

NRA - THAMES 319

187a

WRc

NATIONAL RIVERS AUTHORITY - THAMES REGION

TIME OF TRAVEL ON THE CHERTSEY BOURNE
UNDER LOW FLOW CONDITIONS

WRc Ref: CO 4022
NOVEMBER 1995



**TIME OF TRAVEL ON THE CHERTSEY BOURNE UNDER LOW
FLOW CONDITIONS**

Report No.: CO 4022

November 1995

Authors: M A Wheeler

Contract Manager: M A Wheeler

Contract No.: 08909

RESTRICTION: This report has the following limited distribution:

External: Restricted

Internal: Restricted

Any enquiries relating to this report should be referred to the authors at the following address:

WRc Medmenham, Henley Road, Medmenham, Marlow, Bucks, SL7 2HD.
Telephone: (01491) 571531

ENVIRONMENT AGENCY



121210

© WRc plc 1995

The contents of this document are subject to copyright and all rights are reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted, in any form or by any means electronic, mechanical, photocopying, recording or otherwise, without the prior written consent of the copyright owner.

This document has been produced by WRc plc.

CONTENTS

SUMMARY	1
1. INTRODUCTION	3
2. METHODOLOGY	5
2.1 Choice of tracer	5
2.2 Detection locations	5
2.3 Tracer addition	5
2.4 Tracer detection	6
3. RESULTS AND DISCUSSION	7
4. CONCLUSIONS	13

LIST OF TABLES

Table 2.1	Chertsey Bourne: Time of travel study, addition and detection site locations	5
Table 3.1	Chertsey Bourne: Time of travel under low flow conditions 24-25 August 1995	7

LIST OF FIGURES

Figure 1.1	Sketch plan of the Chertsey Bourne showing the detection site locations	4
Figure 3.1	Chertsey Bourne time of travel (low flow): Chertsey STW to B3859 Road Bridge, 24.08.95	8
Figure 3.2	Chertsey Bourne time of travel (low flow): B3859 Road Bridge to Hamperstone Bridge, 24.08.95	9
Figure 3.3	Chertsey Bourne time of travel (low flow): Hamperstone Bridge to Thames Confluence, 24 - 25.08.95	10
Figure 3.4	Chertsey Bourne time of travel (low flow): Chertsey STW to B3859 Road Bridge, Hamperstone Bridge and Thames Confluence, 24 - 25.08.95	11

SUMMARY

The National Rivers Authority (Thames Region) commissioned WRc to undertake a time of travel study on a section of the Chertsey Bourne during low flow conditions. The section of river studied, Chertsey Sewage Treatment Works to the confluence of The Bourne with the River Thames, was split into three reaches. The dye tracer rhodamine-wt (Rh-wt) was added just down stream of the sewage treatment works discharge and the resulting cloud was monitored using a portable fluorimeter as it passed through each of the three reaches. From information recorded the tracer, peak, mean and tail arrival times and velocities were calculated for each reach. The peak concentration achieved at each detection site was also recorded. The tracer took approximately 22.5 hours to reach the detection site just above the confluence with the River Thames.

1. INTRODUCTION

NRA Thames Region required information on the time of travel for three reaches of the Chertsey Bourne (Bourne (north)) under low flow conditions. The section of river studied was between Chertsey Sewage Treatment Works (Chertsey STW) to a point just upstream of its confluence with the River Thames (Figure 1.1). The dye tracer, rhodamine-wt (Rh wt), was added to the river at NGR TQ 016 680 and the resulting tracer cloud was monitored as it passed through each of the three downstream monitoring locations: Thorpe B3859 Road Bridge, Hamperstone Bridge and the Chertsey Bourne/Thames confluence. For the purpose of this study the Chertsey Bourne was deemed to be in low flow, when the flow in the nearby River Wey was below 3.5 cumecs.

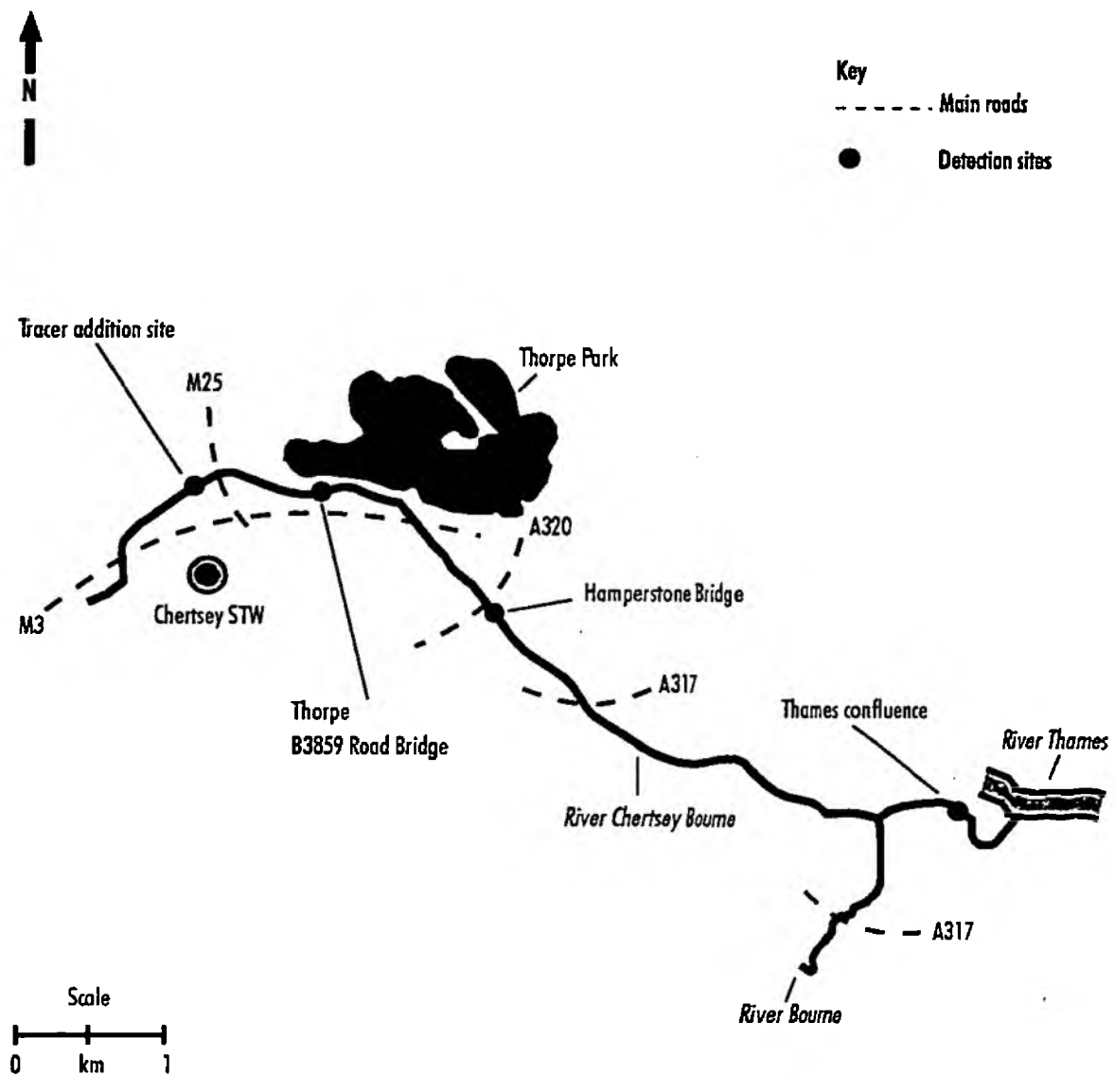


Figure 1.1 Sketch plan of the Chertsey Bourne showing the detection site locations

2. METHODOLOGY

2.1 Choice of tracer

Rhodamine-wt (Rh-wt) was chosen as the tracer, as it has been found to be cost-effective in previous studies and also allows *in situ* detection methods to be used. A review of the literature concerning the toxicity of Rh-wt, undertaken by WRc's toxicologists, indicates that at low concentrations the dye represents an insignificant hazard to consumers of water.

2.2 Detection locations

The choice of reaches was made by the National Rivers Authority (NRA), Thames Region; the choice being dependent on the location of tributaries, effluent discharges, weirs and river sampling points. The three reaches studied are shown in Table 2.1.

Table 2.1 Chertsey Bourne: Time of travel study, addition and detection site locations

Reaches studied	N.G.R	Distance from previous site km
Chertsey STW	TQ 016 680	-
Thorpe B3859 Road Bridge	TQ 024 680	1.2
Hamperstone Bridge	TQ 035 672	1.52
Bourne/Thames confluence	TQ 067 657	4.10

2.3 Tracer addition

As there is no gauging station on the Chertsey Bourne, flow had to be calculated using a discharge relationship with the nearby River Wey at Weybridge. The relationship used was:

flow (in cumecs) at Weybridge x 0.04 + 0.2 = flow (in cumecs) in the Chertsey Bourne

For the purpose of this study low flow was defined as being when the flow in the River Wey was below 3.5 cumecs. Prior to the study being undertaken, the local pollution officer's permission was sought and the owners of the potable water abstraction immediately downstream of the study area were contacted.

To avoid unnecessary public concern the tracer addition was made in the early hours of the morning. Three grams of Rh-wt were added to the river at grid reference TQ 016 680 at 0527 hours on 24 August 1995. The quantity of dye required was calculated from the flow on the day before the addition, such that the fully mixed tracer concentration

downstream of the addition point would not exceed $20 \mu\text{g l}^{-1}$ and that, through mixing and dispersion, the concentration of dye would not exceed $1 \mu\text{g l}^{-1}$ at any potable abstraction point.

2.4 Tracer detection

The tracer was detected *in situ* at the downstream monitoring sites using a portable fluorimeter. Detection was achieved by continually pumping water from the river through a flow cell in the fluorimeter. The output from the fluorimeter was logged at a time interval of one minute, as well as being recorded on a chart recorder.

Calibration of the fluorimeter was carried out in the field using river water spiked with a known quantity of a standard solution of Rh-wt, which had been prepared in the laboratory.

3. RESULTS AND DISCUSSION

The data recorded by the logging equipment were first corrected for the background fluorescence of the river water, and then converted to absolute dye concentrations using the on-site calibration data. Where incomplete tracer curves were recorded, the data were extrapolated to the background levels. Table 3.1 sets out the travel times and peak concentration at each of the detection sites. The corrected data from the logger have been plotted as dye concentration against time in Figures 3.1 to 3.4.

**Table 3.1 Chertsey Bourne: Time of travel under low flow conditions
24-25 August 1995**

DATE	24 August 1995	24 August 1995	24-25 August 1995
SECTION NAME	-	-	-
TOP REACH Name NGR	Chertsey STW TQ 016 680	B3859 Road Br TQ 024 680	Hamperstone Br. TQ 035 672
BOTTOM REACH Name NGR	B3859 Road Br. TQ 024 680	Hamperstone Br. TQ 035 672	Thames confluence TQ 067 657
Section Length (km)	1.20	1.52	4.10
Velocity (km h ⁻¹)			
Arrival	0.471	0.316	0.270
Peak	0.365	0.261	0.235
Mean	0.347	0.252	0.227
Tail	0.275	0.218	0.191
Arrival times from previous site (Dec h)			
Arrival	2.55	4.81	15.215
Peak	3.29	5.82	17.472
Mean	3.46	6.01	18.024
Tail	4.367	6.97	21.47
Gauging Station (GS)	Weybridge G.S.	Weybridge G.S.	Weybridge G.S.
MDF (cumecs) 23/08/95	1.99	1.99	1.99
Background reading (µg l ⁻¹)	0.29	0.24	0.20
Peak concentration (µg l ⁻¹)	4.2	2.3	0.3
Dye mass used (g)	3	-	-

Notes:

MDF - Mean Daily Flow

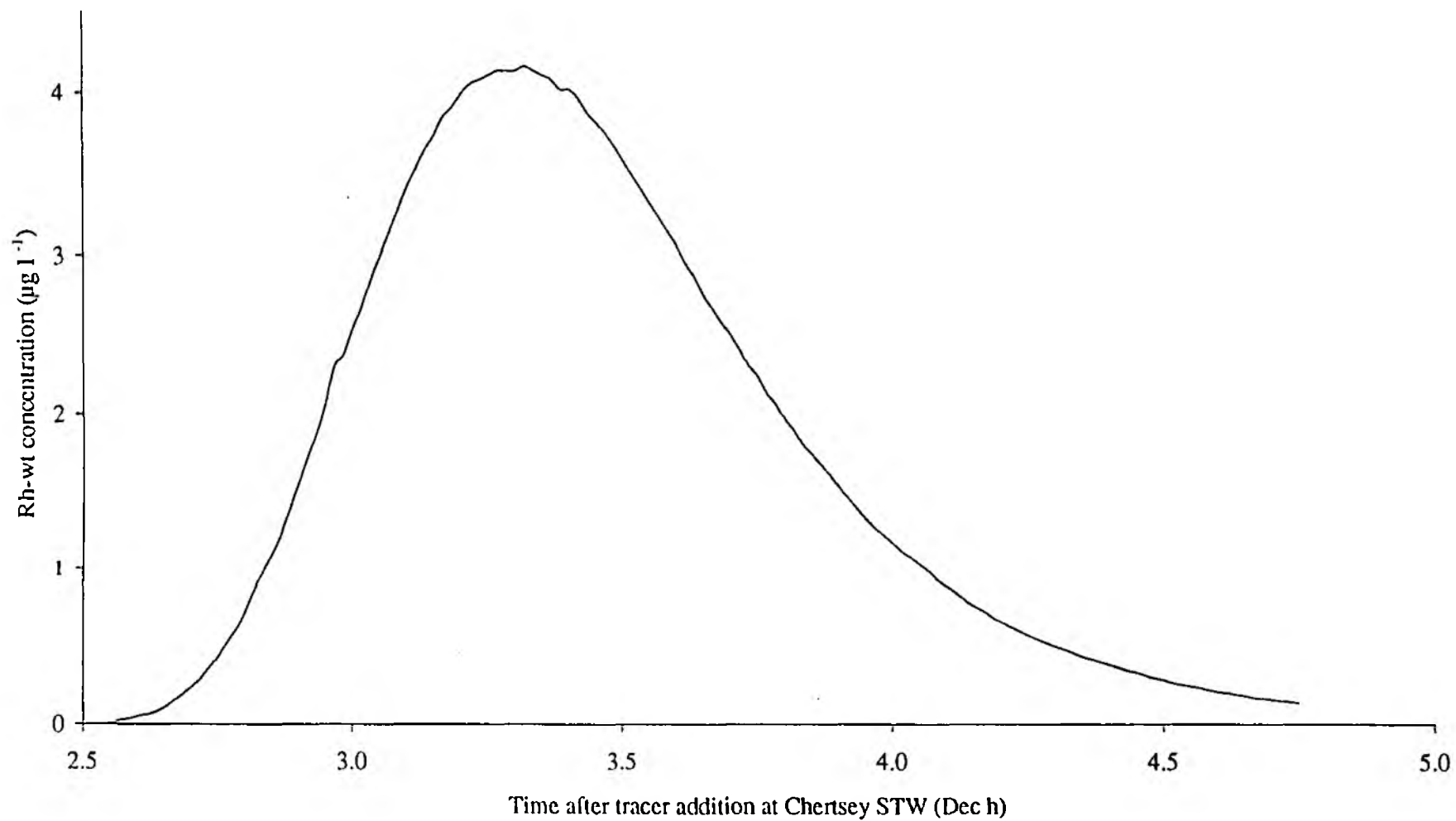


Figure 3.1 Chertsey Bourne time of travel (low flow): Chertsey STW to B3859 Road Bridge, 24.08.95

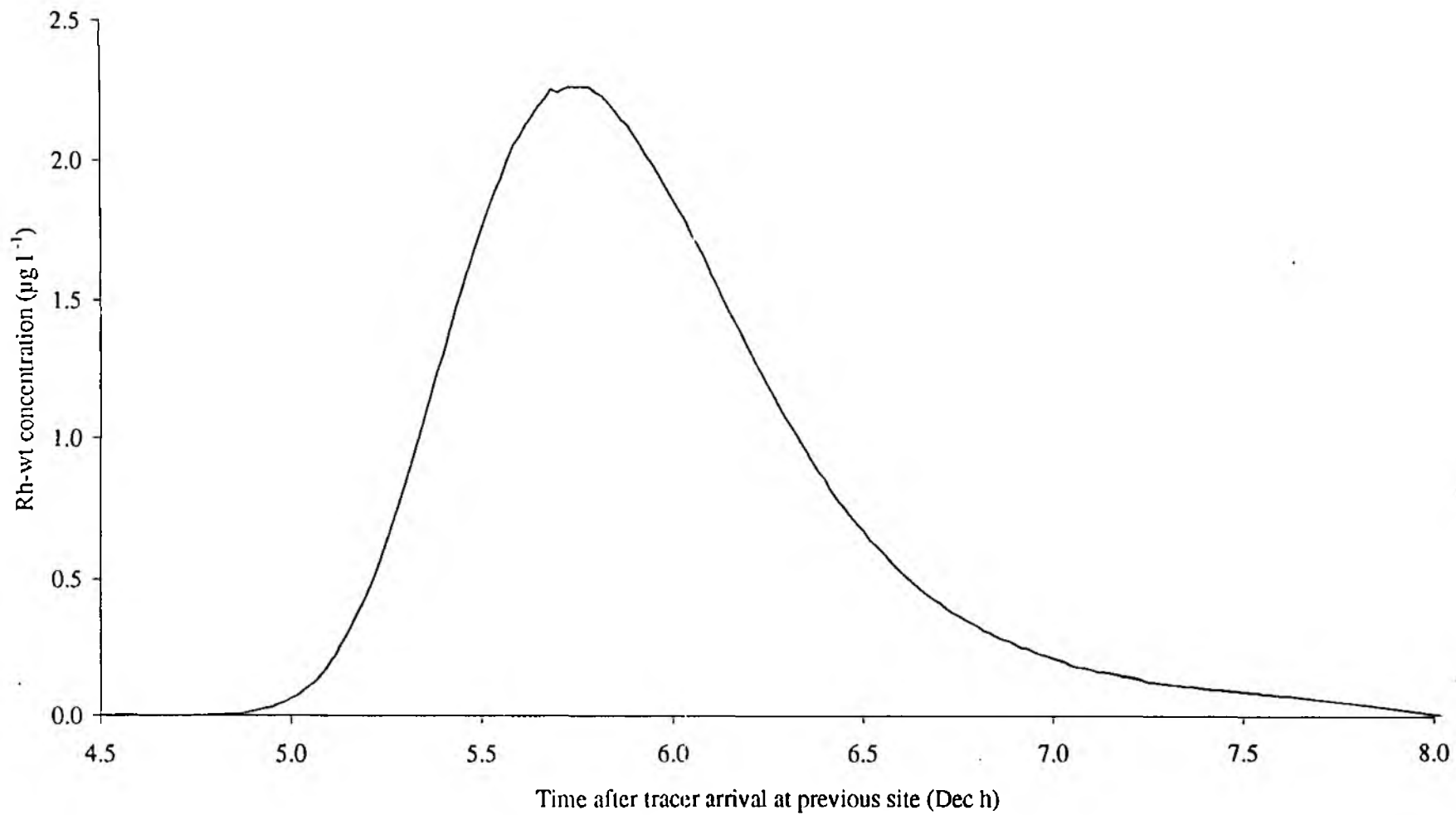


Figure 3.2 Chertsey Bourne time of travel (low flow): B3859 Road Bridge to Hamperstone Bridge 24.08.95

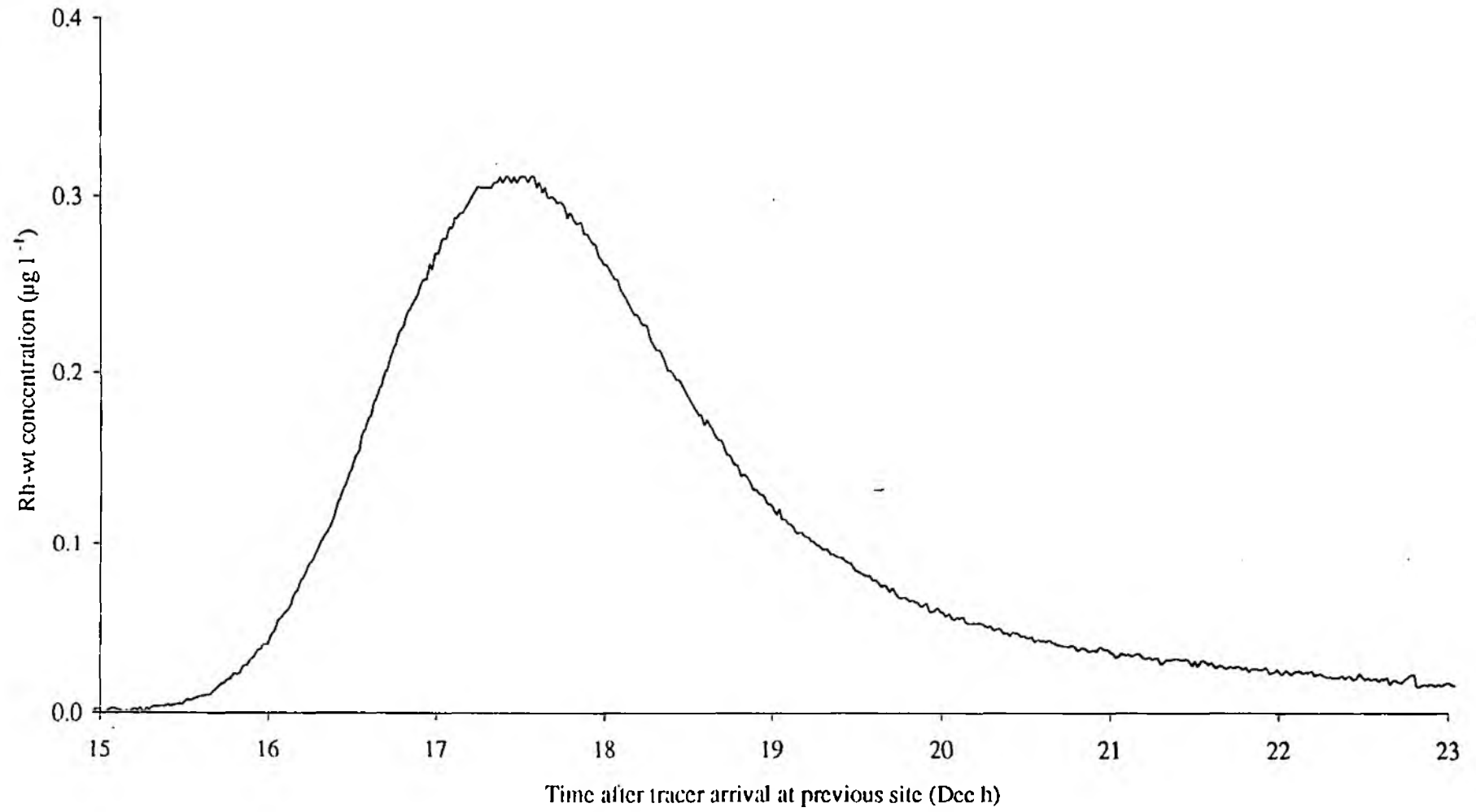


Figure 3.3 Chertsey Bourne time of travel (low flow): Hamperstone Bridge to Thames confluence, 24-25.08.95



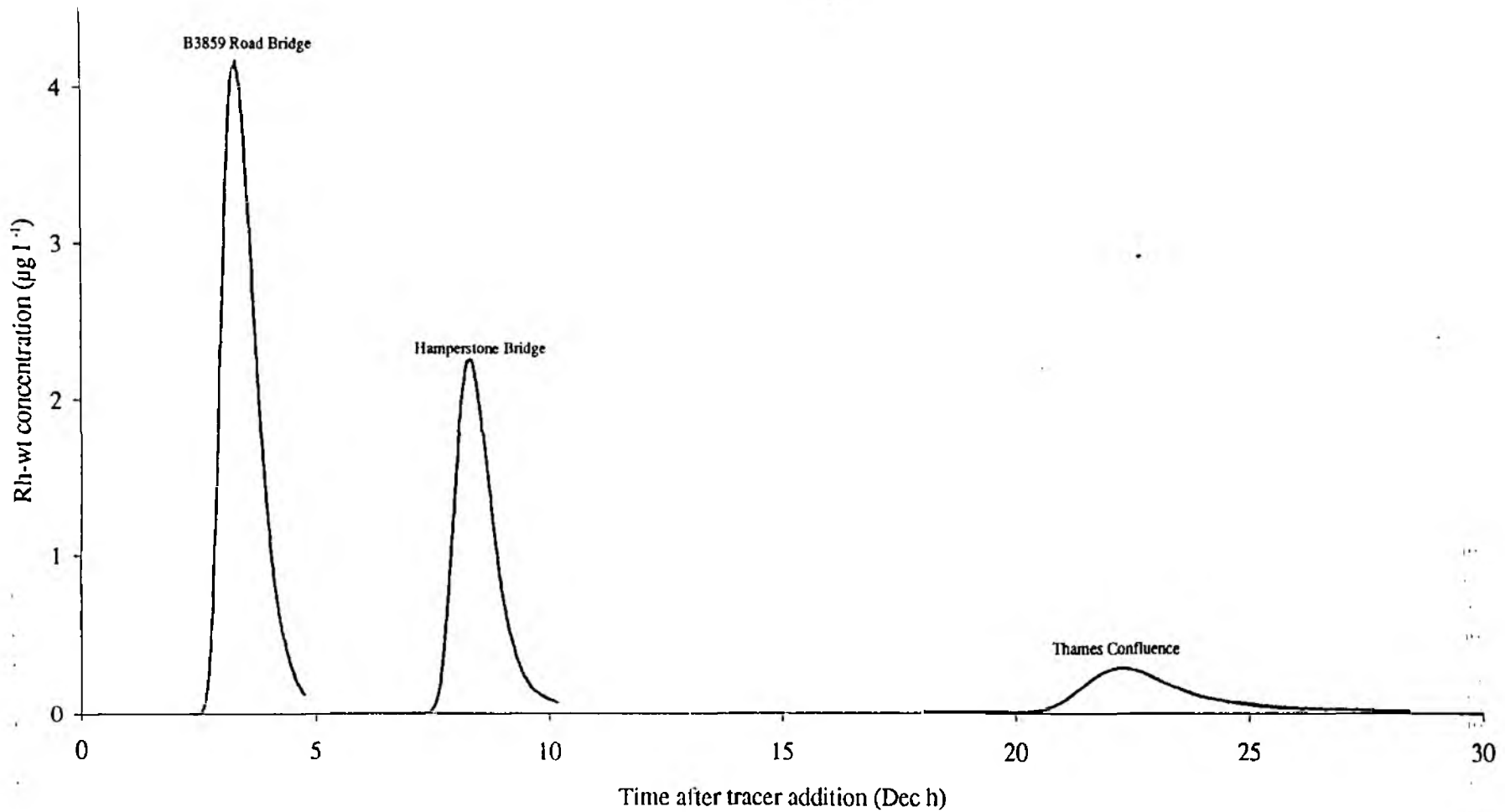


Figure 3.4 Chertsey Bourne time of travel (low flow): Chertsey STW to Thames confluence 24-25.08.95

4. CONCLUSIONS

Times of travel were obtained along three reaches of the Chertsey Bourne between Chertsey STW and its confluence with the River Thames under low flow conditions.

The tracer study was undertaken on 24 - 25 August 1995. The tracer took approximately 2.55 hours, 7.30 hours and 22.52 hours to reach the first, second and third detection sites respectively.

The maximum concentration of tracer entering the River Thames was less than $0.31 \mu\text{g l}^{-1}$.