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ANALYSIS OF LOCH LEVEN NUTRIENT LOADING DATA

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## SUMMARY

1. Progress with the preparation of manuscripts on concentration-flow and loading-flow relationships of phosphorus and silica is described.
2. Plans are outlined for analysing the data in order to compare the impacts of point-source inputs of phosphorus and diffuse inputs of this nutrient on observed seasonal changes of P in the loch.
3. Work with nitrate data has also started.

## 1. INTRODUCTION

The aims of this work are to examine concentration-flow relationships, for soluble and particulate fractions of phosphorus and for dissolved silica and nitrate in feeder streams to Loch Leven, and to assess the total inputs of these nutrients to the loch, and seasonal variation in loadings.

As the contract concerns data analysis, the focus is on the preparation of papers reporting the results. Indeed, it has been agreed that an extensive report will not be necessary - simply a summary of the main findings of the papers (due 31 March 1988). The rest of the report thus comprises statements on progress with the preparation of the manuscripts.

## 2. PROGRESS WITH PREPARATION OF MANUSCRIPTS

### 2.1 Papers on concentration-flow and loading-flow relationships of phosphorus fractions.

#### 2.1.1 Seasonal changes

A paper on concentration-flow and loading-flow relationships of the different fractions of P in streams collecting runoff from ca 75% of the Loch Leven catchment, has been submitted to "Water Research" for publication. This paper includes week-by-week variation in the various parameters, and illustrates, for example, differences in the responses of soluble and particulate forms to rising and falling flows. An exponential increase in loading per unit area of catchment with decrease in catchment size has been found.

#### 2.1.2 Short-term changes during storm events

A detailed analysis of hourly changes in P fractions over a 24-hour period, during which there were 2 major storm events, has been completed and will also be submitted shortly for publication to Water Research. This study was especially instructive in demonstrating, for example, the complex hysteresis in the relationship between particulate transport and flow, the differing trends between storm events only a few hours apart, and on incredibly high input of P to the loch over the 24 hours (equivalent to ca 4% of the annual input).

#### 2.1.3 Monthly summaries

While paper 2.1.1 above gives seasonal information, it has been found that plots of monthly mean values are the most effective way of showing major seasonal trends in loadings. The text to accompany the already-completed drawings will be prepared shortly.

#### 2.1.4 Future work

The next stage of the analysis is well underway. This takes account of the information on P inputs from the point-sources of industrial and treated sewage effluents. In addition to being of major significance in terms of the annual P budget, these inputs show much less seasonal variation compared to the runoff-related loadings. Most of the monthly values have been calculated and graphed; once they have been combined with the runoff values (of 1.3 above), monthly inputs and outputs of total P and the individual fractions can be calculated and compared.

### 2.2 Papers on silica (SiO<sub>2</sub>)

Good progress has been made with the analysis of the SiO<sub>2</sub> data which have been explored in the same way as the P data in 2.1.1 above. In contrast to the strong relationships between many P fractions and flow, plots with SiO<sub>2</sub> levels show considerable scatter. Therefore, mean annual and monthly silica inputs are based on the instantaneous concentrations and flows measured at the times of sampling: for the present, it appears pointless trying to improve on estimates, as was

done for P, by generating silica concentration values on unsampled days from the daily flow records. Setting these problems aside, it has been calculated that, in the absence of diatom growth in Loch Leven, the mean annual concentration of  $\text{SiO}_2$  would be  $9.5 \text{ mg l}^{-1}$ . This value contrasts with the observed mean value of ca  $2 \text{ mg l}^{-1}$ , and reflects the enormous impact of the diatoms in the silica cycle.

### 2.3 Paper on nitrate nitrogen (N)

Analyses of the N data have yet to be started, but a paper discussing the same issues as for P in 2.1.1 above, will not take long to prepare.

## 3 CONCLUDING REMARK

Naturally, the funding by SDD will be acknowledged in all these papers.

This Report is an official document prepared under contract between the Department of Agriculture and Fisheries for Scotland, Nature Conservancy Council, Scottish Development Department, Tayside Regional Council and the Natural Environment Research Council. It should not be quoted without the permission of both the Institute of Terrestrial Ecology and the Department of Agriculture and Fisheries for Scotland, Nature Conservancy Council, Scottish Development Department and Tayside Regional Council