NATIONAL RIVERS AUTHORITY

SOUTH WEST REGION

AN INVESTIGATION INTO AMMONIA LEVELS IN WESTON MILL LAKE, DEVONPORT.

R. GRANTHAM
TIDAL WATERS OFFICER
N.R.A.
MANLEY HOUSE,
KESTREL WAY,
EXETER, EX2 7LQ.

TWU/90/014

JANUARY 1990

AN INVESTIGATION INTO AMMONIA LEVELS IN WESTON MILL LAKE, DEVONPORT.

SUMMARY

On 6/11/89 the Tidal Waters Unit (TWU) of the National Rivers Authority (NRA), South West Region investigated the levels of ammonia in Weston Mill Lake and the adjoining Tamar Estuary. This work was undertaken at the request of the Tidal Waters Officer of the NRA, to determine the levels of un-ionised ammonia and total ammonia in the vicinity of the discharge from Camels Head Sewage Treatment Works (STW).

On the day of sampling, all un-ionised ammonia results obtained from the studied area of Weston Mill Lake and the Hamoaze, were within the water quality standard (WQS) recommended to protect the migration of salmon.

The highest level of total ammonia, excluding the sample collected at the discharge, appeared in the vicinity of the outfall. However, this value was similar to the concentrations of all surface samples and to levels found in previous work on the Tamar Estuary. Consequently, it is believed that further investigations should be made in order to quantify the impact of the discharge from Camels Head Sewage Treatment Works on estuarine waters.

AN INVESTIGATION INTO AMMONIA LEVELS IN WESTON MILL LAKE, DEVONPORT.

CONTENTS

AN INVESTIGATION INTO AMMONIA LEVELS IN WESTON MILL LAKE, DEVONPORT.

1. INTRODUCTION

Weston Mill Lake is an integral part of Devonport Dockyard and adjoins the River Tamar. To the extreme North East of the lake is the outfall from Camels Head Sewage Treatment Works which services an equivalent population of 40,267.

The Tidal Waters Officer of the National Rivers Authority (N.R.A.), South West Region expressed concern over high levels of ammonia that the Sewage Treatment Works (STW) might discharge and the possible deleterious effect the concomitant un-ionised ammonia levels could have on the movement of Salmonids in the adjacent Tamar Estuary.

On 6/11/89 the Tidal Waters Unit (TWU) of the N.R.A., South West Region investigated the levels of ammonia and un-ionised ammonia in Weston Mill Lake and the adjacent Tamar Estuary. This work was undertaken;

(a) To assess whether the ammonia levels would be detrimental to the movement of salmon.

(b) To look at the possibility of consenting the STW on the discharge of ammonia.

2. SAMPLING PROCEDURE

Eleven sampling sites were selected from within Weston Mill Lake and the adjacent estuary, Figure 1. Samples collected at sites 8,9,and 11 in the estuary, were to establish background levels. Additionally, a sample was collected from the culvert to establish the input from the outfall.

Samples for filtered ammonia were collected in a acid washed (10% Hydrochloric acid) N.I.O. Sampler, filtered through a similarly washed Miilipore filter paper and stored in plastic bottles. Temperature and pH measurements were made simultaneously to enable the calculation of un-ionised ammonia.

Site descriptions are given in Table 1.

FIGURE 1. Sampling sites in Weston Mill Lake/Tamar Estuary

SITE NO.	SITE DESRIPTION
1	MID-CHANNEL, WESTON MILL LAKE, OFF NO. 12 WHARF
2	AS ABOVE OFF NO. 11 WHARF
3	AS ABOVE OFF NO. 12 WHARF
4	AT MOUTH OF WESTON MILL LAKE 100m STH OF STH CARDINAL MARKER
5	MID-TAMAR AT MOORING BOUY OFF 250m LOOKING GLASS POINT TROT NTH
6	100m OFF LOOKING GLASS POINT TROT
7	100m OFF GATES TO NO.5 BASIN
8	150m NO.4 WHARF
9	MID-TAMAR OFF NO.4 BASIN
10	MID-TAMAR OFF NO.5 BASIN
11	MID-TAMAR, AT MOORING BOUY OFF KINTERBURY POINT LIGHTER TROT
12	AT CULVERT

TABLE 1. Sampling site descriptions.

3. ANALYSES

The samples were analysed for Total Ammonia and converted to un-ionised ammonia using the following expression;

$$[NH3] = \frac{[NH4]}{\text{ANTILOG } \{(10.75-0.0324T)-pH\}}$$

[NH3] Un-ionised ammonia N mg/l
[NH4] Total ammonia N mg/l
T Temperature C
pH pH

All results are given in Table 2.

4. DISCUSSION

The values of un-ionised ammonia were not significantly high on the day of the survey. All concentrations, except the sample collected at the culvert, were well below the guide level given in the European Community Directive for the protection of salmonids in freshwater, and below the concentration suggested for the protection of marine life (1). As expected, the sample collected at the culvert contained the greatest concentration of un-ionised ammonia; however, the level was less than the guide level quoted in the directive.

On 6/11/89 the background levels of ammonia in the Tamar estuary, in the vicinity of Devonport Dockyard, were similar to those in Weston Mill Lake, ranging from; 0.14-0.19 mg/l at the surface, 0.06-0.16 mg/l at mid-depth, and 0.05-0.08 at depth. The greatest value found in the estuarine water appeared at the surface, in the vicinity of the outfall (site 1).

Work undertaken by Morris et al (2) on the total ammonia concentrations in the Tamar estuary show levels, throughout the estuary, similar to those found during the above survey. The geographical position of the maximum value varied on the survey dates and ranged from the upper reaches of the estuary to near its mouth, in the vicinity of Weston Mill Lake.

HIGHWATER: 0949

SITE	DEPTH (m)	SAMPLING TIME	DEPTH				MIDDLE (7m)				SURFACE			
			pH	TEMP C	NH4+ mg/l	NH3 mg/l	pH	TEMP C	NH4+ mg/l	NH3 mg/l	pH	TEMP C	NH4+ mg/l	NH3 mg/l
1	10	1250	7.74	13.5	0.06	0.0008	7.88	13.5	0.10	0.0018	7.33	12.2	0.19	0.0009
2	13	1303	7.79	13.9	0.05	0.0007	7.96	13.6	0.08	0.0017	7.69	12.2	0.16	0.0017
3	13	1312	7.82	13.7	0.05	0.0008	7.63	13.6	0.06	0.0006	8.04	12.0	0.15	0.0035
4	14	1325	7.87	13.4	0.05	0.0009	7.75	13.6	0.08	0.0011	7.83	11.4	0.15	0.0020
5	16	1338	7.83	13.0	0.06	0.0009	7.85	13.6	0.08	0.0013	7.83	11.1	0.14	0.0019
6	12	1350	7.85	13.6	0.07	0.0012	7.85	13.4	0.08	0.0013	7.71	11.1	0.16	0.0016
7	14	1400	7.84	13.6	0.06	0.0010	7.85	12.8	0.16	0.0025	7.90	11.1	0.16	0.0025
8	13	1410	7.84	13.6	0.08	0.0013	7.86	13.3	0.09	0.0015	7.85	11.0	0.14	0.0019
9	17	1420	7.88	13.7	0.05	0.0009	7.89	13.6	0.07	0.0013	7.88	11.2	0.16	0.0024
10	15	1431	7.83	13.8	0.07	0.0011	7.87	13.2	0.09	0.0015	7.88	11.0	0.14	0.0021
11	17	1443	7.82	13.4	0.06	0.0009	7.86	13.4	0.06		7.87	11.4	0.14	0.0021
CULVERT AT OUTFALL		1216									7.62	12.2	2.28	0.0203

TABLE 2. AMMONIA LEVELS IN WESTON MILL LAKE, PLYMOUTH ON 6/11/89

5. CONCLUSIONS

The un-ionised ammonia results obtained from the investigation of Weston Mill Lake were not sufficiently high to be restrictive to the movement of Salmonids.

The investigation on 6/11/89 detected the greatest total ammonia concentration in the vicinity of Camels Head Sewage Treatment Works. However, this level did not vary greatly from those measured throughout the survey, and appeared to be similar to the findings from previous work on the Tamar estuary.

To ascertain the plausability of consenting the Sewage Treatment Works on the discharge of ammonia would require the collection of further data.

6. REFERENCES

(1) United Kingdom Water Quality Standards Arising From European Community Directives - An Update by the Water Research Centre. PRS 2287-M. November 1989.

(2) Nitrite and Ammonia in the Tamar Estuary
A.W. Morris, R.J.M. Howland, E.M.S. Woodward, A.J. Bale and R.F.C. Mantoura.
Netherlands Journal of Sea Research. 19(3/4):217-222(1985).

M. Harris, February 1990. TWIU/90/014.