06		
3	-2204	L2130	Jochenstein: DE	2.25		
		L2220	Jochenstein: AT	2.11		
	-2120	L2200	Abwinden-Asten	2.04		
4	-1935	L2180	Wien-Nussdorf	2.00	1.91	2.08
	-1874	L2170	Wolfsthal	2.21		
	-1869	L1840	Bratislava	2.17	1.92	1.94
	-1806	L1470	Medve/Medvedov: HU	2.06	1.95	1.99
		L1860	Medvedov/Medve: SK	2.10		
5	-1768	L1475	Komarom/Kedvedov: HU	2.05	1.90	1.98
		L1870	Komarno/Komarom: SK	2.07		
	-1708	L1490	Szob	2.14	2.02	2.04
	-1560	L1520	Dunafoldvar	2.15	1.91	2.05
6	-1435	L1540	Hercegszanto	2.14	2.16	2.08

5.4.2. Combining data sets

The generally matching Aquaterra and TNMN sites (compare section 5.2.1 for the criteria) are included in Annex 2.

5.4.3. Selecting locations in accordance with the 'class boundary - 0.125' criterion

Out of the fourteen AQUATERRA sites that match with TNMN stations, 7 are of high status and the other 7 of good status. The seven high status sites comply with the '<0.125 class boundary' criterion for the high/good class boundary. Unfortunately, none of these sites coincide with any of the 2001 sites that then complied with the '<0.125 class boundary' criterion.

Table 13 Overview of selected sites: quality status according to the SI of Aquaterra

ADS code	TNMN code	Name	Section Type №	rkm	Aquaterra German SI (old version)	status	complies with class boundary
ADS 1	L2180	Wien-Nussdorf	4	1935	1.91	high	high/good
ADS 4	L1840	Bratislava		1869	1.92	high	high/good
ADS 8	L1860	Medvedov/Medve		1806	1.95	high	high/good
ADS 9	L1870	Komarom/Komarno	5	1768	1.90	high	high/good
ADS 10	L1490	Szob		1708	2.02	good	*no*
ADS 13	L1520	Dunafoldvar		1560	1.91	high	high/good
ADS 14	L1540	Hercegszanto	6	1435	2.16	good	*no*
ADS 15	L2370	Novi Sad		1258	2.15	good	*no*
ADS 20	L2390	Pancevo		1155	2.13	good	*no*
ADS 23	L2400	Bantska Palanka		1077	2.03	good	*no*
ADS 24	L0020	Bazias	7	1071	2.05	good	*no*
ADS 26	L2410	Tekija		955	2.10	good	*no*
ADS 28	L2420	Radujevac	8	851	1.93	high	high/good
ADS 29	L009/L0730	Pristol/Novo Selo		834	1.93	high	high/good

5.4.4. NO_3

The results for the calculations for all TNMN stations can be found in Annex 3. In the table below, the results for the matching sites that comply with the 'class boundary – 0.125' criterion are shown.

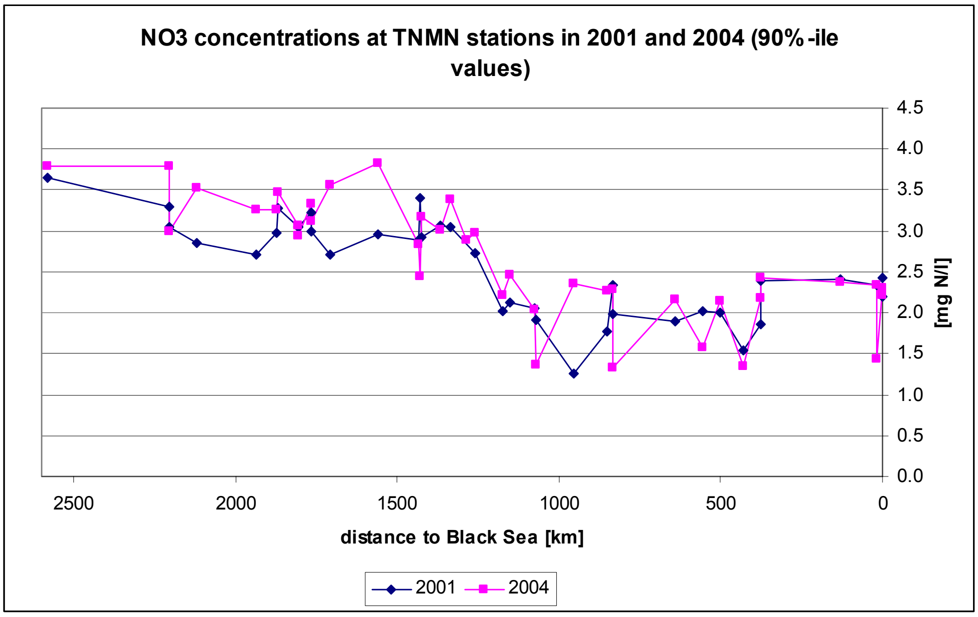
Table 14 NO_3 concentrations (90%-ile values) at TNMN stations meeting the 'class boundary – 0.125' criterion in 2004

Section	Rkm	Country	Location	Class boundary: high/good NO_3, 90%-ile [mg N/l]
4	1935	AT	Wien-Nussdorf	3.3
	1869	SK	Bratislava	3.5
	1806	HU	Medve/Medvedov	3.1
		SK	Medvedov/Medve	2.9
5	1768	HU	Komarom/Kedvedov	3.3
		SK	Komarno/Komarom	3.1
	1560	HU	Dunafoldvar	3.8
8	851	SC	Radujevac	2.3
	834	BG	Novo Selo Harbour/Pristol	2.3
		RO	Pristol/Novo Selo Harbour	1.3

The results for section type 4 ranges from 2.9 to 3.5, another example indicating that for selecting data sets that represent the (quality of) section types additional criteria will have to be developed.

As mentioned earlier above: unfortunately there are no sites that comply with the 'class boundary – 0.125' criterion in both 2001 and 2004. The 90%-ile values for 2004 generally are slightly higher than those for 2001. So, with overall lower SI's in 2004 along the joint Aquaterra/JDS stretch, the 90%-ile nitrate concentrations actually tend to be slightly higher.

Figure 11 NO_3 concentrations at TNMN stations in 2001 and 2004 (90%-ile values)



Refer to section 5.3.4 where relevant details are addressed also for the 2004 results, like the different concentrations found at rkm 834, Pristol/Novo Selo.

5.4.5. P_{tot} and PO_4

The tables below contain the results of those sites complying with the methodological criteria.

For P_{tot}, values range from 0.06 to 0.34 mg P/l. The different minimum/maximum values in each of the section types once more underline the issue of how to relate different sets of (TNMN) data to each section type. The differences between the countries at the TNMN sites Komarom/Kedvedov and Pristol/Novo Selo furthermore are considerable.

Table 15 P_{tot} concentrations (90%-ile values) at TNMN stations meeting the 'class boundary – 0.125' criterion (2004)

Section	rkm	Country	Location	Class boundary: high/good Ptot, 90%-ile [mg P/l]
4	1935	AT	Wien-Nussdorf	0.06
	1869	SK	Bratislava	0.13
	1806	HU	Medve/Medvedov	0.13
		SK	Medvedov/Medve	0.08
5	1768	HU	Komarom/Kedvedov	0.20
		SK	Komarno/Komarom	0.10
	1560	HU	Dunafoldvar	0.16
8	851	SC	Radujevac	0.07
	834	BG	Novo Selo Harbour/Pristol	0.34
		RO	Pristol/Novo Selo Harbour	0.20

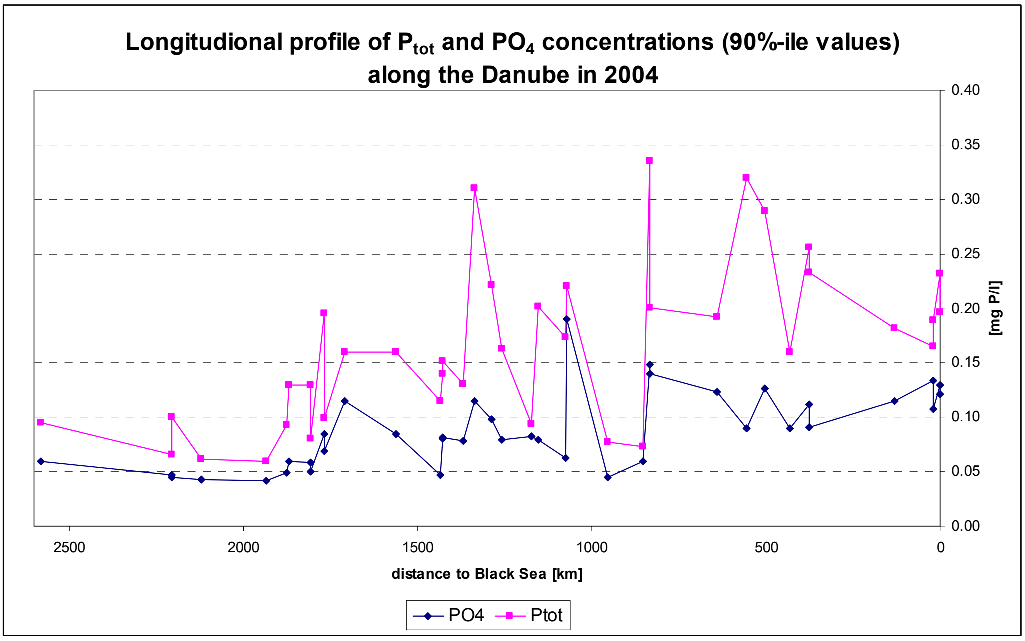
The 90%-ile values for PO_4 with 0.15 mg P/l are highest at rkm 834 Pristol/Novo Selo, with a good match of the Bulgarian and Romanian data.

Table 16 PO_4 concentrations (90%-ile values) at TNMN stations meeting the 'class boundary – 0.125' criterion (2004)

Section	rkm	Country	Location	Class boundary: high/good PO_4, 90%-ile [mg P/l]
4	1935	AT	Wien-Nussdorf	0.04
	1869	SK	Bratislava	0.06
	1806	HU	Medve/Medvedov	0.06
		SK	Medvedov/Medve	0.05
5	1768	HU	Komarom/Kedvedov	0.09
		SK	Komarno/Komarom	0.07
	1560	HU	Dunafoldvar	0.09
8	851	SC	Radujevac	0.06
	834	BG	Novo Selo Harbour/Pristol	0.15
		RO	Pristol/Novo Selo Harbour	0.14

Contrary to 2001, in 2004 there seems to be a clearer tendency of increasing concentrations in a downstream direction.

Figure 12 Longitudinal profile of P_{tot} and PO_4 along the Danube in 2004



5.5. Preliminary synthesis: first lessons-learned from applying the Austrian 1st proposed draft method

This section will be used for a preliminary wrap-up of the findings so far. The discussion in chapter 6 will extend on this.

5.5.1. General applicability to the mainstream of the Danube

The previous sections generally did not indicate any principle obstacles for applying the Austrian 1st proposed draft method as such to the mainstream of the Danube. The major lacking ingredients as experienced so far are considered to be first of all a matter of general implementation:

a) Benthic invertebrate fauna data covering the whole Danube River (and collected in a systematic way, in the same year) currently only are available for the year 2001, thanks to the first Joint Danube Survey. Considering the significance of benthic invertebrate fauna as a (and maybe even: the most important guiding) WFD quality element for assessment of the biological status of rivers, it will be merely a matter of time (and not: if) to expect a Danube-wide coverage.

b) No metrics for instance for 'high, good, moderate' status of the Danube River for -at least- benthic invertebrate fauna for the Danube River have been formulated and agreed upon so far. Also this will be merely a matter of time, since with the implementation of the WFD such (type-specific) metrics will be required anyway.

5.5.2. Extensions and/or deviations from the Austrian 1st proposed draft method

The underlying study needed to improvise in a number of occasions (read: sometimes extend on the methodology), which are enumerated and elaborated below.

5.5.2.1. Danube section types ⬄ water bodies

The underlying study elaborated data and statistics mainly per Danube section type. While implementing the principles of the Austrian 1st proposed draft method (that uses the typology of water bodies as a major binding principle) this approach as such did not appear to be contradictory.

Essentially, the current Danube's typology appears to coincide with a rather linear upstream-downstream direction (compare section 5.1.1). Therefore, it will first of all be a matter of detail to situate individual water bodies inside these section types. Finally it will be relevant that one will be able to distinguish the possible specific features of a water body, including besides its type-specific features characteristics like being 'at risk', 'heavily modified', et cetera.

Matching combinations of hydrobiological and physico-chemical quality elements finally only can be achieved by: a) actually combining monitoring these quality elements, or b) establishing proxy relationships, showing that selected number of sites/water bodies can be considered representative for others (e.g. by mean of clustering, compare 4.5).

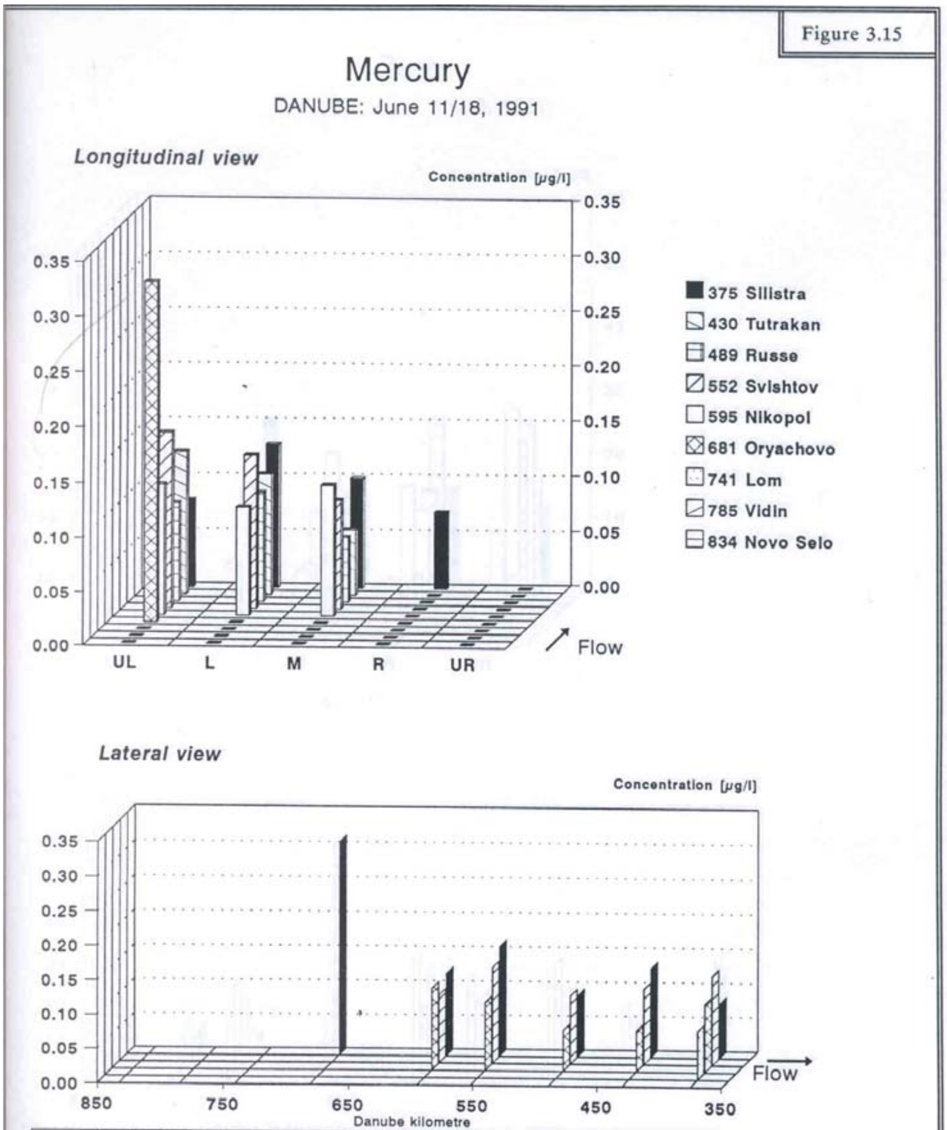
The designation of TNMN stations that are corresponding with the Danube Section Types may have to be fine-tuned. An example has been elaborated in section 5.2.1 for the TNMN Chiciu/Silistra at rkm 375. This station could be positioned in Section Type 9, but seems better to be headed inside Type Section 8.

Further investigations may be needed in order to determine which TNMN stations can be are considered as being (most) representative for the quality (status) inside their related Section Types. Firstly, some sections seem to be rather long compared to others (as mentioned in section 5.1.1, quoting [ICPDR, 2005] "*The smallest water body on the Danube is only 7 km long, the longest is 487 km.*"). Secondly, at some of the TNMN stations with two countries monitoring, substantial differences between the results of both countries can be observed.

5.5.2.2. Homogeneity over cross-sections

Partially extending on the previous subsection: the Danube finally simply becomes a large river, where emissions will need some time and distance to disperse. The figure below shows the results of a survey conducted during the year 1991 along the joint Bulgarian/Romanian stretch of the Danube [Buijs, Uzonov, Tsankov; 1992]. The mercury that apparently was discharged via the Jiul at rkm 692 on the left bank still could not be determined at right bank samples near Silistra, some 400 rkm's downstream.

Figure 13 Example of dispersion of substances in the Danube river: Bulgarian/Romanian stretch 1991



km	834	785	741	692	685	681	636	610	604	600	595	552	536	497	489	432	430	375
TR-L				1.48					0.00							0.11		
*EL											0.08				0.10		0.10	
UL	0.00	0.00	0.00			0.31					0.12	0.16			0.09		0.13	0.08
L	0.00	0.00	0.00			0.00					0.10	0.14			0.10		0.11	0.13
M	0.00	0.00	0.00			0.00					0.12	0.10			0.06		0.06	0.10
R	0.00	0.00	0.00			0.00					0.00	0.00			0.00		0.00	0.07
UR	0.00	0.00	0.00			0.00					0.00	0.00			0.00		0.00	0.00
*ER											0.00	0.00			0.00		0.00	0.00
TR-R					0.00		0.05	0.00		0.00			0.00	0.00				

5.5.2.3. Differences between monitoring results of countries

Several examples indicated that when countries are monitoring at the same TNMN cross section, the results can differ quite significantly (compare e.g. section 5.3.4.1). The underlying study was not able to go very much beyond noticing this observation. However, implications of course are more far-reaching than for the purposes of the underlying study only.

To which extent observed differences between countries at those sites where samples are taken jointly also may apply to other sites (where there is no direct way of comparing data) remains speculative, but nevertheless may be considered relevant an issue.

5.5.3. The calculated results

With applying the Austrian 1st proposed method to the years 2001 and 2004, some more generic observations can be made, like:

Few 'eligible' sites remained after applying the 'class boundary -0.125' criterion.

Although the 2004 Aquaterra SI's tended to be lower than those found during the JDS, no apparently lower 90%-ile values for NO_3, P_{tot} or PO_4 were found.

For Austria, in 2003 only one water type existed with a saprobic ground state of SI ≤ 2.00. The results for this type from the Austrian 1st draft method are summarised in the table below (compare also section 4.6).

Table 17 90%-values calculated for the Austrian bioregion FH, ground state SI ≤ 2.00; compared to study finding

	Austrian bioregion FH high status 90%-ile	Austrian bioregion FH good status 90%-ile		TNMN 2001 min – max 90%-ile	TNMN 2004 min – max 90%-ile
NO_3 [mg N/l]	4	5.5		1.3 – 3.7	1.3 – 3.8
PO_4 [mg P/l]	0.1	0.2		0.03- 0.68*	0.04 – 0.19
$P_{tot(fil)}$ [mg P/l]	0.2	0.25	P_{tot}	0.1 – 0.4**	0.1 – 0.3

* excluding rkm 851, SC, Radujevac, with a 90%-ile value of 1.19 mg PO_4_P/l

** excluding rkm 851, SC, Radujevac, with a 90%-ile value of 1.04 mg P/l

There is no easy way of comparing results, taking into account that:

> the results of the Austrian 1st proposed draft method did not include the Danube river as such ;

> the years do not match (2001 and 2004 for the underlying study, versus 2003 for the Austrian study);

> there seem to be concentration gradients in the longitudinal direction along the Danube.

Nevertheless, a general observation might be that the underlying study did not seem to have resulted in substantially higher values than those included in the Austrian proposed 1st draft method (compare 4.6; for the other ground states, the Austrian study resulted mainly in lower concentrations).

Since the underlying study results cannot be anchored properly (notably through the SI's), it remains a matter of speculation whether the calculated values correspond to high/good, good/moderate, or even moderate/poor quality class conditions.

5.6. Black Sea perspective

From a Danube point of view, the pollution of the Black Sea can be regarded as a 'none WFD type-specific criterion' when dealing with the issue of setting water quality standards. An example for a similar case has been introduced in section 3.2. At present, algal concentrations are not experienced as a problem in the Dutch part of the River Rhine. Nevertheless, target values for the River Rhine have been calculated in order to protect vulnerable waters in downstream lakes of its delta, including coastal waters [Liere *et.al.*, 2002].

This section will mainly focus on the (complementary) considerations for setting quality standards for the Danube River when taking the Black Sea into account. This issue as such goes far beyond the scope and reach of the underlying study. A dedicated programme like the daNUbs Research Project (within the 5th European Research Frame Work Program) has been dealing with the problem of eutrophication in coastal zones in regard to the Danube River Basin and the Black Sea coastal area influenced by the discharge of river Danube.

5.6.1. Summary of the daNUbs final report

This section contains selected text fragments from the Executive Summary of the daNUbs Final report [daNUbs, 2005] for orientation and reference purposes.

5.6.1.1. Introduction

The Danube is about 2,900 km long, and the river catchment of just over 800,000 km^2 covers 33 % of the Black Sea basin. It is the second largest river basin on European territory. Its average discharge of approximately 6,500 m^3/s, contributes 55% to the freshwater discharge to the Black Sea. The catchment area has a population of 82 Million, which is 43 % of the total population within the Black Sea basin. ... Mismanagement of nutrients in the Danube Basin has led to severe ecological problems: the deterioration of groundwater resources and the eutrophication of rivers, lakes and especially the Black Sea. These problems are directly related to social and economic issues (e.g. drinking water supply, tourism and fishery as affected sectors; agriculture, nutrition, industry and waste water management as drivers). In order to recommend proper management for the protection of the water system in the Danube Basin and the Black Sea, an interdisciplinary analysis of the Danube catchment area, the Danube River system and the mixing zone of the Danube River in the North-Western Black Sea needs to be carried out.

5.6.1.2. Objectives:

The main objectives of the daNUbs project are:

- *to improve the knowledge of the sources, pathways, stocks, losses and sinks of nutrients in a large river catchment,*
- *to improve the knowledge of the effects of nutrients (nitrogen, phosphorus and silica) on the receiving ecosystems with special emphasis on the coastal areas,*
- *to develop, improve and combine management tools for nutrients in the Danube Basin; and*
- *to develop scenarios for nutrient management and the effect on water quality and the consequences on the socio-economic development in the Danubian countries.*

..The project concentrates on the Danube as the main contributor to the nutrient pollution of the Western Black Sea shelf.

5.6.1.3. Scientific Achievements

… Historic data on water quality were used to calibrate the models. With the help of the models, data gaps could be closed. A number of indicators were derived from marine ecological data which can be used for efficient monitoring of the Black Sea coastal area status. The combination of modelling and ecological assessment of Black Sea coastal waters influenced by the Danube (including cruise investigations and satellite imaging) allowed the definition of critical loads with a certain range of uncertainty. The strong variations of nutrient discharges over the last 40 years caused by severe political and economical changes were essential for this achievement which is of great importance for management decisions. …

5.6.1.4. Results

The situation in the North-Western Black Sea shallow waters has improved considerably since the early 90s due to reduced nutrient inputs, causing:

- *reduced eutrophication, (reduced phytoplankton biomass, frequency of blooms and extension of high chlorophyll area),*
- *considerable increase in water transparency*
- *improvement of near bottom oxygen regime,*
- *regeneration of phytoplankton species (Diatoms) diversity,*
- *regeneration of phytobenthos,*
- *regeneration of macrozoobenthos (increase of species number and diversity).*

Zooplankton community in the North-western and Western Black Sea is still controlled by the gelatinous macrozooplankton (Mnemiopsis, Aurelia, Pleurobrachia), with respective consequences on the recovery of the pelagic fish stocks. The limiting factor for phytoplankton growth in the eutrophic areas of the N-W-Black Sea is phosphorus (since 1997). In the off shore waters mainly nitrogen limits the primary productivity. As a consequence, the control of easily available P loads from Danube Basin directly control algae growth in N-W-Black Sea shallow waters.

The improvement of the coastal area is a result of decreasing nutrient discharges (especially phosphorus) to this part of the Black Sea. Current low discharges of N and P to the Black Sea by Danube river are the result of

- *improved nutrient removal from waste water in Germany, Austria and the Czech Republic*
- *reduced phosphate discharges from detergents and*
- *the consequence of the economic crisis in central and eastern European countries which lead to: closure of large animal farms (agricultural point sources, dramatic decrease of the application of mineral fertilizers and closure of nutrient discharging industries (e.g. fertilizer industry).*

5.6.1.5. Conclusions

For a sustainable development of the Western Black Sea ecosystem the nutrient discharge from the Danube River should be further reduced but at least kept at its present level. Scenario calculations clearly show that the economic development in the Danube Basin may reverse the improving situation of the quality of the North-Western and Western Black Sea ecosystem, if nutrients are not managed properly. Policy measures have to be proactive and should focus on continuous and long term control of all anthropogenic point and diffuse sources of nutrients (waste water management, agriculture, combustion processes). … Monitoring the effects of nutrient management in the river

Danube and the Black Sea is important but it has to be taken into account that there is a time lag (up to > 20 years) between cognition of deficiencies, implementation of control measures and corresponding effects in the river Danube.

5.6.2. Critical loads

The above summary above introduced the term "critical loads"; more details are included in the boxout below. For the underlying study the following are considered to be important implications:

- the critical loads appear to relate to total-nitrogen and total-phosphorous;
- the critical loads appear annual mean data (concentrations, flows).

Intermezzo: 3.3.2.4. Determination of Critical Loads for Danube Discharges to Western Black Sea. Excerpts from [daNUbs, 2005]

The determination of the amount of river borne nutrients, which can be disposed to a marine ecosystem without harm, requires a solid background knowledge about the system questioned. This includes the original state of the ecosystem before anthropogenic pollution, the kind of pollution in the river and its impact on the marine environment; the kind and extent of damage to the ecosystem under pollution stress, which in turn requires a definition of " harm to the ecosystem" as well as the size and location of the ecosystem. In the Danube - Black Sea system some of these background information exist due to the fact that there has been a strong increase in pollution since the early 1960s and a decrease in nutrient loads since the early 1990s, a period from which valuable data series and descriptions of the Black Sea ecosystem exist. In addition in the frame of the EU-daNUbs project, considerable knowledge of the source, kind and amount of riverine nutrients and of the status quo of the North-Western Black Sea shallow waters (here considered as the most sensitive part of the ecosystem) has been obtained.

With this information we can consider the Danube nutrient loads in the early 1960s as tolerable, because there was no reported damage to the N-W Black Sea shallow water ecosystem. However, we observed a considerable improvement in the N-W Black Sea shallow waters after the late 1990s (reduced dissolved nutrients off the Danube Delta, reduced phytoplankton blooms, strongly improved near bottom oxygen regime, considerable increase in benthic macro fauna). Finally in 2002 and 2004 we observed an extended recovery of epibenthic flora and fauna in the N-W Black Sea shallow waters which is a proof of the absence of long lasting anoxic conditions in this region. On the basis of the results in can be concluded that with the present nutrient loads the N-W Black Sea ecosystem is capable to recover.

When considering hypoxia and its consequences as the main hazard to the marine environment of the N-W Black Sea, phytoplankton biomass production is the determining factor. Phytoplankton primary productivity in the river water influenced eutrophic area off the Danube Delta since the late 1990s appears to be phosphorous limited. Consequently the phosphorous loads determine the "environmental quality" of this region. Therefore the present Danube phosphorous loads, which are of a similar magnitude as those of the late 1960s, may be considered as "tolerable loads" to be disposed for a sustainable N-W Black Sea environment.

However, there are several limitations as to this "statement": The Black Sea environment is subject to continuous alterations as abiotic and biotic factors are concerned. This includes e.g. global warming and atmospheric changes, introduction of foreign species or over fishing. These factors and their influence on the ecosystem and consequently on nutrient depending production processes can be hardly predicted.

5.6.3. Nitrogen

The daNUbs project results indicate that both P and N compounds will be relevant for the Black Sea: "*The limiting factor for phytoplankton growth in the eutrophic areas of the N-W-Black Sea is phosphorus (since 1997). In the off shore waters mainly nitrogen limits the primary productivity"* [daNUbs, 2005; compare also the boxout in the previous section].

When dealing with nitrogen compounds, one normally deals with Dissolved Inorganic Nitrogen (DIN) compounds on the one hand (NO_3, NO_2, NH_4), and organic nitrogen at the other hand[11], with total nitrogen supposed to be the sum of DIN + organic N.

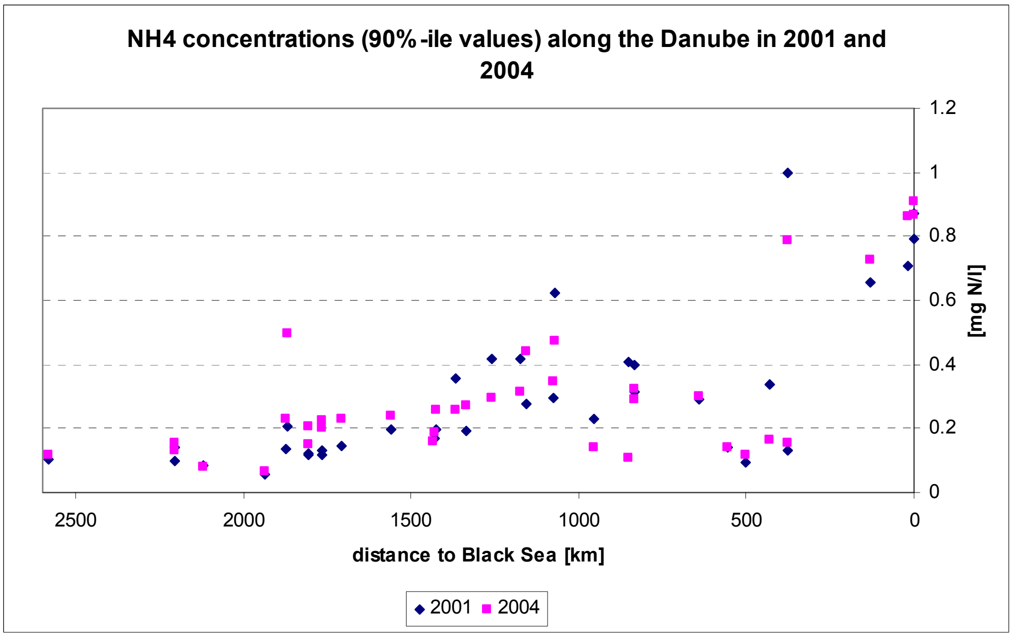
For pollution of marine waters by nutrients, nitrogen conditions often are expressed as Dissolved Organic Nitrogen (DIN), comprising the sum of NO_3, NO_2 and NH_4. The daNUbs reports address nitrogen compounds in both ways, sometimes discriminating DIN from N_{tot}.

5.6.3.1. Dissolved Inorganic Nitrogen: NO_3, NH_4 and NO_2

In the Austrian 1st proposed method of 2005, NH_4 and NO_2 are considered as potentially harmful (toxic) substances. For this reason, no type-specific standards were calculated as such. For the mainstream of the Danube (as well as the Danube tributaries) similar arguments could be used, except for the following: the input of nitrogen compounds into the Black Sea.

In section 5.3.4 the tendency of decreasing NO_3 concentrations in the downstream direction has been mentioned. For NO_2 and NH_4, the situation actually seems to be pointing into an opposite direction: concentrations tending to increase in the downstream direction. Compare for instance the graph below.

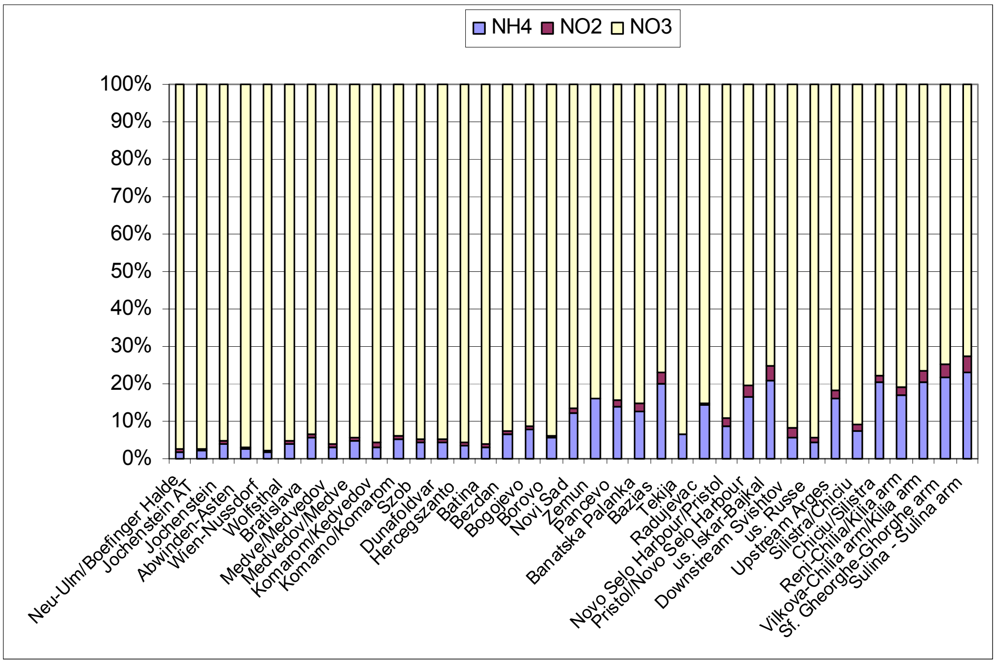
Figure 14 Longitudinal profile of NH_4 concentrations (90%-ile values) along the Danube in 2001 and 2004.



For the graph below, the TNMN data for NO_3, NO_2 and NH_4 have been added together as DIN per date and site of sampling (in case one of the nitrogen compounds were lacking, the data were omitted) for the years 2001.

11 Often, Kjeldahl-nitrogen is reported in this context, basically comprising the sum of organic nitrogen **plus** ammonium (NH_4)

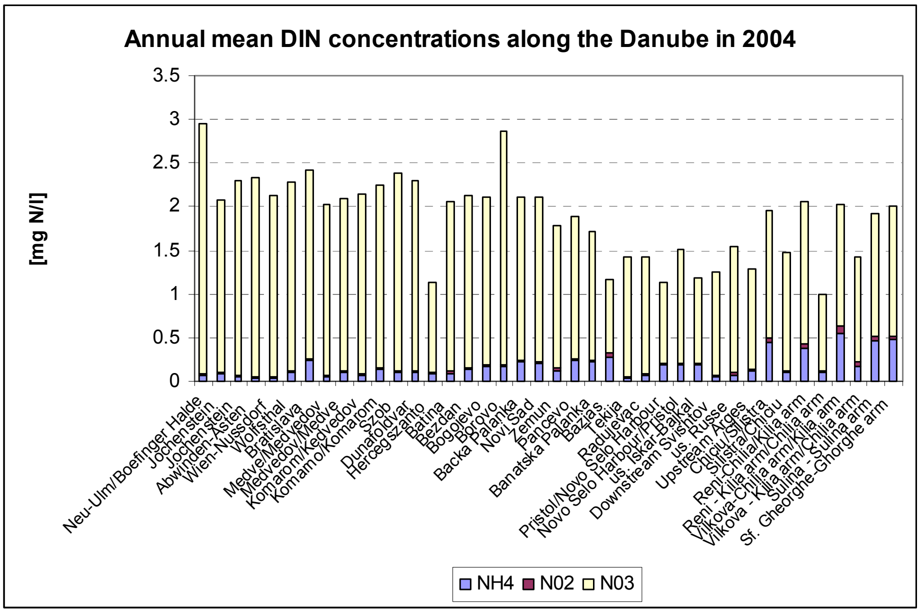
Figure 15 Average ratio of NO_3, NO_2 and NH_4 in DIN along the Danube in the year 2001



The amount of NH_4 in the DIN can be more than 20%.

A similar pattern seems to reveal itself in 2004, as shown in the graph below.

Figure 16 DIN concentrations (NO_3+NO_2+NH_4) along the Danube in the year 2004



5.6.3.2. Organic nitrogen

The available data for organic nitrogen for the year 2001 are summarised in the table below. Please notice that at Medve/Medvedov and Komarom/Kedvedov the Hungarian concentrations are substantially higher than the Slovakian is and also deviate from those found at the other TNMN stations.

Table 18 2001 annual mean organic nitrogen concentrations

section	rkm	Country	Location	organic nitrogen [mg N/l]
4	1869	SK	Bratislava	0.3
	1806	HU	Medve/Medvedov	1.6
	1806	SK	Medvedov/Medve	0.4
5	1768	HU	Komarom/Kedvedov	1.9
	1768	SK	Komarno/Komarom	0.4
	1708	HU	Szob	0.2
6	1435	HU	Hercegszanto	0.3
	1429	HR	Batina	0.3
	1337	HR	Borovo	0.2

In 2004, more TNMN monitoring stations included organic nitrogen in their monitoring programmes.

Table 19 2004 annual mean organic nitrogen concentrations

Section	**Rkm**	**Country**	**Location**	**Organic nitrogen [mg N/l]**
4	1869	SK	Bratislava	0.4
	1806	HU	Medve/Medvedov	0.9
		SK	Medvedov/Medve	0.3
5	1768	HU	Komarom/Kedvedov	0.7
		SK	Komarno/Komarom	0.4
	1708	HU	Szob	0.0
6	1435	HU	Hercegszanto	0.3
	1429	HR	Batina	0.3
	1427	SC	Bezdan	0.4
	1367	SC	Bogojevo	0.5
	1337	HR	Borovo	0.3
	1287	SC	Backa Palanka	0.9
	1258	SC	Novi Sad	0.7
	1174	SC	Zemun	1.1
	1154	SC	Pancevo	1.4
	1076	SC	Banatska Palanka	0.6
7	954	SC	Tekija	0.8
8	851	SC	Radujevac	0.7
	503	BG	us. Russe	1.4
9	375	BG	Silistra/Chiciu	1.6

5.6.3.3. Concluding remarks

There seem to be insufficient data available to evaluate the pollution of the (North-Western shelf) of the Black Sea in terms of setting water quality objectives, while taking into account the requirements of setting type-specific quality nutrient standards for the Danube river as well.

Data for DIN for the years 2001 and 2004 indicate NO_3 concentrations to decrease and NH_4 concentrations to be increasing in an upstream - downstream direction. With organic-nitrogen data only becoming monitored at more TNMN stations in 2004 (albeit only still up to rkm 375), no substantiated statements can be formulated here yet.

5.6.4. Phosphorous

For both P_{tot} and PO_4, monitoring data basically already are available through the TMNM network, including locations near to the Danube's discharge at the Black Sea.

5.6.5. Critical loads versus 90%-ile concentrations

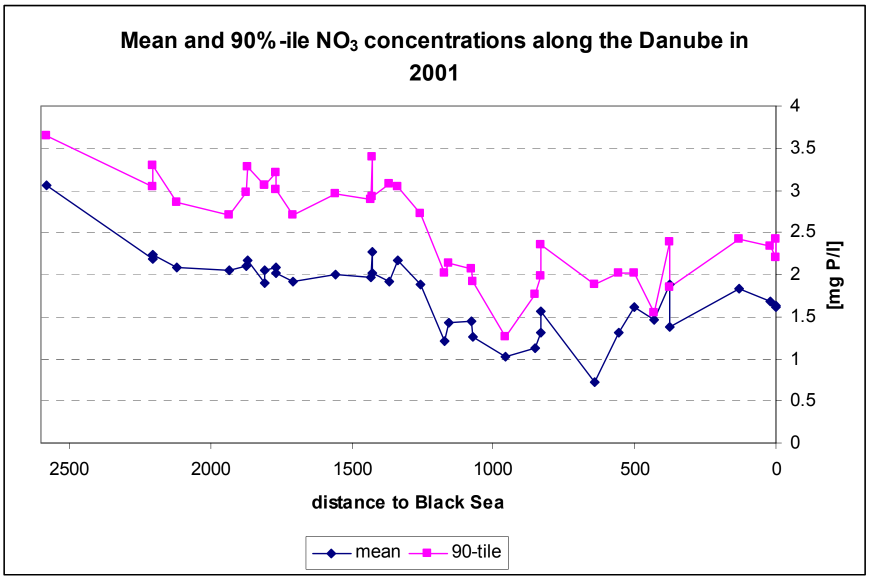
Setting type-specific standards criteria for the Danube River, while taking into account the potential impact of the Danube on the Black Sea, will not be an exercise that automatically grants both purposes.

Several methods can be applied for calculating river loads, ranging from using momentary concentration–times-flow based observations up to annual averaged concentration-times-flow based approaches. For the calculation of (critical) loads, one though cannot use 90%-ile concentrations as such.

The data collected at the most downstream monitoring sites will become most decisive. They will have to comply with methods like the Austrian 1st proposed method as well as providing a proper basis for load calculations. Implying that for setting quality objectives for more upstream situated Danube locations, one may have to take several 'downstream factors' into account as well, like loads expected to be discharged into the Black Sea.

Possible implications can be derived from annex 4, which includes a wider range of statistics for most nutrients at the TNMMN sites for 2001 and 2004. An example is shown in the graph below; annual average NO_3 concentrations in 2001 can be lower than the associated 90%-ile values as much as ranging from 0.1 through 0.8 up to 1.2 mg N/l!

Figure 17 Mean and 90%-ile NO_3 concentrations along the Danube in 2001



6. DISCUSSION

6.1. Benthic invertebrate fauna

The 1st proposed Austrian method heavily depends on data for benthic invertebrate fauna[12].

6.1.1. Data availability

Except for the Joint Danube Survey there are no data encompassing the whole Danube. The TNMN network includes benthic invertebrate fauna only from rkm 2581 Neu-Ulm/Boefinger Halde up to 1435 Hercegszanto (status in 2004). The Aquaterra survey of 2004 covered a limited stretch (between rkm 1942, Klosterneuburg and rkm 795, Calafat).

Because of the limited availability of data, it is not yet possible to investigate the possible differences for instance between years. When comparing the overlapping stretches of JDS and Aquaterra, the data suggested for instance a better hydrobiological quality in 2004 according to the SI's but also higher 90%-ile NO3 concentrations. Without more years of observations it will remain unclear to which extent for instance temporal variations will affect the results.

A good example furthermore is provided with Table 12. For overlapping sites, the status near several TNMN stations would be qualified as 'high' status according to the Aquaterra results (old version German SI index), while with the TNMN monitoring data the status would qualify as 'good'.

6.1.2. Quality status: metrics & index

An important assumption for the underlying study has been to apply a SI of ≤2.00 as the class boundary for high status for the whole of the Danube, also since herewith the remaining metrics (for good, moderate, et cetera) were set. It is obvious that under different baselines also the related quality classes can be expected to be different. Compare for instance the intermezzo in section 5.1.2 which shows that under the Austrian standards ÖNORM M 6232 quality classes are essentially quite different

The Aquaterra survey illustrates the importance of the method for calculation of the Saprobic Index. Calculating the SI according to the 'old' and the 'new' German versions would lead to a different status assigned to several of the sampling sites (compare section 5.4.1).

6.1.3. The 'class boundary – 0.125' criterion

Since it is part of the Austrian 1st proposed method it has been decided not to deviate from the principle to select only those sites with an SI within 0.125 units for the class boundary, despite the fact that after applying the criterion relatively few sites remained (compare sections 5.3 and 5.4).

As more general remarks one could raise as a question whether such a strict criterion is suited to such a dynamic environment like the Danube. From a methodological point of view, the criterion is considered to be sound and relevant, but as shown in practice can complicate affairs. Only after having obtained more data sets (especially: more benthic invertebrate fauna data that can be linked with the TNMN monitoring stations) there could be sufficient material to evaluate and possibly adjust this criterion.

Meanwhile, by using expert judgements one may consider including the results of the 'non-eligible' sites as well while assessing the overall picture.

[12] Exercises using e.g. phytoplankton and fish are under preparation in Austria.

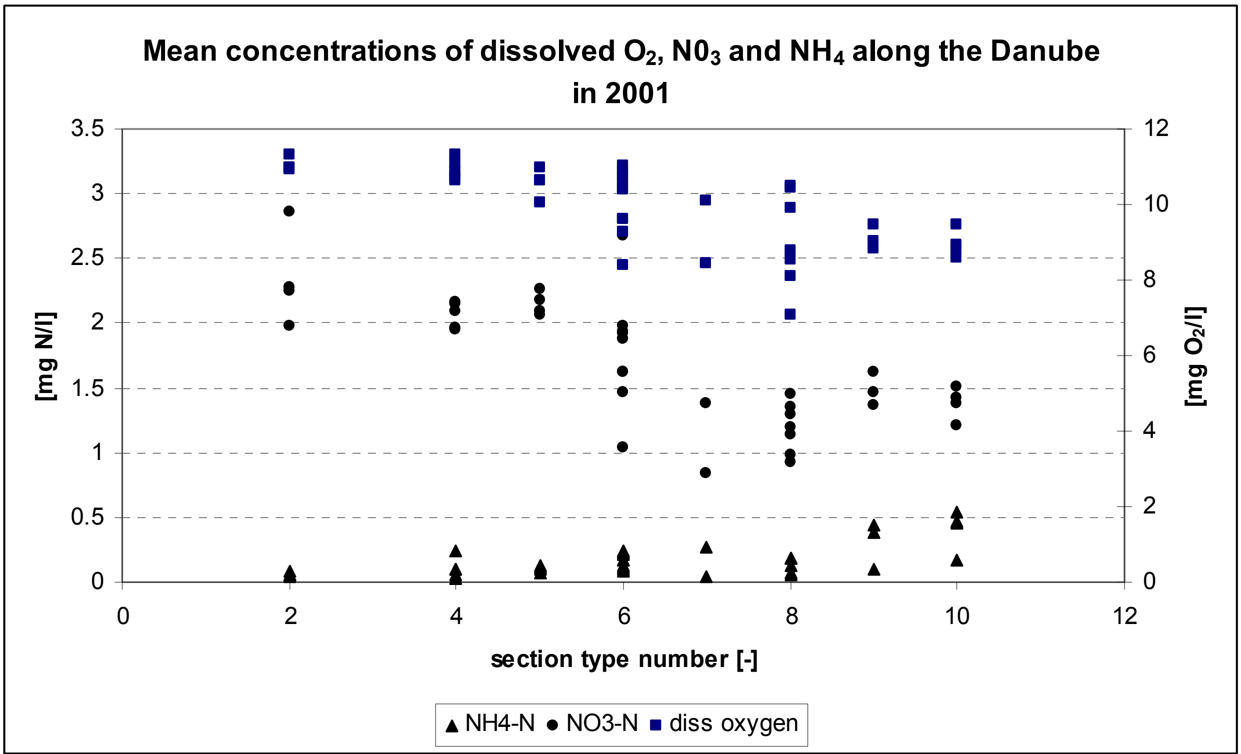
6.2. Physico-chemical data

6.2.1. Physico-chemical 'finger-printing' of the Danube Section Types

In the preceding study "Einteilung Österreichischer Fliessgewässer nach allgemein-chemischen Parametern", Kreuzinger and Deutsch combined the phsyco-chemical monitoring data and the various surface water types as a first step to determining type-specific class boundaries for physico-chemical quality elements [Kreuzinger, Norbert; Deutsch, Karin, 2003)]. With the Austrian 1st proposed draft method of 2005, the authors mention to have abandoned this approach in favour of the hydrobiologically based method (compare chapter 4).

It will be useful to conduct a comparable study dedicated to analysing the physico-chemical TNMN monitoring data (and adding at least quantitative parameters like flow) within the various Danube Section Types with the purpose of investigating their physico-chemical characteristics.

For example: the 2001 and 2004 data indicate a difference in NO3 concentrations between the upper and the lower reaches. The figure below shows the data for dissolved oxygen, nitrate and ammonium for the year 2001. The pattern for dissolved oxygen and nitrate show lower values in the lower reaches, while the ammonium concentrations there tend to be higher[13].



Whether these phenomena are expressions of accumulated (organic) pollution or indeed from more type-specific differences partially might be revealed by examining and cross-linking the various physico-chemical parameters. Information on pollution sources and inflow of tributaries are to be included in the assessment and interpretation of results.

[13] The 'turning point' seems to be section type 7, which includes the Iron Gate reservoir.

6.2.2. Different monitoring results between countries

Several examples indicate that two countries can report quite different results at the same TNMN cross section (compare for example the intermezzo in section 5.3.4.1). When finding such differences at one TNMN station, one may wonder how such differences possibly also can affect data of surrounding stations where there is only one monitoring country. It is obvious that such differences can have far-reaching implications when assessing the water quality or when conducting studies like the underlying one. It is not within the reach of the underlying study to go beyond the mere noticing of the possible existence of such differences.

6.3. The calculated 90%-iles

6.3.1. Robustness of the results

Also taking into account the various remarks in the previous sections and chapters, one has to conclude that the basis of the exercises of the underlying study has been too fragile to use the results already in more absolute terms (like as fixed quality standards for nutrients).

As a parallel, the situation could be described like 'measuring the water temperature with an uncallibrated thermometer'. Although one knows that the thermometer as such measures the temperature, one cannot say exactly how warm or cold the water is since the reference point of the thermometer is not known and the differences in temperature along the scalar units on the thermometer are not yet defined.

For example: the tables in Annex 3 contain results under the 'high/good' and 'good/moderate' status column for 2001 and under the 'high/good' status columns for 2004. By comparison, the 90%-ile values appear to be merely the same. Taking into account the Saprobic Index according to the TNMN data for 2004 at the matching Aquaterra sites, then these sites would have been qualified as 'good' status, in stead of 'high'. The assignment of the status as such again is primarily based on the assumption of setting the ground state ('high status') at a SI of ≤2.00. The JDS report summarises the results of the macrozoobenthos as "*The saprobity of the Danube varied between water quality class II (moderately polluted) and II-III (critically polluted)*" [JDS 2003, section 4.2], using the ÖNORM M 6232 as the classification scheme. Which of course makes a difference with classifying most of the sites as being of 'good status'.

6.3.2. Type-specific features?

As mentioned in section 6.2 and chapter 5, for a parameter like NO_3 in 2001 and 2004, but seemingly also for P_{tot} and PO_4 in the year 2004, there appear to be noteworthy differences between the upstream and downstream parts (with section type 7 possibly somehow the turning point). Such observations already justify that for the mainstream of the Danube indeed a type-specific approach will be required (so, besides external factors like the Water Framework Directive). It should be added that the JDS 2001 data on benthic invertebrate fauna did not indicate a certain tendency in the development in the upstream- downstream direction.

Theoretically, the observed NO_3 trend in decreasing concentrations in the downstream direction might be interpreted as allowing for more pollution in the upstream sections. Of course, such should not be the conclusion. If only that more pollution upstream would imply possible larger problems in meeting the perceived more stringent conditions in the lower sections.

Even when dissecting the mainstream of the Danube in 10 different typological sections, it stills remain one continuous river. From this point of view, future derivations of type-specific quality standards should keep these inter-connections into mind.

6.4. Black Sea perspective

Section 5.6 introduced some additional considerations when establishing quality standards for the Danube River while also taking into account the pollution of the Black Sea. At least it will have to be verified whether 'good' status quality standards for the (lower part of the) Danube river also will safeguard pollution of the Black Sea. The daNUbs project as such seems to have provided with most (if not: all) necessary tools for doing so.

6.5. Closing remarks

Although the underlying study has not been able to produce already sound type-specific quality standards for nutrients in the Danube River, the exercise at least has shown the applicability of the Austrian 1st proposed method to the Danube.

Basically, the underlying study has not revealed any principle obstacles for applying the Austrian method, except for the current lack of monitoring benthic invertebrate fauna at a series of TNMN stations and not yet fully developed and agreed metrics like ecological quality ratios for benthic invertebrate fauna. Considering that monitoring of macrozoobenthos along the full stretch of the Danube and the development of metrics will have to be realised anyway, this may be first of all a matter of time

Meanwhile, in Austria activities are currently undertaken for further development of the method, including:

- a second round of the work repeated with data 2003-2005 to sharpen the criteria as well as to correlate imission data with other biological methods (trophic situation, fish data); in this round the "large rivers" will be implemented too;
- publishing of a corresponding project on lakes;

Activities are expected to be completed by summer 2006 [Deutsch & Kreuzinger, 2006].

The second Joint Danube Survey scheduled for 2007 provides an opportunity on short term to collect additional data that also can be used for the purposes of further development of type-specific nutrient water quality standards. The findings of the underlying study and the new reports expected for Austria may trigger inclusion of some additional measurements in the coming Joint Danube Survey.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

- The underlying study has identified the 1st draft method developed in Austria in 2005 as a promising candidate method for developing WFD-compliant, type-specific quality standards for nutrients in the Danube River. Other angles and/or approaches are deemed to be too complex to render useful results for the Danube River, at least on short term.
- The Austrian 1st draft proposed method as such could be applied to the mainstream of the Danube as well. Two important gaps though were identified while applying the Austrian 2005 1st draft method:
  - There is no routine monitoring of biological quality elements at all Transnational Monitoring Network (TNMN) sites. Monitoring for instance benthic invertebrate fauna so far has not been realised at all TNMN stations (status up to 2004).
  - No agreed metrics for assessing a WFD-compliant biological status are available for the Danube river yet.
- Because of these gaps, no conclusive type-specific quality standards could be developed yet, although the basic physico-chemical data as such seem to be available.
- A type-specific approach for establishing nutrient quality standards for the Danube River seems to be justified anyway. The 2001 and 2004 monitoring data indicate different characteristics for the ‘upper’ and ‘lower’ Danube reaches (with riverkilometre 1300, and possibly Iron Gates, seemingly a pivot).
- Applying the Austrian 1st draft proposed method not automatically will warrant meeting safeguarding the pollution of the Black Sea from inputs of nutrient via the Danube; additional checks and calculations will be required.

7.2. Recommendations

- Monitoring of biological quality elements should be introduced at all TNMN monitoring stations for at least: benthic invertebrate fauna and phytoplankton (including: chlorophyll-a).
- WFD-compliant and Danube Section Type’s specific metrics (Ecological Quality Ratios) for biological quality elements will have to be developed; otherwise a crucial basis for developing type-specific quality standards is missing.
- The available TNMN monitoring data should be examined and processed for ‘fingerprinting’ the current Danube Section Types.

REFERENCES

Andersen, Jens Møller; Dunbar, Michael ; Friberg, Nikolai (*editors*) 2004. Report on existing methods and relationships linking pressures, chemistry and biology in rivers. REBECCA WP4 Rivers Deliverable D6. December 2004. http://www.rbm-toolbox.net/docstore3/docstore_free.php?service=3&groupid=5

BLFUW, 2006. Summary report of the characterisation, impacts and economics analyses required by Article 5 - Austrian River Basins. Federal Ministry of Agriculture, Forestry, Environment and Water Management, Vienna, 2006. http://wasser.lebensministerium.at/article/archive/5659

Buijs, Paul; Uzonov, Yordan; Tsankov, Konstantin; 1992. Water quality profile of the Danube river along the Bulgarian-Romanian stretch (June 1991). ICWS-report 92.01. ICWS, Amsterdam, The Netherlands.

Buijs, Paul, 2003. Orientation on environmental quality standards for nutrients and other Danube specific priority substances.

CIW, 2002. Gedifferentieerde normstelling voor nutriënten in oppervlaktewateren. Methodiek voor het afleiden van gedifferentieerde normen voor fosfor en stikstof op stroomgebiedniveau. Commissie Integraal Waterbeheer, Den Haag, The Netherlands. June, 2002. http://www.rijkswaterstaat.nl/rws/riza/leidraad/pdf/Gedifferentieerde_normstelling.pdf

daNUbs, 2005. Nutrient Management in the Danube Basin and its Impact on the Black Sea. daNUbs. Final Report. Section 5: Executive Summary. Section 6: Detailed Report. Institute for Water Quality and Waste Management, Vienna University of Technology. Wien, Austria.

Deutsch, Karin; Kreuzinger, Norbert, 2005. Leitfaden zur typspezifischen Bewertung der allgemeinen chemisch/physikalischen Parameter in Fließgewässer. 1. Vorschlag September 2005. Bundesministerium für Land- und Fortwirtschaft, Umwelt und Wasserwirtschaft – Sektion VII. BMLFUW – UW.3.1.2./0013-VII/1/2005. Vienna, September 2005. http://wasser.lebensministerium.at/article/archive/5659

Deutsch & Kreuzinger, 2006. personal communication

DG Environment, 2005. Eutrophication Guidance (Eutrophication assessment in the context of European water policies); version 11, November 2005. EC-DG Environment D2 and Steering Group (DE, FI, NL, UK, EEA and JRC).

ECOSTAT, 2003. Overall Approach to the Classification of Ecological Status and Ecological Potential. Working Group 2 A Ecological Status (ECOSTAT), November 2003. http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents&vm=detailed&sb=Title

Heiskanen, Anna-Stiina; Solimini, Angelo G. (*editors*), 2005. Analysis of the current knowledge gaps for the implementation of the Water Framework Directive. REBECCA project. EUR 21497 EN. http://www.rbm-toolbox.net/docstore3/docstore_free.php?service=3&groupid=5

ICPDR, 2002. Joint Danube Survey. Technical Report of the International Commission for the Protection of the Danube River. September 2002. ICPDR, Vienna.

ICPDR, 2005. The Danube River Basin District. River basin characteristics, impact of human activities and economic analysis required under Article 5, Annex II and Annex III, and inventory of protected areas required under Article 6, Annex IV of the EU Water Framework Directive (2000/60/EC). Part A – Basin-wide overview. ICPDR, Vienna.

Kreuzinger, Norbert; Deutsch, Karin (2003) Einteilung Österreichischer Fliessgewässer nach allgemein-chemischen Parametern. Wiener Mitteilungen (2003) Band 183, 25-51. Institut für Wassergüte / TU-Wien

Kreuzinger, Norbert, 2005. Erarbeitung und Anwendung eines typspezifischen chemischen Bewertungsschemas für Fließgewässer in Österreich. Institut für Wassergüte, Technische Universität Wien. Vienna, July 2005. http://wasser.lebensministerium.at/article/archive/5659

Liere, E. van; Jonkers, D.A. (*editors*), 2002. "Watertypegerichte normstelling voor nutriënten in oppervlaktewater". RIVM rapport 703715005/2002. Bilthoven, the Netherlands, 2002 (in Dutch, with some parts translated into English; available at http://www.rivm.nl/bibliotheek/rapporten/703715005.html).

Moog, Otto; Schmidt-Kloiber, Astrid; Ofenböck, Thomas; Gerritsen, Jeroen, 2001. Aquatische Ökoregionen und Fließgewässer-Bioregionen Österreichs. Bundesministerium für Land - und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wasserwirtschaftskataster. Vienna, 2001. http://wasser.lebensministerium.at/article/archive/5659

REFCOND, 2003. Guidance on establishing reference conditions and ecological status class boundaries for inland surface waters. Produced by Working Group 2.3 Reference conditions for inland surface waters (REFCOND), 30 April 2003. http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents&vm=detailed&sb=Title

Solheim, Anne Lyche (*editor*), 2005. Reference Conditions of European Lakes. Indicators and methods for the Water Framework Directive Assessment of Reference conditions. Draft Version 5; Dec. 30, 2005. REBECCA D7. http://www.rbm-toolbox.net/docstore3/docstore_free.php?service=3&groupid=5

Sommerhäuser, Mario; Robert, Sabina; Birk, Sebastian; Hering, Daniel; Moog, Otto; Stubauer, Ilse; Ofenböck, Thomas, 2003. UNDP/GEF Danube Regional Project "Strengthening the implementation capacities for nutrient reduction and transboundary cooperation in the Danube River Basin". Activity 1.1.2 "adapting and implementing common approaches and methodologies for stress and impact analysis with particular attention to hydromorphological conditions"; Activity 1.1.6 "developing the typology of surface waters and defining the relevant reference conditions"; Activity 1.1.7 "implementing ecological status assessment in line with requirements of EU Water Framework Directive using specific bioindicators". FINAL REPORT. Vienna, Austria December, 2003. http://danubis.icpdr.org/undp-drp/

Stubauer, Ilse; Moog, Otto (2003). Integration of the Saprobic System into the WFD approach - A proposal for the the Danube River. 2nd Surface Water Workshop, Zagreb, 4-5 September 2003. http://danubis.icpdr.org/undp-drp/

US-EPA, 2000. Nutrient Criteria. Technical Guidance Manual Lakes and Reservoirs. First Edition. EPA-822-B00-001, April 2000. http://www.epa.gov/waterscience/criteria/nutrient/guidance/lakes/index.html

ANNEX 1: OVERVIEW OF TNMN, JDS AND AQUATERRA SAMPLING SITES WITHIN DANUBE'S SECTION TYPES

This annex contains the overview of the various sampling/monitoring sites along the mainstream of the Danube River included for the purposes of the underlying study. Please refer to section 5.2.1 for details.

The sites with **bold printed** typeface indicate a match between TNMN and JDS/AQUATERRA sampling sites.

Section Type №	**Reach**	**TNMN station(s) inside Section** [DEFF code; rkm; name]	**Nearest JDS sampling site(s)** [JDS code; rkm; name]	**Nearest AQUATERRA sampling site(s)** [AQUATERRA code; rkm; name]	**Remarks**
2	rkm 2581: Neu Ulm – rkm 2225: Passau	**TNMN L2140** **rkm 2581** **Neu-Ulm**	**JDS 01** **rkm 2591** **Neu-Ulm** *JDS02: rkm 2412, Kelheim* *JDS03: rkm 2358 Upstream dam Geisling (Regensburg)* *JDS04: rkm 2233 Upstream dam Kachlet (Passau)*		tributary Inn at rkm 2225
3	rkm 2225: Passau – rkm 2001: Krems	**TNMN L2130 (DE) / TNMN L2220 (AU)** **rkm 2204** **Jochenstein**	**JDS06** **rkm 2204, Jochenstein** *JDS07: rkm 2165, Upstream dam Aschach*		two sets of TNMN monitoring data
		TNMN L2200 **rkm 2120** **Abwinden-Asten**	**JDS08** **rkm 2120** **Upstream dam Abwinden-Asten** *JDS09: rkm 2096, Wallsee* *JDS10: rkm 2061, Upstream dam Ybbs-Persenbeug* *JDS11: rkm 1950, Upstream dam Greifenstein*		
4	rkm 2001: Krems – rkm 1789.5: Gönyű/Kližská Nemá	**TNMN L2180** **rkm 1935** **Wien-Nussdorf**	**JDS12** **rkm 1942, Klosterneuburg** *JDS14: rkm 1895, Wildungsmauer*	**ADS 1** **rkm 1942** **Klosterneuburg** *ADS 2: rkm 1895, Wildungsmauer*	
		TNMN L2170 rkm 1874 Wolfsthal	JDS15: rkm 1881, Upstream Morava (Hainburg)	ADS 3: rkm 1881, upstream Morava (Hainburg)	tributary Morava at rkm 1880
		TNMN L1840 **rkm 1869** **Bratislava**	**JDS17** **rkm 1869** **Bratislava** *JDS18: rkm 1856, Gabcikovo reservoir entrance* *JDS19: rkm 1852, Gabcikovo reservoir*	**ADS 4** **rkm 1869** **Bratislava** *ADS 5: rkm 1856, Gabcikovo reservoir entrance* *ADS 6: rkm 1852, Gabcikovo reservoir*	

Section Type №	**Reach**	**TNMN station(s) inside Section** [DEFF code; rkm; name]	**Nearest JDS sampling site(s)** [JDS code; rkm; name]	**Nearest AQUATERRA sampling site(s)** [AQUATERRA code; rkm; name]	**Remarks**
			JDS20: rkm 1846, Gabcikovo reservoir 2 *JDS21 rkm 1812, Sap (Outlet-channel)* *JDS22: rkm 1812, Ásványráró (old Danube)*	*ADS 7: rkm 1846, Gabcikovo reservoir 2*	
		TNMN L1470 (HU) **TNMN L1860 (SK)** **rkm 1806, Medvedov/Medve**	**JDS23** **rkm 1806** **Medvedov/ Medve**	**ADS 8** **rkm 1806** **Medvedov/Medve**	two sets of TNMN monitoring data
5	rkm 1789.5: Gönyű/ Kližská Nemá – rkm 1497: Baja	**TNMN 1475 (HU)** **TNMN L1870 (SK)** **rkm 1768** **Komarom/Komarno**	**JDS25** **rkm 1768** **Komarno/Komarom** *JDS27: rkm 1761, Iza/Szon* *JDS28, rkm 1719, Sturovo/Esztergom*	*ADS 9; rkm 1761 Iza/Szony*	two sets of TNMN monitoring data; tributary: Vah at rkm 1766; Hron at rkm 1716
		TNMN L1490 **rkm 1708** **Szob**	**JDS31** **rkm 1707** **Szob** *JDS32: rkm 1691, Upstream end of Szentendre Island* *JDS34: rkm 1659 Budapest upstream* *JDS37: rkm 1632, Budapest downstream* *JDS39: rkm 1586, Tass*	**ADS 10** **rkm 1707** **Szob** *ADS 11: rkm 1659, Budapest upstream* *ADS 12: rkm 1632, Budapest downstream*	tributary Ipel at rkm 1708
		TNMN L1520 **rkm 1560** **Dunafoldvar**	**JDS40** **rkm 1560** **Dunafoldvar** *JDS41: rkm 1533, Paks* *JDS43: rkm 1481, Baja*	**ADS 13** **rkm 1560** **Dunafoldvar**	tributary Sio at rkm 1497
6	rkm 1497: Baja – rkm 1075 : Bazias	**TNMN L1540** **rkm 1435** **Hercegszanto**	**JDS44** **rkm 1434** **Hercegszanto**	**ADS 14** **rkm 1434** **Hercegszanto**	
		TNMN L1315 **rkm 1429** **Batina**	**JDS45** **rkm 1429** **Batina**		
		TNMN L2350: rkm 1427, Bezdan	*JDS46: rkm 1384, Upstream Drava*		tributary Drava at rkm 1379
		TNMN L2360 **rkm 1367** **Bogojevo**	**JDS48** **rkm 1367** **Downstream Drava (Erdut/Bogojevo)** *JDS49: rkm 1355 Dalj*		
		TNMN L1320: rkm 1337, Borovo	*JDS50: rkm 1300, Ilak-Backa Palanka*		
		TNMN L2430: rkm 1278, Backa Palanka (2004)	*JDS51: rkm 1259, Upstream Novi Sad*	*ADS 15: rkm 1262, Upstream Novi-Sad*	
		TNMN L2370 **rkm 1258** **Novi Sad**	**JDS51** **rkm 1259** **Upstream Novi Sad** *JDS52: rkm 1252, Downstream Novi-Sad* *JDS53: rkm 1216,*	**ADS 15:** **km 1262** **Upstream Novi-Sad** *ADS 16: 1252 Downstream Novi-Sad* *ADS 17: rkm 1216,*	tributary Tisza

Section Type №	**Reach**	**TNMN station(s) inside Section** [DEFF code; rkm; name]	**Nearest JDS sampling site(s)** [JDS code; rkm; name]	**Nearest AQUATERRA sampling site(s)** [AQUATERRA code; rkm; name]	**Remarks**
			Upstream Tisa (Stari Slankamen) *JDS55: rkm 1202, Downstream Tisa/ Upstream Sava (Belegis)*	*Upstream Tisa (Stari slankamen)* *ADS 18: rkm 1200, Downstream Tisa/ Upstream Sava (Belegis)*	at rkm 1215
		TNMN L2380: rkm 1174, Zemun	*JDS57: rkm 1161, Upstream Pancevo/ Downstream Sava*	*ADS 19: rkm 1159, Upstream Pancevo/ Downstream Sava*	tributary Sava at rkm 1170
		TNMN L2390 **rkm 1154.8** **Pancevo**	**JDS58** **rkm 1151** **Downstream Pancevo** *JDS59: rkm 1132, Grocka* *JDS60: rkm 1107, Upstream Veliko Morava* *JDS62: rkm 1097, Downstream Veliko Morava*	**ADS 20** **rkm 1151** **Downstream Pancevo** *ADS 21: rkm 1107, Upstream Veliko Morava* *ADS 22: rkm 1097, Downstream Veliko Morava*	tributary Velika Morava at rkm 1103
		TNMN L2400 **rkm 1076.6** **Banatska Palanka**	**JDS63** **rkm 1077** **Starapalanka – Ram**	**ADS 23** **rkm 1077** **Starapalanka – Ram**	
7	rkm 1075: Bazias – rkm 943: Turnu Severin	**TNMN L0020** **rkm 1071** **Bazias**	**JDS64** **rkm 1071** **Banatska Palanka/Bazias** *JDS65: rkm 1040 Irongate reservoir (Golubac/Koronin)*	**ADS 24** **rkm 1071** **Banatska Palanka/ Bazias** *ADS 25: rkm 1040, Irongate reservoir (Golubac/ Koronin)*	
		TNMN L2410 **rkm 954,6** **Tekija**	**JDS66** **rkm 956** **Irongate reservoir (Tekija/Orsova)** *JDS67: rkm 943, Vrbica/Simijan*	**ADS 26** **rkm 955** **Irongate reservoir (Tekija/Orsova)** *ADS 26 C1: rkm 955, Irongate reservoir (Tekija/Orsova)* *ADS 26 C2: rkm 955, Irongate reservoir (Tekija/Orsova)* *ADS 27; rkm 926, Vrbica/Simijan*	
8	rkm 943: Turnu Severin – rkm 375.5: Chiciu/Silistra	**TNMN L2420** **rkm 851** **Radujevac**	**JDS68** **rkm 849** **Upstream Timok (Rudujevac/Gruia)**	**ADS 28** **rkm 849** **Upstream Timok (Rudujevac/Gruia)**	tributary Timok at rkm 845
		TNMN L009 (RO) **TNMN L0730 (BG)** **rkm 834** **Pristol / Novo Selo Harbour**	**JDS70** **rkm 834** **Pristol/ Novo Selo Harbour** *JDS71: rkm 795 Calafat* *JDS72: rkm 685, Downstream Kozloduy*	**ADS 29** **rkm 834** **Pristol/ Novo Selo Harbour** *ADS 30: rkm 795, Calafat*	two sets of TNMN monitoring data
		TNMN L0780 **rkm 642** **upstream Iskar-Bajkal**	**JDS73** **rkm 640** **Upstream Iskar (Bajkal)**		tributary Iskar at rkm 637 Olt at rkm 605

Section Type №	Reach	TNMN station(s) inside Section [DEFF code; rkm; name]	Nearest JDS sampling site(s) [JDS code; rkm; name]	Nearest AQUATERRA sampling site(s) [AQUATERRA code; rkm; name]	Remarks
			JDS75: rkm 629, Downstream Iskar *JDS76: km 606, Upstream Olt* *JDS78: rkm 602, Downstream Olt* *JDS79: rkm 579 Downstream Turnu-Magurele/Nikopol*		
		TNMN L0810 rkm 554 downstream Svishtov	**JDS80 rkm 550 Downstream Zimnicea/Svishtov** *JDS82: rkm 532, Downstream Jantra*		tributary Jantra at rkm 537
		TNMN L0820 rkm 503 upstream Russe	**JDS83 rkm 500 Upstream Ruse** *JDS85: rkm 488, Downstream Ruse/Giurgiu*		Russenski Lom at rkm 489
		TNMN L0240 rkm 432 upstream Arges	**JDS86 rkm 434 Upstream Arges** *JDS88: rkm 429, Downstream Arges, Oltenita*		tributary Arges at rkm 432
9	rkm 375.5: Chiciu/Silistra – rkm 100: Isaccea	**TNMN L0280 (RO), TNMN L0850 (BG) rkm 375 Chiciu/Silistra**	**JDS89: rkm 378, Chiciu/Silistra** *JDS90: rkm 295, Upstream Cernavoda* *JDS91: 231, Giurgeni* *JDS92: rkm 167, Braila*		two sets of TNMN monitoring data tributary Siret at rkm 154
		TNMN L0430 (RO) TNMN L0630 (UA) rkm 132 Reni - Chilia/Kilia arm	**JDS95 rkm 130 Reni - Chilia/Kilia arm**		two sets of TNMN data, one from RO and one from UA tributary Prut at rkm 135
10	rkm 100: Isaccea – rkm 20 on Chilia arm, rkm 19 on Sulina arm and rkm 7 on Sf. Gheorghe arm	TNMN L0450 (RO) TNMN L0690 (UA) rkm 18 Vilkova - Chilia arm/Kilia arm	*JDS96: rkm 56, Kilia arm*		two sets of TNMN data, one from RO and one from UA
		TNMN L0490: rkm 0, Sf. Gheorghe – Ghorghe arm	*JDS98: rkm 64, St. George arm*		
		TNMN L0480: rkm 0, Sulina - Sulina arm	**JDS97: rkm 12, Sulina arm**		

ANNEX 2: OVERVIEW OF SELECTED JDS AND AQUATERRA SAMPLING SITES FOR FURTHER DATA PROCESSING FOR THE UNDERLYING REPORT

Selected JDS / TNMN stations

JDS_code	TNMN_code	Name	rkm	Section Type №
JDS01	L2140	Neu-Ulm	2581	2
JDS06	L2130 (DE) / L2220 (AU)	Jochenstein	2204	3
JDS08	L2200	Upstream dam Abwinden-Asten	2120	
JDS12	L1860	Wien-Nussdorf (JDS: Klosterneuburg)	1935	4
JDS17	L1840	Bratislava	1869	
JDS23	L1470 (HU) / L1860 (SK)	Medvedov/Medve	1806	
JDS25	L1475 (HU) / L1870 (SK)	Komarom/Komarno	1768	5
JDS31	L1490	Szob	1708	
JDS40	L1520	Dunafoldvar	1560	
JDS44	L1540	Hercegszanto	1435	6
JDS45	L1315	Batina	1429	
JDS48	L2360	Downstream Drava (Erdut/Bogojevo)	1367	
JDS51	L2370	Upstream Novi Sad	1258	
JDS58	L2390	Downstream Pancevo	1155	
JDS63	L2400	Starapalanka - Ram	1077	
JDS64	L0020	Banatska Palanka/Bazias	1071	7
JDS66	L2410	Tekija	955	
JDS68	L2420	Upstream Timok (Rudujevac/Gruia)	851	8
JDS70	L009 (RO) / L0730 (BG)	Pristol/Novo Selo Harbour	834	
JDS73	L0780	Upstream Iskar (Bajkal)	642	
JDS80	L0810	Downstream Zimnicea/Svishtov	554	
JDS83	L0820	Upstream Ruse	503	
JDS86	L0240	Upstream Arges	432	
JDS89	L0280 (RO) / L0850 (BG)	Chiciu/Silistra	375	9
JDS95	L0430	Reni - Chilia/Kilia arm	132	
JDS97	L0480 (RO)	Sulina arm	12	10

Selected AQUATERRA / TNMN stations

AQUATERRA code	TNMN code	TNMN [rkm]	TNMN name	Section Type №
ADS 1	L2180	1935	Wien-Nussdorf	4
ADS 4	L1840	1869	Bratislava	
ADS 8	L1470 (HU) / L1860 (SK)	1806	Medvedov/Medve	
ADS 9	L1475 (HU) / L1870 (SK)	1768	Komarom/Komarno	5
ADS 10	L1490	1708	Szob	
ADS 13	L1520	1560	Dunafoldvar	
ADS 14	L1540	1435	Hercegszanto	6
ADS 15	L2370	1258	Novi Sad	
ADS 20	L2390	1155	Pancevo	
ADS 23	L2400	1077	Bantska Palanka	
ADS 24	L0020	1071	Bazias	7
ADS 26	L2410	955	Tekija	
ADS 28	L2420	851	Radujevac	8
ADS 29	L0090 (RO) / L0730 (BG)	834	Pristol/Novo Selo	

ANNEX 3: 90%-ILE CONCENTRATIONS FOR THE YEARS 2001 AND 2004

90%-ile concentrations for the years 2001 and 2004: NO3 [mg N/l]

				2001				2004			
Section	km	Country	Location	high / good	good / moderate	nm	nmz	high / good	good / moderate	nc	nmz
2	2581	DE	Neu-Ulm/Boefinger Halde	3.7							3.8
3	2204	AT	Jochenstein		3.3						3.8
		DE	Jochenstein		3.1						3.0
	2120	AT	Abwinden-Asten		2.9						3.5
4	1935	AT	Wien-Nussdorf			2.7		3.3			
	1874	AT	Wolfsthal				3.0				3.3
	1869	SK	Bratislava			3.3		3.5			
	1806	HU	Medve/Medvedov			3.1		3.1			
		SK	Medvedov/Medve			3.1		2.9			
5	1768	HU	Komarom/Kedvedov			3.2		3.3			
		SK	Komarno/Komarom			3.0		3.1			
	1708	HU	Szob			2.7				3.6	
	1560	HU	Dunafoldvar			3.0		3.8			
6	1435	HU	Hercegszanto		2.9					2.8	
	1429	HR	Batina			3.4					2.4
	1427	SC	Bezdan				2.9				3.2
	1367	SC	Bogojevo		3.1						3.0
	1337	HR	Borovo				3.0				3.4
	1297	SC	Backa Palanka							2.9	
	1258	SC	Novi Sad			2.7				3.0	
	1174	SC	Zemun				2.0				2.2
	1154.8	SC	Pancevo			2.1				2.5	
	1076.6	SC	Banatska Palanka			2.1				2.0	
7	1071	RO	Bazias			1.9				1.4	
	954.6	SC	Tekija			1.3				2.4	
8	851	SC	Radujevac			1.8		2.3			
	834	BG	Novo Selo Harbour/Pristol			2.3		2.3			
		RO	Pristol/Novo Selo Harbour			2.0		1.3			
	641	BG	us. Iskar-Bajkal			1.9					2.2
	554	BG	Downstream Svishtov				2.0				1.6
	503	BG	us. Russe			2.0					2.1
	432	RO	Upstream Arges			1.6					1.3
9	375	BG	Silistra/Chiciu			1.9					2.2
		RO	Chiciu/Silistra			2.4					2.4
	132	RO	Reni-Chilia/Kilia arm				2.4				2.4
10	18	RO	Vilkova-Chilia arm/Kilia arm				2.3				2.3
		UA	Vilkova - Kilia arm/Chilia arm								1.4
	0	RO	Sf. Gheorghe-Ghorghe arm				2.4				2.3
		UA	Sulina - Sulina arm			2.2					2.2

***NM**= not meeting 'class boundary – 0.125' criterion; **NMZ**: no matching JDS or AQUATERRA macrozoobenthos sites*

90%-ile concentrations for the years 2001 and 2004: NH4 [mg N/l]

				2001				2004			
Section	rkm	Country	Location	high/good	good/moderate	nm	nmz	high/good	good/moderate	nm	nmz
2	2581	DE	Neu-Ulm/Boefinger Halde	0.11							0.12
3	2204	AT	Jochenstein		0.10						0.13
		DE	Jochenstein		0.14						0.16
	2120	AT	Abwinden-Asten		0.08						0.08
4	1935	AT	Wien-Nussdorf			0.06		0.07			
	1874	AT	Wolfsthal				0.14				0.23
	1869	SK	Bratislava			0.21		0.50			
	1806	HU	Medve/Medvedov			0.12		0.15			
		SK	Medvedov/Medve			0.12		0.21			
5	1768	HU	Komarom/Kedvedov			0.13		0.20			
		SK	Komarno/Komarom			0.12		0.23			
	1708	HU	Szob			0.14				0.23	
	1560	HU	Dunafoldvar			0.20		0.24			
6	1435	HU	Hercegszanto		0.17					0.16	
	1429	HR	Batina			0.17					0.19
	1427	SC	Bezdan				0.20				0.26
	1367	SC	Bogojevo		0.35						0.26
	1337	HR	Borovo				0.19				0.27
	1287	SC	Backa Palanka							0.41	
	1258	SC	Novi Sad			0.42				0.30	
	1174	SC	Zemun				0.42				0.31
	1154.8	SC	Pancevo			0.28				0.44	
	1076.6	SC	Banatska Palanka			0.29				0.35	
7	1071	RO	Bazias			0.62				0.47	
	954.6	SC	Tekija			0.23				0.14	
8	851	SC	Radujevac			0.41		0.11			
	834	BG	Novo Selo Harbour/Pristol			0.31		0.29			
		RO	Pristol/Novo Selo Harbour			0.40		0.32			
	641	BG	us. Iskar-Bajkal			0.29					0.30
	554	BG	Downstream Svishtov				0.14				0.14
	503	BG	us. Russe			0.09					0.12
	432	RO	Upstream Arges			0.34					0.17
9	375	BG	Silistra/Chiciu			0.13					0.15
		RO	Chiciu/Silistra			1.00					0.79
	132	RO	Reni-Chilia/Kilia arm				0.65				0.73
10	18	RO	Vilkova-Chilia arm				0.71				0.86
		UA	Vilkova - Kilia arm								0.30
	0	RO	Sf. Gheorghe-Ghorghe arm				0.79				0.87
		UA	Sulina - Sulina arm			0.87					0.91

***NM**= not meeting 'class boundary – 0.125' criterion; **NMZ**: no matching JDS or AQUATERRA macrozoobenthos sites*

90%-ile concentrations for the years 2001 and 2004: NO2 [mg N/l]

				2001				2004			
Section	Rkm	Country	Location	high/good	good/moderate	nm	nmz	high/good	good/moderate	nm	nmz
2	2581	DE	Neu-Ulm/Boefinger Halde	0.03							0.03
3	2204	AT	Jochenstein		0.01						0.02
		DE	Jochenstein		0.03						0.02
	2120	AT	Abwinden-Asten		0.02						0.02
4	1935	AT	Wien-Nussdorf			0.02		0.03			
	1874	AT	Wolfsthal				0.03				0.04
	1869	SK	Bratislava			0.03		0.03			
	1806	HU	Medve/Medvedov			0.03		0.03			
		SK	Medvedov/Medve			0.03		0.03			
5	1768	HU	Komarom/Kedvedov			0.04		0.03			
		SK	Komarno/Komarom			0.03		0.03			
	1708	HU	Szob			0.03				0.03	
	1560	HU	Dunafoldvar			0.04		0.04			
6	1435	HU	Hercegszanto		0.04					0.03	
	1429	HR	Batina			0.04					0.04
	1427	SC	Bezdan				0.04				0.04
	1367	SC	Bogojevo		0.03						0.04
	1337	HR	Borovo				0.02				0.02
	1287	SC	Backa Palanka							0.03	
	1258	SC	Novi Sad			0.03				0.03	
	1174	SC	Zemun				0.00				0.07
	1154.8	SC	Pancevo			0.03				0.04	
	1076.6	SC	Banatska Palanka			0.05				0.03	
7	1071	RO	Bazias			0.06				0.04	
	954.6	SC	Tekija			0.00				0.03	
8	851	SC	Radujevac			0.00		0.03			
	834	BG	Novo Selo Harbour/Pristol			0.05		0.03			
		RO	Pristol/Novo Selo Harbour			0.07		0.04			
	641	BG	us. Iskar-Bajkal			0.03					0.03
	554	BG	Downstream Svishtov				0.04				0.01
	503	BG	us. Russe			0.03					0.03
	432	RO	Upstream Arges			0.05					0.03
9	375	BG	Silistra/Chiciu			0.03					0.03
		RO	Chiciu/Silistra			0.05					0.12
	132	RO	Reni-Chilia/Kilia arm				0.07				0.13
10	18	RO	Vilkova-Chilia arm/Kilia arm				0.12				0.15
		UA	Vilkova - Kilia arm/Chilia arm								0.06
	0	RO	Sf. Gheorghe-Ghorghe arm				0.16				0.09
		UA	Sulina - Sulina arm			0.12					0.10

***NM**= not meeting 'class boundary – 0.125' criterion; **NMZ**: no matching JDS or AQUATERRA macrozoobenthos sites*

90%-ile concentrations for the years 2001 and 2004: Ptot [mg P/l]

				2001				2004			
Section	Rkm	Country	Location	high/good	good/moderate	nm	nmz	high/good	good/moderate	nm	nmz
2	2581	DE	Neu-Ulm/Boefinger Halde	0.15							0.10
3	2204	AT	Jochenstein		0.12						0.07
		DE	Jochenstein		0.12						0.10
	2120	AT	Abwinden-Asten		0.11						0.06
4	1935	AT	Wien-Nussdorf			0.08		0.06			
	1874	AT	Wolfsthal				0.12				0.09
	1869	SK	Bratislava			0.12		0.13			
	1806	HU	Medve/Medvedov			0.15		0.13			
		SK	Medvedov/Medve			0.10		0.08			
5	1768	HU	Komarom/Kedvedov			0.16		0.20			
		SK	Komarno/Komarom			0.11		0.10			
	1708	HU	Szob			0.22				0.16	
	1560	HU	Dunafoldvar			0.20		0.16			
6	1435	HU	Hercegszanto		0.19					0.12	
	1429	HR	Batina			0.19					0.14
	1427	SC	Bezdan				0.16				0.15
	1367	SC	Bogojevo		0.14						0.13
	1337	HR	Borovo				0.26				0.31
	1287	SC	Backa Palanka							0.22	
	1258	SC	Novi Sad			0.13				0.16	
	1174	SC	Zemun				0.10				0.09
	1154.8	SC	Pancevo			0.12				0.20	
	1076.6	SC	Banatska Palanka			0.11				0.17	
7	1071	RO	Bazias			0.18				0.22	
	954.6	SC	Tekija			0.08				0.08	
8	851	SC	Radujevac			1.04		0.07			
	834	BG	Novo Selo Harbour/Pristol			0.21		0.34			
		RO	Pristol/Novo Selo Harbour			0.18		0.20			
	641	BG	us. Iskar-Bajkal			0.21					0.19
	554	BG	Downstream Svishtov				0.42				0.32
	503	BG	us. Russe			0.18					0.29
	432	RO	Upstream Arges			0.26					0.16
9	375	BG	Silistra/Chiciu			0.21					0.26
		RO	Chiciu/Silistra			0.11					0.23
	132	RO	Reni-Chilia/Kilia arm				0.13				0.18
10	18	RO	Vilkova-Chilia arm/Kilia arm				0.22				0.17
		UA	Vilkova - Kilia arm/Chilia arm								0.19
	0	RO	Sf. Gheorghe-Ghorghe arm				0.12				0.23
		UA	Sulina - Sulina arm			0.20					0.20

***NM**= not meeting 'class boundary – 0.125' criterion; **NMZ**: no matching JDS or AQUATERRA macrozoobenthos sites*

90%-ile concentrations for the years 2001 and 2004: PO4 [mg P/l]

				2001				2004			
Section	Rkm	Country	Location	high/good	good/moderate	nm	nmz	high/good	good/moderate	nm	nmz
2	2581	DE	Neu-Ulm/Boefinger Halde	0.06							0.06
3	2204	AT	Jochenstein		0.07						0.05
		DE	Jochenstein		0.05						0.05
	2120	AT	Abwinden-Asten		0.05						0.04
4	1935	AT	Wien-Nussdorf			0.05		0.04			
	1874	AT	Wolfsthal				0.04				0.05
	1869	SK	Bratislava			0.06		0.06			
	1806	HU	Medve/Medvedov			0.07		0.06			
		SK	Medvedov/Medve			0.05		0.05			
5	1768	HU	Komarom/Kedvedov			0.08		0.09			
		SK	Komarno/Komarom			0.06		0.07			
	1708	HU	Szob			0.12				0.12	
	1560	HU	Dunafoldvar			0.09		0.09			
6	1435	HU	Hercegszanto		0.09					0.05	
	1429	HR	Batina			0.03					0.08
	1427	SC	Bezdan				0.08				0.08
	1367	SC	Bogojevo		0.07						0.08
	1337	HR	Borovo				0.05				0.12
	1287	SC	Backa Palanka							0.10	
	1258	SC	Novi Sad			0.07				0.08	
	1174	SC	Zemun				0.06				0.08
	1154.8	SC	Pancevo			0.07				0.08	
	1076.6	SC	Banatska Palanka			0.08				0.06	
7	1071	RO	Bazias			0.13				0.19	
	954.6	SC	Tekija			0.06				0.04	
8	851	SC	Radujevac			1.19		0.06			
	834	BG	Novo Selo Harbour/Pristol			0.12		0.15			
		RO	Pristol/Novo Selo Harbour			0.16		0.14			
	641	BG	us. Iskar-Bajkal			0.68					0.12
	554	BG	Downstream Svishtov				0.28				0.09
	503	BG	us. Russe			0.34					0.13
	432	RO	Upstream Arges			0.14					0.09
9	375	BG	Silistra/Chiciu			0.29					0.11
		RO	Chiciu/Silistra			0.04					0.09
	132	RO	Reni-Chilia/Kilia arm				0.05				0.11
10	18	RO	Vilkova-Chilia arm/Kilia arm				0.05				0.13
		UA	Vilkova - Kilia arm/Chilia arm								0.11
	0	RO	Sf. Gheorghe-Ghorghe arm				0.07				0.13
		UA	Sulina - Sulina arm			0.06					0.12

NM*= not meeting‘class boundary – 0.125’ criterion;* ***NMZ****: no matching JDS or AQUATERRA macrozoobenthos sites*

ANNEX 4: SUMMARY STATISTICS FOR POOLED DATA AT TNMN STATIONS

NO_3 [mg N/l], year 2001

Section	Rkm	Country	Location	N	min	10-tile	25-ile	50-tile	mean	75-ile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	26	2.2	2.5	2.8	3.1	3.1	3.3	3.7	4.3
3	2204	DE	Jochenstein	26	1.2	1.3	1.5	2.3	2.2	2.8	3.1	3.3
3	2204	AT	Jochenstein	12	1.2	1.4	1.6	2.2	2.2	2.9	3.3	3.4
3	2120	AT	Abwinden-Asten	12	1.2	1.4	1.6	2.1	2.1	2.6	2.9	2.9
4	1935	AT	Wien-Nussdorf	12	1.1	1.2	1.5	2.2	2.0	2.7	2.7	2.7
4	1874	AT	Wolfsthal	25	1.2	1.3	1.4	2.2	2.1	2.7	3.0	3.1
4	1869	SK	Bratislava	25	1.0	1.4	1.5	2.2	2.2	2.7	3.3	3.6
4	1806	HU	Medve/Medvedov	26	0.0	1.1	1.4	1.7	1.9	2.6	3.1	3.2
4	1806	SK	Medvedov/Medve	12	1.0	1.3	1.4	1.9	2.0	2.7	3.1	3.2
5	1768	HU	Komarom/Kedvedov	78	0.8	1.3	1.5	1.9	2.1	2.7	3.2	3.3
5	1768	SK	Komarno/Komarom	12	0.8	1.2	1.4	1.9	2.0	2.7	3.0	3.3
5	1708	HU	Szob	78	0.8	1.2	1.5	1.8	1.9	2.4	2.7	3.6
5	1560	HU	Dunafoldvar	78	0.0	1.1	1.4	2.0	2.0	2.6	3.0	3.4
6	1435	HU	Hercegszanto	36	0.5	1.1	1.3	2.0	2.0	2.5	2.9	3.4
6	1429	HR	Batina	12	0.5	1.3	1.6	2.1	2.3	3.1	3.4	3.6
6	1427	SC	Bezdan	12	0.5	0.9	1.3	2.1	2.0	2.8	2.9	3.0
6	1367	SC	Bogojevo	12	0.8	0.9	1.4	1.6	1.9	2.6	3.1	3.2
6	1337	HR	Borovo	26	0.7	1.4	1.8	2.3	2.2	2.7	3.0	3.6
6	1258	SC	Novi Sad	12	0.9	1.0	1.3	1.9	1.9	2.5	2.7	2.9
6	1174	SC	Zemun	12	0.2	0.6	0.8	1.0	1.2	1.4	2.0	3.1
6	1154.8	SC	Pancevo	10	0.9	0.9	1.0	1.3	1.4	1.7	2.1	2.5
6	1076.6	SC	Banatska Palanka	12	0.7	0.9	1.1	1.5	1.4	1.7	2.1	2.2
7	1071	RO	Bazias	60	0.4	0.7	0.9	1.2	1.3	1.6	1.9	3.1
7	954.6	SC	Tekija	9	0.7	0.8	0.8	1.0	1.0	1.2	1.3	1.6
8	851	SC	Radujevac	9	0.4	0.6	0.8	0.9	1.1	1.7	1.8	1.8
8	834	RO	Pristol/Novo Selo Harbour	61	0.5	0.8	1.0	1.2	1.3	1.6	2.0	2.6
8	834	BG	Novo Selo Harbour/Pristol	36	0.7	0.9	1.1	1.4	1.6	2.0	2.3	2.9
8	641	BG	us. Iskar-Bajkal	12	0.1	0.1	0.2	0.5	0.7	0.9	1.9	2.0
8	554	BG	Downstream Svishtov	14	0.6	0.7	0.9	1.2	1.3	1.8	2.0	2.1
8	503	BG	us. Russe	12	0.7	1.2	1.3	1.5	1.6	1.8	2.0	3.4
8	432	RO	Upstream Arges	33	0.9	1.0	1.1	1.2	1.5	1.3	1.6	4.8
9	375	RO	Chiciu/Silistra	69	0.6	1.3	1.5	2.0	1.9	2.2	2.4	2.7
9	375	BG	Silistra/Chiciu	36	0.7	0.9	1.1	1.4	1.4	1.7	1.9	2.0
9	132	RO	Reni-Chilia/Kilia arm	69	0.8	1.3	1.5	1.9	1.8	2.1	2.4	2.9
10	18	RO	Vilkova-Chilia arm/Kilia arm	36	0.8	1.2	1.3	1.6	1.7	1.9	2.3	2.7
10	0	RO	Sulina - Sulina arm	36	0.7	1.2	1.4	1.6	1.6	1.8	2.2	2.5
10	0	RO	Sf. Gheorghe-Ghorghe arm	36	0.2	1.0	1.4	1.6	1.6	1.9	2.4	2.6

NH$_4$ [mg N/l], year 2001

Section	Rkm	Country	Location	N	min	10-tile	25-ile	50-tile	mean	75-ile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	26	0.00	0.01	0.02	0.04	0.05	0.07	0.11	0.15
3	2204	DE	Jochenstein	26	0.03	0.03	0.04	0.07	0.08	0.12	0.14	0.16
3	2204	AT	Jochenstein	12	0.02	0.02	0.03	0.04	0.05	0.07	0.10	0.11
3	2120	AT	Abwinden-Asten	12	0.02	0.03	0.04	0.05	0.05	0.08	0.08	0.11
4	1935	AT	Wien-Nussdorf	12	0.00	0.01	0.02	0.03	0.03	0.05	0.06	0.06
4	1874	AT	Wolfsthal	25	0.00	0.03	0.05	0.07	0.08	0.10	0.14	0.24
4	1869	SK	Bratislava	25	0.05	0.07	0.08	0.11	0.13	0.16	0.21	0.29
4	1806	HU	Medve/Medvedov	26	0.00	0.02	0.03	0.05	0.06	0.08	0.12	0.16
4	1806	SK	Medvedov/Medve	12	0.04	0.07	0.07	0.09	0.09	0.09	0.12	0.20
5	1768	HU	Komarom/Kedvedov	78	0.02	0.02	0.03	0.05	0.07	0.10	0.13	0.21
5	1768	SK	Komarno/Komarom	12	0.05	0.07	0.07	0.09	0.10	0.11	0.12	0.20
5	1708	HU	Szob	78	0.00	0.02	0.02	0.04	0.07	0.09	0.14	0.34
5	1560	HU	Dunafoldvar	78	0.02	0.02	0.02	0.07	0.09	0.15	0.20	0.23
6	1435	HU	Hercegszanto	36	0.02	0.02	0.03	0.05	0.07	0.09	0.17	0.23
6	1429	HR	Batina	12	0.02	0.02	0.03	0.05	0.07	0.12	0.17	0.17
6	1427	SC	Bezdan	12	0.02	0.05	0.07	0.10	0.12	0.15	0.20	0.37
6	1367	SC	Bogojevo	12	0.03	0.03	0.07	0.13	0.15	0.18	0.35	0.45
6	1337	HR	Borovo	26	0.00	0.07	0.07	0.07	0.11	0.18	0.19	0.29
6	1258	SC	Novi Sad	12	0.10	0.14	0.18	0.22	0.26	0.33	0.42	0.44
6	1174	SC	Zemun	12	0.02	0.04	0.10	0.13	0.17	0.17	0.42	0.52
6	1154.8	SC	Pancevo	10	0.00	0.05	0.10	0.19	0.19	0.22	0.28	0.60
6	1076.6	SC	Banatska Palanka	12	0.10	0.11	0.15	0.21	0.20	0.23	0.29	0.30
7	1071	RO	Bazias	60	0.09	0.12	0.17	0.26	0.30	0.37	0.62	0.75
7	954.6	SC	Tekija	9	0.02	0.03	0.04	0.09	0.12	0.16	0.23	0.37
8	851	SC	Radujevac	7	0.04	0.06	0.08	0.16	0.21	0.18	0.41	0.75
8	834	RO	Pristol/Novo Selo Harbour	61	0.02	0.11	0.17	0.21	0.24	0.30	0.40	0.70
8	834	BG	Novo Selo Harbour/Pristol	36	0.05	0.06	0.08	0.11	0.16	0.20	0.31	0.40
8	641	BG	us. Iskar-Bajkal	12	0.00	0.01	0.06	0.08	0.12	0.17	0.29	0.40
8	554	BG	Downstream Svishtov	14	0.00	0.01	0.02	0.07	0.07	0.10	0.14	0.23
8	503	BG	us. Russe	12	0.00	0.00	0.00	0.06	0.05	0.08	0.09	0.10
8	432	RO	Upstream Arges	33	0.02	0.13	0.17	0.22	0.24	0.29	0.34	0.54
9	375	RO	Chiciu/Silistra	69	0.04	0.18	0.23	0.35	0.44	0.55	1.00	1.36
9	375	BG	Silistra/Chiciu	36	0.00	0.04	0.05	0.06	0.08	0.09	0.13	0.23
9	132	RO	Reni-Chilia/Kilia arm	69	0.06	0.13	0.18	0.28	0.35	0.41	0.65	1.10
10	18	RO	Vilkova-Chilia arm/Kilia arm	36	0.05	0.12	0.17	0.31	0.37	0.50	0.71	0.98
10	0	RO	Sulina - Sulina arm	36	0.12	0.14	0.19	0.33	0.44	0.47	0.87	2.12
10	0	RO	Sf. Gheorghe-Ghorghe arm	36	0.06	0.20	0.25	0.32	0.42	0.50	0.79	1.69

NO_2 [mg N/l], year 2001

Section	Rkm	Country	Location	N	min	10-tile	25-ile	50-tile	mean	75-ile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	27	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03
3	2204	DE	Jochenstein	11	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03
3	2204	AT	Jochenstein	12	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
3	2120	AT	Abwinden-Asten	12	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
4	1935	AT	Wien-Nussdorf	12	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
4	1874	AT	Wolfsthal	25	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04
4	1869	SK	Bratislava	25	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.04
4	1806	HU	Medve/Medvedov	26	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.05
4	1806	SK	Medvedov/Medve	12	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.04
5	1768	HU	Komarom/Kedvedov	78	0.00	0.01	0.02	0.02	0.02	0.03	0.04	0.07
5	1768	SK	Komarno/Komarom	12	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.04
5	1708	HU	Szob	78	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.04
5	1560	HU	Dunafoldvar	78	0.00	0.01	0.02	0.02	0.02	0.03	0.04	0.06
6	1435	HU	Hercegszanto	36	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.04
6	1429	HR	Batina	12	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.04
6	1427	SC	Bezdan	12	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.04
6	1367	SC	Bogojevo	12	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03
6	1337	HR	Borovo	26	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.07
6	1258	SC	Novi Sad	12	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04
6	1174	SC	Zemun	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	1154.8	SC	Pancevo	10	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.04
6	1076.6	SC	Banatska Palanka	12	0.01	0.01	0.02	0.03	0.03	0.03	0.05	0.08
7	1071	RO	Bazias	60	0.02	0.02	0.03	0.04	0.04	0.05	0.06	0.21
7	954.6	SC	Tekija	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	851	SC	Radujevac	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
8	834	RO	Pristol/Novo Selo Harbour	61	0.02	0.03	0.03	0.04	0.04	0.05	0.07	0.09
8	834	BG	Novo Selo Harbour/Pristol	36	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.07
8	641	BG	us. Iskar-Bajkal	12	0.00	0.01	0.02	0.03	0.02	0.03	0.03	0.04
8	554	BG	Downstream Svishtov	14	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.11
8	503	BG	us. Russe	12	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04
8	432	RO	Upstream Arges	36	0.00	0.01	0.02	0.03	0.03	0.03	0.05	0.09
9	375	RO	Chiciu/Silistra	69	0.01	0.01	0.02	0.03	0.04	0.03	0.05	0.38
9	375	BG	Silistra/Chiciu	36	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04
9	132	RO	Reni-Chilia/Kilia arm	69	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.19
10	18	RO	Vilkova-Chilia arm/Kilia arm	36	0.00	0.01	0.01	0.03	0.04	0.05	0.12	0.19
10	0	RO	Sulina - Sulina arm	36	0.01	0.01	0.02	0.04	0.07	0.08	0.12	0.44
10	0	RO	Sf. Gheorghe-Ghorghe arm	36	0.00	0.01	0.02	0.02	0.05	0.05	0.16	0.28

P_{tot} [mg P/l], year 2001

Section	Rkm	Country	Location	N	min	10-tile	25-ile	50-tile	mean	75-ile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	26	0.04	0.05	0.06	0.07	0.08	0.09	0.15	0.17
3	2204	DE	Jochenstein	26	0.04	0.04	0.06	0.07	0.09	0.08	0.12	0.66
3	2204	AT	Jochenstein	12	0.04	0.05	0.05	0.07	0.07	0.08	0.12	0.12
3	2120	AT	Abwinden-Asten	12	0.04	0.05	0.05	0.06	0.07	0.08	0.11	0.11
4	1935	AT	Wien-Nussdorf	12	0.05	0.05	0.05	0.06	0.07	0.07	0.08	0.13
4	1874	AT	Wolfsthal	25	0.03	0.04	0.05	0.06	0.07	0.09	0.12	0.16
4	1869	SK	Bratislava	25	0.07	0.07	0.08	0.09	0.10	0.10	0.12	0.20
4	1806	HU	Medve/Medvedov	26	0.05	0.08	0.08	0.10	0.11	0.13	0.15	0.16
4	1806	SK	Medvedov/Medve	12	0.06	0.07	0.07	0.08	0.08	0.09	0.10	0.10
5	1768	HU	Komarom/Kedvedov	78	0.03	0.09	0.10	0.12	0.12	0.15	0.16	0.19
5	1768	SK	Komarno/Komarom	12	0.00	0.07	0.08	0.08	0.08	0.10	0.11	0.12
5	1708	HU	Szob	78	0.02	0.04	0.08	0.11	0.13	0.16	0.22	0.59
5	1560	HU	Dunafoldvar	78	0.02	0.12	0.13	0.14	0.15	0.17	0.20	0.26
6	1435	HU	Hercegszanto	36	0.03	0.11	0.13	0.15	0.15	0.17	0.19	0.27
6	1429	HR	Batina	12	0.03	0.07	0.10	0.12	0.13	0.15	0.19	0.27
6	1427	SC	Bezdan	12	0.08	0.10	0.10	0.11	0.12	0.14	0.16	0.16
6	1367	SC	Bogojevo	12	0.05	0.08	0.10	0.11	0.11	0.13	0.14	0.17
6	1337	HR	Borovo	26	0.06	0.08	0.08	0.13	0.15	0.22	0.26	0.33
6	1258	SC	Novi Sad	12	0.09	0.10	0.10	0.12	0.12	0.13	0.13	0.17
6	1174	SC	Zemun	4	0.07	0.07	0.08	0.09	0.09	0.09	0.10	0.10
6	1154.8	SC	Pancevo	10	0.08	0.09	0.09	0.10	0.11	0.11	0.12	0.17
6	1076.6	SC	Banatska Palanka	12	0.07	0.07	0.08	0.11	0.10	0.11	0.11	0.13
7	1071	RO	Bazias	45	0.05	0.07	0.09	0.12	0.12	0.14	0.18	0.23
7	954.6	SC	Tekija	4	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.09
8	851	SC	Radujevac	4	0.07	0.07	0.07	0.36	0.50	0.79	1.04	1.22
8	834	RO	Pristol/Novo Selo Harbour	43	0.04	0.07	0.08	0.10	0.11	0.12	0.18	0.20
8	834	BG	Novo Selo Harbour/Pristol	36	0.07	0.07	0.08	0.11	0.13	0.16	0.21	0.38
8	641	BG	us. Iskar-Bajkal	12	0.07	0.08	0.09	0.11	0.13	0.13	0.21	0.30
8	554	BG	Downstream Svishtov	11	0.07	0.08	0.10	0.14	0.17	0.15	0.42	0.46
8	503	BG	us. Russe	12	0.12	0.13	0.14	0.16	0.16	0.18	0.18	0.23
8	432	RO	Upstream Arges	36	0.11	0.13	0.15	0.17	0.18	0.20	0.26	0.29
9	375	RO	Chiciu/Silistra	63	0.01	0.02	0.02	0.04	0.05	0.06	0.11	0.52
9	375	BG	Silistra/Chiciu	36	0.10	0.11	0.14	0.16	0.18	0.18	0.21	0.57
9	132	RO	Reni-Chilia/Kilia arm	63	0.01	0.02	0.03	0.05	0.06	0.09	0.13	0.20
10	18	RO	Vilkova-Chilia arm/Kilia arm	33	0.01	0.02	0.04	0.05	0.09	0.12	0.22	0.29
10	0	RO	Sulina - Sulina arm	33	0.01	0.02	0.03	0.06	0.08	0.10	0.20	0.25
10	0	RO	Sf. Gheorghe-Ghorghe arm	33	0.01	0.02	0.03	0.07	0.07	0.09	0.12	0.19

PO_4 [mg P/l], year 2001

Section	Rkm	Country	Location	N	min	10-tile	25-ile	50-tile	mean	75-ile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	26	0.02	0.02	0.03	0.04	0.04	0.06	0.06	0.07
3	2204	DE	Jochenstein	26	0.00	0.00	0.02	0.03	0.03	0.04	0.05	0.07
3	2204	AT	Jochenstein	12	0.00	0.02	0.02	0.03	0.03	0.05	0.07	0.07
3	2120	AT	Abwinden-Asten	12	0.00	0.01	0.02	0.03	0.03	0.04	0.05	0.06
4	1935	AT	Wien-Nussdorf	12	0.00	0.01	0.02	0.02	0.03	0.04	0.05	0.05
4	1874	AT	Wolfsthal	25	0.00	0.01	0.02	0.03	0.03	0.04	0.04	0.07
4	1869	SK	Bratislava	25	0.00	0.01	0.03	0.04	0.04	0.05	0.06	0.07
4	1806	HU	Medve/Medvedov	26	0.00	0.00	0.01	0.04	0.04	0.06	0.07	0.07
4	1806	SK	Medvedov/Medve	12	0.00	0.00	0.02	0.03	0.03	0.05	0.05	0.06
5	1768	HU	Komarom/Kedvedov	78	0.00	0.00	0.03	0.05	0.05	0.07	0.08	0.10
5	1768	SK	Komarno/Komarom	12	0.00	0.00	0.02	0.04	0.03	0.05	0.06	0.06
5	1708	HU	Szob	78	0.00	0.02	0.04	0.06	0.06	0.07	0.12	0.15
5	1560	HU	Dunafoldvar	78	0.00	0.00	0.03	0.06	0.05	0.08	0.09	0.11
6	1435	HU	Hercegszanto	36	0.00	0.00	0.02	0.06	0.05	0.07	0.09	0.10
6	1429	HR	Batina	12	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.06
6	1427	SC	Bezdan	12	0.01	0.01	0.03	0.04	0.05	0.06	0.08	0.08
6	1367	SC	Bogojevo	12	0.01	0.02	0.02	0.04	0.04	0.07	0.07	0.07
6	1337	HR	Borovo	26	0.01	0.01	0.01	0.03	0.03	0.04	0.05	0.07
6	1258	SC	Novi Sad	12	0.01	0.02	0.04	0.05	0.05	0.06	0.07	0.08
6	1174	SC	Zemun	12	0.01	0.02	0.02	0.03	0.03	0.04	0.06	0.06
6	1154.8	SC	Pancevo	10	0.02	0.02	0.03	0.05	0.04	0.06	0.07	0.07
6	1076.6	SC	Banatska Palanka	12	0.02	0.02	0.03	0.04	0.04	0.05	0.08	0.09
7	1071	RO	Bazias	60	0.01	0.05	0.07	0.09	0.09	0.11	0.13	0.23
7	954.6	SC	Tekija	9	0.01	0.02	0.03	0.05	0.04	0.06	0.06	0.07
8	851	SC	Radujevac	9	0.05	0.06	0.08	0.11	0.52	0.60	1.19	2.21
8	834	RO	Pristol/Novo Selo Harbour	61	0.02	0.05	0.07	0.09	0.10	0.12	0.16	0.19
8	834	BG	Novo Selo Harbour/Pristol	36	0.02	0.04	0.06	0.07	0.08	0.09	0.12	0.24
8	641	BG	us. Iskar-Bajkal	12	0.00	0.07	0.09	0.18	0.29	0.33	0.68	1.00
8	554	BG	Downstream Svishtov	14	0.12	0.13	0.14	0.19	0.20	0.26	0.28	0.29
8	503	BG	us. Russe	12	0.17	0.19	0.21	0.24	0.26	0.32	0.34	0.36
8	432	RO	Upstream Arges	36	0.07	0.08	0.09	0.10	0.10	0.11	0.14	0.16
9	375	RO	Chiciu/Silistra	69	0.00	0.01	0.01	0.02	0.03	0.03	0.04	0.45
9	375	BG	Silistra/Chiciu	36	0.13	0.18	0.20	0.26	0.24	0.28	0.29	0.31
9	132	RO	Reni-Chilia/Kilia arm	69	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.10
10	18	RO	Vilkova-Chilia arm/Kilia arm	36	0.00	0.01	0.01	0.03	0.03	0.04	0.05	0.18
10	0	RO	Sulina - Sulina arm	36	0.01	0.01	0.01	0.03	0.03	0.04	0.06	0.11
10	0	RO	Sf. Gheorghe-Ghorghe arm	36	0.00	0.01	0.01	0.02	0.03	0.05	0.07	0.09

NO_3 [mg N/l], year 2004

Section	Km	Country	Location	N	min	10-tile	25-tile	50-tile	mean	75-tile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	26	1.9	2.1	2.3	2.7	2.9	3.5	3.8	4.0
3	2204	DE	Jochenstein	26	1.0	1.0	1.2	1.7	2.0	2.6	3.0	4.3
3	2204	AT	Jochenstein	12	1.2	1.2	1.2	1.9	2.2	2.8	3.8	4.7
3	2120	AT	Abwinden-Asten	12	1.3	1.3	1.4	2.0	2.3	2.8	3.5	4.6
4	1935	AT	Wien-Nussdorf	12	1.1	1.1	1.2	1.7	2.1	2.5	3.3	4.8
4	1874	AT	Wolfsthal	24	1.0	1.2	1.4	2.0	2.2	2.8	3.3	4.4
4	1869	SK	Bratislava	72	1.2	1.2	1.4	1.8	2.2	2.9	3.5	4.2
4	1806	HU	Medve/Medvedov	27	0.9	1.1	1.3	1.7	1.9	2.5	3.1	4.3
4	1806	SK	Medvedov/Medve	12	1.2	1.2	1.3	1.7	2.0	2.5	2.9	3.5
5	1768	HU	Komarom/Kedvedov	79	1.0	1.2	1.4	1.8	2.1	2.7	3.3	4.4
5	1768	SK	Komarno/Komarom	12	1.3	1.4	1.4	1.8	2.1	2.7	3.1	3.5
5	1708	HU	Szob	63	1.0	1.3	1.6	1.9	2.3	3.0	3.6	4.3
5	1560	HU	Dunafoldvar	81	0.8	1.1	1.4	2.0	2.2	2.7	3.8	4.8
6	1435	HU	Hercegszanto	26	0.2	0.2	0.2	0.5	1.0	1.8	2.8	3.5
6	1429	HR	Batina	12	1.1	1.3	1.4	1.6	1.9	2.2	2.4	4.1
6	1427	SC	Bezdan	23	0.7	1.1	1.3	1.8	2.0	2.7	3.2	4.2
6	1367	SC	Bogojevo	11	0.8	1.0	1.3	1.9	1.9	2.3	3.0	3.9
6	1337	HR	Borovo	26	1.1	2.0	2.3	2.6	2.7	3.1	3.4	4.5
6	1287	SC	Backa Palanka	11	0.9	1.1	1.2	1.7	1.9	2.1	2.9	4.0
6	1258	SC	Novi Sad	23	0.9	1.1	1.2	1.7	1.9	2.6	3.0	4.0
6	1174	SC	Zemun	21	1.0	1.1	1.3	1.6	1.6	2.0	2.2	2.7
6	1154	SC	Pancevo	11	0.8	1.1	1.3	1.6	1.6	1.8	2.5	2.6
6	1076	SC	Banatska Palanka	12	0.8	1.0	1.1	1.4	1.5	1.6	2.0	2.6
7	1071	RO	Bazias	70	0.1	0.3	0.5	0.8	0.8	1.1	1.4	1.9
7	954	SC	Tekija	12	0.7	0.8	1.0	1.2	1.4	1.5	2.4	2.8
8	851	SC	Radujevac	11	0.9	0.9	0.9	1.2	1.3	1.5	2.3	2.7
8	834	RO	Pristol/Novo Selo Harbour	70	0.1	0.5	0.7	0.9	0.9	1.1	1.3	2.2
8	834	BG	Novo Selo Harbour/Pristol	34	0.5	0.7	0.8	1.0	1.3	1.8	2.3	3.5
8	641	BG	us. Iskar-Bajkal	12	0.1	0.3	0.5	0.8	1.0	1.2	2.2	2.5
8	554	BG	Downstream Svishtov	13	0.3	0.7	1.0	1.1	1.2	1.5	1.6	2.0
8	503	BG	us. Russe	11	0.7	0.9	1.1	1.3	1.5	1.7	2.1	2.7
8	432	RO	Upstream Arges	36	0.9	1.0	1.0	1.1	1.1	1.2	1.3	1.5
9	375	RO	Chiciu/Silistra	72	0.1	0.6	0.7	1.4	1.5	2.1	2.4	3.2
9	375	BG	Silistra/Chiciu	33	0.7	0.8	0.9	1.2	1.4	1.6	2.2	2.4
9	132	RO	Reni-Chilia/Kilia arm	72	0.6	0.9	1.0	1.6	1.6	2.1	2.4	3.4
10	18	RO	Vilkova-Chilia arm/Kilia arm	36	0.1	0.4	1.0	1.3	1.4	2.0	2.3	2.5
10	18	UA	Vilkova - Kilia arm/Chilia arm	8	0.8	0.9	1.1	1.3	1.2	1.4	1.4	1.5
10	0	RO	Sulina - Sulina arm	36	0.1	0.8	1.0	1.3	1.4	2.0	2.2	2.9
10	0	RO	Sf. Gheorghe-Ghorghe arm	36	0.6	0.9	1.0	1.2	1.5	2.1	2.3	2.7

NH_4 [mg N/l], year 2004

Section	Km	Country	Location	N	min	10-tile	25-tile	50-tile	mean	75-tile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	26	0.00	0.03	0.04	0.06	0.06	0.07	0.12	0.16
3	2204	DE	Jochenstein	26	0.03	0.04	0.04	0.07	0.08	0.09	0.16	0.18
3	2204	AT	Jochenstein	12	0.00	0.02	0.02	0.02	0.05	0.07	0.13	0.14
3	2120	AT	Abwinden-Asten	12	0.00	0.00	0.01	0.04	0.04	0.05	0.08	0.12
4	1935	AT	Wien-Nussdorf	12	0.00	0.00	0.01	0.02	0.03	0.04	0.07	0.10
4	1874	AT	Wolfsthal	24	0.00	0.02	0.03	0.07	0.10	0.10	0.23	0.54
4	1869	SK	Bratislava	72	0.03	0.07	0.11	0.23	0.24	0.33	0.50	0.67
4	1806	HU	Medve/Medvedov	27	0.02	0.02	0.02	0.02	0.06	0.07	0.15	0.20
4	1806	SK	Medvedov/Medve	12	0.03	0.04	0.06	0.09	0.11	0.15	0.21	0.22
5	1768	HU	Komarom/Kedvedov	79	0.02	0.02	0.02	0.04	0.07	0.10	0.20	0.21
5	1768	SK	Komarno/Komarom	12	0.03	0.09	0.10	0.11	0.13	0.14	0.23	0.26
5	1708	HU	Szob	62	0.02	0.03	0.05	0.08	0.11	0.14	0.23	0.37
5	1560	HU	Dunafoldvar	81	0.02	0.02	0.02	0.06	0.10	0.16	0.24	0.35
6	1435	HU	Hercegszanto	26	0.02	0.03	0.04	0.05	0.08	0.10	0.16	0.33
6	1429	HR	Batina	12	0.02	0.03	0.04	0.06	0.09	0.11	0.19	0.31
6	1427	SC	Bezdan	23	0.02	0.04	0.08	0.12	0.13	0.17	0.26	0.30
6	1367	SC	Bogojevo	11	0.05	0.10	0.11	0.14	0.16	0.18	0.26	0.42
6	1337	HR	Borovo	26	0.07	0.07	0.10	0.15	0.16	0.19	0.27	0.38
6	1287	SC	Backa Palanka	11	0.08	0.11	0.13	0.17	0.22	0.28	0.41	0.48
6	1258	SC	Novi Sad	23	0.10	0.11	0.14	0.19	0.21	0.25	0.30	0.56
6	1174	SC	Zemun	24	0.00	0.00	0.00	0.05	0.12	0.12	0.31	0.80
6	1154	SC	Pancevo	10	0.10	0.11	0.12	0.19	0.24	0.36	0.44	0.46
6	1076	SC	Banatska Palanka	12	0.10	0.12	0.14	0.20	0.23	0.32	0.35	0.43
7	1071	RO	Bazias	70	0.02	0.09	0.19	0.26	0.27	0.35	0.47	0.68
7	954	SC	Tekija	11	0.00	0.00	0.00	0.03	0.04	0.05	0.14	0.16
8	851	SC	Radujevac	11	0.00	0.00	0.00	0.00	0.07	0.08	0.11	0.45
8	834	RO	Pristol/Novo Selo Harbour	70	0.02	0.04	0.09	0.15	0.18	0.25	0.32	0.68
8	834	BG	Novo Selo Harbour/Pristol	34	0.07	0.10	0.13	0.18	0.19	0.25	0.29	0.31
8	641	BG	us. Iskar-Bajkal	12	0.01	0.02	0.09	0.20	0.18	0.30	0.30	0.40
8	554	BG	Downstream Svishtov	13	0.00	0.00	0.02	0.05	0.06	0.07	0.14	0.17
8	503	BG	us. Russe	11	0.03	0.04	0.04	0.07	0.07	0.08	0.12	0.19
8	432	RO	Upstream Arges	36	0.08	0.09	0.10	0.12	0.13	0.14	0.17	0.21
9	375	RO	Chiciu/Silistra	72	0.02	0.19	0.25	0.41	0.44	0.59	0.79	1.15
9	375	BG	Silistra/Chiciu	33	0.00	0.04	0.05	0.08	0.10	0.14	0.15	0.32
9	132	RO	Reni-Chilia/Kilia arm	72	0.02	0.05	0.21	0.33	0.38	0.54	0.73	0.95
10	18	RO	Vilkova-Chilia arm/Kilia arm	36	0.02	0.18	0.33	0.58	0.55	0.75	0.86	1.17
10	18	UA	Vilkova - Kilia arm/Chilia arm	8	0.05	0.10	0.13	0.15	0.18	0.20	0.30	0.36
10	0	RO	Sulina - Sulina arm	36	0.02	0.14	0.20	0.30	0.46	0.61	0.91	1.82
10	0	RO	Sf. Gheorghe-Ghorghe arm	36	0.04	0.15	0.22	0.46	0.47	0.63	0.87	1.20

NO_2 [mg N/l], year 2004

Section	Km	Country	Location	N	min	10-tile	25-tile	50-tile	mean	75-tile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	13	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
3	2204	DE	Jochenstein	23	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03
3	2204	AT	Jochenstein	12	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03
3	2120	AT	Abwinden-Asten	12	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
4	1935	AT	Wien-Nussdorf	12	0.00	0.01	0.01	0.01	0.01	0.01	0.03	0.03
4	1874	AT	Wolfsthal	24	0.01	0.02	0.02	0.02	0.02	0.03	0.04	0.04
4	1869	SK	Bratislava	72	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.04
4	1806	HU	Medve/Medvedov	27	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04
4	1806	SK	Medvedov/Medve	12	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.03
5	1768	HU	Komarom/Kedvedov	79	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04
5	1768	SK	Komarno/Komarom	12	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.03
5	1708	HU	Szob	62	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.08
5	1560	HU	Dunafoldvar	81	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.06
6	1435	HU	Hercegszanto	26	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.07
6	1429	HR	Batina	12	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.04
6	1427	SC	Bezdan	23	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.04
6	1367	SC	Bogojevo	11	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.04
6	1337	HR	Borovo	26	0.01	0.01	0.01	0.02	0.03	0.02	0.02	0.32
6	1287	SC	Backa Palanka	11	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.04
6	1258	SC	Novi Sad	23	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04
6	1174	SC	Zemun	17	0.00	0.02	0.02	0.04	0.04	0.06	0.07	0.10
6	1154	SC	Pancevo	11	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.05
6	1076	SC	Banatska Palanka	12	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.04
7	1071	RO	Bazias	70	0.01	0.01	0.02	0.03	0.05	0.04	0.04	0.81
7	954	SC	Tekija	12	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.03
8	851	SC	Radujevac	11	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.09
8	834	RO	Pristol/Novo Selo Harbour	70	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.05
8	834	BG	Novo Selo Harbour/Pristol	34	0.00	0.02	0.02	0.03	0.02	0.03	0.03	0.04
8	641	BG	us. Iskar-Bajkal	12	0.00	0.01	0.02	0.02	0.02	0.02	0.03	0.03
8	554	BG	Downstream Svishtov	13	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02
8	503	BG	us. Russe	11	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.04
8	432	RO	Upstream Arges	36	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.04
9	375	RO	Chiciu/Silistra	72	0.01	0.01	0.02	0.04	0.06	0.06	0.12	0.41
9	375	BG	Silistra/Chiciu	33	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04
9	132	RO	Reni-Chilia/Kilia arm	72	0.01	0.01	0.01	0.03	0.05	0.08	0.13	0.18
10	18	RO	Vilkova-Chilia arm/Kilia arm	36	0.01	0.01	0.01	0.03	0.09	0.09	0.15	1.51
10	18	UA	Vilkova - Kilia arm/Chilia arm	8	0.02	0.02	0.02	0.03	0.04	0.05	0.06	0.09
10	0	RO	Sulina - Sulina arm	36	0.01	0.01	0.01	0.02	0.05	0.07	0.10	0.25
10	0	RO	Sf. Gheorghe-Ghorghe arm	36	0.01	0.01	0.02	0.02	0.03	0.03	0.09	0.13

P_{tot} [mg P/l], year 2004

Section	Km	Country	Location	N	minimum	10-tile	25-tile	50-tile	mean	75-tile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	70	0.02	0.06	0.07	0.11	0.12	0.17	0.22	0.30
3	2204	DE	Jochenstein	70	0.01	0.04	0.06	0.09	0.11	0.13	0.20	0.36
3	2204	AT	Jochenstein	36	0.08	0.11	0.12	0.14	0.13	0.15	0.16	0.19
3	2120	AT	Abwinden-Asten	69	0.01	0.03	0.07	0.10	0.26	0.17	0.23	4.07
4	1935	AT	Wien-Nussdorf	72	0.01	0.06	0.09	0.12	0.12	0.14	0.18	0.28
4	1874	AT	Wolfsthal	36	0.06	0.08	0.10	0.12	0.12	0.14	0.17	0.26
4	1869	SK	Bratislava	36	0.00	0.07	0.09	0.12	0.13	0.14	0.20	0.25
4	1806	HU	Medve/Medvedov	37	0.02	0.08	0.09	0.13	0.14	0.14	0.23	0.32
4	1806	SK	Medvedov/Medve	8	0.06	0.08	0.10	0.12	0.13	0.15	0.19	0.19
5	1768	HU	Komarom/Kedvedov	34	0.04	0.05	0.09	0.12	0.16	0.16	0.34	0.57
5	1768	SK	Komarno/Komarom	12	0.03	0.04	0.07	0.10	0.10	0.11	0.19	0.21
5	1708	HU	Szob	13	0.00	0.06	0.07	0.11	0.14	0.15	0.32	0.43
5	1560	HU	Dunafoldvar	11	0.04	0.11	0.12	0.14	0.18	0.23	0.29	0.41
6	1435	HU	Hercegszanto	33	0.05	0.12	0.13	0.16	0.17	0.21	0.26	0.28
6	1429	HR	Batina	12	0.06	0.10	0.10	0.12	0.12	0.13	0.14	0.15
6	1427	SC	Bezdan	26	0.05	0.08	0.09	0.15	0.24	0.19	0.31	2.05
6	1367	SC	Bogojevo	27	0.05	0.07	0.08	0.09	0.10	0.12	0.13	0.16
6	1337	HR	Borovo	79	0.00	0.08	0.09	0.11	0.13	0.16	0.20	0.34
6	1287	SC	Backa Palanka	63	0.02	0.03	0.05	0.08	0.09	0.12	0.16	0.20
6	1258	SC	Novi Sad	81	0.09	0.11	0.12	0.13	0.14	0.14	0.16	0.37
6	1174	SC	Zemun	26	0.03	0.05	0.06	0.07	0.07	0.09	0.12	0.14
6	1154	SC	Pancevo	72	0.05	0.06	0.07	0.08	0.09	0.10	0.13	0.18
6	1076	SC	Banatska Palanka	12	0.05	0.05	0.06	0.07	0.07	0.07	0.08	0.10
7	1071	RO	Bazias	12	0.06	0.07	0.08	0.09	0.08	0.09	0.10	0.11
7	954	SC	Tekija	26	0.05	0.05	0.06	0.07	0.07	0.07	0.10	0.10
8	851	SC	Radujevac	26	0.04	0.05	0.07	0.08	0.08	0.08	0.10	0.14
8	834	RO	Pristol/Novo Selo Harbour	24	0.03	0.03	0.03	0.04	0.09	0.06	0.09	0.77
8	834	BG	Novo Selo Harbour/Pristol	12	0.02	0.03	0.04	0.04	0.05	0.05	0.06	0.14
8	641	BG	us. Iskar-Bajkal	12	0.03	0.03	0.04	0.05	0.05	0.06	0.06	0.10
8	554	BG	Downstream Svishtov	12	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.09
8	503	BG	us. Russe	12	0.09	0.11	0.11	0.12	0.13	0.13	0.15	0.20
8	432	RO	Upstream Arges	10	0.08	0.10	0.10	0.11	0.11	0.12	0.13	0.14
9	375	RO	Chiciu/Silistra	12	0.08	0.08	0.10	0.11	0.12	0.14	0.16	0.22
9	375	BG	Silistra/Chiciu	23	0.02	0.03	0.05	0.06	0.07	0.08	0.09	0.15
9	132	RO	Reni-Chilia/Kilia arm	11	0.12	0.12	0.13	0.15	0.16	0.18	0.20	0.20
10	18	RO	Vilkova-Chilia arm/Kilia arm	12	0.06	0.08	0.09	0.12	0.12	0.16	0.17	0.19
10	18	UA	Vilkova - Kilia arm/Chilia arm	12	0.03	0.03	0.03	0.04	0.05	0.05	0.08	0.09
10	0	RO	Sulina - Sulina arm	11	0.01	0.04	0.05	0.05	0.05	0.06	0.07	0.09
10	0	RO	Sf. Gheorghe-Ghorghe arm	11	0.11	0.11	0.12	0.13	0.15	0.18	0.22	0.23

PO_4 [mg P/l], year 2004

Section	Km	Country	Location	N	minimum	10-tile	25-tile	50-tile	mean	75-tile	90-tile	max
2	2581	DE	Neu-Ulm/Boefinger Halde	26	0.01	0.02	0.03	0.04	0.04	0.06	0.06	0.07
3	2204	DE	Jochenstein	26	0.00	0.01	0.02	0.03	0.03	0.04	0.05	0.06
3	2204	AT	Jochenstein	12	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.06
3	2120	AT	Abwinden-Asten	12	0.00	0.00	0.02	0.02	0.03	0.04	0.04	0.05
4	1935	AT	Wien-Nussdorf	12	0.00	0.00	0.01	0.02	0.03	0.04	0.04	0.06
4	1874	AT	Wolfsthal	24	0.00	0.00	0.01	0.03	0.03	0.04	0.05	0.06
4	1869	SK	Bratislava	36	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.07
4	1806	HU	Medve/Medvedov	27	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.09
4	1806	SK	Medvedov/Medve	12	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.06
5	1768	HU	Komarom/Kedvedov	79	0.01	0.01	0.03	0.05	0.05	0.07	0.09	0.17
5	1768	SK	Komarno/Komarom	12	0.01	0.02	0.04	0.05	0.05	0.06	0.07	0.07
5	1708	HU	Szob	63	0.01	0.01	0.03	0.05	0.06	0.08	0.12	0.15
5	1560	HU	Dunafoldvar	81	0.00	0.01	0.02	0.04	0.05	0.07	0.09	0.12
6	1435	HU	Hercegszanto	26	0.00	0.01	0.01	0.01	0.02	0.03	0.05	0.07
6	1429	HR	Batina	12	0.01	0.02	0.02	0.05	0.05	0.07	0.08	0.08
6	1427	SC	Bezdan	23	0.00	0.01	0.01	0.04	0.04	0.08	0.08	0.09
6	1367	SC	Bogojevo	11	0.01	0.01	0.01	0.05	0.05	0.08	0.08	0.09
6	1337	HR	Borovo	26	0.02	0.03	0.05	0.06	0.07	0.08	0.12	0.27
6	1287	SC	Backa Palanka	11	0.01	0.01	0.04	0.06	0.06	0.08	0.10	0.12
6	1258	SC	Novi Sad	23	0.00	0.01	0.02	0.05	0.05	0.07	0.08	0.11
6	1174	SC	Zemun	23	0.01	0.01	0.03	0.04	0.04	0.05	0.08	0.13
6	1154	SC	Pancevo	11	0.01	0.02	0.02	0.04	0.05	0.07	0.08	0.09
6	1076	SC	Banatska Palanka	11	0.01	0.02	0.02	0.05	0.04	0.06	0.06	0.08
7	1071	RO	Bazias	70	0.02	0.05	0.06	0.09	0.10	0.12	0.19	0.28
7	954	SC	Tekija	12	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.06
8	851	SC	Radujevac	11	0.01	0.02	0.02	0.03	0.03	0.03	0.06	0.06
8	834	RO	Pristol/Novo Selo Harbour	70	0.01	0.04	0.06	0.08	0.09	0.11	0.14	0.30
8	834	BG	Novo Selo Harbour/Pristol	34	0.03	0.04	0.05	0.07	0.09	0.10	0.15	0.35
8	641	BG	us. Iskar-Bajkal	12	0.00	0.02	0.04	0.05	0.06	0.06	0.12	0.16
8	554	BG	Downstream Svishtov	13	0.00	0.01	0.03	0.06	0.05	0.08	0.09	0.10
8	503	BG	us. Russe	11	0.03	0.04	0.06	0.07	0.08	0.09	0.13	0.14
8	432	RO	Upstream Arges	36	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.10
9	375	RO	Chiciu/Silistra	72	0.01	0.01	0.01	0.03	0.04	0.07	0.09	0.18
9	375	BG	Silistra/Chiciu	33	0.02	0.04	0.05	0.07	0.07	0.10	0.11	0.15
9	132	RO	Reni-Chilia/Kilia arm	72	0.01	0.01	0.01	0.05	0.05	0.10	0.11	0.15
10	18	RO	Vilkova-Chilia arm/Kilia arm	36	0.01	0.01	0.02	0.04	0.08	0.10	0.13	0.82
10	18	UA	Vilkova - Kilia arm/Chilia arm	8	0.04	0.05	0.05	0.07	0.07	0.10	0.11	0.12
10	0	RO	Sulina - Sulina arm	36	0.01	0.01	0.01	0.05	0.06	0.10	0.12	0.14
10	0	RO	Sf. Gheorghe-Ghorghe arm	36	0.01	0.01	0.01	0.03	0.05	0.09	0.13	0.24