



# ENVIRONMENTAL PROTECTION NRA

*National Rivers Authority  
South West Region*

## WATER QUALITY INVESTIGATIONS IN THE NEWLYN RIVER CATCHMENT

APRIL 1989  
EP/WQ/89/3

GORDON H BIELBY BSc  
Regional General Manager

C V M DAVIES BSc  
Environmental Protection  
Manager

504.4.06 SDJ

CONSULTATIVE DRAFT 18 MAY 1989

EP/WQ/89/3

SOUTH WEST WATER

RIVERS UNIT

ENVIRONMENTAL PROTECTION

WATER QUALITY INVESTIGATIONS IN THE

NEWLYN RIVER CATCHMENT

April 1989

B Milford  
Water Quality Planner  
South West Water  
Manley House  
Kestrel Way  
Sowton  
EXETER

ENVIRONMENT AGENCY



110214

WATER QUALITY INVESTIGATIONS IN THE NEWLYN RIVER CATCHMENT

Summary.

Following the discovery of high aldrin and dieldrin concentrations in eels obtained from the Newlyn River an investigation was carried out to determine the source of these pesticides.

Water quality, sediment analysis and invertebrate surveys indicate that aldrin and dieldrin are entering the Trereife Stream a tributary of the Newlyn River. Concentrations of dieldrin were found to be high in trout and eels collected from the Newlyn River downstream of the Trereife Stream. Marine shellfish analysed from various sites in Mount's Bay were found to have minimal contamination by these pesticides.

The Soil Survey & Land Research Centre (contracted by the NRA South West Region) have identified substantial areas of daffodil cultivation in the Trereife Stream catchment. Aldrin is applied to daffodil bulbs to control large narcissus fly. Aldrin and dieldrin combine onto organic soil particles which are flushed into the river during heavy rainfall. Bulb growing activities encourage soil erosion because soil is prepared by ploughing to a fine tilth. The control of weeds and creation of wheel-furrows by tractors encourages the formation of colluvium when heavy rain occurs. Colluvium can contain enhanced levels of pesticide residues.

Weekly monitoring of pesticides in the Newlyn Catchment commenced in January 1989 to determine the range of pesticide concentrations present in the Newlyn Catchment. Pollution staff have visited all farms within the catchment to assess drainage problems and to request farmers that they terminate the use of aldrin for agricultural purposes. Further studies are also planned.

Recommendations have been made to control pesticide contamination of the Newlyn River and include:

1. Notification of the findings to MAFF, DoE and relevant authorities.
2. Continuation of water quality and biota monitoring and a review of the findings in April 1990.

April 1989

B Milford  
Water Quality Planner  
South West Water  
Manley House  
Kestrel Way

## LIST OF CONTENTS

<u>Contents</u>	<u>Page Number</u>
1. Introduction	1
2. Newlyn River Catchment	1
3. Catchment Investigations	3
3.1 River Water Quality	3
3.2 River Sediments	3
3.3 Pesticide Residues in Fish	4
3.4 Macroinvertebrate Fauna	5
3.5 Pesticide Residues in Marine Shellfish	5
3.6 Marine Sediments	6
3.7 Continuing Investigations	6
3.7.1 River Water Quality	6
3.7.2 Soil Survey & Land Research Centre	8
3.7.3 Fish	12
3.7.4 Macroinvertebrate Fauna	12
3.7.5 Farm Campaign	12
3.7.6 River Flows and Pesticide Loadings	13
3.7.7 Agricultural Use of Aldrin	13
4. Conclusions	15
5. Recommendations	16
6. References	17
7. Photographs	18
8. Appendices	19

1. INTRODUCTION

A survey of pesticide residues in freshwater eels was undertaken through November 1988 at thirteen locations in Cornwall and Devon and was subsequently reported, (1).

All ten eels collected from the Newlyn River near Stable Hobba had aldrin, dieldrin and endrin concentrations in excess of the limit of detection, as indicated in Table 1 below:

TABLE 1

CYCLODIENE PESTICIDE RESIDUES IN EELS AT STABLE HOBBA

<u>Cyclodiene Pesticide</u>	<u>Concentration</u>	
	micrograms/kilogram (wet weight)	
	mean	maximum
Aldrin	110	230
Dieldrin	7492	22,000
Endrin	132	320

It was recommended that investigations should commence immediately in the Newlyn River catchment in order to locate the source or sources of aldrin, dieldrin and endrin with the objective of terminating their entry to the aquatic environment.

2. NEWLYN RIVER CATCHMENT

The Newlyn River catchment lies to the west of Penzance on the Lands End peninsula. The source of the main river is at 190 meters above sea level near the Nine Maidens Stone Circle. In these higher parts of the catchment the land is used for rough grazing of beef stock. At four kilometers southwards from source is the village of Newbridge (population 136). The community is served by a sewage treatment works which discharges to the Newlyn River. Land use below Newbridge is mainly mixed arable farming including potatoes and brassica with a few dairy farms.

At eight kilometers from source the Newlyn River has been impounded to create Drift Reservoir which is a source of potable water for the Penzance - Newlyn area. In the sheltered valley below Drift Reservoir the land is used for bulb growing, mainly daffodils and other narcissus varieties and small scale horticulture in glass houses and under plastic tunnels and sheeting. There is also small rural industries in this area; the biggest base being the Stable Hobba Industrial Estate upstream of Newlyn where fishing-related activities and vehicle repairs are undertaken. Surface and foul water from these activities would drain via the sewerage system to a sea-outfall at Newlyn. The Newlyn River enters Mount's Bay to the east of Newlyn Harbour thirteen kilometers from source.

The major tributary of the Newlyn River is the Sancreed Brook which has its source at Trevarthen at 160 meters above sea level. This

tributary flows generally eastwards for four kilometers where it enters Drift Reservoir near Sellan. Land use in the sub-catchment is similar to that between Newbridge and Drift Reservoir along the Newlyn River.

An aerial overview of the catchment is provided in Photographs 1, 2 and 3.

Water use has been identified in the Newlyn River catchment and quality objectives have been established as detailed in Table 2 below.

TABLE 2

NEWLYN RIVER CATCHMENT

WATER USE RELATED QUALITY OBJECTIVES

<u>Water Use Related Quality Objectives</u>	<u>Newlyn River (Source to Tidal Limits)</u>	<u>Sancreed Brook (Source to Drift Reservoir)</u>
Aesthetic quality	Yes	Yes
Protection of salmonid fish	Yes	Yes
Protection of other freshwater life & dependent organisms	Yes	Yes
Watering of livestock	Yes	Yes
Irrigation of crops	Yes	Yes

River quality objectives (RQO's) have been assigned to river lengths in the catchment as indicated in Table 3 below. The assessment of river water quality is by use of the National Water Council's River Classification System. Using the NWC system, the classification of river water quality is undertaken annually and is detailed in Table 3 below.

TABLE 3

NEWLYN RIVER CATCHMENT

RIVER WATER QUALITY

River	Length	River Quality				RQO
		1985	1986	1987	1988	
Newlyn	Source to Skimmell Bridge	-*	1B	1B	-	1B
	Skimmell Bridge to Buryas Bridge	1B	1B	1B		1A
	Buryas Bridge to Newlyn Bridge	2	1B	1B		1B

\* Not monitored

The Newlyn River from Drift Reservoir to Newlyn has been designated for the protection of salmonid fish under the EC Freshwater Fish Directive.

### 3. CATCHMENT INVESTIGATIONS

An investigation of the Newlyn River catchment commenced in early December 1988, with staff of the Pollution Controller undertaking an inspection of all farms and industrial premises to identify sources and uses of the organo-chlorine pesticides.

Staff of the Field Controller commenced the collection of samples of river water, river sediment and fish from the main river and tributaries at locations indicated in Appendix 1.

#### 3.1 River Water Quality

As part of the 1988 river water quality monitoring programme samples were collected from the Newlyn River at Skimmel Bridge, Buryas Bridge and Newlyn Bridge. No samples were collected routinely for pesticide analysis within the catchment. Consequently river water samples were collected from seven locations within the catchment on 14 December 1988. The results of analysis for organo-chlorine pesticide concentrations are reported in Appendix 2. At six locations aldrin and dieldrin concentrations were less than the limits of detection of 1ng/l and 3 ng/l respectively.

Aldrin and dieldrin were present in the Newlyn River at Stable Hobba at concentrations of 11 ng/l and 3 ng/l respectively. Gamma-HCH was also present at a concentration of 110 ng/l. This sampling location is the same as that at which the eels were collected as reported in Table 1.

The sampling point on the Newlyn River upstream from Stable Hobba is located 1.3 kilometers westward at Buryas Bridge. At this sampling point the concentrations of aldrin and dieldrin were below their limits of detection whilst gamma-HCH was present at 4 ng/l.

#### 3.2 River Sediments

Since the organo-chlorine pesticide contamination of the River Mole in 1982, (2), river sediments (when present) have proved to be an excellent material for tracing sources of such pesticides.

Such sediments were collected from the same locations as the river water samples on 14 December 1988. The results of analysis for organo-chlorine pesticide concentrations are reported in Appendix 3. At six locations aldrin and dieldrin concentrations were less than the limits of detection of 1ug/kg (dried weight) and 3 ug/kg (dried weight) respectively.

Aldrin, dieldrin and gamma-HCH were present in sediment collected from the Newlyn River at Stable Hobba at concentrations of 210 ug/kg (dried weight), 45 ug/kg (dried weight) and 88 ug/kg (dried weight) respectively. The sediment sample collected upstream at Buryas Bridge indicated that concentrations of aldrin and dieldrin were below the limits of detection.

Within this 1.3 kilometre length between Buryas Bridge and Stable Hobba, the Trereife Stream enters the Newlyn River at a point 400 meters above the sampling point at Stable Hobba. The source of the Trereife Stream is upstream of Dennis Place at an altitude of 83 meters above sea level. This stream flows south-easterly through mixed arable and pasture land for the first 800 meters. Over the last 400 meters prior to its confluence with the Newlyn River it passes through land in which daffodils, other narcissus varieties and other bulbs have been grown for many years as indicated in Photograph 4.

On 20 December 1988 four sediment samples were collected from the bed of the Trereife Stream between the A30 Roadbridge and the confluence with the Newlyn River. These sampling locations (Nos 6 - 9) are indicated on Photograph 5 and in Appendix 1. The results of analysis for organo-chlorine pesticide concentrations are reported in Appendix 3. These results indicate that a source of aldrin and dieldrin was entering the Trereife Stream between Dennis Place and the confluence with the Newlyn River as shown on Table 4 below.

TABLE 4

TREREIFE STREAM - PESTICIDE CONCENTRATIONS IN RIVER SEDIMENTS

<u>Map*</u> <u>Reference</u>	<u>Location</u>	<u>Aldrin</u>	<u>Dieldrin</u>
micrograms per kilogram (dried weight)			
5	Dennis Place	<1	<3
6	180m prior to Newlyn River	1200	250
7	130m prior to Newlyn River	760	300
8	80m prior to Newlyn River	170	41
9	5m prior to Newlyn River	320	57

\*see Appendix 1

### 3.3 Pesticide Residues in Fish

Fish were collected on 14 December 1988 from the Newlyn River at Bodinnar and Skimmel Bridge (as indicated in Appendix 1 and as shown in Photograph 2) above Drift Reservoir. The individual results of organo-chlorine pesticide residues in the flesh of fish collected are given in Appendices 4 and 5. All four brown trout collected at Bodinnar and all five brown trout collected at Skimmel Bridge had aldrin and dieldrin concentrations less than the limits of detection of 1ug/kg (wet weight) and 3ug/kg (wet weight) respectively. The one eel caught at Bodinnar contained 30 ug/kg (wet weight) of dieldrin and also 33ug/kg (wet weight) of pp-DDE, a metabolite of DDT.

Five brown trout and five eels were collected from the Newlyn River at Buryas Bridge, 1.3 kilometers below the dam wall of Drift Reservoir as indicated in Photograph 1. The individual results of organo-chlorine



pesticide residues in the flesh of fish collected are given in Appendix 6. All trout and eels had aldrin concentrations less than the limit of detection of 1ug/kg (wet weight).

Dieldrin concentrations in the eels varied from 45 to 260 ug/kg (wet weight) with a mean value of 95.6 ug/kg (wet weight). Lesser overall concentrations were found in the brown trout with a range from 6 to 270 ug/kg (wet weight) and a mean value of 65.8 ug/kg (wet weight).

In four of the five eels collected from the Newlyn River at Buryas Bridge, concentrations of pp-DDE were present in the range 15 to 31 ug/kg (wet weight).

The individual results of organo-chlorine pesticide residues in the flesh of fish collected from the Newlyn River at Stable Hobba on 14 December 1988 are given in Appendix 7, and are summarised in Table 5 below.

TABLE 5

NEWLYN RIVER AT STABLE HOBBA

ORGANO-CHLORINE PESTICIDE RESIDUES IN FRESHWATER FISH

<u>Fish Species</u>	<u>Number Analysed</u>	<u>Aldrin</u>		<u>Dieldrin</u>		<u>gamma-HCH</u>	
		<u>micrograms per kilogram (wet weight)</u>					
		<u>range</u>	<u>mean</u>	<u>range</u>	<u>mean</u>	<u>range</u>	<u>mean</u>
Brown Trout	5	<1	<1	100-2500	966	50-86	60
Eel	10	<1-96	16.2	490-9000	2651	<1-50	38.1

Brown trout were collected from the Sancreed Brook at Bosence and Sellan (as indicated in Appendix 1 and as shown in Photograph 3) above Drift Reservoir. The individual results of organo-chlorine pesticide residues in the flesh of the fish collected are given in Appendices 8 and 9. All fish collected at Bosence and Sellan had aldrin concentrations less than the limit of detection of 1ug/kg (wet weight).

One of the five fish collected at Bosence had dieldrin concentrations above the limit of detection of 3 ug/kg (wet weight) at a concentration of 6 ug/kg (wet weight). Two of the five fish collected at Sellan had dieldrin concentrations above the limit of detection at concentrations of 6 and 13 ug/kg (wet weight).

All fish had concentrations of gamma-HCH above the limit of detection of 1 ug/kg (wet weight). At Bosence the range of values were 9 to 38 ug/kg (wet weight) with a mean value of 21.6 ug/kg (wet weight). At Sellan, the range of values were 1 to 17 ug/kg (wet weight) with a mean value of 5.2 ug/kg (wet weight).

### 3.4 Macroinvertebrate Fauna

A macroinvertebrate fauna survey was carried out on 14 December 1988 with 10 sites being examined in the catchment. Qualitative samples of aquatic macroinvertebrate fauna were obtained by the standard kick sampling method and BMWP and Average Score Per Taxon (ASPT) values calculated. Data from four sites are shown in Table 6 below together with previous data where available.

TABLE 6

#### NEWLYN RIVER - MACROINVERTEBRATE FAUNA SURVEYS

Location	Date Sampled	Biotic Indices		Number of Taxa
		BMWP Score	Average Score Per Taxon	
Trereife Stream, Dennis Place	14.12.88	60	4.26	14
Trereife Stream, Prior to confluence with Newlyn River	14.12.88	30	4.29	9
Newlyn River at Buryas Bridge	14.12.88	58	5.27	13
	23.11.88	40	4.44	10
	28.08.88	36	6	7
	29.06.87	72	5.56	16
	17.06.87	46	5.11	10
Newlyn River at Stable Hobba	14.12.88	45	4.5	14
	23.11.88	41	4.56	11
	28.08.87	17	3.4	7
	29.06.87	33	4.71	10
	17.06.87	43	4.78	11

Assessment of the previous data of the Newlyn River suggests considerable organic enrichment is occurring in the watercourse which is restricting the diversity of the macroinvertebrate fauna to those taxa tolerant of organic pollution. The fauna of the Trereife Stream is apparently exceptionally restricted with only 9 taxa present at the site prior to the confluence with the Newlyn River. The site at Stable Hobba on the Newlyn River downstream of the confluence with the Trereife Stream has also shown a consistently poorer quality invertebrate fauna than the upstream site at Buryas Bridge. The cause of these impoverished faunas is likely to be the result of insecticides entering the Trereife Stream and the Newlyn River. However, more detailed assessment is required to determine specific effects on the invertebrate community. This requires quantitative sampling of the aquatic invertebrate fauna.

### 3.5 Pesticide Residues in Marine Shellfish

The Newlyn River enters Mount's Bay at Newlyn as shown on the map as part of Appendix 10 and in Photograph 1. At six locations in Mounts Bay, (Mousehole, Carn Gwavas, Newlyn, Wherry Town, Penzance

Pier and Marazion), batches of shellfish were collected from along the shoreline. Each batch contained between 20 to 30 shellfish of an individual species. Where possible mussels and periwinkles were sought. At all six locations periwinkles were found and collected. At two locations, Mousehole and Marazion, limpets were collected as a substitute for mussels.

The individual results of organo-chlorine pesticide residues in the flesh of the batches of shellfish are given in Appendix 11. At all six locations aldrin concentrations were less than the limit of detection of  $1\text{ug/kg}$  (wet weight) in limpets, mussels and periwinkles. At four locations, dieldrin concentrations were less than the limit of detection of  $3\text{ug/kg}$  (wet weight) in limpets, mussels and periwinkles. At Newlyn, periwinkles contained  $5\text{ug/kg}$  (wet weight) whilst mussels contained  $<3\text{ug/kg}$  (wet weight). At Wherry Town, mussels contained  $3\text{ug/kg}$  (wet weight) whilst periwinkles contained  $<3\text{ug/kg}$  (wet weight).

### 3.6 Marine Sediments

Marine sediments were collected from six locations in Mount's Bay. Each location was in the vicinity of where the batches of shellfish were collected. The sediments were analysed for organo-chlorine pesticide residues.

At all six locations the aldrin and dieldrin concentrations were less than the limits of detection of  $1\text{ug/kg}$  (dried weight) and  $3\text{ug/kg}$  (dried weight) respectively. Traces of gamma-HCH were present in sediments collected from Mousehole, Newlyn and Penzance Pier at concentrations of 1, 3 and  $2\text{ug/kg}$  (dried weight) respectively.

### 3.7 Continuing Investigations

#### 3.7.1 River Water Quality

A monitoring programme commenced in early January 1989 to determine the range of concentrations of organo-chlorine pesticides present in the Trereife Stream and the Newlyn River. Weekly sampling has been planned from the Trereife Stream at Dennis Place (above the bulb growing area) and prior to the confluence with the Newlyn River. The results of analysis for organo-chlorine pesticide concentrations are reported in Appendices 13 and 14.

Thirteen samples have been collected since early January from Dennis Place. On twelve occasions, aldrin and dieldrin concentrations were less than the limits of detection of  $1\text{ng/l}$  and  $3\text{ng/l}$  respectively. On 14 March when 29 millimeters of rain fell in the day, aldrin and dieldrin concentrations were  $9\text{ng/l}$  and  $15\text{ng/l}$  respectively. Thirteen samples have also been collected on co-incident dates from the sampling point prior to the Newlyn River. On all occasions aldrin and dieldrin concentrations were greater than the limits of detection. Aldrin concentrations have ranged between 10 and  $160\text{ng/l}$  with a mean value of  $39.0\text{ng/l}$ . Dieldrin concentrations have ranged from 17 to  $92\text{ng/l}$  with a mean value of  $36.3\text{ng/l}$ .

The maximum concentrations of aldrin and dieldrin were present in the first sample collected on 5 January 1989. All successive samples have declined in concentration such that the samples collected on 5 April 1989 were at 9% of the original aldrin concentrations and 18% of the original dieldrin concentrations. This may be explained in part by the abnormally low flows recorded up to 27 January when rainfall recorded in the catchment was 23% of the long-term average. Since then substantial quantities of rain have fallen and river levels have increased substantially diluting aldrin and dieldrin inputs as indicated in Appendix 18.

A sample collected on 14 March (on a day when 29 millimeters of rain was recorded) had aldrin and dieldrin concentrations of 110ng/l and 76ng/l respectively. This sample was collected by consultants investigating the pathways of aldrin and dieldrin from land to watercourse. Additional samples collected on this day supported the view that high concentrations of aldrin and dieldrin are associated with surface run-off from the bulb growing areas, (see Section 3.7.3).

The European Council Directive 88/347/EEC has set an environmental quality standard (EQS) for aldrin, dieldrin, endrin and isodrin. From January 1989 inland surface waters must contain less than 30ng/l of aldrin, dieldrin, endrin and isodrin in total in order to comply with the EQS. Currently, twelve of the thirteen samples collected since January 1989 have combined aldrin and dieldrin concentrations in excess of the EQS as indicated in Table 7 below.

TABLE 7

TREELIFE STREAM PRIOR TO NEWLYN RIVER  
ALDRIN AND DIELDRIN CONCENTRATIONS

<u>Date Sampled</u>	<u>Concentration (ng/l)</u>			<u>EQS</u>
	<u>Aldrin</u>	<u>Dieldrin</u>	<u>Aldrin plus Dieldrin</u>	<u>Compliance</u>
5.1.1989	160	92	252	No
12.1.1989	35	33	68	No
17.1.1989	39	40	79	No
23.1.1989	32	44	76	No
30.1.1989	21	29	50	No
9.2.1989	26	34	60	No
21.2.1989	13	25	38	No
27.2.1989	12	23	35	No
9.3.1989	10	19	29	Yes
14.3.1989	110	76	186	No
15.3.1989	14	18	32	No
22.3.1989	20	21	42	No
5.4.1989	15	17	32	No

Weekly sampling has also taken place since early January to determine the effect of pesticide inputs to the Trereife Stream on the Newlyn River. Samples have been collected from the Newlyn River upstream of the Trereife Stream at Buryas Bridge and at a downstream point at Newlyn Bridge (prior to the entry of the Newlyn River into Mount's Bay) (see Appendix 1 and Photograph 1). The results of analysis for organo-chlorine pesticide concentrations are reported in Appendices 15 and 16.

Eleven samples have been collected since early January from Buryas Bridge. On ten occasions, aldrin and dieldrin concentrations were less than the limits of detection of 1ng/l and 3ng/l respectively. On 12 January aldrin and dieldrin concentrations were 35ng/l and 38ng/l respectively. No rainfall was recorded on 11 or 12 January although 11.6 millimeters was recorded on 8 January after many days of no recorded rain and 7.9 millimeters on 10 January.

Ten samples were analysed for gamma-HCH which was present above the limit of detection in all samples with a range of 2 to 5 ng/l with a mean value of 3.2ng/l.

Twelve samples have been collected since early January from Newlyn Bridge. On seven occasions, aldrin concentrations were greater than the limit of detection of 1 ng/l with a maximum value of 7 ng/l. On ten occasions, dieldrin concentrations were greater than the limit of detection of 3 ng/l with a maximum value of 13 ng/l. On all occasions, the combined aldrin and dieldrin concentrations were less than the EQS of 30 ng/l at Newlyn Bridge.

Gamma - HCH was present in all eleven samples analysed with a range of 2 to 9 ng/l and a mean value of 4.8 ng/l.

Commencing in May 1989 an additional monitoring point will be introduced at Stable Hobba to record aldrin and dieldrin concentrations in the Newlyn River nearer to the confluence with the Trereife Stream than the monitoring point at Newlyn Bridge. Sampling frequency will be weekly and co-incident with the other four monitoring points.

### 3.7.2 Soil Survey and Land Research Centre

The Soil Survey and Land Research Centre of Silsoe, Bedford have been contracted to undertake a study of land use and farming practice in the Newlyn River catchment. Present land use has been surveyed. The farmers and growers have been interviewed with respect to land use practices, patterns and changes, with respect to use of chemicals, cultivation and drainage of land. Summaries of agricultural census data have been extracted from the Public Record Office.

Land use in the catchment is dominated by livestock farming on small farms with strong emphasis on dairy cattle. The sheep population is very small. Several farms also grow broccoli, cabbage, first early or crisping potatoes and cereals. The arable fields being moved around the farm in rotations that also include ley grassland with only very steep ground or small areas of wetland being avoided and left in permanent pasture. Around Trereife there are substantial areas of

daffodils, other narcissus varieties and other bulbs which have been cropped for cut-flowers for many years.

With an understanding of practices, critical areas of the catchment have been studied to identify likely pathways for movement of persistent pesticides from the land to watercourses. It seemed likely that the various arable farming and horticultural activities encouraged run-off of water and sediment to watercourses by a number of means. Few of the fields are absolutely flat and are normally cultivated, drilled or planted up and down the gradient. The soil is normally worked to a fine tilth for ease of planting and harvesting of potatoes and bulbs, and for efficient use of agrochemicals.

These practices encourage overland flow of turbid water during storms and can cause erosion and deposition of soil downslope or into watercourses. This process was observed at a number of sites in March 1989. Use of herbicides prevents development of a groundcover of grass and other plants which otherwise would help check soil run-off. In cereals and new leys tramlines or wheelmarks, again usually up and down the gradient, also concentrate flow of water and can produce soil erosion.

Samples of soil and subsoil, and of water from land drains, springs and surface run-off have been collected and analysed to provide an indication of downward movement through the soil.

Between 14 and 17 March 1989 samples of soil and water were taken from the bulb farm at Trereife. At this farm there are longstanding bulb fields where there have been at least two applications of Aldrex in the last 10 years. At the time of planting daffodil and narcissus bulbs, Aldrex, which contains aldrin, is added to the soil for the control of narcissus fly. Bulbs are normally planted in and remain in the soil for up to three years. There is no further addition of Aldrex during the cultivation period.

As a study area, the Titanic Field at Trereife was selected as being typical of a situation which could affect river water quality. Titanic Field and the two fields upgradient are identified in Photograph 5. At the time of study in March 1989, the field was laid down to daffodil bulbs planted up slope and ridged much as for potatoes. A field ditch on the north east side enters the Newlyn River prior to its confluence with the Trereife Stream, and probably originates from piped and buried land drains. On 14 March 1989, when 29 millimeters of rain fell, heavy run-off from this field and the upslope field pooled in the lower part of the field and entered the Newlyn River by overland flow and into the field ditch. The overland flow led to the deposition of colluvium at the lower end of the field, possibly by sheet erosion. The results of samples of soil sediment and water taken from Titanic Field on 14 March are shown in Table 8 below.

TABLE 8

TITANIC FIELD, TREREIFE  
ALDRIN AND DIELDRIN CONCENTRATIONS

<u>Sample Description</u>	<u>Aldrin</u>		<u>Dieldrin</u>	
	Value	Unit	Value	Unit
Ditch water at source	77	ng/l	70	ng/l
Ditch water prior to Newlyn R.	650	ng/l	670	ng/l
Run-off from field entering ditch	960	ng/l	890	ng/l
(suspended solids = 1130 mg/l)				
Ditch sediment prior to Newlyn River	90	ug/kg (dry wt)	45	ug/kg (dry wt)
Fresh colluvium from run-off	2100	ug/kg (dry wt)	590	ug/kg (dry wt)

Samples of field soil were taken from the westerly field upslope from Titanic Field (indicated as 'Field A' in Photograph 5) at two depths to determine the aldrin and dieldrin concentrations present. These results are presented in Table 9 below.

TABLE 9

TREREIFE BULB FIELD 'A'

ALDRIN AND DIELDRIN CONCENTRATIONS IN SOIL

<u>Sample Description</u>	<u>Aldrin</u>	<u>Dieldrin</u>
	micrograms per kilogram (dried weight)	
Field soil taken from ridge flanks		
0-20 cm	<100	1200
45-60 cm	<1	7

Similar studies took place in a bulb field adjacent to the Trereife Stream, indicated as 'Field B' in Photograph 5. The results of samples of water collected on 14 March are shown in Table 10 below:

TABLE 10

## TREREIFE BULB FIELD 'B'

## ALDRIN AND DIELDRIN CONCENTRATIONS

<u>Sample Description</u>	<u>Aldrin</u> (ng/l)	<u>Dieldrin</u>
Trereife Stream at Dennis Place (above bulb fields)	9	15
Run-off from Field 'B' to Trereife Stream	77	240
Land drainage to Trereife Stream	60	250
Trereife Stream prior to Newlyn River	110	76

These studies by the Soil Survey and Land Research Centre have identified that aldrin and dieldrin are entering both the Newlyn River and Trereife Stream. Further extended surveys are planned subject to appropriate weather conditions to confirm these initial results.

During the period of heavy rainfall experienced on 14 March 1989, survey staff noticed numbers of earthworms being washed from the bulb fields into the Trereife Stream and Newlyn River. On future surveys, earthworms will be collected from selected bulb fields for the analysis of pesticide residues.

A further study area has been selected at a farm bordering the Newlyn River above Drift Reservoir. At Roskennals, a field called Roskennals Ley had been used to grow potatoes. Aldrex had been used for the control of wireworm as this field had been previously laid down to permanent grass. After the lifting of the potato crop in 1988, the field was reseeded with grass as now illustrated in Photographs 2 and 6. This field has rills and a shallow dendritic "gully" system with colluvium on the footslope. On 14 March 1989 samples of soil, colluvium and water standing in pools over the colluvium were sampled and the results are given in Appendix 11 below:

TABLE 11

## ROSKENNALS LEY

## ALDRIN AND DIELDRIN CONCENTRATIONS

<u>Sample Description</u>		<u>Aldrin</u>		<u>Dieldrin</u>	
		<u>Value</u>	<u>Unit</u>	<u>Value</u>	<u>Unit</u>
Water in pools over colluvium		99	ng/l	79	ng/l
Colluvium		1400	ug/kg(drywt)	430	ug/kg(drywt)
Soil	0-20 cm	12	ug/kg(drywt)	57	ug/kg(drywt)
	45-60 cm	1	ug/kg(drywt)	3	ug/kg(drywt)





Investigations are taking place to identify if surface run-off and colluvium could enter the Newlyn River downslope of this field. Further surveys will take place at this location subject to appropriate weather conditions.

The above information has been provided by Dr. Tim Harrod of the Soil Survey and Land Research Centre and will form part of a land use report which will be presented to South West Water in the near future.

### 3.7.3 Fish

With the commencement of the fishing season for brown trout in mid-March, ten brown trout were collected from the Newlyn River at Stable Hobba for analysis. The individual results of organo-chlorine pesticide residues in the flesh of fish collected are given in Appendix 17. All ten brown trout had aldrin and gamma-HCH concentrations less than the limits of detection of 1ug/kg (wet weight) and 1 ug/kg (wet weight) respectively.

Dieldrin concentrations in the ten brown trout varied from 120 to 370 ug/kg (wet weight) with a mean value of 231 ug/kg (wet weight). The Environmental Health Officer for Penwith District Council has been informed of these continuing high concentrations of dieldrin residues in brown trout.

It is proposed to resample the Newlyn River in the vicinity of the Trereife Stream in the Autumn of 1989 to determine the levels of pesticide residues in brown trout and eels.

### 3.7.4 Macroinvertebrate fauna

A macroinvertebrate fauna survey of the Newlyn River in the vicinity of the Trereife Stream is planned for May 1989. Aquatic invertebrate communities will be sampled to allow for a more detailed assessment. Where possible, samples of benthic fauna will be collected and analysed for pesticide residues.

### 3.7.5 Farm Campaign

All farms in the catchment have been visited by staff of the Pollution Controller assisted by staff of the Field Controller. The drainage arrangements at each farm were thoroughly investigated. Whilst not wishing to over dramatize the pesticide issue in the catchment, staff have endeavoured to ascertain all the chemicals, herbicides, pesticides and fertilisers used on each premises together with application rates and dosing times and frequencies.

Where drainage problems have been identified, MAFF advisory officers have been contacted. Schemes for drainage improvements have been drawn up by MAFF and implementation of the remedial works are awaited. Follow up inspections are planned when works are completed. Certain farms which had potential risks are to be re-inspected.

Certain farmers have been written to with a request that they terminate completely the use of aldrin or dieldrin on their land and

crops between the time of the letter and the withdrawal of approved use status. Recipients of these letters will receive a personal visit from staff of the Pollution Controller to determine the success of these requests.

### 3.7.6 River Flows and Pesticide Loadings

In order to calculate pesticide loadings in the watercourses, river flows are needed. Difficulties are being experienced in obtaining accurate river flows because of the effects that the operation of Drift Reservoir had on the lower catchment.

### 3.7.7 Agricultural Use of Aldrin

Aldrex is a proprietary product manufactured by Shell and contains aldrin. Approval for the sale, supply and advertisement of aldrin products will cease on 31 December 1990. Approval for storage and use will cease on 31 December 1992. There is only limited approved use for aldrin, one being the control of narcissus fly in dormant narcissus bulbs which will remain in the soil for 2-3 years. Another approved use is for the control of wireworm in fields where potato crops were grown after the field had previously been laid down to permanent grass. Both these uses of aldrin have been found in the Newlyn River catchment. The major bulb fields are below Drift Reservoir whilst at least two farms above Drift Reservoir have used aldrin with potato crops in recent years.

Aldrin is metabolically converted to dieldrin. This epoxidation has been shown to occur in various species of biota including mammals and freshwater fish. The aldrin molecule is biologically altered in the environment to a more stable and at least more toxic form, dieldrin. Whilst dieldrin has been shown to be metabolically degraded, its persistence in the environment is due to its extremely low volatility and low solubility in water. Whilst this epoxidation of aldrin to dieldrin has been demonstrated at Trereife what has also been noted is the ability of aldrin to persist in the environment (both terrestrial and aquatic) when associated with colluvium, soil and river sediment.

In addition, dieldrin is extremely apolar, resulting in a high affinity for fat which accounts for its retention in animal fats, plant waxes and other such organic matter in the environment. The fat solubility of dieldrin results in the progressive accumulation in the food chain which may result in a concentration in an organism which would exceed the lethal limit for a consumer. Many organisms not in direct contact with contaminated water, soil and sediment accumulate aldrin and dieldrin from the food supply. This biological concentration results in tissue concentrations many times those found in the surrounding environment as illustrated by the freshwater fish in the Newlyn River at Stable Hobba.

Dieldrin is probably the most stable pesticide among the cyclodienes. The time required for 95 percent of the dieldrin to disappear from soil has been estimated to vary from 5 to 25 years depending upon the microbial flora of the soil, (3). This is, in part, supported by evidence supplied by land managers in the Newlyn River catchment which suggests that the effects on the aquatic environment being recorded in

1989 are the result of land use and farming practices undertaken in previous years. Therefore, if agreement is reached that aldrin will not be used in the catchment in future, a strategy will have to be developed to contain soil contaminated by past farming practices away from watercourses.

#### 4. CONCLUSIONS

1. River water quality, sediment analysis and macroinvertebrate data indicated that aldrin and dieldrin was entering the Trereife Stream between Dennis Place and the Newlyn River confluence.
2. Highest pesticide residues in eels and trout were found in the Newlyn River at Stable Hobba downstream of the Trereife Stream confluence.
3. Pesticide residues in marine shellfish sampled at various sites in Mount's Bay were generally below the limit of detection although trace amounts were found at Newlyn. Aldrin and dieldrin were not found in marine sediment samples.
4. Work by the Soil Survey and Land Research Centre revealed large areas of daffodil cultivation bordering the Trereife Stream where aldrin is used as an insecticide to control the large narcissus fly.
5. Movement of soil particles with aldrin and dieldrin bound to them, occurs during heavy rainfall which subsequently contaminates the Trereife Stream and Newlyn River.
6. Approved use of organo-pesticides has caused serious pollution which has been exacerbated by methods of husbandry.

## 6. RECOMMENDATIONS

1. Notification of the findings of this study to MAFF and DoE.
2. Undertake independent analysis to provide confirmatory evidence for the presence of aldrin and dieldrin.
3. Inform Fenwith District Council of survey results.
4. Advise Pollution Controller of the results of the investigation.
5. Continue ongoing monitoring programme of river water and biota and review findings in April 1990.
6. The Hayle Catchment, where aldrin and dieldrin have also been found, should receive similar attention.

6. REFERENCES

1. B Milford. Organo-Chlorine Pesticide Residues in Freshwater Eels. Environmental Protection Report EP/WQ/89/2. South West Water, Exeter, January 1989.
2. South West Water. Pollution of the River Mole. Exeter, 1983.
3. C.A. Edwards. Insecticide residues in soils. Residue Rev. 13:83, 1966.

7. PHOTOGRAPHS

<u>Photograph</u>	<u>Title</u>
1	Newlyn River eastwards from Drift Reservoir to Mount's Bay.
2	Newlyn River northwards from Drift Reservoir to source.
3	Sancreed Brook westwards from Drift Reservoir to source.
4	Trereife Stream from source looking southeast to Newlyn Harbour.
5	Trereife and the Bulb Fields.
6	Roskennals Ley



1



2







3



4





5



6



8. APPENDICES

Appendix

1. Sampling locations in the Newlyn River catchment.
2. Pesticide concentrations in River Water (14 December 1988).
3. Pesticide concentrations in River Sediments (14 and 20 December 1988).
4. Pesticide residues in freshwater fish - Newlyn River at Bodinnar.
5. Pesticide residues in freshwater fish - Newlyn River at Skimmel Bridge.
6. Pesticide residues in freshwater fish - Newlyn River at Buryas Bridge.
7. Pesticide residues in freshwater fish - Newlyn River at Stable Hobba (December 1988).
8. Pesticide residues in freshwater fish - Sancreed Brook at Bosence.
9. Pesticide residues in freshwater fish - Sancreed Brook upstream of Sellan.
10. Sampling locations in Mount's Bay.
11. Pesticide residues in shellfish - Mount's Bay.
12. Pesticide residues in marine sediments - Mount's Bay.
13. Pesticide concentrations in River Water - Trereife Stream at Dennis Place (January to April 1989).
14. Pesticide concentrations in River water - Trereife Stream prior to Newlyn River (January to April 1989).
15. Pesticide concentrations in River Water - Newlyn River at Buryas Bridge (January to April 1989).
16. Pesticide concentrations in River Water - Newlyn River at Newlyn Bridge (January to April 1989).
17. Pesticide residues in freshwater fish - Newlyn River at Stable Hobba (March 1989).
18. Daily rainfall - Drift Water Treatment Works (January to April 1989).



Appendix I. Newlyn River Catchment Investigation.

Sampling locations for organo-chlorine residues in river sediments, river waters and freshwater fish



# APPENDIX 2

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE CONCENTRATIONS IN RIVER WATER

Date collected : 14 December 1988

Date analysed: 15 December 1988

#### ORGANO-CHLORINE PESTICIDES nanograms per litre (ng/l)

MAP *									
REF	WATERCOURSE	LOCATION	<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
1	Newlyn River	Bodinnar	<1	<3	<3	<1	<3	<5	<3
2	Newlyn River	Skimmel Bridge	<1	<3	<3	2	<3	<5	<3
3	Newlyn River	Buryas Bridge	<1	<3	<3	4	<3	<5	<3
4	Newlyn River	Stable Hobba	11	3	<3	110	<3	<5	<3
5	Trereife Stream	Dennis Place	<1	<3	<3	1	<3	<5	<3
9	Sancreed Brook	Bosence	<1	<3	<3	<1	<3	<5	<3
11	Sancreed Brook	Sellan	<1	<3	<3	1	<3	<5	<3

\* See Appendix 1

# APPENDIX 3

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE CONCENTRATIONS IN RIVER SEDIMENTS

Date Collected : 14 December 1988\*  
20 December 1988\*

Analysed during January 1989

MAP(a) REF	WATERCOURSE	LOCATION	ORGANO - CHLORINE PESTICIDES (micrograms per kilogram (dried weight))						
			<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
1.	Newlyn River	Bodinnar*	<1	<3	-	<1	<5	<5	<5
2.	Newlyn River	Skimmel Bridge*	<1	<3	-	2	<5	<5	<5
3.	Newlyn River	Buryas Bridge*	<1	<3	-	1	<5	<5	<5
4.	Newlyn River	Stable Hobba*	210	45	-	88	<5	<5	<5
5.	Trereife Stream	Dennis Place*	<1	<3	-	1	<5	<5	<5
6.	Trereife Stream	prior to Newlyn R+	1200	250	-	7	<5	<5	<5
7.	Trereife Stream	prior to Newlyn R+	760	300	-	23	<5	<5	<5
8.	Trereife Stream	prior to Newlyn R+	170	41	-	<1	<5	<5	<5
9.	Trereife Stream	prior to Newlyn R+	320	57	-	1	<5	<5	<5
10.	Sancreed Brook	Bosence*	<1	<3	-	<1	<5	<5	<5
11.	Sancreed Brook	Sellan*	<1	<3	-	<1	<5	<5	<5

(a) See Appendix 1



APPENDIX 4

SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

NEWLYN RIVER CATCHMENT INVESTIGATION

ORGANO-CHLORINE PESTICIDE RESIDUES IN FRESHWATER FISH

LOCATION: NEWLYN RIVER AT BODINNAR  
O.S. REF. N.G.R. : SW 421 325

DATE 14 December 1988  
Map Reference 1\*

FISH SPECIES	LENGTH (mm)	WEIGHT (g)	ORGANO-CHLORINE PESTICIDES (micrograms per kilogram (wet weight))						
			<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
Eel	340	67.0	<1	130	<3	4	33	<5	19
Brown trout	174	61.1	<1	<3	<3	<1	<5	<5	<5
	266	182	<1	<3	<3	<1	<5	<5	<5
	234	129	<1	<3	<3	<1	<5	<5	<5
	245	158	<1	<3	<3	<1	<5	<5	<5

\* See Appendix 1

# APPENDIX 5

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE RESIDUES IN FRESHWATER FISH

LOCATION: NEWLYN RIVER AT SKIMMEL BRIDGE  
O.S. REF. N.G.R. : SW 434 302

DATE 14 December 1988  
MAP REFERENCE 2\*

FISH SPECIES	LENGTH (mm)	WEIGHT (g)	ORGANO-CHLORINE PESTICIDES (micrograms per kilogram (wet weight))						
			<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
Brown trout	154	35.5	<1	<3	<3	<1	<5	<5	<5
	166	45.3	<1	<3	<3	<1	<5	<5	<5
	176	60.8	<1	<3	<3	<1	<5	<5	<5
	156	39.7	<1	<3	<3	<1	<5	<5	<5
	148	34.9	<1	<3	<3	<1	<5	<5	<5

\* see Appendix 1

# APPENDIX 6

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE RESIDUES IN FRESHWATER FISH

LOCATION: NEWLYN RIVER AT BURYAS BRIDGE  
O.S. REF. N.G.R. : SW 446 291

DATE 14 December 1988  
MAP REFERENCE 3\*

FISH SPECIES	LENGTH (mm)	WEIGHT (g)	ORGANO-CHLORINE PESTICIDES (micrograms per kilogram (wet weight))						
			<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
Brown trout	175	66.0	<1	6	<3	<1	<5	<5	<5
	201	105	<1	37	<3	2	<5	<5	<5
	189	85.7	<1	10	<3	2	<5	<5	<5
	219	122	<1	270	<3	3	<5	<5	<5
	169	60.2	<1	6	<3	1	<5	<5	<5
Eel	272	36.7	<1	62	<3	3	22	<5	<5
	201	12.2	<1	45	<3	3	18	<5	<5
	298	37.2	<1	66	<3	2	31	<5	<5
	380	70.4	<1	260	<3	<1	<5	<5	<5
	226	14.2	<1	45	<3	3	15	<5	<5

\* See Appendix 1

# APPENDIX 7

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE RESIDUES IN FRESHWATER FISH

LOCATION: NEWLYN RIVER AT STABLE HOBBA  
O.S. REF. N.G.R.: SW 454 294

DATE 14 December 1988  
MAP REFERENCE 4\*

FISH SPECIES	LENGTH (mm)	WEIGHT (g)	ORGANO-CHLORINE PESTICIDES (micrograms per kilogram (wet weight))						
			<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
Brown trout	210	125	<1	600	<3	57	<5	<5	<5
	235	171	<1	430	<3	86	<5	<5	<5
	224	148	<1	1200	<3	57	<5	<5	<5
	238	159	<1	100	<3	50	<5	<5	<5
	220	131	<1	2500	<3	50	<5	<5	<5
Eel	229	143	<1	1100	<3	43	<5	<5	<5
	298	38.8	<1	900	<3	43	<5	<5	<5
	334	49.8	<1	1000	<3	36	<5	<5	<5
	364	63.2	<1	820	<3	43	<5	<5	<5
	334	62.9	24	4300	<3	36	<5	<5	<5
	310	46.8	12	3900	<3	43	<5	<5	<5
	344	57.5	24	2900	<3	43	<5	<5	<5
	276	31.7	<1	2100	<3	43	<5	<5	<5
	356	87.5	96	9000	<3	50	<5	<5	<5
	348	50.4	<1	450	<3	<1	<5	<5	<5

\* see Appendix 1

APPENDIX 8

SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

NEWLYN RIVER CATCHMENT INVESTIGATION

ORGANO-CHLORINE PESTICIDE RESIDUES IN FRESHWATER FISH

LOCATION: SANCREED BROOK AT BOSENCE

O.S. REF. N.G.R. : SW 406 304

DATE 14 December 1988  
MAP REFERENCE 10\*

FISH SPECIES	LENGTH (mm)	WEIGHT (g)	ORGANO-CHLORINE PESTICIDES (micrograms per kilogram (wet weight))						
			<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
Brown trout	159	42.7	<1	<3	<3	38	<5	<5	<5
	151	34.8	<1	<3	<3	9	<5	<5	<5
	155	33.1	<1	<3	<3	25	<5	<5	<5
	183	54.7	<1	<3	<3	9	<5	<5	<5
	268	188	<1	6	<3	27	<5	<5	<5

\* See Appendix 1

# APPENDIX 9

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE RESIDUES IN FRESHWATER FISH

LOCATION: SANCREED BROOK UPSTREAM OF SELLAN  
O.S. REF. N.G.R. : SW 427 298

DATE 14 December 1988  
MAP REFERENCE 11\*

FISH SPECIES	LENGTH (mm)	WEIGHT (g)	ORGANO-CHLORINE PESTICIDES (micrograms per kilogram (wet weight))						
			<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
Brown Trout	283	216	<1	<3	<3	1	<5	<5	<5
	256	157	<1	<3	<3	2	<5	<5	<5
	280	189	<1	<3	<3	1	<5	<5	<5
	198	74.9	<1	6	<3	5	<5	<5	<5
	160	35.0	<1	13	<3	17	<5	<5	<5

\* See Appendix 1

Appendix 10. Newlyn River Catchment Investigation.

Sampling locations for organo-chlorine pesticide residues in shellfish and sediments.







# APPENDIX 11

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE RESIDUES IN SHELLFISH

Date collected: 22 December 1988

Analysed during January 1989

MAP * REF	LOCATION	SPECIES	ORGANO-CHLORINE PESTICIDES (micrograms per kilogram (wet weight))						
			Aldrin	Dieldrin	Endrin	gamma-HCH	pp-DDE	pp-DDT	pp-TDE
1.	Mousehole	Limpiets	<1	<3	<3	<1	<5	<5	<5
		Periwinkles	<1	<3	<3	<1	<5	<5	<5
2.	Carn Gwavas	Mussels	<1	<3	<3	<1	<5	<5	<5
		Periwinkles	<1	<3	<3	<1	<5	<5	<5
3.	Newlyn	Mussels	<1	<3	<3	<1	<5	<5	<5
		Periwinkles	<1	5	<3	1	<5	<5	<5
4.	Wherry Town	Mussels	<1	3	<3	3	<5	<5	<5
		Periwinkles	<1	<3	<3	<1	<5	<5	<5
5.	Penzance Pier	Mussels	<1	<3	<3	8	<5	<5	<5
		Periwinkles	<1	<3	<3	<1	<5	<5	<5
6.	Marazion	Limpets	<1	<3	<3	<1	<5	<5	<5
		Periwinkles	<1	<3	<3	<1	<5	<5	<5

\* See Appendix 10

# APPENDIX 12

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE RESIDUES IN MARINE SEDIMENTS

Date collected: 22 December 1988

Analysed during January 1989

#### ORGANO-CHLORINE PESTICIDE (micrograms per kilogram (dried weight))

MAP* REF	LOCATION	<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
1	Mousehole	<1	<3	-	1	<5	<5	<5
2	Carn Gwavas	<1	<3	-	<1	<5	<5	<5
3	Newlyn	<1	<3	-	3	<5	<5	<5
4	Wherry Town	<1	<3	-	<1	<5	<5	<5
5	Penzance Pier	<1	<3	-	2	<5	<5	<5
6	Marazion	<1	<3	-	<1	<5	<5	<5

\* see Appendix 10

# APPENDIX 13

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE RESIDUES IN RIVER WATER

Location: Trereife Stream at Dennis Place

MAP REFERENCE: 5

Date sampled	ORGANO-CHLORINE PESTICIDE (micrograms per kilogram (wet weight))						
	<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
5 Jan 1989	<1	<3	<3	1	<3	<5	<3
12 Jan 1989	<1	<3	<3	<1	<3	<5	<3
17 Jan 1989	<1	<3	<3	1	<3	<5	<3
23 Jan 1989	<1	<3	<3	<1	<3	<5	<3
30 Jan 1989	<1	<3	<3	<1	<3	<5	<3
9 Feb 1989	<1	<3	<3	<1	<3	<5	<3
21 Feb 1989	<1	<3	<3	13	<3	<5	<3
27 Feb 1989	<1	<3	<3	2	<3	<5	<3
4 March 1989	<1	<3	<3	<1	<3	<5	<3
14 March 1989	9	15	<3	-	<3	<5	<3
15 March 1989	<1	<3	<3	<1	<3	<5	<3
22 March 1989	<1	<3	<3	<1	<3	<5	<3
5 April 1989	<1	<3	<3	-	<3	<5	<3

APPENDIX 14

SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

NEWLYN RIVER CATCHMENT INVESTIGATION

ORGANO-CHLORINE PESTICIDE CONCENTRATIONS IN RIVER WATER

Location: Trereife Stream prior to Newlyn River

MAP REFERENCE: 9

ORGANO-CHLORINE PESTICIDES  
nanograms per litre (ng/l)

<u>Date sampled</u>	<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
5 Jan 1989	160	92	<3	3	<3	<5	<3
12 Jan 1989	35	33	<3	2	<3	<5	<3
17 Jan 1989	39	40	<3	2	<3	<5	<3
23 Jan 1989	32	44	<3	2	<3	<5	<3
30 Jan 1989	21	29	<3	<1	<3	<5	<3
9 Feb 1989	26	34	<3	10	<3	<5	<3
21 Feb 1989	13	25	<3	1	<3	<5	<3
27 Feb 1989	12	23	<3	2	<3	<5	<3
9 March 1989	10	19	<3	<1	<3	<5	<3
14 March 1989	110	76	<3	-	<3	<5	<3
15 March 1989	14	18	<3	<1	<3	<5	<3
22 March 1989	20	21	<3	<1	<3	<5	<3
5 April 1989	15	17	<3	-	<3	<5	<3

APPENDIX 15

SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

NEWLYN RIVER CATCHMENT INVESTIGATION

ORGANO-CHLORINE PESTICIDE CONCENTRATIONS IN RIVER WATER

Location: Newlyn River at Buryas Bridge

MAP REFERENCE: 3

ORGANO-CHLORINE PESTICIDES  
nanograms per litre (ng/l)

<u>Date sampled</u>	<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
5 Jan 1989	<1	<3	<3	5	<3	<5	<3
12 Jan 1989	35	38	<3	2	<3	<5	<3
17 Jan 1989	<1	<3	<3	3	<3	<5	<3
23 Jan 1989	<1	<3	<3	3	<3	<5	<3
9 Feb 1989	<1	<3	<3	3	<3	<5	<3
21 Feb 1989	<1	<3	<3	5	<3	<5	<3
27 Feb 1989	<1	<3	<3	3	<3	<5	<3
9 March 1989	<1	<3	<3	2	<3	<5	<3
15 March 1989	<1	<3	<3	2	<3	<5	<3
22 March 1989	<1	<3	<3	4	<3	<5	<3
5 April 1989	<1	<3	<3	-	<3	<5	<3

APPENDIX 16

SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

NEWLYN RIVER CATCHMENT INVESTIGATION

ORGANO-CHLORINE PESTICIDE CONCENTRATIONS IN RIVER WATER

Location: Newlyn River at Newlyn Bridge

MAP REFERENCE: 12

ORGANO-CHLORINE PESTICIDES  
nanograms per litre (ng/l)

<u>Date sampled</u>	<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
5 Jan 1989	6	12	<3	5	<3	<5	<3
12 Jan 1989	7	8	<3	4	<3	<5	<3
17 Jan 1989	5	6	<3	3	<3	<5	<3
23 Jan 1989	2	5	<3	4	<3	<5	<3
30 Jan 1989	<1	4	<3	3	<3	<5	<3
9 Feb 1989	<1	4	<3	6	<3	<5	<3
21 Feb 1989	1	4	<3	2	<3	<5	<3
27 Feb 1989	<1	10	<3	6	<3	<5	<3
9 March 1989	5	3	<3	4	<3	<5	<3
15 March 1989	1	<3	<3	6	<3	<5	<3
22 March 1989	<1	13	<3	9	<3	<5	<3
5 April 1989	<1	<3	<3	-	<3	<5	<3

# APPENDIX 17

## SOUTH WEST WATER - ENVIRONMENTAL PROTECTION

### NEWLYN RIVER CATCHMENT INVESTIGATION

#### ORGANO-CHLORINE PESTICIDE RESIDUES IN FRESHWATER FISH

LOCATION: NEWLYN RIVER AT STABLE HOBBA

DATE: 2 March 1989

O.S. Ref N.G.R. SW 454 294

MAP REFERENCE 4\*

FISH SPECIES	LENGTH (mm)	WEIGHT (g)	ORGANO - CHLORINE PESTICIDES (micrograms per kilogram (dried weight))						
			<u>Aldrin</u>	<u>Dieldrin</u>	<u>Endrin</u>	<u>gamma-HCH</u>	<u>pp-DDE</u>	<u>pp-DDT</u>	<u>pp-TDE</u>
Brown trout	235	161	<1	370	<3	<1	<5	<5	<5
	217	128	<1	300	<3	<1	<5	<5	<5
	225	132	<1	210	<3	<1	<5	<5	<5
	258	246	<1	160	<3	<1	<5	<5	<5
	262	264	<1	340	<3	<1	<5	<5	<5
	218	122	<1	180	<3	<1	<5	<5	<5
	233	165	<1	130	<3	<1	<5	<5	<5
	245	158	<1	260	<3	<1	<5	<5	<5
	215	118	<1	240	<3	<1	<5	<5	<5
	220	130	<1	120	<3	<1	<5	<5	<5

\* see Appendix 1

# APPENDIX 18

## NEWLYN RIVER CATCHMENT INVESTIGATION

### DAILY RAINFALL (in millimetres)

LOCATION: DRIFT WATER TREATMENT WORKS

O.S. REF N.G.R.: SW 4400 2870

ALTITUDE: 76 metres

MONTHLY LONG TERM AVERAGE (1941 - 70) = 138MM

JANUARY		FEBRUARY		MARCH	
DATE	MM	DATE	MM	DATE	MM
1	0.0	1	0.0	1	16.0
2	0.0	2	0.0	2	1.8
3	0.0	3	)	3	)
4	0.0	4	)	4	)
5	0.0	5	1.8	5	13.2
6	0.0	6	0.0	6	0.4
7	0.0	7	0.0	7	0.6
8	11.6	8	0.0	8	14.0
9	0.4	9	3.9	9	2.1
10	7.9	10	)	10	)
11	0.0	11	)	11	)
12	0.0	12	6.2	12	1.0
13	0.0	13	4.5	13	0.0
14	0.0	14	0.0	14	29.0
15	0.0	15	1.9	15	17.0
16	2.0	16	10.0	16	5.1
17	1.1	17	)	17	)
18	)	18	)	18	)
19	)	19	26.5	19	14.2
20	2.8	20	0.0	20	7.4
21	0.0	21	8.4	21	1.3
22	1.0	22	3.9	22	3.1
23	0.0	23	12.3	23	)
24	0.0	24	)	24	)
25	)	25	)	25	)
26	)	26	22.0	26	7.7
27	4.8	27	3.0	27	0.0
28	19.1	28	0.6	28	)
29	32.8			29	)
30	2.3			30	0.0
				31	0.0
Monthly total	85.8	Monthly total	105.0	Monthly total	133.9