

NRA NORTH WEST 90

UN-IONISED AMMONIA  
IN NORTH WEST ESTUARIES  
USING 1992/3 DATA

Marine and Special Projects  
EQ & PC  
July 1994

Report: MSP-94-006

## UN-IONISED AMMONIA in NORTH WEST ESTUARIES

### 1. Introduction

It is generally accepted that the toxicity of ammonia to aquatic life is dominated by free ammonia ( $\text{NH}_3$ ), with the ammonium ion ( $\text{NH}_4^+$ ) being relatively non toxic.

Algorithms for calculating un-ionised ammonia are readily available for freshwater systems. However they have not been sufficiently accurate in saline systems where the fraction of the total ammonia present in the unionised form is dependent on pH, temperature and salinity.

Recently Plymouth Marine Laboratory have produced a new algorithm for the N.R.A., specifically to improve our understanding of the behaviour of ammonia in estuaries and coastal waters.

### 2. An Environmental Quality Standard for Ammonia

Ammonia is a list two substance as defined by the E.U. Dangerous Substances directive.

The WRC have produced for the U.K. government recommendations for a series of E.Q.S. values for ammonia. The proposed figure for the protection of salt water life is a maximum acceptable concentration of 21 ug/l (0.021 mg/l) un-ionised ammonia. This recommendation has not yet been adopted as a National Monitoring Standard, but is a useful value against which to judge our estuaries.

### 3. Response of ammonia to external parameters

As temperature increases the proportion of unionised ammonia increases.

As pH increases the proportion of unionised ammonia increases.

As salinity increases the proportion of unionised ammonia decreases.

### 4. The Results

The remainder of this document gives a visual presentation of the unionised ammonia data for the following estuaries:

Ribble - Wyre - Lune - Kent - Leven - Duddon - Waver and Wampool -  
Ravenglass Harbour - Solway Firth

The Mersey Estuary results are being reviewed as a separate exercise.

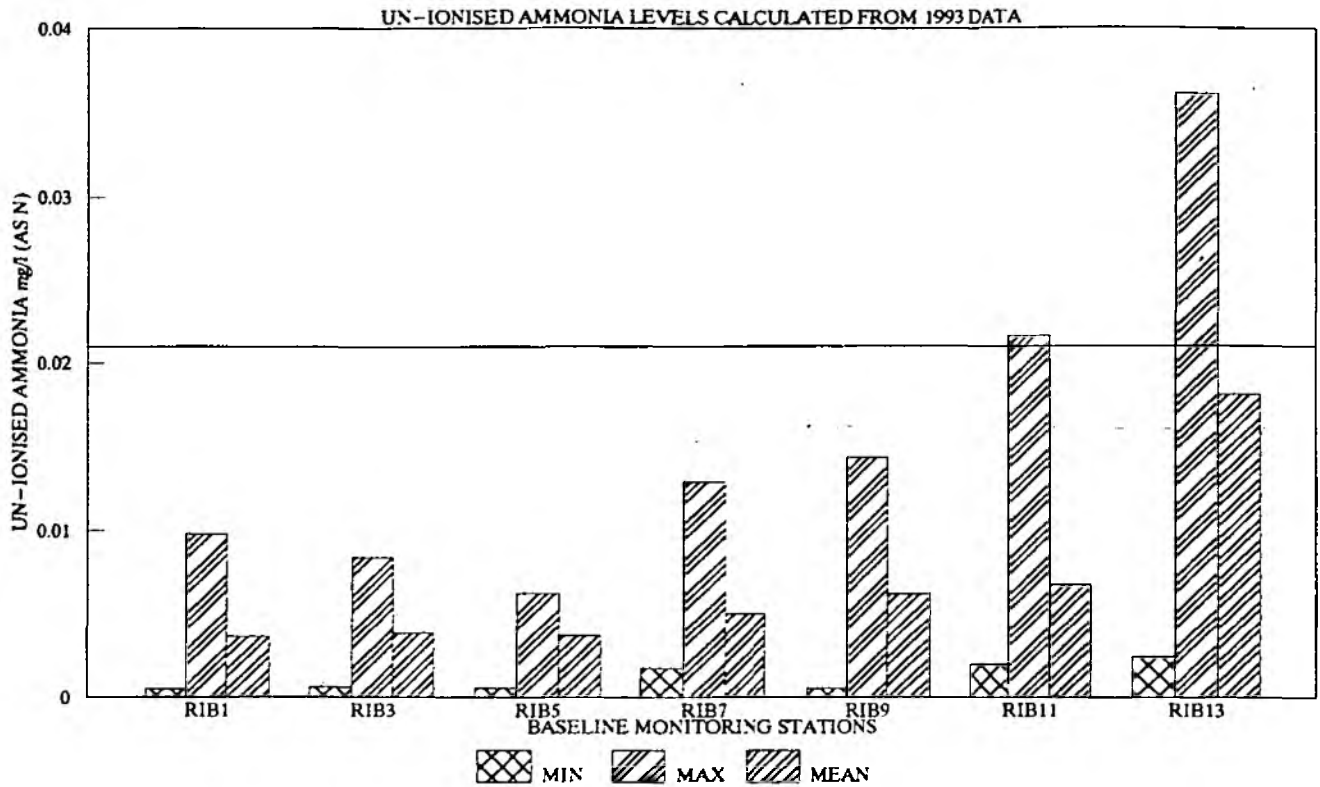
If you are interested in any other saline waters please let us know.

The following points should be considered before using the data:

- a) The majority of routine estuary monitoring takes place around high water. Conditions at extreme low water may well be very different.
- b) The behaviour of ammonia can be quite sensitive to small changes in pH. Present laboratory methods for measuring pH in saline conditions are not perfect.
- c). The worst - average - best estimates are based on combinations of parameters actually encountered, and will not necessarily reflect theoretical 'worst case' conditions.



# RIBBLE ESTUARY



- PROPOSED EQS FOR UN-IONISED AMMONIA (0.021mg/l AS N)

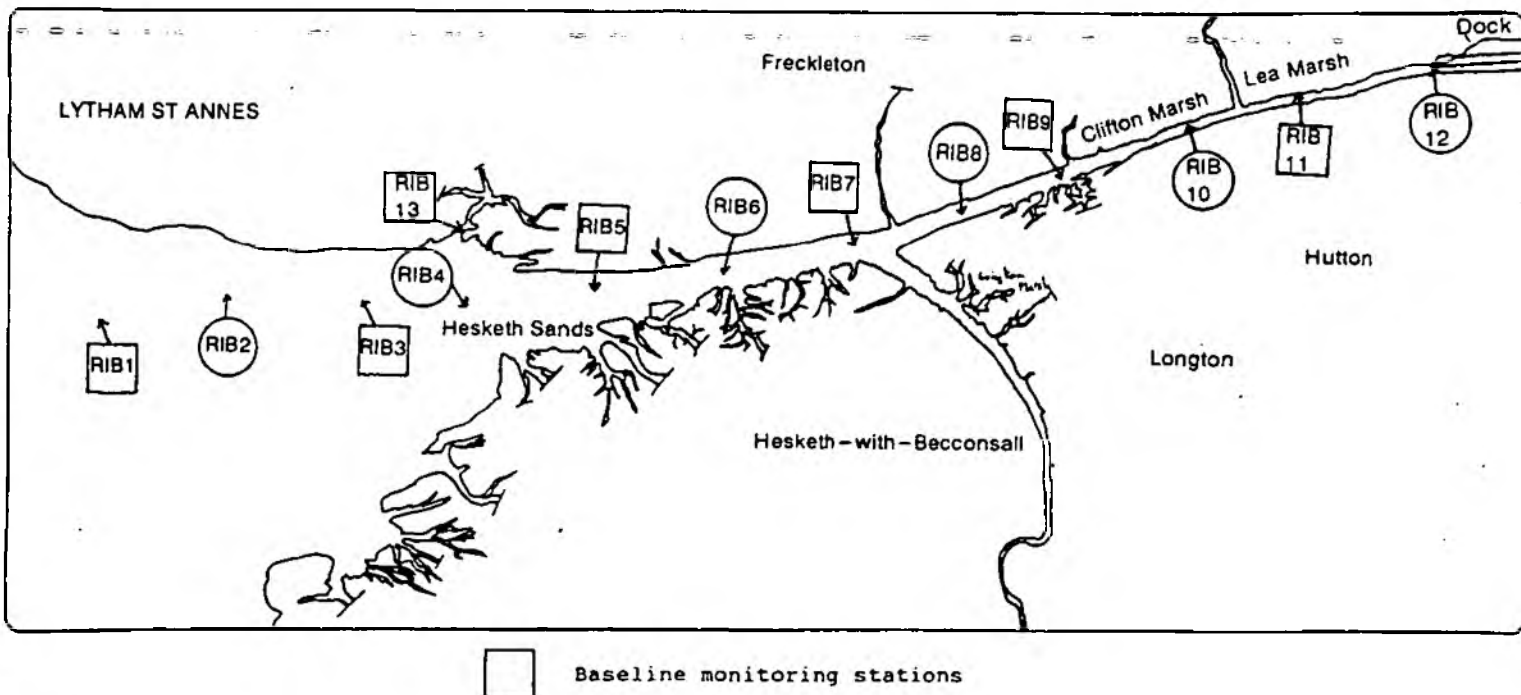
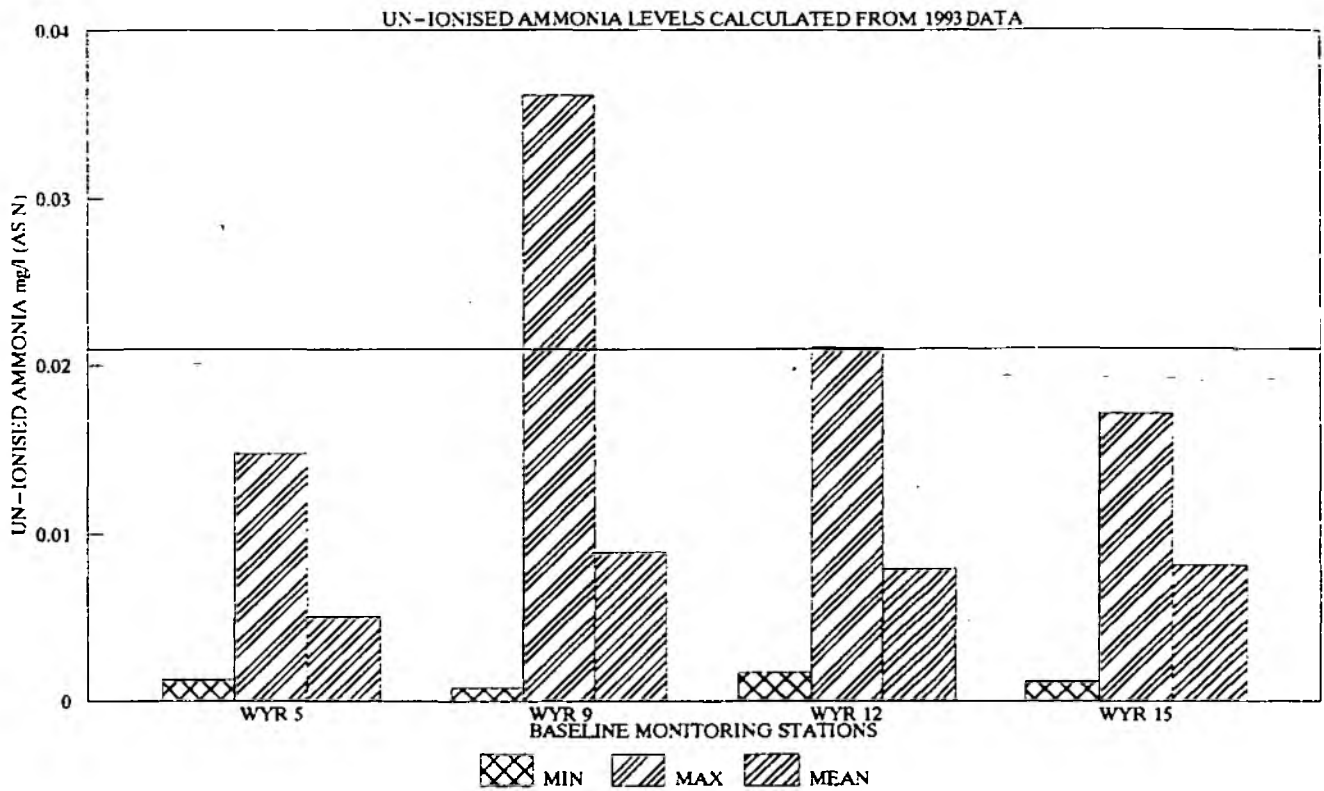


Figure 1: Un-ionised ammonia levels calculated at Baseline Monitoring Stations in the Ribble Estuary, together with schematic representation showing the sampling sites

# WYRE ESTUARY



- PROPOSED EQS FOR UN-IONISED AMMONIA (0.021 mg/l AS N)

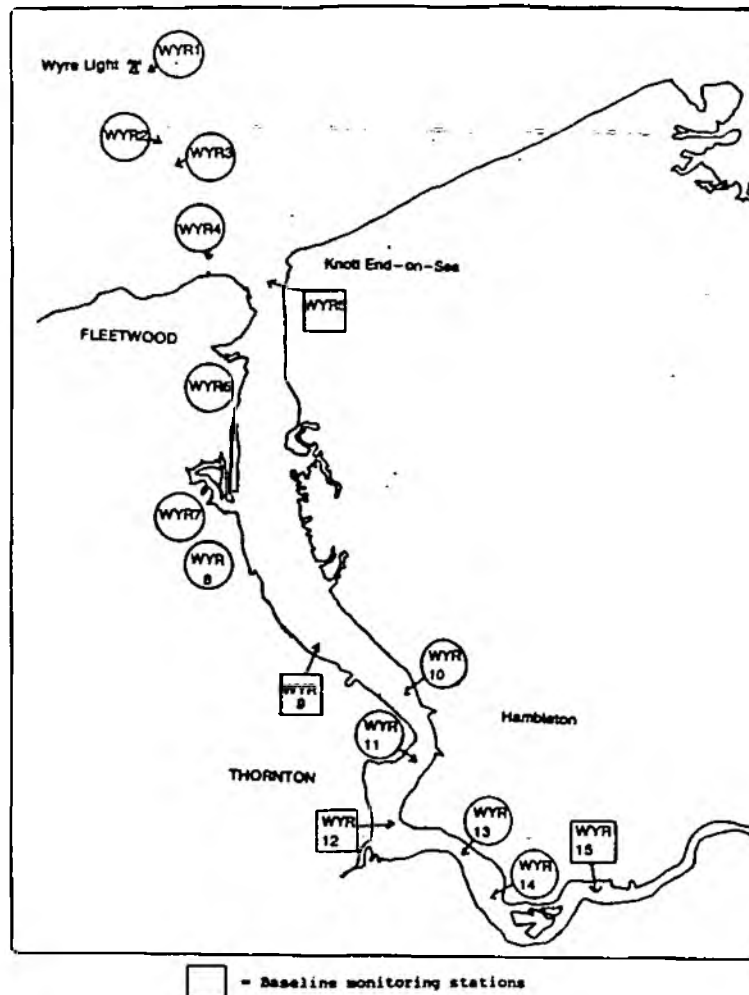
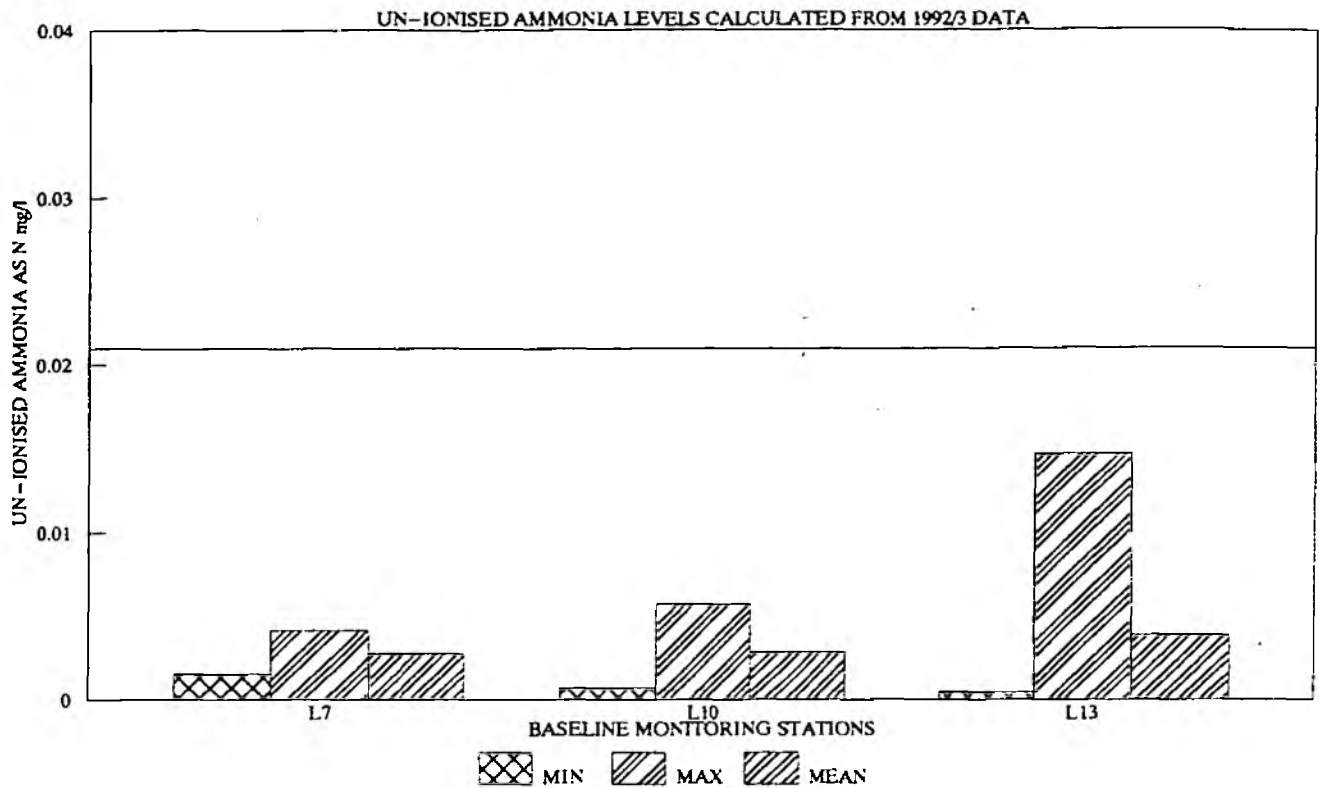


Figure 2: Un-ionised ammonia levels calculated at Baseline Monitoring Stations in the Wyre Estuary, together with schematic representation showing the sampling sites

# LUNE ESTUARY



- PROPOSED EQS FOR UN-IONISED AMMONIA (0.021 mg/l AS N)

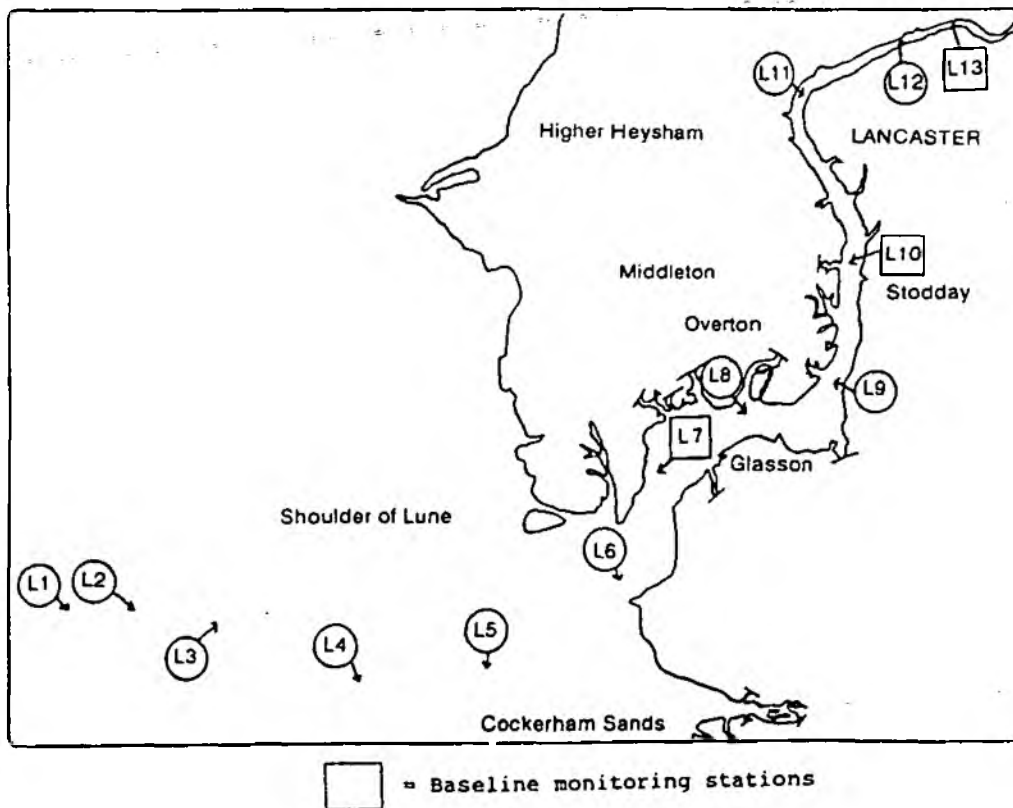


Figure 3: Un-ionised ammonia levels calculated at Baseline Monitoring Stations in the Lune Estuary, together with schematic representation showing the sampling sites

# KENT ESTUARY

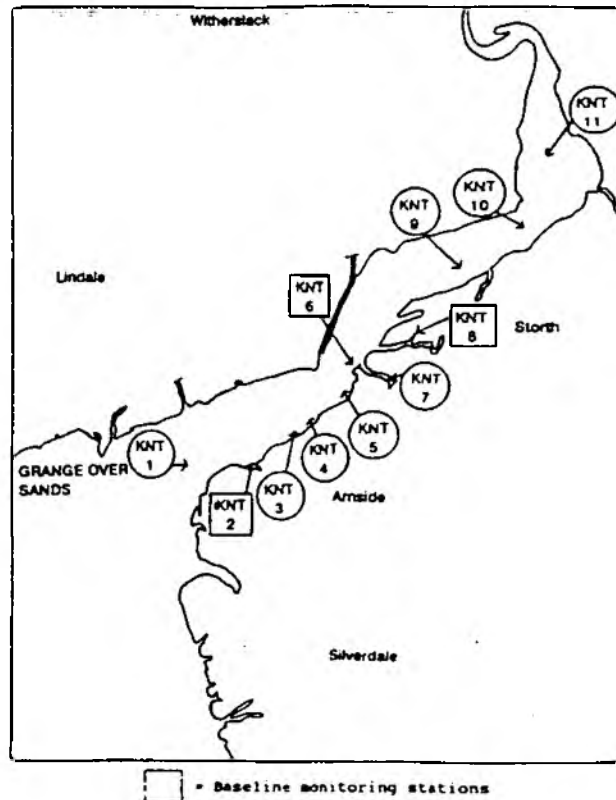
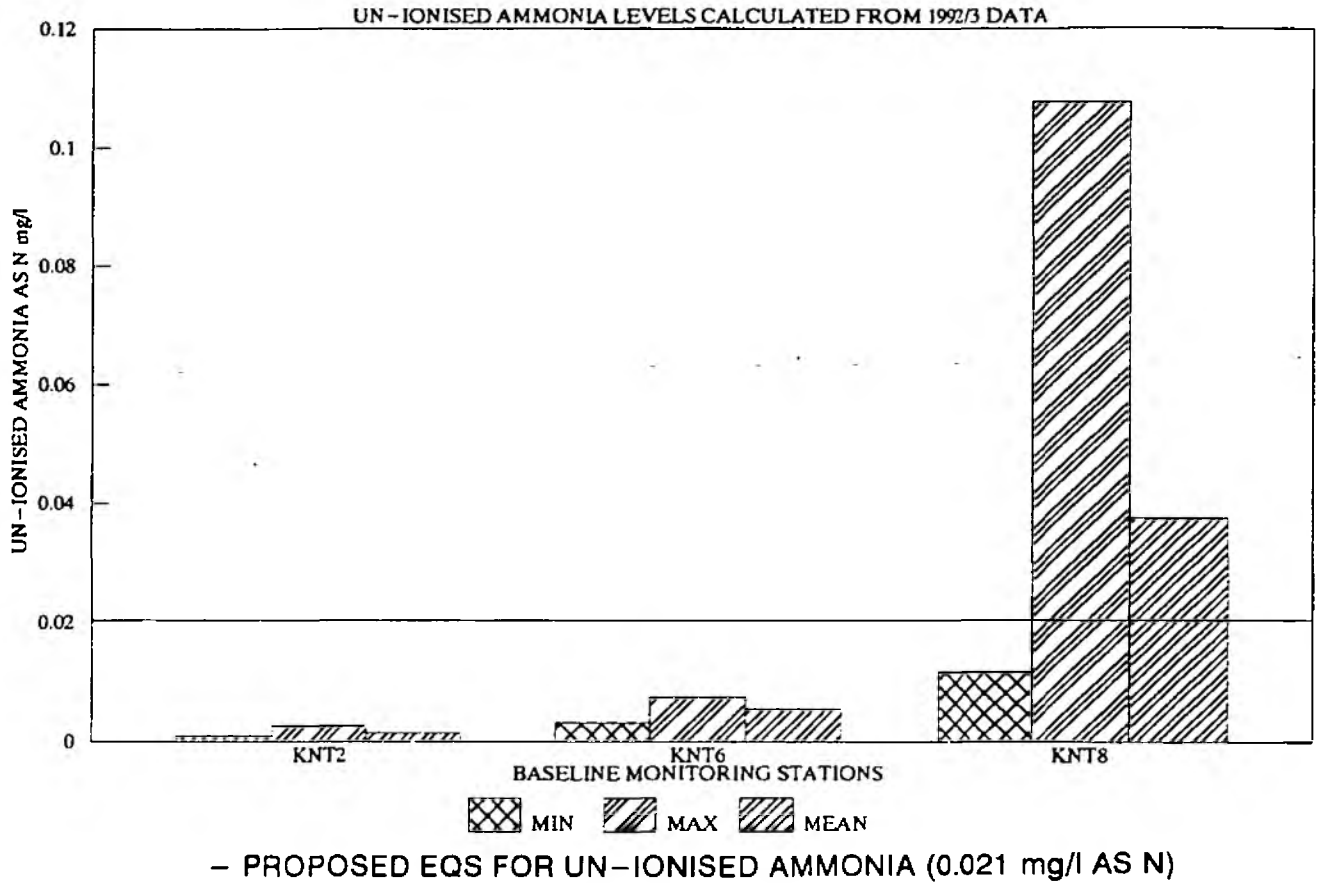
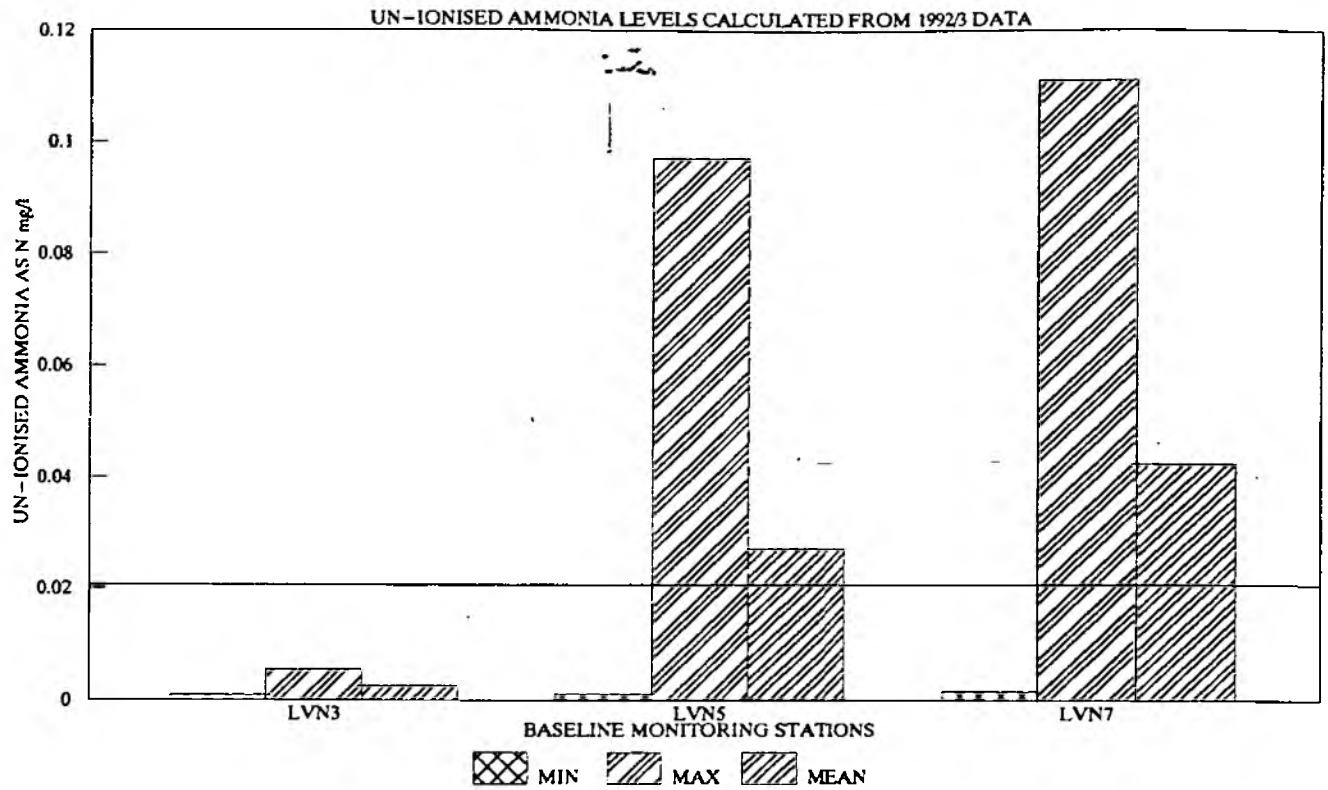


Figure 4: Un-ionised ammonia levels calculated at Baseline Monitoring Stations in the Kent Estuary, together with schematic representation showing the sampling sites

# LEVEN ESTUARY



- PROPOSED EQS FOR UN-IONISED AMMONIA (0.021mg/l AS N)

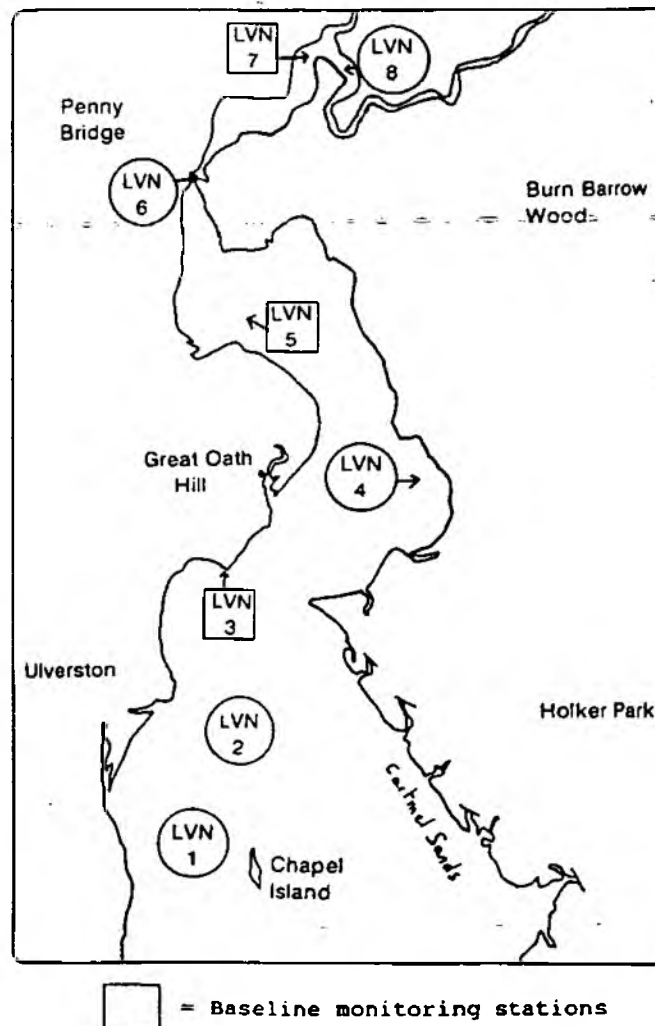
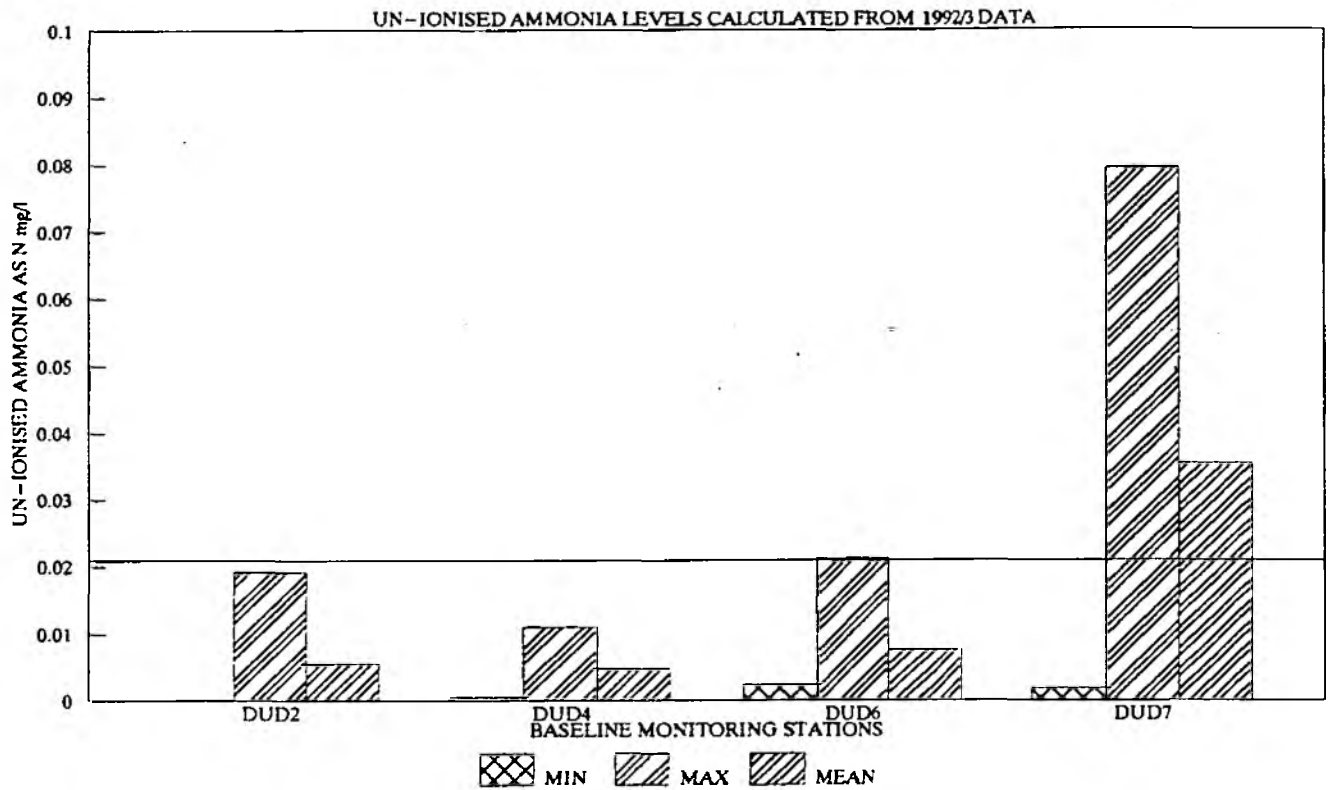


Figure 5: Un-ionised ammonia levels calculated at Baseline Monitoring Stations in the Leven Estuary, together with schematic representation showing the sampling sites

# DUDDON ESTUARY



– PROPOSED EQS FOR UN-IONISED AMMONIA (0.021mg/l AS N)

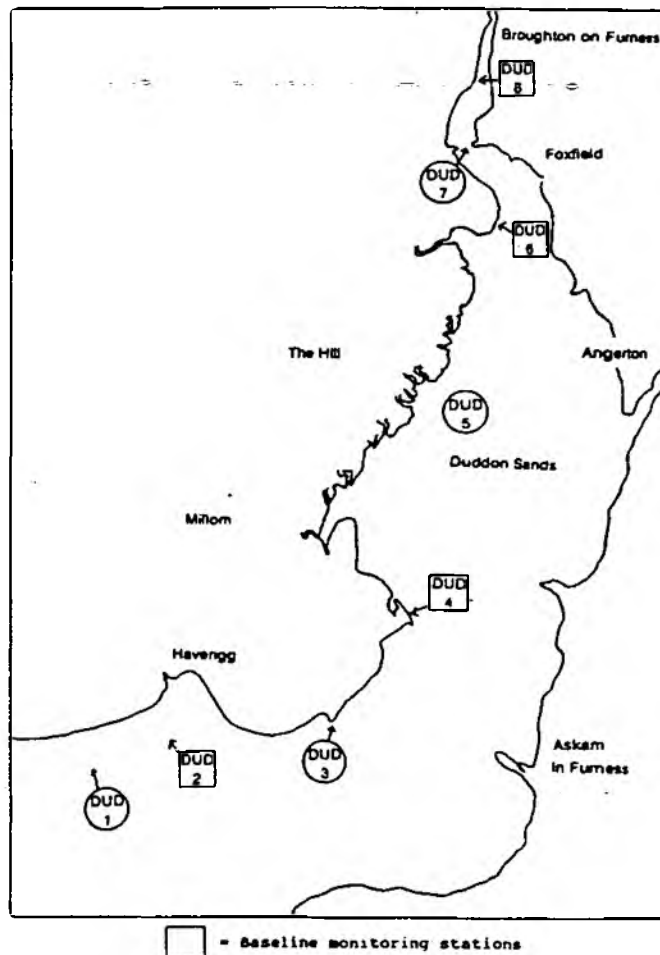
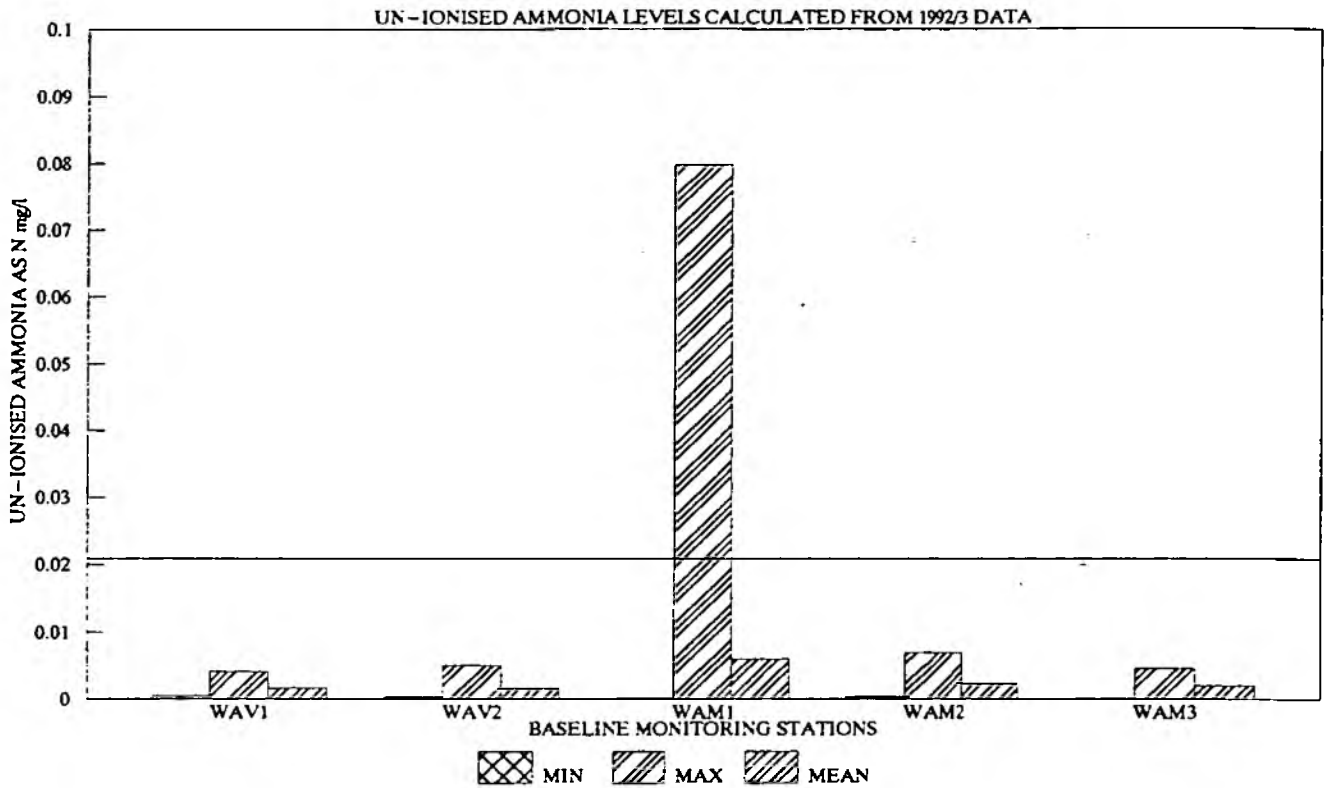


Figure 6: Un-ionised ammonia levels calculated at Baseline Monitoring Stations in the Duddon Estuary, together with schematic representation showing the sampling sites



# WAVER AND WAMPOOL ESTUARIES



- PROPOSED EQS FOR UN-IONISED AMMONIA (0.021 mg/l AS N)

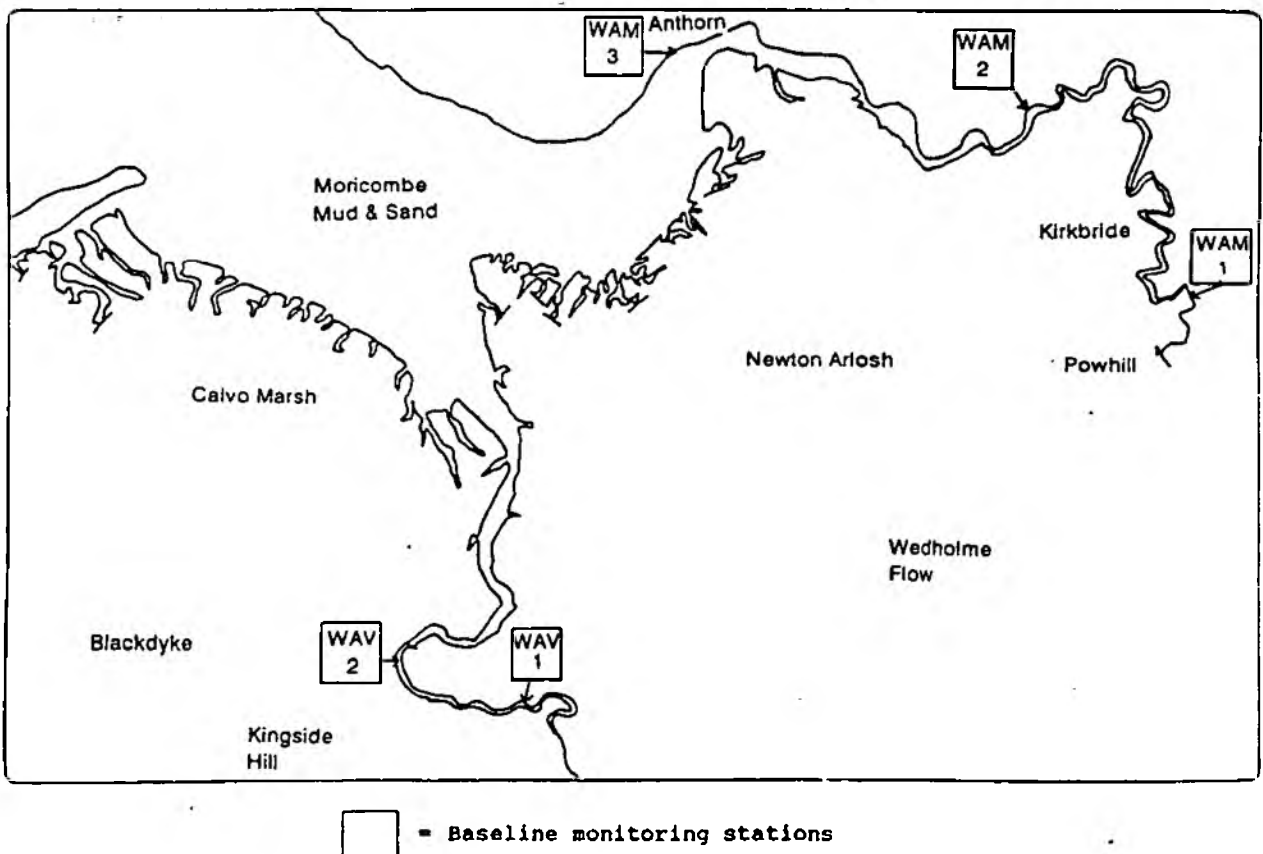
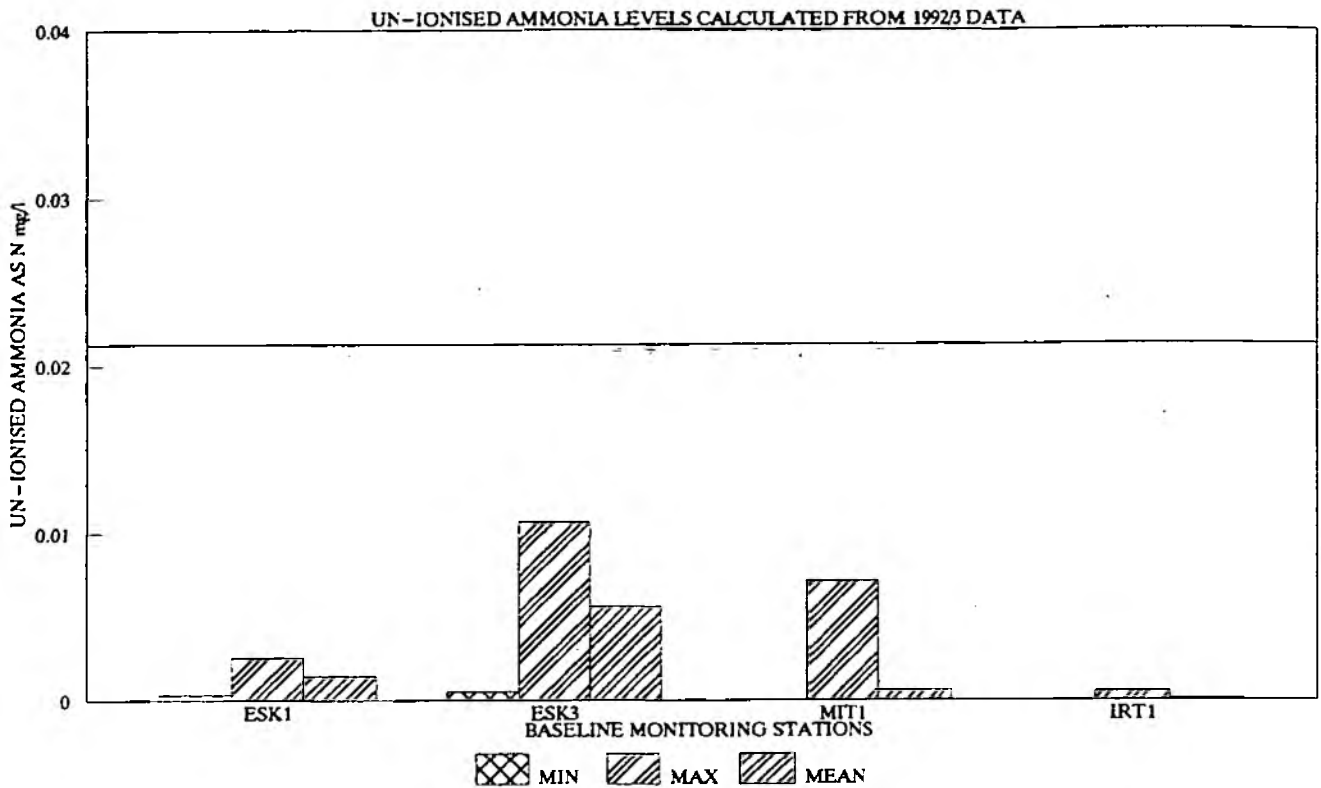


Figure 7: Un-ionised ammonia levels calculated at Baseline Monitoring Stations in the Waver and Wampool Estuaries, together with schematic representation showing the sampling sites

# RAVENGLASS HARBOUR



- PROPOSED EQS FOR UN-IONISED AMMONIA (0.021 mg/l AS N)

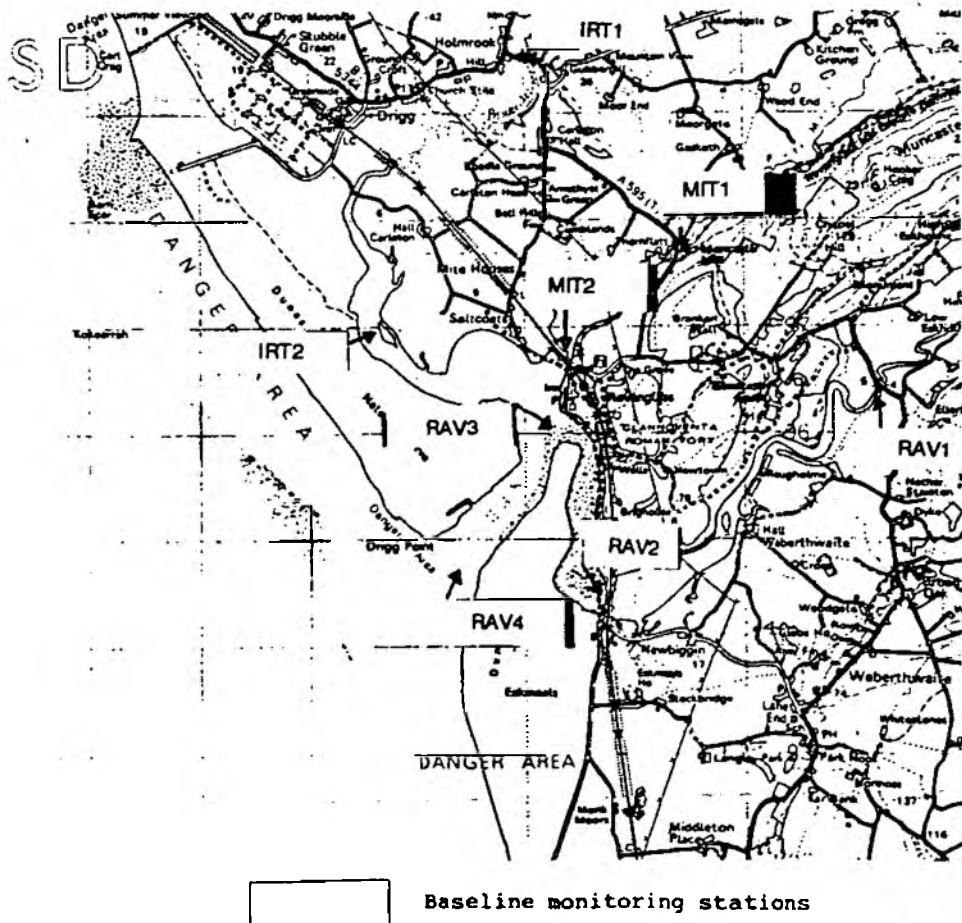
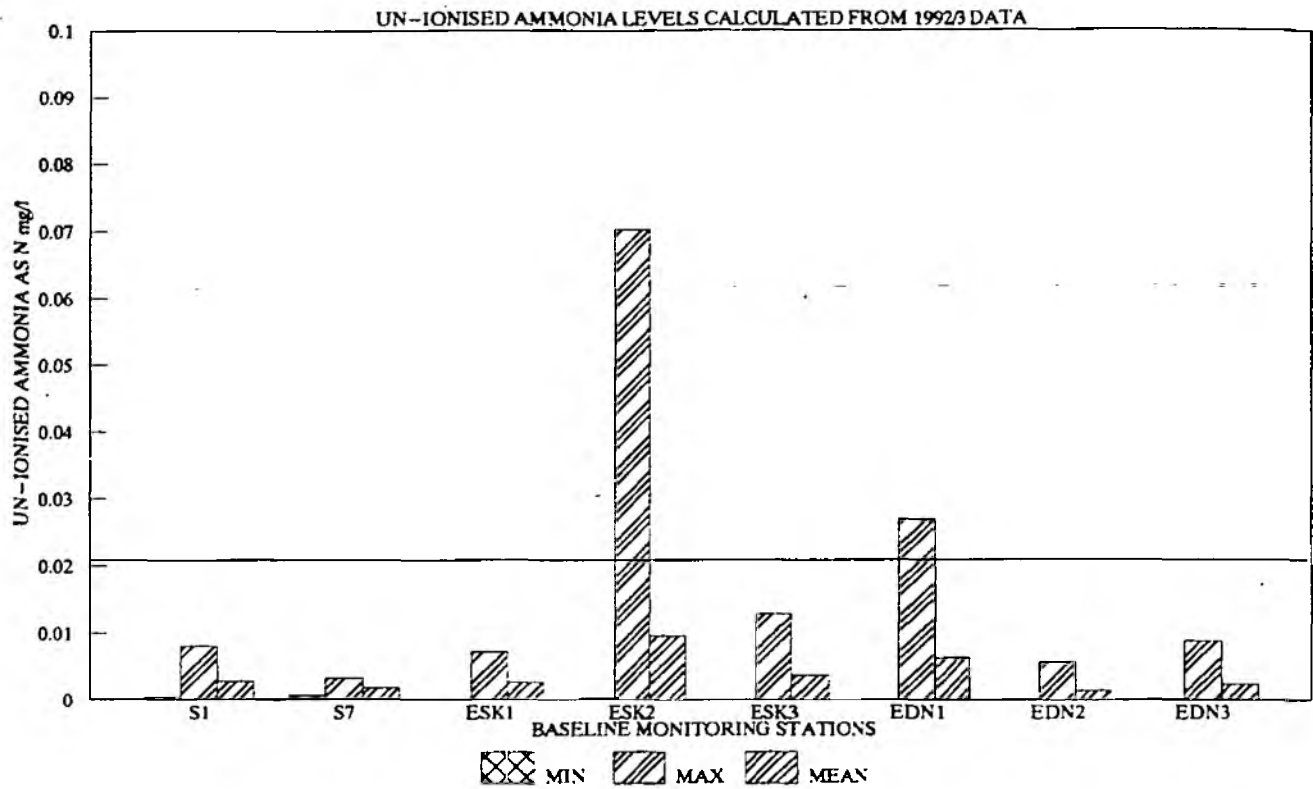


Figure 8: Un-ionised ammonia levels calculated at Baseline Monitoring Stations in Ravenglass Harbour, together with schematic representation showing the sampling sites

# SOLWAY FIRTH INCLUDING ESK AND EDEN ESTUARIES



- PROPOSED EQS FOR UN-IONISED AMMONIA (0.021 mg/l AS N)

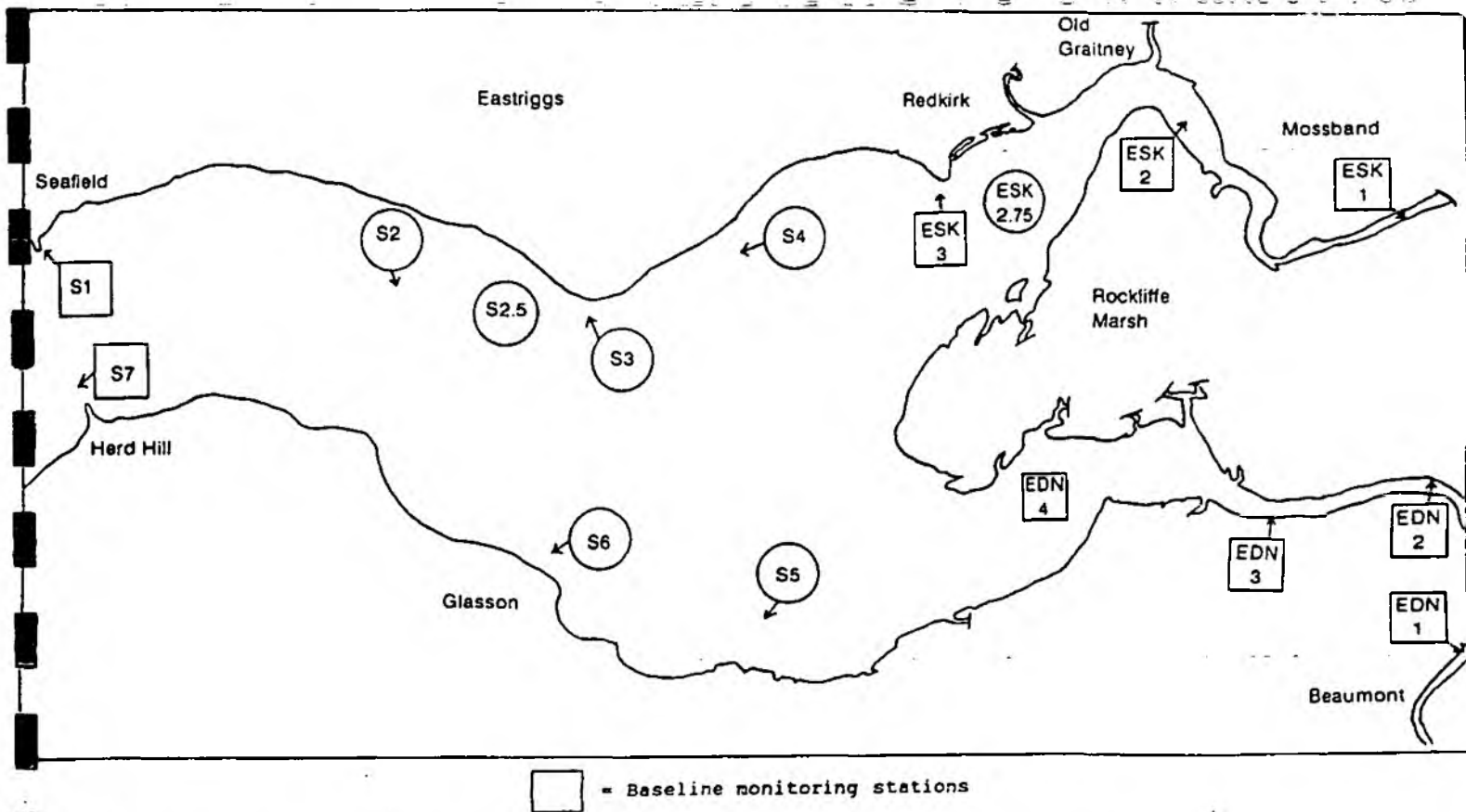


Figure 9: Un-ionised ammonia levels calculated at Baseline Monitoring Stations in the Solway Firth, together with schematic representation showing the sampling sites