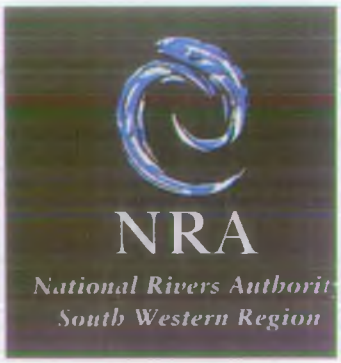
# A Preliminary Investigation Into the Extent of Saline Ingress Into Curry Moor from the River Tone

January 1994

C James S Richardson



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## Summary

This report presents the findings of a preliminary investigation undertaken to assess the extent of saline water ingress into Curry Moor near North Curry, Taunton. This work was prompted by allegations that salt water is being allowed to enter moorland from the River Tone during flood conditions. Two sites were chosen for the investigation, Burrowbridge on the upper tidal section of the Parrett and Hook Bridge on the Tone, near to the point where the water flows into the moorland rhyne system. A site on the lower tidal Parrett in Bridgwater was also chosen for comparison.

It was found that under these conditions, salt water was not measured in significant quantities and it is unlikely that saline water enters Curry Moor from the River Tone.

Further work is recommended to investigate the extent of salinity in the Rivers Parrett and Tone during various tidal conditions.

## CONTENTS

## 1.0 INTRODUCTION

### 1.1 Source

During periods of prolonged heavy rainfall, water is allowed to flow into Curry Moor from the River Tone in order to alleviate the risk of the Tone and Parrett from flooding residential areas.

It has been alleged that saline water brought on the flood tide is entering the moorland via the Tone and Parrett channels during flood conditions.

### 1.2 Measurement

This investigation examines the likelihood of saline water entering the moorland by the measurement of salinity, conductivity and chloride ions in the River Tone where it flows into the moor, and in the tidal River Parrett.

## 2.0 INVESTIGATION

### 2.1 Sampling Sites

The sites identified for investigation were:

Site 1 - River Tone at Hook Bridge NGR ST 3370 2770

Hook Bridge is immediately downstream of the spillway where water enters Curry Moor from the Tone during flood conditions. Samples were taken of the river water from the surface, the river bed, and at depths in between.

Site 2 - River Parrett at Burrow Bridge NGR ST 3570 3040

Burrow Bridge is just downstream of the confluence with the River Tone. Samples were taken of the river water from the surface, the river bed, and at depths in between.

Site 3 - River Tone at Cut Row Bridge NGR ST 3470 2915

Cut Row Bridge is at a point between the spillway into Curry Moor on the Tone its confluence with the River Parrett. Samples were taken of the river water from the surface, the river bed, and at depths in between.

Site 4 - River Parrett at Bridgwater NGR ST 3000 3740

This site in the lower tidal section of the Parrett channel was chosen for comparison. Samples were taken of the river water at the surface.

## 2.2 Sampling Methods

Aqueous samples were taken from the mid point of the channel using a Casella sampling device which enables samples to be taken from different depths.

The samples were then transferred into 1 litre plastic bottles and analysis by the NRA Exeter Laboratory started the next day.

Conductivity, salinity and temperature were measured in situ using a Grant/YSI 3800 water quality logger.

## 3.0 RESULTS AND DISCUSSION

The results are shown in graphs 1 to 15.

Conductivity is expressed in microsiemens per centimetre (uS/cm), salinity in parts per thousand (ppt) and chloride in milligrammes per litre (mg/l).

3.1 The first survey, conducted on 17th January, examined the variations in conductivity salinity and chloride at different depths in the River Tone at Hook Bridge and Cut Row Bridge. Samples were taken every half metre from the bed to the surface. Figures 1 and 2 show that there was no significant change in conductivity or chloride concentration and no change at all in salinity with depth.

3.2 The second survey took place on 18th January and investigated the levels of saline water and changes in the three parameters over different states of the tide. Samples were taken every hour. At Hook Bridge and Burrow Bridge, samples were taken at the surface the river bed and at a distance half way between, at Bridgwater samples were taken from the surface only.

3.3 Figures 3 and 4 show that at Hook Bridge and Burrow Bridge the conductivity salinity and chloride concentration varied little with the change in tide. The salinity was only 0.2 to 0.3 ppt, a very low level, and the chloride levels were similarly low; between 26 and 27 mg/l. Figure 5 shows that in the Parrett at Bridgwater, although the chloride concentrations are higher than at Burrow Bridge and Hook Bridge, they are only marginally so. Unfortunately no salinity data is available for this site due to equipment failure.

3.4 Figure 6 shows the comparison between chloride concentrations measured at Hook Bridge in 1993 and the mean values obtained for Hele Bridge (a site in the freshwater section of the Tone) during the same period. The values for 1993 at Hook and Hele Bridges are very similar, in fact the mean for the freshwater site is higher than that for the upper tidal site .

## 4.0 CONCLUSIONS AND RECOMMENDATIONS

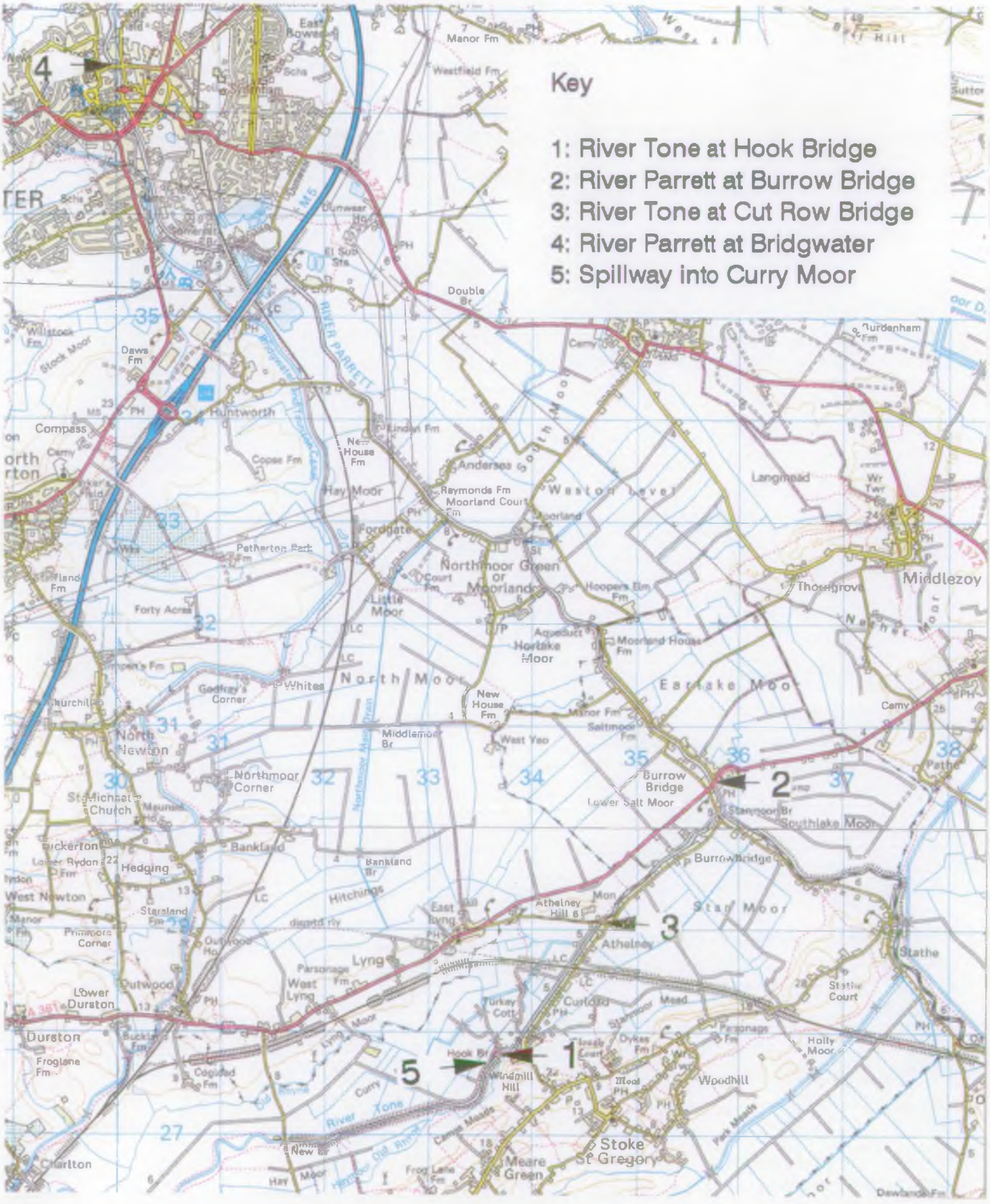
4.1 The levels of salinity found in the Rivers Parrett and Tone in their upper tidal sections near to where flood water enters Curry Moor were found to be very low. Other indicators of saline water, conductivity and chloride ion concentration, were found to be similar to the values obtained from freshwaters.

4.2 The values obtained for the three parameters did not vary significantly with tide or depth.

4.3 Therefore it is unlikely that saline water enters Curry Moor from the River Tone during flood conditions.

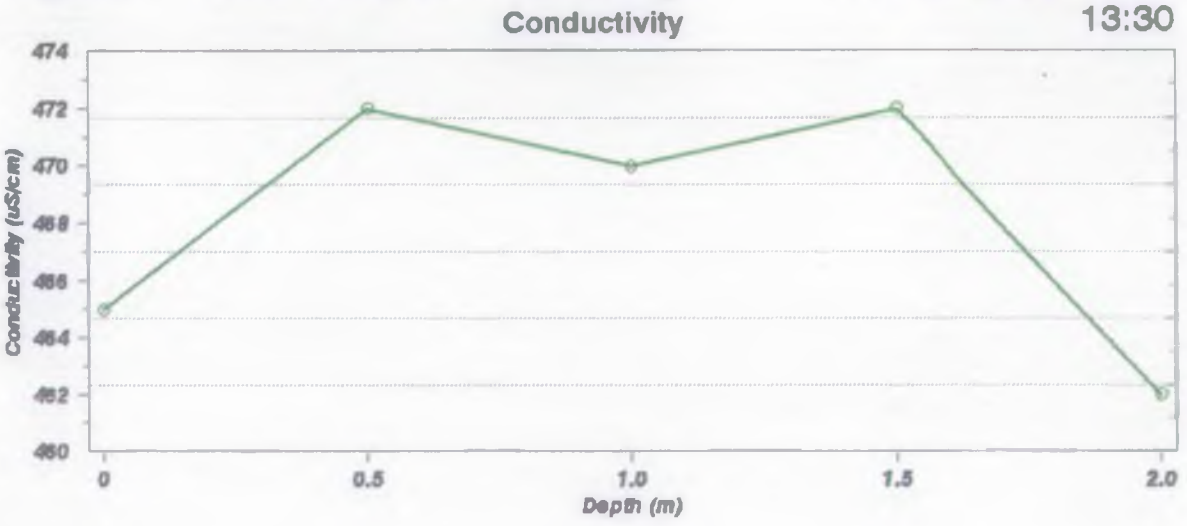
4.4 Further work is recommended to investigate the extent of salinity in the Parrett and Tone during various tidal conditions

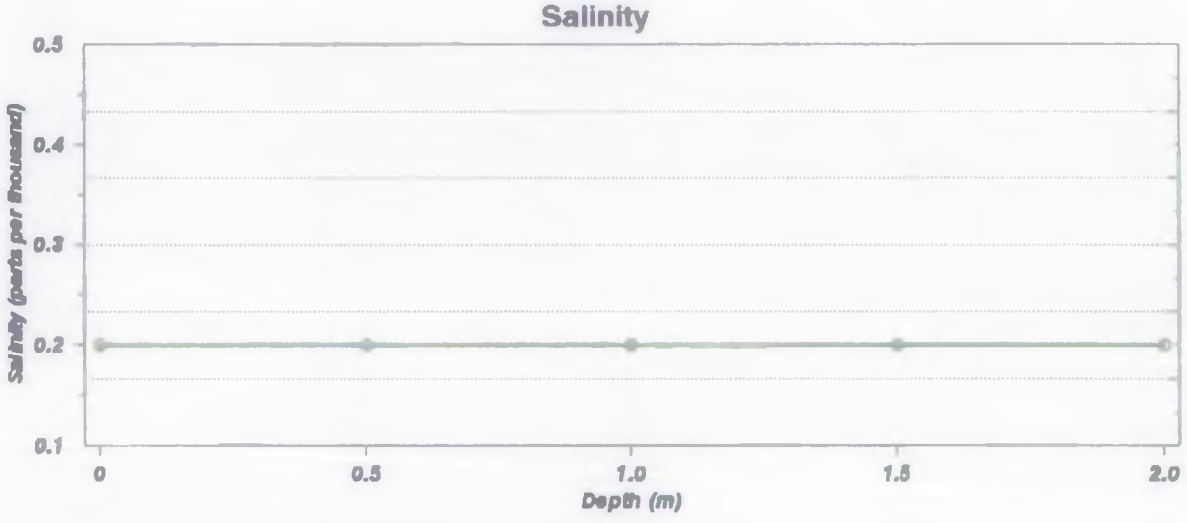
# MAP OF SAMPLING SITES



# RESULTS

Figure 1 River Tone at Hook Bridge 17th January 1994
13:30



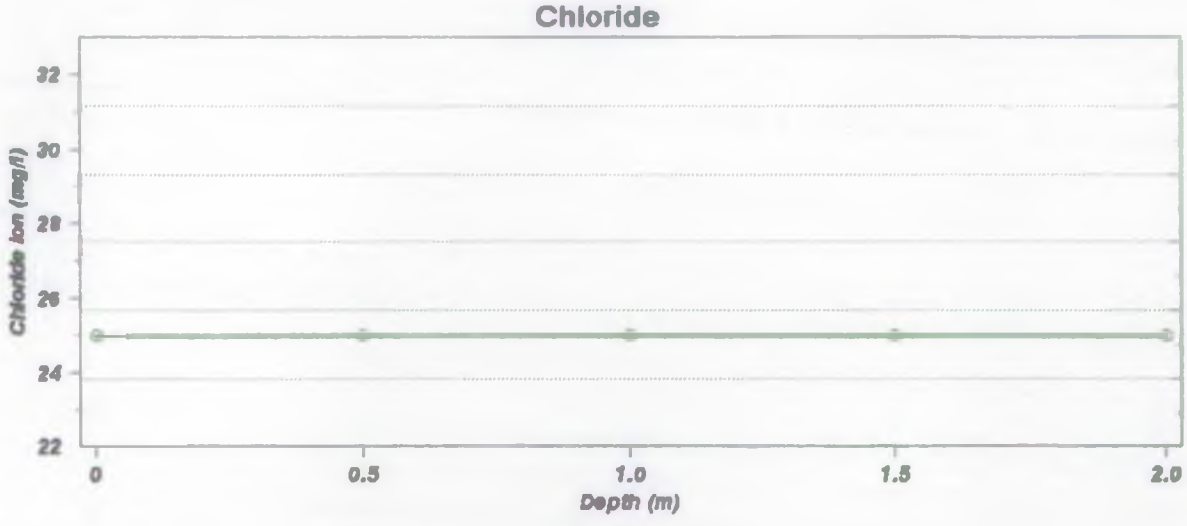
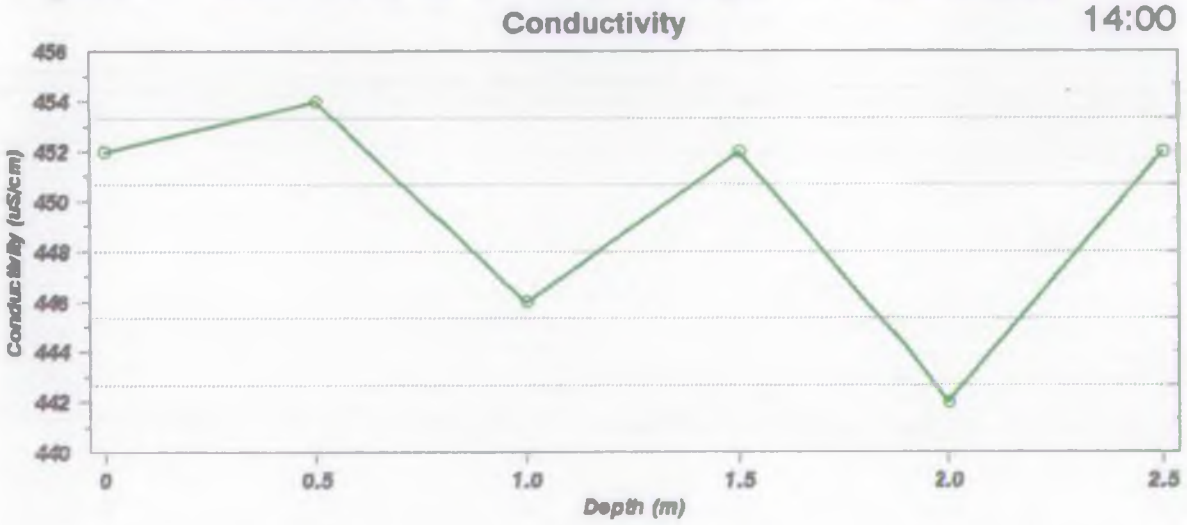
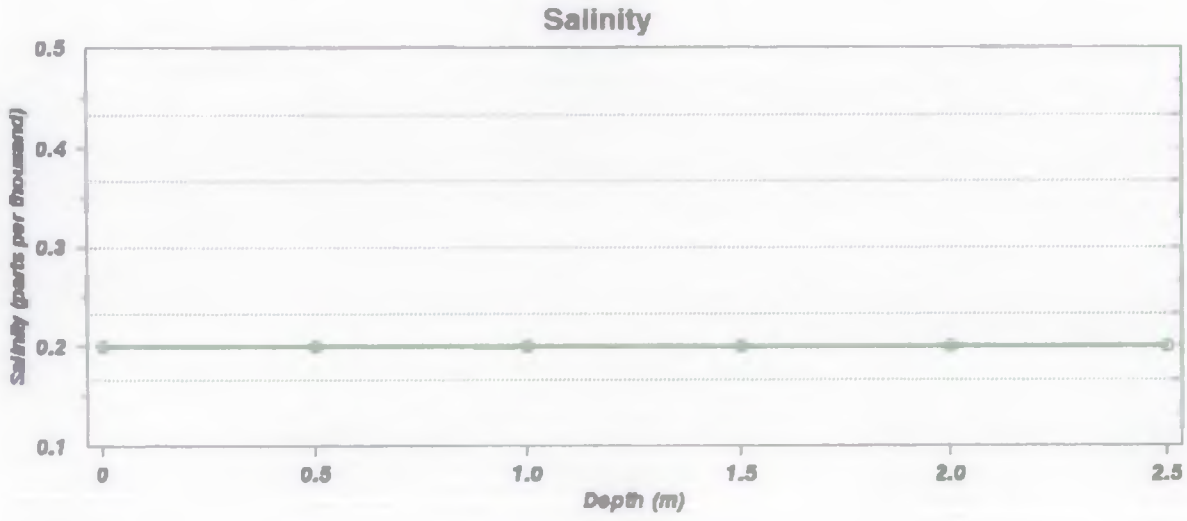



Figure 2 River Tone at Cut Row Bridge 17th January 1994 14:00



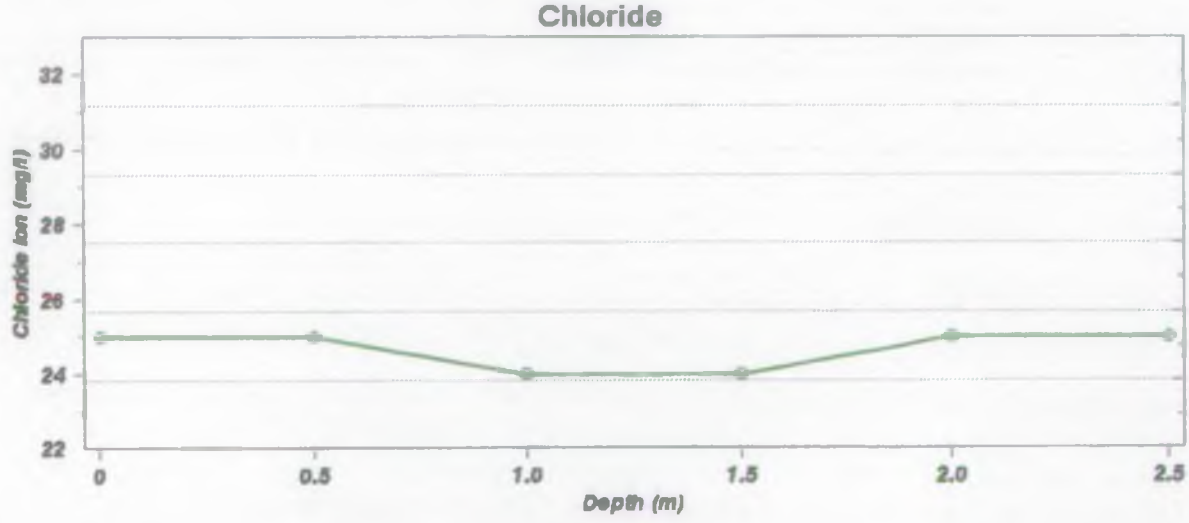



Figure 3 River Tone at Hook Bridge 18th January 1994

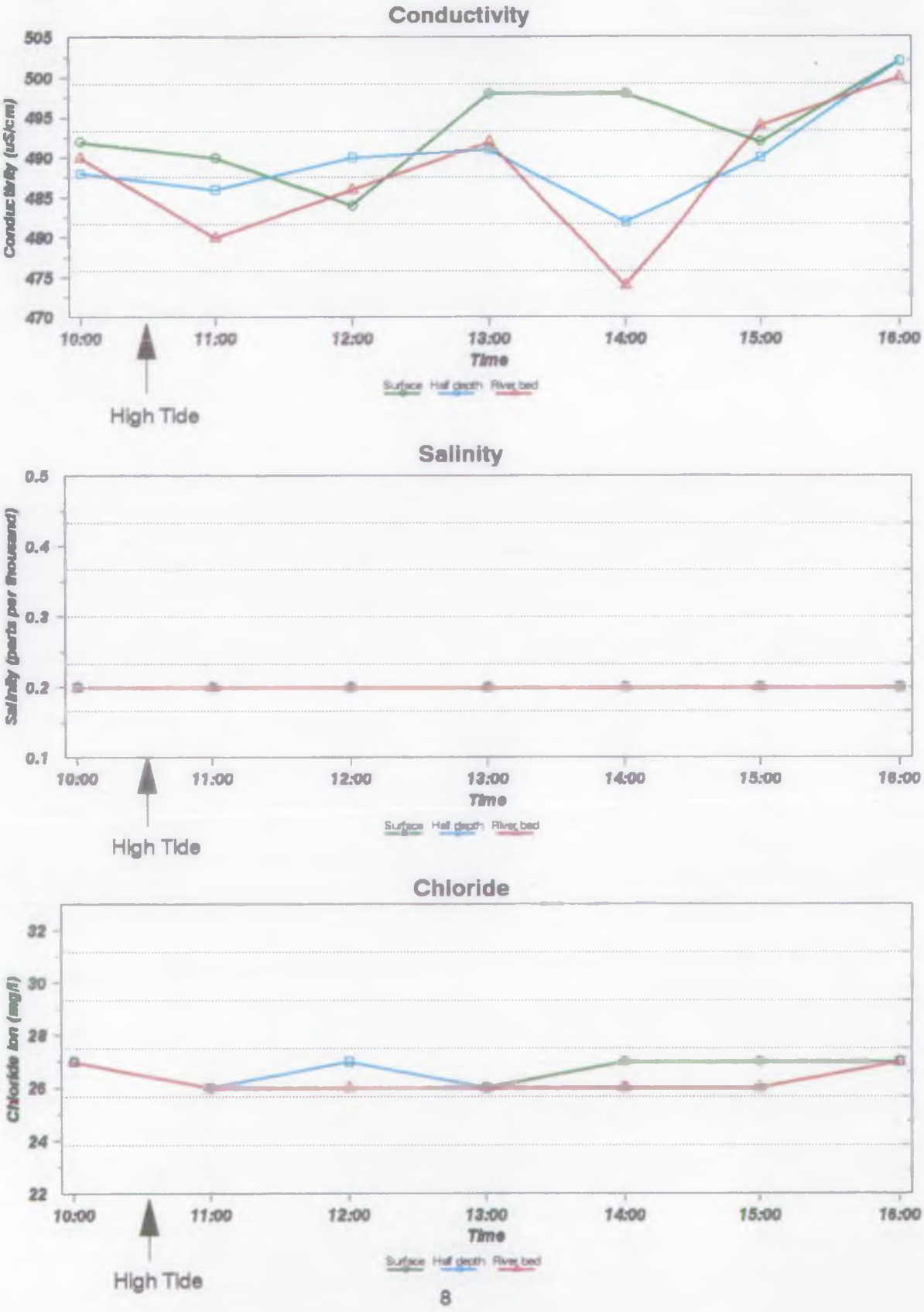
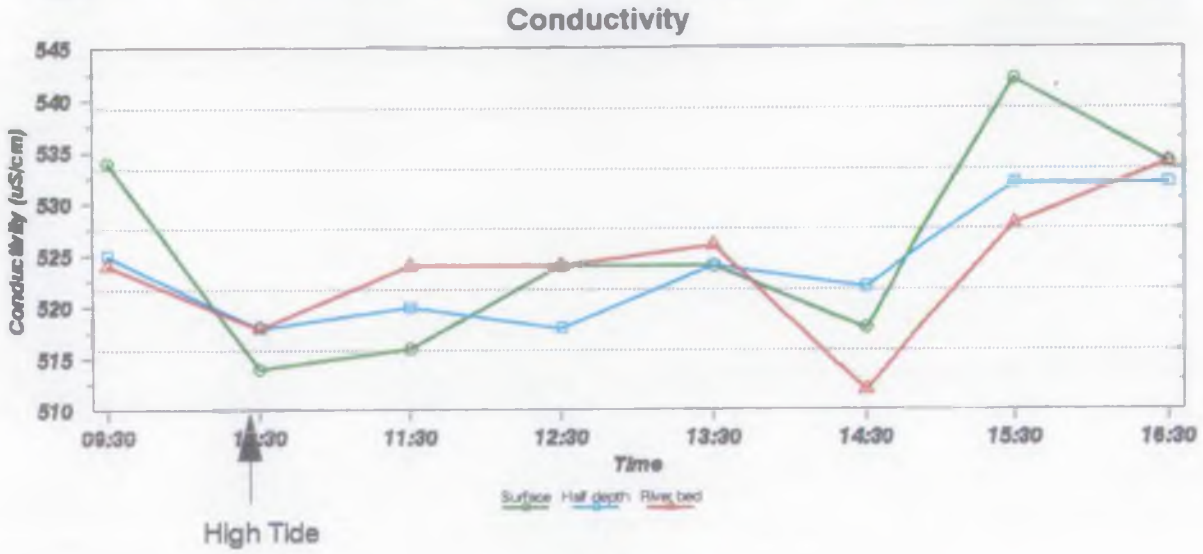
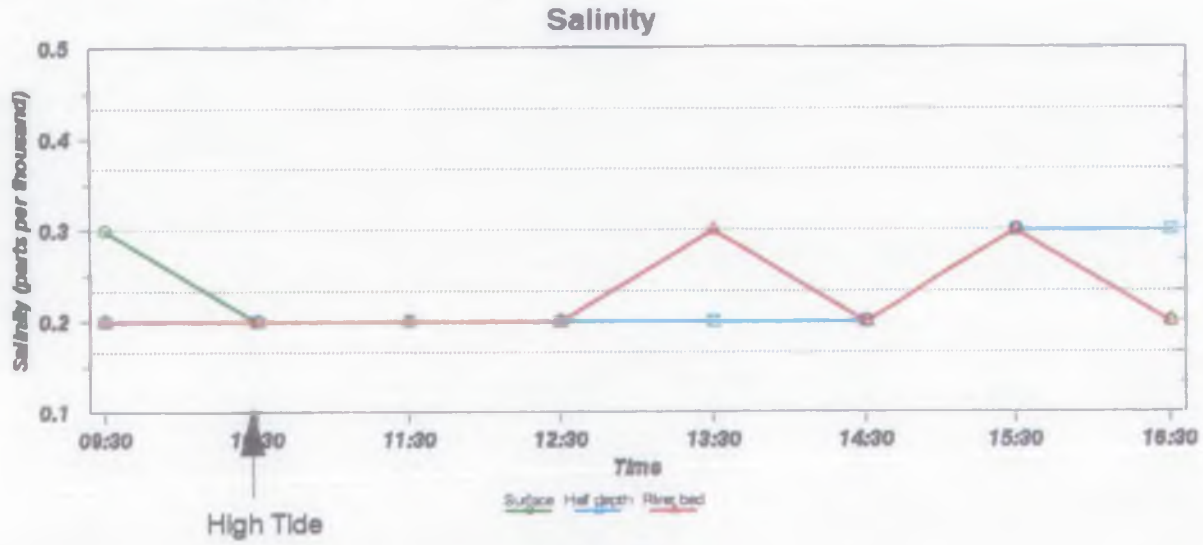


Figure 4 River Parrett at Burrow Bridge 18th January 1994



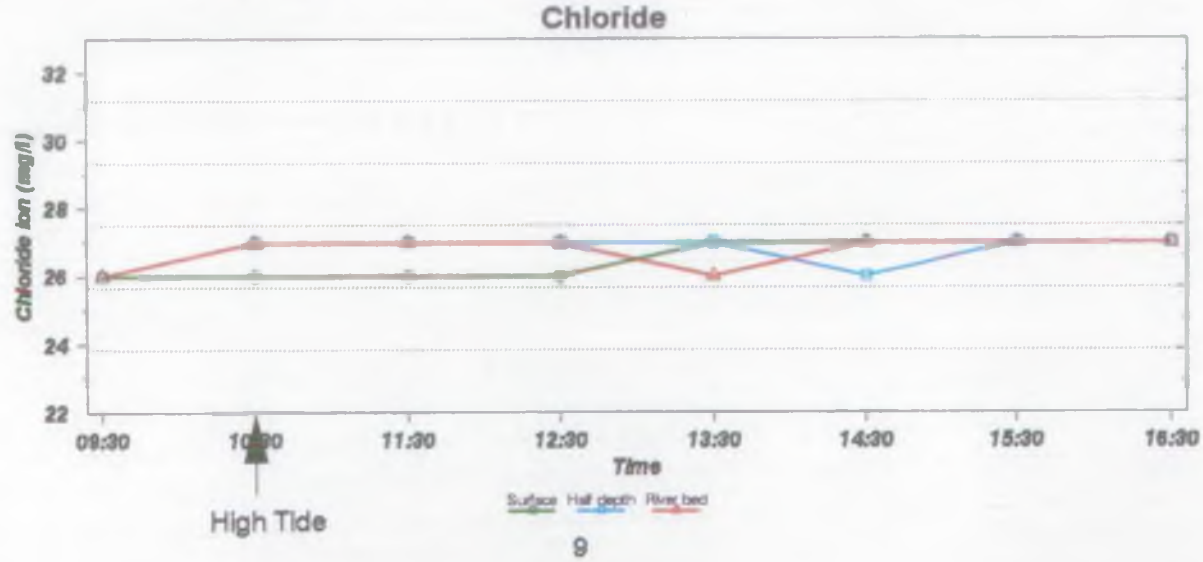



Figure 5 River Parrett at Bridgwater 18th January 1994

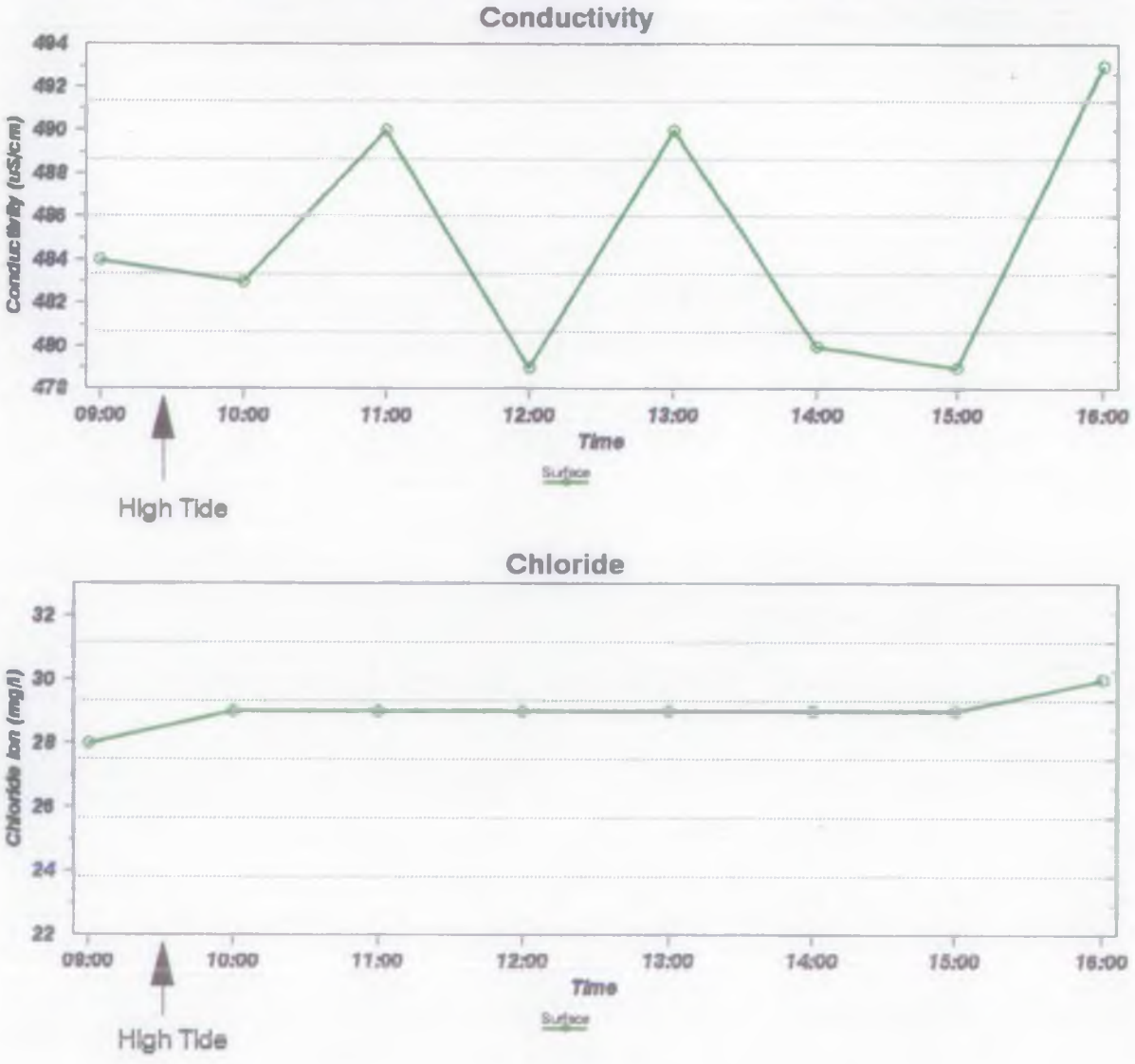
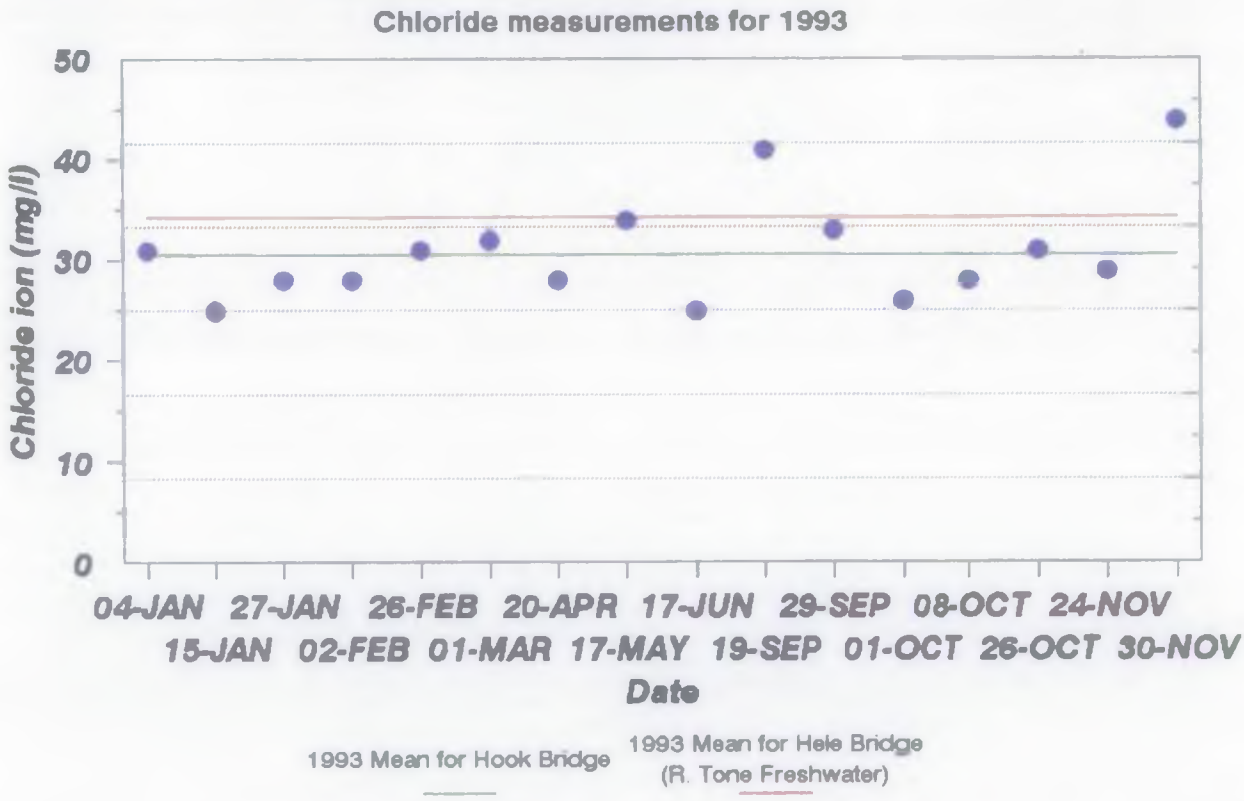


Figure 6 River Tone at Hook Bridge



## APPENDIX I
## Analysis of Flood Water from Curry Moor

7.1 The results of analysis for samples of floodwater taken from Curry Moor are as follows:

| Site | Date | Time | Cond'ty (uS/cm) | Salinity (ppt) | Chloride (mg/l) |
|---|---|---|---|---|---|
| Hook Bridge | 15th Jan | 09:30 | - | - | 27 |
| Flood water adj to Hook Bridge | 15th Jan | 09:43 | - | - | 25 |
| Flood at Moor Cottage | 16th Jan | 22:25 | - | - | 24 |
| Adj Hook Bridge | 17th Jan | 13:43 | 460 | 0.2 | 24 |

7.2 There is no evidence from these results that there is an accumulation of saline water in the flooded moorland.

## APPENDIX II
## Photographs

8.1 Use of Casella Sampler (left) and Grant/YSI Logger (Right) at Burrow Bridge



8.2 Floodwater on Curry Moor

## APPENDIX III
## Correspondence

820/306

# NATURE CONSERVANCY COUNCIL

South West Region

Roughmoor, Bishops Hull, Taunton, Somerset TA1 5AA Telephone Taunton (0823) 283211 Fax (0823) 272978

Mr N Reader
National Rivers Authority
Rivers House
East Quay
Bridgwater
Somerset
TA6 4YS



Your Ref

Our Ref
BRJ/SF

Date

25 February 1991

Dear Nigel

FLOOD DAMAGE ON CURRY MOOR AND HAY MOOR

I understand from Anthony Gibson of the NFU and several local papers that the NRA is about to be sued for alleged flood damage on Curry Moor!

As you may be aware, my view is that the sward damage on Curry Moor was not caused directly by the floods but appeared to be damage to shallow rooted grasses and herbs which may well be related to high salt concentrations ~~and~~ at the soil surface in April and May. I have looked at all the available analyses from that period including those performed by yourselves and ADAS and they confirm that a salt crust, not necessarily sodium chloride, had indeed formed on the surface of the soil during the early part of the drought. I have spoken to David Loveland, an expert in droughted soils, based at Silsoe College and he has told me that, from the available analyses, it is highly unlikely that the salt was derived from the river but came instead from the deeper clays in the soil itself having been brought to the surface by capillary action and deposited there by evaporation.

My purpose in writing to you is to ask that Bristol University, who have been given the task of looking at the analyses, are given the widest possible brief in order to ascertain the real cause of sward damage on Curry Moor. I hope they have been supplied with details of water analyses of the Tone system in flood, since I believe that, under flood conditions, estuarine salt water does not penetrate up the Parrett much beyond Bridgwater. I presume that Bristol have been asked also to look at the possible effects of high soil surface salt concentrations on the survival of shallow rooted grasses and herbs within the sward. There is published literature about tolerances of these species and it should be possible to predict whether damage would occur as a result of the accumulation of salt on the soil surface. As you can imagine, NCC would be very interested in seeing a copy of the report from Bristol University, if only to satisfy ourselves that the report has sufficient scope to answer the questions that are being asked by both ourselves and the farming community.

I look forward to hearing from you.

Yours sincerely

Dr B R Johnson
Assistant Regional Officer
Somerset Levels

both

& file (separate
S20/306/1

NOTES OF MEETING 22 APRIL 1991

Mr Chedzoy )
B Tinkler ) NRA (Wessex)
D Palmer )
K Taylor )

Simon James ) BEC
Mike Martin ) Bristol Environmental Consultants

DEATH OF GRASS - CURRYMOOR ETC 1990

1. Purpose of meeting:-

To discuss analysis of samples taken jointly with MAFF in November 1990.

To discuss possible causes and try to establish the most likely cause.

To decide if further work is necessary.

2. As introduction the nature of the problem and actions to date were stated.

3. BEC summarised the results and conclusions drawn from them as follows:-

a) some samples wrongly labelled as to depth. Appearance and analysis clearly indicate mislabelling and this is consistent with data from MAFF (ie their samples mislabelled also). This could have occurred at the time of taking or during the drying and milling of the samples.

b) No samples contain chloride concentrations which are unusually high or likely to cause plant death.

c) Those samples with higher chloride concentrations also contain the most plant material (which itself is high in chloride content).

d) Neither the chloride concentration or the amount of magnesium in any of the samples indicate that sea water had been present on the land.

(Although rain had fallen between the flood and the November sampling, BEC would have expected to find elevated magnesium concentrations within the soil if sea water inundation had occurred).

4. Reseeding in April failed but later reseeding in Autumn was successful. This indicates that the concentration of salts at the top of the soil by transport and evaporation is not likely to have been the cause of plant death because the concentration is a slow effect.

5a) Under prolonged flooding the soil becomes anaerobic and root death follows. This effect is exacerbated when water temperature is high because of the increased metabolic rate of both deoxygenating bacteria and the grass.

b) As water levels fall, the top of the soil becomes aerobic again and, if the plant is not completely dead, new roots are produced near the surface. These roots allow the plant to recover and produce deeper roots which follow the falling water table as the land dries out.

6. If the conditions changed quickly from waterlogged to dry then recovery might not be possible and the surface would be too dry for successful recovery or reseeding.

(Mr Chedzoy recalled that in the summer flood of 1968 large areas of grass were killed and blackened).

7a) The high concentrations of chloride found in the previous NRA samples were discussed. Enquiries at the time had excluded laboratory error as far as was possible and the range of values found made it unlikely.

b) As the samples were surface scrapes from the most affected areas of the worst affected fields they would not be expected to give results consistent with these taken on a whole field and deeper basis.

c) If high chloride concentrations were not the cause of the grass death, then explanation is necessary for the presence of high salinity in the areas of plant death.

d) Plant material contains high concentrations of chloride in the cellular and intercellular fluids. As the dead grass decomposes these fluids would be released and, in dry weather would evaporate on the surface of the soil. Both root and shoot material contain chloride. By this means the surface of the soil together with the litter of dead plant material would have a higher chloride content than areas where little or no grass loss was experienced.

8a) Most of the areas have now been reseeded with commercial grass seed and not seed from the grasses in the old permanent pastures which were particularly badly affected following this flood.

b) Previous experience, expressed by Mr Chedzoy, was that the older grasses usually survive winter floods better than later planted leys. If this pattern is repeated in the future then the replanted areas could be less productive after winter floods than the original permanent pasture.

c) Because edges of fields were less badly affected than lower areas, reserves of the old grasses are still present and if conditions favour them there might be gradual natural reintroduction into the new commercial leys.

9. It was agreed that from the aspect of Flood Defence there was little point in carrying out further work in this area but, should a similar circumstance arise again, the need for a suitable investigation as soon as possible after the flood was recognised.

210/79/1

S FRSC

**M E M O R A N D U M**

**TO:** D G ALSOP - PRINCIPAL FLOOD DEFENCE ENGINEER

**FROM:** C TEW - SENIOR WATER QUALITY OFFICER

**DATE:** 25TH JANUARY 1994

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**RE:** FLOOD DAMAGE AND ALLEGED SALT CONTAMINATION - CURRYMOOR

**REF:** 820/306/1

I attach a report of the recent survey undertaken to establish the extent of saline intrusion into the Rivers Parrett and Tone at high tide conditions.

It can be safely be concluded from the report that there is no evidence of salt water reaching the River Tone at Hook Bridge on a 4.9m tide. In addition, the analysis of actual flood water taken from the surface of Currymoor showed no evidence of salt contamination.

There was also no evidence of salt water reaching Burrowbridge on the River Parrett. However, further studies will be undertaken at higher spring tides in order to assess the precise location of the salt water/fresh water interface.

C Tew
Senior Water Quality Officer