The water quality of the LOIS rivers: a perspective from the LOIS RACS(R) monitoring programme

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A vast range of research has been carried into hydrological, biological and hydrochemical processes controlling river water quality for the highly heterogenous LOIS catchments. LOIS has generated large volumes of new data which are crucial to process understanding. Public agencies have also made available large and invaluable data resources. All these data have been integrated within an highly structured LOIS database, a vital component of large scale research involving many research teams. These data have been used to elucidate many aspects of the physical, chemical and biological dynamics of large scale river basins.

Background research indicates that a major impact of man upon water quality and the environment came during the industrial revolution. This change peaked between the mid nineteenth century and the first two decades of the twentieth century. Because of this, many of the LOIS rivers became extremely polluted leading to major ecological damage. For example the rivers Aire and Tweed were described in terms of "a liquid more the appearance of ink than of water". Regulatory organisations and legislation were introduced during the latter half of the nineteenth century in response to problems of pollution. From this time, dramatic improvements in water quality were brought about by the curtailment of untreated sewage discharges to rivers and the development of modern sewage treatment plants. As environmental issues came more and more to the fore during the last 20 years, new UK and EC legislation have brought about even further improvements with, for example, the declines in organic chemicals entering rivers. Further, there was a major decline in heavy industry across Europe during the post war years coupled with major industrial competition from other countries and a move towards greater self sufficiency. For example, the dramatic improvement in the water quality of the River Trent following the decline of the wool industry means that it is now one of the few undeveloped sources of potable water supply in England and Wales.

Although there have been major improvements across the LOIS rivers, flood plain contamination persists on the Ouse and Tees, owing to mid nineteenth century mining activity. Within the Humber catchment there is a major divide between North Yorkshire and South Yorkshire/Trent. The southern rivers, which drain the major industrial centres of Leeds, Bradford, Sheffield and Birmingham exhibit unacceptably high concentrations of many pollutants such as trace metals, nutrients, organic matter and micro-organic compounds.

Atypical climatic variability has occurred over the past 50 years with a move towards drier summers and wetter winters with an increase in hydrological extremes. A sequence of extreme droughts and high river flows has been experienced during the LOIS study. This has led not only to problems of both drought and flooding in the LOIS area, but also to more extreme chemical and biological conditions. For example, during 1995, an algal bloom on the Tweed reduced fish stocks. While algal blooms have caused damage in the past, perhaps once every 10 to 30 years, the type of algae has changed to one associated with extended warm and dry periods. The impacts of extreme summer dry periods are particularly significant in the more polluted rivers; it is during these times that concentrations of algae and pollutant concentrations are at their highest. The summer extreme low flows are of particular significance in the lowlands because of

the diminished dilution of effluents. In other areas, such as the southern parts of the LOIS region, in East Anglia in particular, intensive farming coupled with low rainfall and high evaporation rates leads to high nutrient concentrations in the rivers.

Fluxes of pollutants to the North Sea cannot be estimated accurately and the flux estimation methods available give widely differing values. Consequently, attention is being given to improving the methodologies and assessing their accuracy and precision. There is a requirement to assess current pollutant discharges to the North Sea and to formulate European based limits to pollutant discharges. Given the variability of weather and flow extremes experienced in the rivers, such fluxes clearly must be considered within a time frame of 10 to 30 years. Furthermore, an even longer time frame needed to be considered as present-day inputs of many pollutants to the North Sea are probably much lower than at the height of the industrial revolution. Thus, the relative significance of past and present stresses on the North Sea environment must be assessed. A major historical source of several metals and possibly persistent micro-organics is currently in the sediments of the flood plain environment. Transport of this material may well be determined by extreme flow events on the centennial scale. Presently, flux estimation procedures do not cater for this longer time frame and legislation is confined to issues of present day fluxes within a European context.

With regards to future issues, the cultural, urban and industrial landscapes are changing. There may be population moves to more rural locations and a continuing trend to light and service industries. Agriculture will change with legislative actions having an important influence. Inevitably, major change will also be linked to changing levels of consents for discharges and the associated legislation. Current and future concerns relate to changes in the nature and distribution of sewage and industrial effluents, long term problems such as the storage of contaminants in the river flood plains and transfer through the river system and the potential for metal pollution with rising water levels within abandoned mines. Of particular concern are the persistence of man-made micro-organic contaminants in fine sediments. Vast numbers of compounds and their metabolites are now persistent in the industrial and urban rivers and although many of these compounds have not been identified either by the Environment Agency or within the LOIS, it is highly likely that several if not many are highly toxic or mutagenic. These substances may have chronic effects over decadal time scales and their impact on the food chain is not currently understood.

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