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Vienna/Sievering, 26 June 2009

# My observations and proposals regarding the ICPDR v6 Draft Management Plan

***For the reader with very limited time: The main items I came across***

- The data in Fig. 3 are from my point of view non-comparable. I am informed that an update is foreseen. However, I wonder whether it will be possible to achieve a fully comparable update before the final editing of the DRBD Management Plan has to take place. Under the assumption that only limited changes are made I present and discuss an updated version of Fig. 3.
- I dare to suggest that Table 3 be deleted. I am giving reasons for my bias in my discussion.
- I am taking up the question of <reproducibility / precision / variance> in nutrient load assessment, based on recent work by TU Vienna. I dare to propose that the issue of the <uncertainty range> around a value be covered when loads are presented, discussed, fixed as targets, and when finally the reaching of target values has to be documented and proven.
- I am suggesting a full disclosure and an open documentation of the values in Fig. 5 (with the inclusion of an uncertainty range around the values), and also a matching with the values in the Figs. 32 and 34.
- I am discussing the contents of the existing Table 4 in Draftv6, and I am aiming at an improvement; I alone can not do more than described, it is up to you in the Danubian States to check and to further improve.
- I am suggesting an altered text for page 14.
- I am taking up a sentence under <Sediment balance> on p. 26 and proposing an amendment.
- I am somewhat lost in regard to the presentation of the <agricultural nutrient scenarios>.
- I am suggesting a full disclosure and an open documentation of the values in the Figs. 32 and 34.
- I am asking for a clarification of the text under <7.1.2.3.3>.

- ***My introductory remarks***
- I refer to the publicly downloadable v6 Draft Management Plan, including its Annexes and Maps.
- I am fully aware of all the efforts and strenuous work input it contains.
- As a former national delegate to the RBM/EG (Austria) I very much hope that my subsequent observations are accepted in a collegial way, and are not looked upon as a destructive nagging.
- I have throughout all my life tried to compare and to weigh as impartially as possible. I have further learnt that all the statements made must be documented down to their basic source, as otherwise wrong interpretations and misunderstandings might take place.
- In the subsequent steps I am screening the v6 Draft. I am communicating my observations to you, as well as related discussions and proposals based on them.
- My method is <screening the text> page by page.
- My conclusions may seem harsh. However, they are not intended this way; please weigh them, I know I can also be wrong. My <problem> resides i.a. in the fact that what I come across is best directly discussed with you in a personal manner. However, this seems not to be possible, and thus my approach is to note down these written statements in the <public participation process>.

***I <spotted> the following main points***

- Fig. 3, p. 9, is for sure in need of an enhancement. I am discussing reasons for mismatches, and I am also showing how – from my point of view – an improved Fig. 3 could look like.

  My proposal for the text, starting with the last sentence on p. 8, is as follows:

  *Fig. 3 provides an overview of the %-distribution of the <types of waste water disposal> (designation at right-hand) for the Danubian States as well as the Danube River Basin District, expressed in population equivalents (p.e.). Data are made available by the States and summed-up for the DRBD, for agglomerations > 2,000 p.e. (urban waste water). The ratios of the assessed sums of p.e. for the States versus the number of inhabitants of the Danubian States (from Table 2) vary strongly, see the numbers in red in the header. Clearing the mismatches between the # of p.e. and the # of inhabitants in states resp. the DRBD is a task to be tracked over time.*
- I dare to suggest that Table 3 be deleted. I am giving reasons for my bias in my discussion.
- I am taking up the question of <reproducibility / precision> in nutrient load assessment, based on recent work by TU Vienna. I dare to propose that the issue of the <uncertainty range> around a value be covered when loads are presented, discussed, fixed as targets, and when finally the reaching of targets has to be documented and proven.
- I am suggesting a full disclosure and an open documentation of the values in Fig. 5 (with the inclusion of an uncertainty range around the values), and also a matching with the values in the Figs. 32 and 34.

- I am discussing the contents of the existing Table 4 in Draftv6, and I am aiming at an improvement; I alone can not do more than described, it is up to you in the Danubian States to check and to further improve.
- I am suggesting an altered text for page 14, and I welcome an improvement of Fig. 8 (with reference to the pathways for NOx and NHy, and a change of the narrow term <deposition> as actually used in the old terminology of MONERIS).
- I am taking up a sentence under <Sediment balance> on p. 26, and based on certain assumptions I am putting forward a proposal.
- I am somewhat lost in regard to the presentation of the <agricultural nutrient scenarios>.
- I am suggesting a full disclosure and an open documentation of the values in the Figs. 32 and 34, including future ways of tracking the matching of chosen target loads by the loads actually discharged. I am aware of the fact that in addition to the issue of the <uncertainty range> of the loads assessed certain transformations are undertaken based on values of the hydrological regime.
- I am asking for a clarification of the text under <7.1.2.3.3>.
- If the route to set <target loads> is maintained I suggest the development and the agreeing upon a reliable <checking procedure> between the <target loads> and the loads discharged to the Black Sea that have at least to match these target loads.
- Actual acting demands a further minimising of the emissions (of N and P). This can only be achieved by a proper acting in every-day life, and with a never-ending stamina.

## Detailed observations, related discussions and my proposals

- ***Consistent value of the population in the DRB/DRBD:***

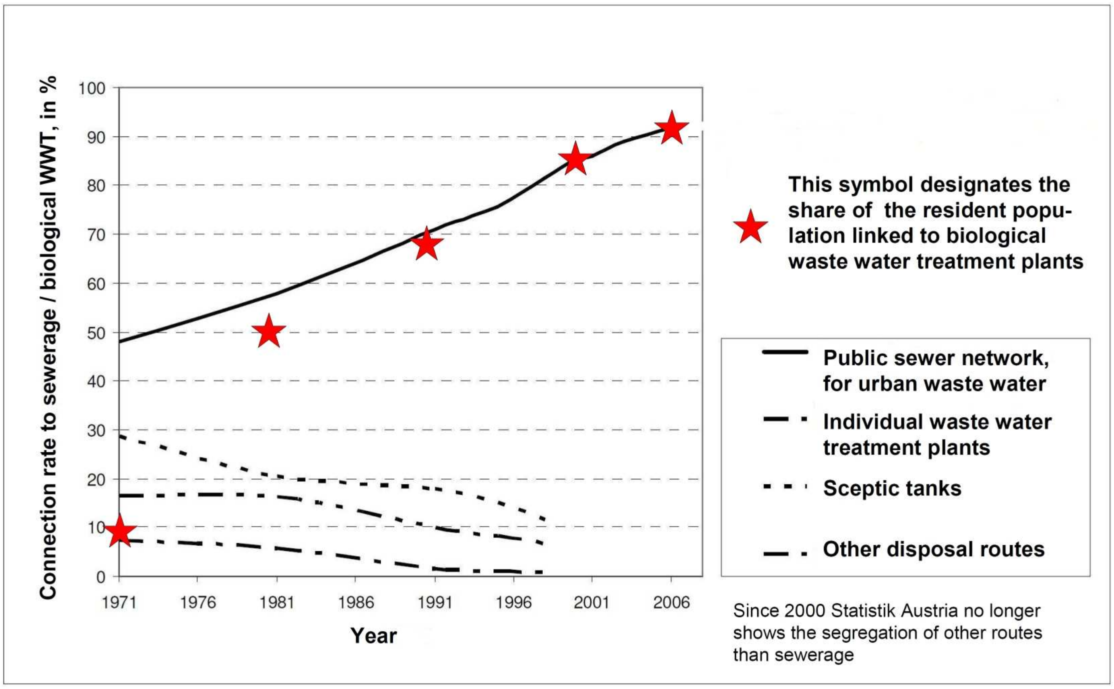
  p. 2, Table 1, total population in DRB/DRBD (**?**): approx. 83 mio. inhabitants, versus p. 4, Table 2, 81.0 mio. inhabitants in DRBD. The difference is for sure based on a more recent assessment (Table 1) versus the data of the Year 2004 Roof Report (Table 2). Either an explanation or a straightening-out to the same value is needed, but I do not know whether ICPDR holds <new population data> for the share of every state.

  My own preference is sticking to the values in the Year 2004 Roof Report.

- ***Figure 3***, p. 9.

  As contained in Draftv6 it seems that e.g. Austria produces an extremely big load from its agglomerations > 2,000 p.e., whereas e.g. the loads from Germany, Hungary and Serbia are – despite the fact that their population according to Table 2 in the DRBD is bigger than the one of Austria – comparatively smaller.

  One of the reasons quite likely can be deduced from the development of sewerage and waste water treatment over time in Austria (e.g. compared with Hungary and Serbia). The attached next figure is based on Fig. 2-3 (and the corresponding Table 2-2) on p. 12 in the last Report by Austria on implementing Directive 91/271 EEC ([1]). Good insight on the status of sewerage and waste water treatment is in Austria available since ~ 1991, before it was weaker; most of the population linked to sewerage was in 1991 also linked to biological waste water treatment. As of 2009 in many Danubian States information allowing a good description of the <sewerage and treatment status> over time is quite likely not yet available; nevertheless, if an improvement is still possible for this Plan this is a big step forward.




Development of the share of sewerage and waste water treatment between 1971 and 2006 in Austria (basis: resident population); the respective rate is also cross-checked via the link to waste water treatment plants> 50 p.e.

([1]) **Kommunale Abwasserrichtlinie der EU – 91/271/EWG**, Österreichischer Bericht 2008 (in German); can be downloaded from the website http://gpool.lfrz.at/gpoolexport/media/file/Lagebericht_2008.pdf.

The main question is whether only a relation for the population living in agglomerations >2,000 p.e. is asked for, or whether an overview for all agglomerations is actually needed.

From my point of the task resides in a <full comparison>, albeit Directive 91/271 EEC asks EU Member States only for information for agglomerations > 2,000 p.e.. My point of view will be better understandable when I'll dig into the issue of nutrient point source pollution.

I do not know what the PM/EG – with input from the States and outside expert support – can still improve within the few months remaining towards finishing this Management Plan.

One simple option in regard to Fig. 3 is an additional explanation in the accompanying text. The inclusion of the number of <total inhabitants> in the sub-header of Fig.3 (see the next figure) and the ratio between # of p.e. versus # of inhabitants (in red) will from my point of view improve the compatibility and the comparability of the data (as presently collected); I am aware of the fact that the underlying assumption in Fig. 3 as it stands is assessing the conditions of the Directive 91/271 EEC (for agglomerations > 2,000 p.e.), whereas the number of inhabitants in the share of the Danubian States is a <total value> and does not reflect the number of inhabitants living in agglomerations > 2,000 p.e.. The thus obtained values for the <ratio p.e./inhabitant> are not fully comparable, but from my point of view they hint at what share of loads are assessed by this present ICPDR inventory, either within the Danubian States and as a total for the whole DRBD.

The information on the <share of sewerage as % of the population> (see Fig. 28 and the related Annex 14) and its complement to 100% could also be used with the aim towards improving Fig. 3, provided the aim is a <total assessment>, and not only the share for agglomerations > 2,000 p.e..

In case no measured influent loads to waste water treatment were available plant design in Austria and Germany required in the past that 1 inhabitant was set equivalent to 2 p.e.. Under actual operating conditions data in ([2]) all over Austria show that a value at ~ 1.8 p.e. per 1 inhabitant was valid in 2000.

The size of loads as assessed by the ICPDR emissions inventory is not only determined by loads measured resp. estimated, but also by

- the inclusion (as is the case in Austria of joint treatment of domestic with industrial/trade waste waters) versus the non-inclusion of industrial/trade waste water residing within the agglomerations and fit for <combined treatment>, as well as the amount of pre-treatment in industries and trade;
- the settlement structure of States (i.e. the question what share of the total inhabitants is living in agglomerations bigger than 2,000 p.e. versus those below 2,000 p.e.);
- the missing insight what share of the number of inhabitants in municipalities > 2,000 p.e. is actually <hooked up> to the sewage system.

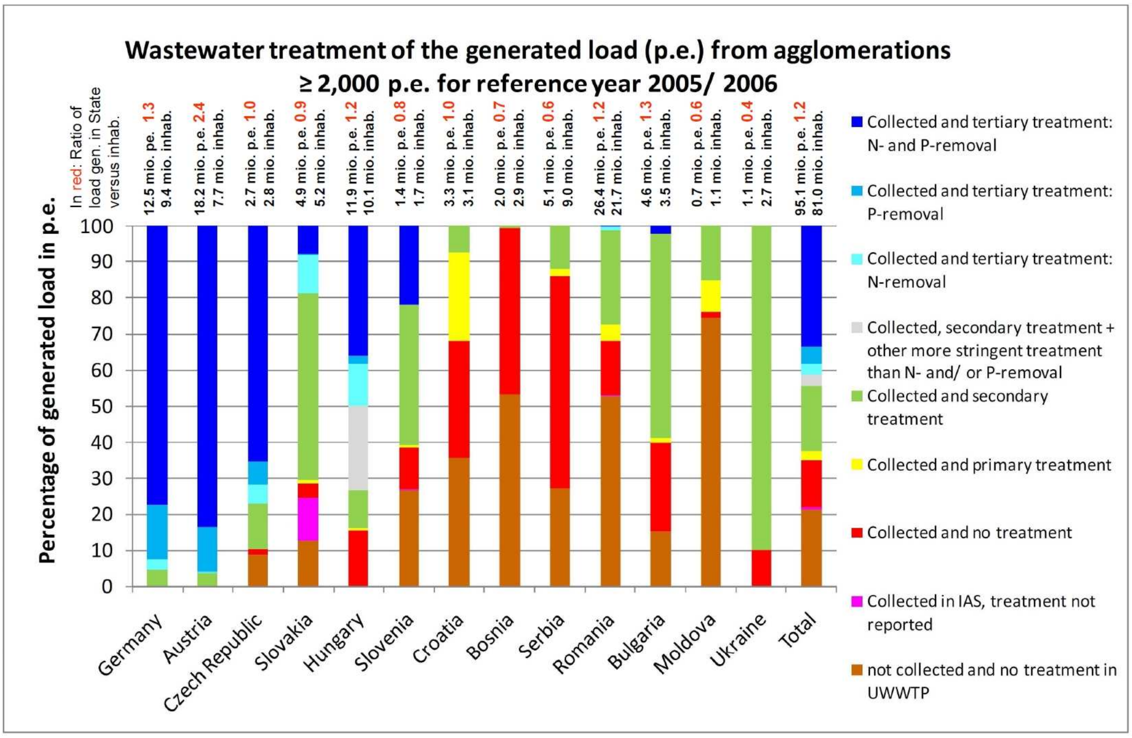
I dare to propose using a Figure 3 re-drafted as presented overleaf and I draw the following conclusions:

- The ratio between # of population equivalents as assessed by the PM/EG with its inventory (for agglomerations > 2,000 p.e.) versus # of all inhabitants in Danubian States in their territories within the DRBD varies between 0.4 and 2.4. The # of p.e. must be at

([2]) **St. Lindtner, M. Zessner**: Abschätzung von Schmutzfrachten in der Abwasserentsorgung bei unvollständiger Datenlage. Wiener Mitteilungen (2003), Band 183, p. 195-227. BOD5 and COD used stems from the Tables 4 and 5; the specific value (p.e. specific to 1 inhabitant) shown above (1.8 to 1) considers the Austrian population linked in the year 2000 to waste water treatment plants > 2,000 p.e.. The value valid for 2006 is quite similar and amounts to 1.96 to 1, as can be concluded from Table 3-4 on p. 15 in quote ([1]).

least as big as the # of inhabitants living in the agglomerations assessed, and a ratio of p.e./inhabitant > 1.5 is from my point of view very probable.

- This big spread in this ratio is quite likely caused by the assessment / non-assessment of trade waste and industrial waste water, and by the type of settlement structure resp. the non-assessment of urban inhabitants that differs between the Danubian States.
- The overall goal of the WFD implementation towards assessing the situation in human settlements requires from my point of view that the delimiter of "> 2,000 p.e." be lifted, and all point source emissions from urban waste water be assessed, irrespective whether the Directive 91/271/EC sets a delimiter.
- Industrial and trade wastes have to be covered in equal ways in all Danubian States.




My proposal for the text, starting with the last sentence on p. 8, is at present as follows:

*Fig. 3 provides an overview of the %-distribution of the <types of waste water disposal> (designation at right-hand) for the Danubian States as well as the Danube River Basin District, expressed in population equivalents (p.e.). Data are made available by the States and summed-up for the DRBD, for agglomerations > 2,000 p.e. (urban waste water). The ratios of the assessed sums of p.e. for the States versus the number of inhabitants of the Danubian States (from Table 2) vary strongly, see the numbers in red in the header. Clearing the mismatches between the # of p.e. and the # of inhabitants in states resp. the DRBD is a task to be tracked over time.*

The population equivalents indicated in Fig. 3 are also linked with the Tables 3 and 4, and yield there unfortunately also non-comparable and seemingly non-compatible results.

- ***Table 3, COD and BOD$_5$ discharged to receiving waters***.
  - Table 3 presents – for every Danubian State as well as the DRBD – the loads of COD and BOD$_5$ discharged to receiving waters. This table can only be correctly understood and be used in a compatible and comparative way if – in addition to the Table per se – supplementary information on <COD> and <BOD$_5$> is provided, and a link to the data in

Fig. 3 is established. Another thought – towards which I have a strong bias – is skipping Table 3, as the relevant information is to a large extent already contained in Fig. 3.

- COD and $BOD_5$ are assessed via specified methods, yielding results on <overall organic pollution strength>, for COD by chemical digestion, and for $BOD_5$ via microbial metabolism. In regard to $BOD_5$ care has to be taken that only organic matter is assessed.
- The ratio of 1 untreated (= generated) urban waste water p.e., as COD versus $BOD_5$, is 110 g COD/day versus 60 g $BOD_5$/day; the underlying concentrations are both several hundred mg/l. The resulting <ratio COD/ $BOD_5$> is ~ 1.85 to 1. Untreated urban waste water impacts quite negatively on receiving waters by forming the growth of visible colonies of bacteria, see the publications by Karl Wuhrmann from EAWAG ([3]). A more than 100-fold dilution fully across the river profile is needed if such visible growth should not be perceivable. Such dilutions do not exist in nearly all cases. Urban agglomerations and states with low degrees of biological waste water treatment are characterised by values in this range, or somewhat higher.
- The <ratio COD/$BOD_5$> in biologically treated urban waste water is much bigger; it depends on the one hand on the biodegradability of organic pollution (determining the level of COD remaining) and the amount of biological flocs leaving the final clarifiers of waste water treatment plants (the dissolved $BOD_5$ is usually in the range of several mg/l). The EU Urban Waste Water Treatment Directive holds permissible discharge concentrations of 125 mg COD/l and 25 mg $BOD_5$/l, the resulting <ratio> is thus 5 to 1; even bigger ratios are reported. Karl Wuhrmann showed in the work already quoted, see ([3]), that low dilutions in receiving waters are possible, without any negative impact on the growth of bacterial colonies. Work by A. Franz et al., see ([4]), demonstrates that an effluent of an advanced biological treatment plant – discharged straight from the final clarifiers, without sand filtration to a receiving creek with a “dilution” of 10 parts treated effluent to 1 part creek water – does not lead to a visible growth of bacterial colonies due to a remaining biodegradable COD resp. $BOD_5$. Algal growth, however, is strong where shade (i.e. the coverage of bushes and trees) is missing.
- Based on these remarks one has to conclude that there are substantial differences between untreated and treated waste water.
- Untreated wastewater thus could be characterised in the language of finance as <bad money>, and treated waste water could be named <good money>. *As the adding-up of good and foul credits has led to tremendous problems, the <summing-up> of both* ***untreated*** *and* ***treated*** *COD resp. $BOD_5$* ***neither seems to be a good idea****.*
- *From this one can conclude that the forming of discharged loads and their comparison is meaningful only if* ***the sums of untreated discharges as well as treated discharges are presented separately****. Another possibility is a comparison of the true aggregated untreated and treated loads*, see e.g. Figure / Abbildung 3-7 on p. 19 in quote ([1]).
- The ICPDR TNMN load assessment does not contain loads for COD. Untreated waste water is biodegraded along the path of flow (thus decreasing the size of COD); a direct comparison of the accumulated COD-loads of Table 3 (that hold also untreated dis-

([3]) **K. Wuhrmann**, High-rate activated sludge treatment and its relation to stream sanitation, II: Biological River Tests of Plant Effluents, Sewage and Industrial Wastes, Vol.26/2, Feb. 1954, (212 – 220). **K. Wuhrmann** (1969): Reinigungsgrad und Gewässerschutz. 4. Seminar des Österreichischen Wasserwirtschaftsverbandes, Raach, B-1 to B-30. Can be ordered from EAWAG/CH. **K. Wuhrmann**: Aktuelle Ziele des Gewässerschutzes: Alter Wein aus neuen Schläuchen? Münchener Beiträge zur Abwasser-, Fischerei- und Flussbiologie, 1980 (32), p. 9 – 23.

([4]) **A. Franz, O. Nowak** and **H. Kroiss**: Mödling WWTP - treatment efficiency and relationship to receiving water quality. Water Science and Technology, Vol 33, No 12, pp 47–55 © IWA Publishing 1996, see abstract at http://www.iwaponline.com/wst/03312/wst033120047.htm charges subject to self-purification along the path of flow) with loads in River Danube at Reni is in-commensurate.

- Averaging the yearly concentrations at Reni for COD (left; middle; right) yields 30 yearly means (based on samples # between 7 and 23 per year), and itself yields an overall average $COD_{Cr}$-concentration of ~ 21 mg/l. Assuming an average flow of River Danube of 6,500 m³/s to be valid the <rough average yearly COD-load at Reni> is thus estimated with ~ 4,300 kt/year.
- Applying the minimal requirements of the Directive 91/271 EEC for the removal of COD (η= 75%) in waste water treatment for ~ 95 mio. p.e. (i.e. the basis for Fig. 3 and Table 3) leads to a remaining load of ~950 kt COD / year. Applying the person-specific data in Table 3 of Austria (30.5 kt COD/a * 1/0.9 * 1/7.7 mio inhab = 4 kg COD/inhab*a) to 81 mio. inhabitants within the DRBD yields a value of ~360 kt COD / year remaining. Both these loads are substantially smaller than the preceding estimate of the COD-load at Reni. This in turn implies that the substantially larger part of the COD in River Danube reaching the Black Sea stems from other sources (quite likely natural ones, e.g. dry-fall of organic material) than urban waste water.
- Based on all the preceding considerations I dare to present my strong bias towards skipping Table 3 and the associated 4 lines of text.
- I am also having a negative bias towards presenting the comparison of the scenarios as shown in Fig. 29, p. 57, as also there untreated and treated discharges are summed up to <unitary> values of COD and $BOD_5$; a segregation within the columns will from my point of view improve the presentation.
- The same principle thought applies to the values in Fig. 4.

• ***Nutrient pollution***, starting with p. 11 (later also relating to the pages 59 to 68).

  In 2008 work was run in Austria on the reliability of <in-stream load estimations>, see the Report ([5]) that is as yet not published, but will be made available by the Austrian Ministry for Agriculture, Forestry, Environment and Water Management upon request. The starting point was the then yet unresolved following set of questions:

  - Based on actually sampled data, what frequency in sampling is needed in order to arrive at yearly in-stream loads with a prescribed reproducibility?
  - How are the methods for the load assessment and the sampling frequency interrelated, and which methods deliver a good fit?

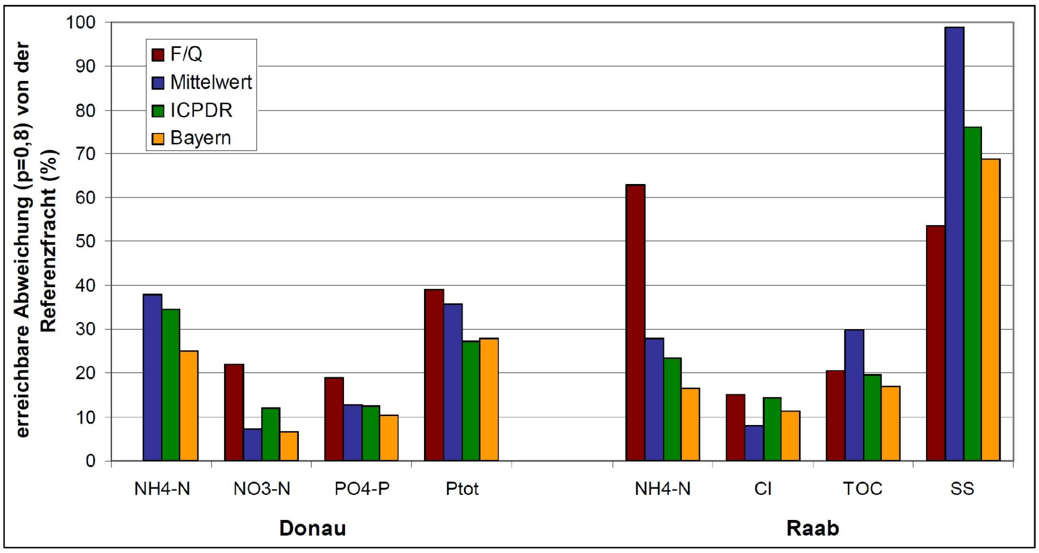
  Automated measuring stations allowed at arriving at large numbers of samples; two such stations were in operation in Austria, one close to Wolfsthal on River Danube, and the other one on River Raab. Both present insight only on <point observations>.

  This report by TU Vienna offers the following results for River Danube, based on the two subsequent figures:

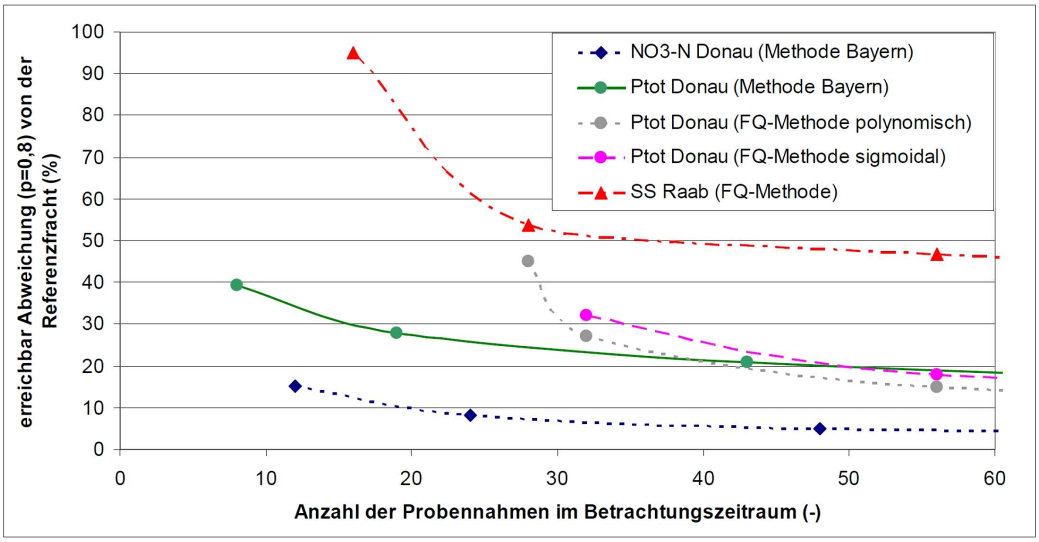
  - The work assumes that the values monitored (concentration; flow) represent <true values>; in actual practice they hold uncertainties, and these are included in the estimation procedures.

([5]) Optimierung von Frachterhebungen in Gewässern unter Berücksichtigung von Probenahmehäufigkeit und Berechnungsmethodik (this report is in German; translated into English this means: Optimisation of in-stream load assessments considering the sampling frequency as well as the method for load assessment). Endbericht, erstellt im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien, Oktober 2008, xii + 136 p. Bearbeitet von IWAG / TU Wien, Verfasser / Authors: **M. Zessner, St. Winkler, St. Natho**

- Due to limitations of data availability (only one continuous monitoring station representing a monitoring of a <single point> over time) it is not possible to resolve the question how the reproducibility of loads in regard to the overall river profile (in the case of River




This figure corresponds to Fig. 51 of the Report by IWAG/TU Vienna cited. It represents the reproducibility in + / - % of the average yearly load, for a confidence interval of 80%, for various methods of load assessment. The number of samples per year is 24 (Mittelwert/mean, ICPDR, Bavarian method), and 24+4 for the F/Q method. The sites covered are from the automated monitoring station Wolfsthal on River Danube, and from an automated monitoring station at River Raab.
The data for River Danube clearly show that $NO_3$-N and $PO_4$-P have a more narrow reproducibility, com – pared with the results for $NH_4$-N and totP.




This is Fig. 52 of the Report by IWAG/TU Vienna as cited. The <Methode Bayern> is quite similar to the ICPDR method for load assessment, but not identical. The graph shows that for River Danube at Hainburg and for totP 24 samples per year yield a reliability of the value of the load of +/- 27% around the average yearly value assessed, at a confidence interval of 80%. For $NO_3$-N the achievable results are with + / - 9% substantially better. Data for totN were not available for such type of basic assessment.
These results are based on a total of ~ 6,000 data points for totP and ~ 21,200 data points for NO3-N. The results for River Raab on the assessment of suspended solids shows that the reproducibility is much more endangered.

Danube i.e. a width of ~ 300m with a depth of ~ 3m on average, depending on flow conditions) could be assessed or improved. Certain dissolved parameters (NO3-N; PO4-P) hold – with 24 assured time-equidistant samples per year for the years sampled – a fairly good reproducibility (~ + / - 10%), with a confidence interval of 80%.

- NH4-N and totP do not allow such good reproducibility, and reach only ~ + / - 25 to 30%, with the same confidence interval.
- A statement on totN is not possible, as no data were available to run such investigation.
- Increasing the number of samples per year (e.g. to 52) improves the reproducibility of the yearly load, but the gain beyond 24 samples per year is small.
- An additional possibility is running averaging over several years (e.g. in the sense of a gliding average).
- Monitoring the <left>, <middle> and <right> positions and averaging the data to a yearly load improves the resulting reproducibility; this statement is based on the error propagation principle. Where information is also missing is a sampling across the full profile, as the present grab samples are taken close from the river surface.

My summary on this recent work at TU Vienna:

- We have to be aware of that there are inherent limits in determining the precision and reproducibility of in-stream riverine yearly loads.
- We can perceive that – with 24 equi-distant samples per year – dissolved parameters (NO3-N; PO4-P) allow a better reproducibility/precision/variance than e.g. totP (that includes also particle-bound phosphorus).
- At present we hold no information on the reproducibility/precision/variance of totN.
- Assumption, still to be verified: The actually existing <reproducibility/precision/variance> of the <true load> of totP is +/- 30%, for the confidence interval of 80%. This then means that all values up to 30% bigger and smaller than the load assessed can not really be distinguished from this load.
- My main conclusion is: The fixing of a target load and the reaching resp. the failing of an actual yearly load observed with reference to such prescribed yearly target load needs reasoning and a procedure on how such statistical approach could be covered. The v6 Draft ICPDR Management Plan does not yet give any clue on this observation.

• ***Development of in-stream nutrient loads over time, Fig. 5, p. 11***.

- Information is missing how the values in Fig. 5 are generated. It is therefore mandatory that this information is given in the relevant Annex in detail, and in summary in the text.
- It is further unclear whether – what I presently assume – data generated by MONERIS (for 1955 till 1995) are supplemented by measured values (2000; 2005).
- Full clearness has to exist what these data represent.
- An <uncertainty/variance band> around the <likely value>, as presented in previous versions of MONERIS (see e.g. the Roof Report 2004, Fig. 48), is missing; it is at present not clear how the reproducibility of in-stream loads is actually covered in MONERIS. In regard to this the developer of MONERIS should clarify whether he is using a size of the uncertainty range / reproducibility / variance as indicated in the paper compiled by TU Vienna; if this is not yet the case this should be discussed and decided upon.

My conclusions are as follows:

- The inclusion of an <uncertainty band> in the data of Fig. 5 is a necessity.
- The explanations in the text can refer to the means, but we have to be aware of the fact that the means <assumed to be true values> hold uncertainty ranges / variance.
- Please give full clearness how these data are obtained (a short sentence in the Plan, full coverage in the Annex), and please bring also the data in Fig. 5 and the ones in regard to the discharge to the Black Sea in the Figs. 32 and 34 fully in line.

- In regard to the wording I propose not to write of <present level> for 2005/2006, but to mention a time reference in the text (e.g. *2005*).

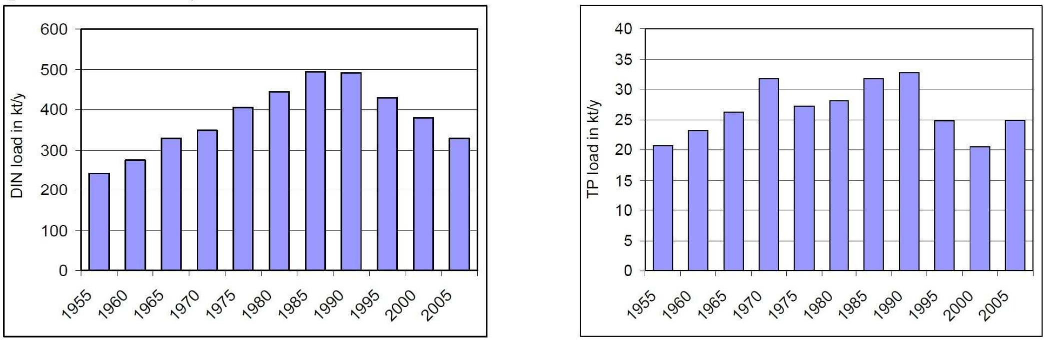



**Figure 5: Long-term discharges of nitrogen and phosphorus (1955-2005)** Danube to Black Sea

- What counts from my point of view is the definition of good status of the coastal waters in the Black Sea resp. the Black Sea itself, and the reaching of this status. Loads discharged via River Danube to the Black Sea are important, but from my point of view they are not the <primary management target>.
- As the text relates also to the settling-out in the man-made lake behind Iron Gate I, I take the freedom to state that the removal / holding-back of particle-bound P will strongly vary from year to year. The year 2005 was one with the worst flooding in recent history in the middle and lower Danube; a flushing of the deposits in the backwater of the Iron Gates I dam must have taken place, thus increasing the load discharged to the Black Sea (is the load of totP in Fig. 5 due to this reason bigger than the vale for 2000?). The specifying of a <permissible load for totP> and complying with it in any case has also to reflect the flushing of deposits.

- ***Point source nutrient loads in urban waste water, Table 4, p. 12, revision, discussion and proposal:***

  - Based on the mismatch in regard to population equivalents in Fig. 3 it is evident that also the data in Table 4 are as yet not really compatible and comparable. The main question is whether assessing the loads of agglomerations > 2,000 p.e. is really the correct way in arriving at an estimate of the (potential) nutrient point source discharges from urban waste water, including the inputs of industrial and trade wastes usually generated in agglomerations. The following table is my trial towards improving Table 4, based on <the # of total inhabitants in the Danube parts of the Danubian States>.

| **Nitrogen** | AT | BA | BG | CZ | DE | HR | HU | MD | RO | RS | SI | SK | UA | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inhabitants (Table 2 of Draftv6), in mio. | 7.7 | 2.9 | 3.5 | 2.8 | 9.4 | 3.1 | 10.1 | 1.1 | 21.7 | 9.2 | 1.7 | 5.2 | 2.7 | **81.1** |
| estimate for inhabitant-specific load of N (gN/inhab*d) | 15.8 | 11.5 | 13.7 | 15.8 | 15.8 | 13.7 | 13.7 | 11.5 | 13.7 | 11.5 | 15.8 | 13.7 | 11.5 | |
| estimate for total N-load before treatment, all agglomerations, kt/a | 44.4 | 12.2 | 17.5 | 16.1 | 54.2 | 15.5 | 50.5 | 4.6 | 108.5 | 38.6 | 9.8 | 26.0 | 11.3 | **409.3** |
| emissions Ntot (kt/a) from agglom > 2,000 p.e., EMIS inventory in Table 4 | 9.5 | 7.3 | 6.5 | 3.1 | 12.3 | 10.9 | 14.7 | 1.9 | 69.3 | 16.8 | 3.2 | 11.4 | 2.1 | **168.0** |

| Phosphorus | AT | BA | BG | CZ | DE | HR | HU | MD | RO | RS | SI | SK | UA | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| estimate for inhabitant-specific load of P (gP/inhab*d) | 3.0 | 3.5 | 3.5 | 3.4 | 3.0 | 4.1 | 3.4 | 4.1 | 3.0 | 3.5 | 3.8 | 3.1 | 3.5 | |
| estimate for total P-load before treatment, all agglomerations, kt/a | 8.4 | 3.7 | 4.5 | 3.5 | 10.3 | 4.6 | 12.5 | 1.6 | 23.8 | 11.8 | 2.4 | 5.9 | 3.4 | **96.4** |
| emissions Ptot (kt/a) from agglom > 2,000 p.e., EMIS inventory in Table 4 | 0.8 | 1.6 | 1.3 | 0.4 | 1.0 | 2.8 | 2.8 | 0.4 | 11.5 | 2.9 | 0.7 | 1.7 | 0.7 | **28.6** |

- The basis is: the number of inhabitants (Table 2 Draftv6, equivalent to the information provided in the Year 2004 Roof Report) and inhabitant-specific estimates for N and P; it contrasts estimated total loads with the loads shown in Table 4 of v6 Draft ICPDR RBM-Plan. I am fully aware of that my estimate for the <total loads> is not discharged to surface waters, but it gives a feeling for the potential.
- The inhabitant specific estimates (N and P) in the preceding table are derived as follows:

  For N information is available for Austria, see ([6]). The data (collected from 30 waste water treatment plants of various sizes) can be transformed from the dimension (p.e./day) into (inhab/day), for the ratio of inhabitant/p.e. prevailing with these 30 plants (1.59). The result is that 11 g N/inhab*day in waste water stem form direct human activities, and a total of 15.8 g N/inhab*day finally end up in waste water, the difference being due to other activities within the sewage collection system. This inhabitant-specific value is also used in CZR, DE and SI. In order to reflect the reduced socio-economic situation in BG, HR, HU, RO and SK I opted for an inhabitant-specific value of 13.7 g N/inhab*day; a still lower value of 11.5 g N/inhab*day is used in BA, MD, RS and UA.

  For P information is available for the Danubian states AT, CZR, DE, HR, HU, MD, RO, SI and SK, see ([7]), as shown in my preceding table. For the other Danubian states I opted for a value of 3.5 g P / inhab*day, in order to reflect a share of poly-P in detergents.

  I hold no better insight, and I do not intend to state that my preferences are really the <true choice>.
- I am aware of the fact that the data in the existing Table 4 of Dractv6 try comparing the emissions of agglomerations > 2,000 p.e. between the Danubian States, and showing the total sum for the DRBD. Based on Directive 91/271 EEC the binding legal basis for EU Member States holds only for agglomerations > 10,000 p.e.; however, every Danubian State is free to choose a more stringent ruling. The rulings in Austria are more stringent than in Directive 91/271 EEC.
- If one would like to hold a <complete picture>, and this is for sure the case for the joint work under ICPDR, all possible sources – also the agglomerations < 2,000 p.e. – have to be adequately assessed. Austria's experience also shows that even in large cities

([6]) **M. Zessner** and **St. Lindtner** (2005): Estimations of municipal point source pollution in the context of river basin management. WatSciTechn., Vol. 52, No. 9, p. 175 – 182.
([7]) **Van Gils J., Behrendt H., Costantinescu A., Isermann K., Isermann R., Zessner M.** (2005): Assessment results for scenarios, deliverable D5.12 of the project "Nutrient Management in the Danube Basin and its Impact on the Black Sea" (daNUbs) supported under contract EVK1-CT-2000-00051 by the Energy, Environment and Sustainable Development (EESD) Programme of the 5th EU Framework Programme, http://danubs.tuwien.ac.at/. Results also published in: **Kroiss, H., Zessner, M., Lampert, C.** (2008): Die Bedeutung des Phosphormanagements in der Siedlungswasserwirtschaft am Beispiel des Donaueinzugsgebietes / The Importance of Phosphorus in Residential Water Management as demonstrated in the Danube Basin. Österreichische Wasser- und Abfallwirtschaft, Heft 3 – 4, März/ April 2008.

(like e.g. at Vienna) it will be impossible to link all inhabitants to sewers, and that local solutions are needed in addition.

- The discrepancies between the <population equivalents shown in Fig. 3> and the <number of inhabitants in Table 2> quite likely are caused by the non-assessment of agglomerations < 2,000 p.e., a missing full insight what share of inhabitants of municipalities > 2,000 p.e. are actually linked to sewer system, but also a non-assessment of industrial and trade waste waters.
- Not because I am Austrian, but because the data are documented for Austria in reports to the European Commission, see e.g. the quote ([1]), and because of all what I learnt over time and what I was able to cross-check I profess that the urban nutrient loads emitted in AT and DE for agglomerations > 2,000 p.e. are rather proper values.
- All Danubian States are invited arriving at proper estimates for the overall emissions from their urban sources. MONERIS is in need of data as <true> as possible. In case the values contained in Table 4 of the v6Draft Management Plan are the point-source nutrient inputs into MONERIS I have the strong feeling that something goes wrong.
- Please check my assumptions, resp. re-check also what reasons might cause the differences between my estimates for the <gross loads generated> in the preceding table and the <estimates in the existing EMIS-inventory in Table 4>. As long as my estimates for the <gross nutrient loads generated> are correct a resulting balance must exist – what is not removed either actually reaches surface water bodies (see Table 4 in v6Draft MP), the soil (valid for P), or it enters groundwater bodies (mostly valid for N).

- ***Explanation in the text to Fig. 9, p. 14, linked with Fig. 8***.
  - Fig. 8 does not show at all how the deposited nitrogen (NOx; NHy) from the atmosphere is reaching surface waters (initially – and this is still shown in Fig. 8 – MONERIS defined <deposition> as only that flux from the atmosphere that is in direct contact with surface waters; surface waters represent at maximum ~ 2% of the total surface within the DRBD).
  - What is still missing is an explanation what the term <emissions> means in the context of Fig. 9; a short description on the type of river network thus assessed within the River Danube Basin District will be very helpful.
  - The text is in need of an explanation what NOx-N and NHy-N actually are, how they are generated, where them come from, and that they impact on all surfaces, not only the agricultural ones. I also propose to skip the last break on p. 15, and to transfer the text from there into the one on p. 14.

  The text on p. 14 could thus read from my point of view as follows:

  *Figure 9 shows the MONERIS results describing that altogether 686 kt of N (**what type of N?**) and 61,6 kt of P (**what type of P?**) in total are annually emitted into the river network* [please describe this river network based on the MONERIS Manual] *within the DRBD. The background conditions contained in MONERIS (7% for N; 9 % for P) represent the pre-industrial situation with very limited emissions of reactive N to the atmosphere and the erosion of soils not yet saturated with P; consequently, these values are small in comparison with the current emissions.*

*In the DRB, the share of nutrient pollution from atmospheric deposition is significant (for N 39%, for P only 13%* ***Remark: These 13% can not be deduced from Fig. 9, and quite likely the correct value is only 4%, "other sources than background (which to my understanding relates to soil erosion)" in Fig. 35, "Present State"****). Emissions of atmospheric nitrogen pollution are caused by human activities, including energy transformation, heating, transportation and industry (that all cause the creation of oxidized volatile nitrogen, NOx-N), and the wide field of human nutrition / agriculture (with a dominance of the forming of reduced volatile nitrogen, NHy-N, in livestock farming). Airborne nitrogen emissions from outside the River Danube Basin are deposited within, as airborne emissions within the Basin are also deposited outside. Atmospheric nitrogen depositions over the DRBD deviate in different regions.*

*A very big contributor for N emissions are agglomerations (with / without sewerage collection and wastewater treatment); the emissions caused by agricultural activities (fertilisers, manure, NHx) and through agricultural land for NOx are the most important ones (totalling 43% of total N emissions). Also NOx emitted from non-agricultural areas and deposited on other areas is bigger than the share of N for the background.*

*For P, emissions from agriculture (area under cultivation, erosion, intensity of production, specific crops and livestock densities) are the second largest source, after input from urban settlements. The share of agricultural emissions varies significantly between countries (for details see Chapter 7).*

- ***Sediment balance, p. 26.***

  I quote the following sentence: *At present the torrent control works and impoundments on the upper Danube retain about 1/3 of the suspended load (see Annex 8).* In Annex 8 no paper or publication proofing this statement is contained. It is further unclear what reference status the term <sediment load> relates to (in the sense of the initial load that is retained); a quote for a retention value of suspended matter makes only meaning if both the initial value as well as the resulting one are clearly defined. This principle should also apply for this aspect within this RBM-Plan.

  Assuming that the results underlying the statement are true torrent control works and impoundments in other parts of the Danube River Basin will also impact on the sediment balance.

  My proposal for a re-phrasing this sentence is thus as follows: *Estimates undertaken in the upper Danube indicate that the torrent control works and impoundments retain about 1/3 (*and a reliable description of which values are compared for this retention is contained) *of the sediment load (see Annex 8). Such retention quite likely also takes place in other parts of the River Danube Basin where torrent control works and impoundments exist.*

- ***Nutrient pollution, p. 59 to 68:***

  - Sorry, I can not fully grasp the explanations on the agricultural scenarios (text; Table 13; Fig. 30; Fig. 31).
  - The reference to <footnote 84> in Table 13 is misleading. Is the dimension <% change> valid for all lines, or is the dimension in line 1 <kg/ha*a> (as a difference to the Reference Scenario, or as a baseline in 2005, based on which percentage change is shown in the lines 2 and 3?).

- I am aware of the statement that the values in Figs. 32 and 34 are normalized to the long-term hydrological situation (valid for both the <emissions to Danube> and the <loads to Black Sea>; the <emissions to Danube>, however, are quite likely ones into a river network within the Danube River Basin that still has to be specified in the text). A full explanation in the Annex is missing what this means and how this is achieved.
- Comparing Fig. 5 and Fig. 32 resp. Fig. 34 the values shown are totally unclear to me. The Draftv6 states in Fig. 32 that the <reference nitrogen load discharged to the Black Sea> is close to 500 kt/a. However, Fig. 5 presents only ~ 330 kt/a for the year 2005. Similar situations exist in regard to totP.

• ***Compared with Fig. 5 the following issues arise from my point of view in Fig. 32 resp. in Fig. 34:***

- *What does the wording <nitrogen load> mean in Fig. 32, compared to <DIN load> in Fig. 5? Does <nitrogen> in Fig. 32 refer to <total nitrogen>?*
- *What does the wording <P flux> mean in Fig. 34, compared to <totP> in Fig. 5?*
- *How are the loads <state of 1960's with Iron Gate> in Fig. 32 / Fig. 34 derived, and why are the values presented not the same as in Fig. 5 for 1960? Why is there no full documentation in the Annex? Why is there no linking between the status of the waters in the Black Sea and the discharged loads?*
- *With reference to the preceding discussion on the <reproducibility of load data / their variance>, it is from my point view mandatory that these loads be specified with an <uncertainty range / variance>. For DIN (= dissolved inorganic nitrogen; in River Danube NO3-N dominates) and for totP values are available (Hainburg/Austria), for total nitrogen (totN) no such information is yet available.*
- *In case the dimension for <nitrogen> in Fig. 32 is <total nitrogen> I draw your attention to the fact that no experience exists how such parameter is to be interpreted, and specifically what a <checking> of reaching a target value means.*
- *I am aware that the parameter <totN> is from a reasoning point of view better than DIN (provided that good quality data for totN is assessed).*

• ***Remarks to parts of the text under <7.1.2.3.3. Estimated effects of national measures on the basin-wide scale>***

- In regard to nitrogen pollution, the following sentence is unclear: *However, the total nitrogen* ( does this here really mean <total nitrogen = TN>, and not <total dissolved nitrogen = T_DIN>?) *load into the receiving Black Sea is currently 468 kt/a, the BS 419 kt/a, which is still 40 % higher than the loads of the 1960s*. It seems that the value <468 kt/a> is the one for the <reference situation> (i.e. close to 500 kt/a in Fig. 32). The value <419 kt/a> is not documented in Fig. 32, and no information is given from where it stems and what it means.
  *Please be aware of the all the preceding remarks on TN (where no experience exists what values for TN / total N actually are in the longer run; only for 2005 and 2006 a load estimation is undertaken at Reni for TN / total N, with estimated values somewhat smaller than the emissions into the river network within the DRB according to MONERIS.*

*No information is as yet available how this parameter evolves at all the other TNMN stations within the Danube River Basin).*

- In regard to phosphorus pollution, the following sentence is unclear: *However, the total phosphorus load into the receiving Black Sea (taking into account retention processes) is currently 29 kt/a, and according to the BS 23.5 kt/year, which is still 15% higher than the loads of the 1960s.* The <29 kt/a> is the reference situation in Fig. 34; the value <23.5 kt/a> is not documented in Fig. 34 and it is not clear from where it stems (what is <according to BS>? In the past ICPDR had decided that it itself is the body to agree and to report on the loads River Danube discharges to the Black Sea, and nobody else).
- With reference towards fixing the <target load, status of the 1960's> I am asking how hydrologic years with a flushing of the man-made impoundment behind Iron Gate I dam can be adequately reflected. I further hint at the fact that the storage of totP in this impoundment is due to its existence, and not only due to emissions from up-stream.

- ***The checking of <target loads> and the achieving of <good status>***
  - This Draftv6 RBM-Plan does not yet contain a procedure describing how keeping the <target loads fixed> (i.e. the status of the 1960's) will be checked.
  - In order to avoid any future misunderstanding a reliable <checking procedure> has to be developed and agreed upon. This procedure will have to take the following items into account:
    - the load data, including their <reproducibility/precision/variance> = the <uncertainty range> around values
    - any transformation of the load data observed (relating to hydrologic data, as indicated in the footnotes to the Figs. 32 and 34)
    - the status (ecological; chemical) of the transitional and coastal waters in the DRBD, and also the status of the Black Sea (referring to the conditions expressed in the EU Marine Strategy Directive).

- ***My personal view: What we are really in need of to undertake in the wide field of nutrient emissions***
  - All the matching and checking of loads is from my point of view of secondary importance compared with reaching the good ecological / chemical status caused the nutrient emissions into the Danubian river network and the discharge by River Danube to the Black Sea (EU WFD / EU Marine Strategy Directive).
  - The minimising of emissions is of primary importance.
  - Supposing that the gross loads of N and P generated in urban agglomerations is bigger than documented in the present Table 4 in Draftv6 it might well be that a steeper reduction of the emissions of P is possible (including the substitution of poly-P in detergents) over time than anticipated in this Draftv6 DRBD MP. In regard to nitrogen the situation is more complicated, specifically also due to the way by which <reactive nitrogen> is emitted to soil and water, and also due to the air-borne transfer of NOx-N and NHy-N across the boundaries of river basins.
  - In regard to *point source nutrient emissions* this requires every-day acting in regard to sewage collection (where flushing toilets and similar principles dominate), adequate waste water treatment, replacement of poly-phosphates in detergents, and also keeping excreta away from the formation of waste water (only possible where from a local planning point of view such principle can be applied; in order to be as clear as possible: this means the discarding of flushing toilets in homes as common at present, substituted by a safely operating replacement).
  - In regard to *nonpoint-source emissions* minimising soil erosion and leaching is mandatory with phosphorus. In regard to nitrogen and in the longer run a proper matching of the human diet (ratio of primary protein versus protein in meat) with the agricultural production potential (including the way in which renewable material for other purposes than nutrition are grown) under adequate fertilisation, and minimising the formation of nitrous oxides and reduced nitrogen (NHy) are from my point of view the most promising ones.