



Threshold values and management options for phosphorus in a catchment of an estuary in Denmark with poor ecological status

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Assessment of the ecological status of an estuary in Denmark (Horsens estuary) indicate that beside reducing total N loads also total phosphorus (TP) loads should be reduced to a level corresponding to 56% of current TP loads to obtain a good ecological status as required by the EU Water Framework Directive (Hinsby et al., 2012). The estimated maximum acceptable TP load to the estuary amounting to 13 tonnes per year corresponds to a reduction of the current TP loadings (2000-2005) with an average of 10.4 tonnes P per year. The maximum allowed stream threshold TP concentration entering the estuary is then calculated to amount to 0.084 mg P L⁻¹. A source apportionment of TP loads during the period 2000-2005 showed that point source emissions of TP contributed with 31% and diffuse sources including background loadings, agricultural losses and scattered dwellings contributed with the remaining 69% of the TP loadings to the estuary. The reduction targets for TP can be obtained by implementing different mitigation measures directed against diffuse losses in the catchment and introducing improved treatment of sewage water at point sources discharging either to freshwater or directly to the estuary. We developed a management option for the catchment and estuary that could be applied together with a reduction of the total nitrogen loadings in order to obtain a good ecological status in the Horsens estuary (Hinsby et al., 2012). The management scenario included a reduction of point source emissions of TP amounting to 4.14 tonnes P yr⁻¹, restoration of 300 ha of riparian wetlands (3.0 tonnes P yr⁻¹) and implementation of mandatory 10 m buffer strips with planting of trees along 300 km of watercourses (3.0 tonnes P yr⁻¹). We find it impossible to calculate a threshold concentration for TP in groundwater within the catchment as the pathways of dissolved (leaching and groundwater discharges) and particulate (erosional) P forms are more complex than it is the case for nitrogen (Kronvang et al., 2007). The average concentration of total dissolved P (TDP) in aerobic groundwater in the catchment amounts to 0.018 mg P L⁻¹, whereas it is much higher in anaerobic groundwater 0.130 mg P L⁻¹. Knowledge on the distribution of groundwater between aerobic and anaerobic groundwater within the catchment exists from the DK-model but TDP fluxes and especially emissions from groundwater to surface waters cannot be reliably estimated as part of TDP from anaerobic groundwater pathways is captured by sorption and precipitation processes in discharge areas before entering the watercourses as natural background concentrations of TDP in watercourses are much lower than could be estimated from the measured groundwater concentrations.

References

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