THE POLLUTION LOAD ENTERING SOUTHAMPTON WATER AND THE SOLENT

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Introduction

For the purposes of this paper, "pollution load" is defined as the quantity of matter of any description which is discharged into a body of water from any source. It therefore includes matter of both natural and manmade origin and is not synonymous with pollution. Pollution load has been expressed as the weight (kg) of matter discharged in a predetermined period of time (one day), derived from the product of volume (v in m^3 d^{-1}) and concentration (c in gm^{-3}) of discharge. Thus, pollution load = $\frac{v \times c}{1000}$ kgd^{-1}

For ease of classification, the coastal and estuarine regions under the jurisdiction of Hampshire River and Water Division of the Southern Water Authority have been divided into five sub-areas:

(i) Southampton Water, including the area of water from Redbridge to a line drawn from Calshot Castle on the western shore to Hillhead on the eastern shore.

(ii) The mainland coast of the western approach to Southampton Water from Hurst Castle to Calshot Castle.

(iii) The mainland coast of the eastern approach to Southampton Water from Hillhead to Gilkicker Point.

(iv) Portsmouth Harbour.

(v) Langstone Harbour.

The following account is based on information collected between 1971 and 1974, and is restricted to the coastal and estuarine regions of the mainland due to lack of comprehensive data for the Isle of Wight. Although it is considered that the values still represent a valid approximation of conditions in the area, it is likely that the pollution load derived from effluent discharge has fallen during the past six years. Recent studies on the Isle of Wight suggest that freshwater inputs contribute 1,469kg BOD d^{-1}, 4,968kg total Nd^{-1} and 77.6kg Pd^{-1}, whilst sewage discharges from the northern side of the island contribute 4,200kg BOD d^{-1} and 523kg Pd^{-1}

Sources of pollution load

The matter constituting the pollution load enters the five sub-areas from sources which include the English Channel, rivers and streams, trade and sewage effluents and the effluents discharged in wet weather from storm sewage overflows and surface water sewers. In addition there are more diffuse sources such as bird droppings, rain, litter and sub-marine springs, which are not included in this paper. Since the rate at which the matter is subject to diurnal and seasonal fluctuations and changes caused both by wet weather and "accidental" discharges, the volume discharged from, and composition at, the source needs to be measured with sufficient frequency over a long period of time in order to obtain a reasonably accurate assessment of the pollution load. Ideally, volume and composition should be monitored continuously for all conceivable pollutants. Since the Solent system receives discharges from:

(i) the English Channel via The Needles and Spithead

(ii) 18 major and an unknown (but large) number of minor streams

(iii) 16 major and a significant, but unknown number of minor sewage works outlets

(iv) 9 major industrial outlets

(v) an unknown but probably large number of surface water outlets from roads, roofs etc.

(vi) storm water overflows

it has been impossible to monitor all of the above sources to a standard which would make it possible to obtain a reasonably complete and accurate estimate of the load to the system. Hence the present account has been based on those sources for which accurate data can be obtained from records or deduced from other sources.

As part of their routine programme, the Hampshire River Authority monitored the composition at monthly intervals of the more important streams which enter the five sub-areas from the mainland. Similarly, the composition of most (but not all) of the major discharges of trade and sewage effluent was determined several times each year. In addition the flow in the most important streams was measured continuously and that of the other important streams periodically. The volumes of some of the trade and sewage effluents were also recorded continuously. The routine monitoring programme was designed to assist the Authority to carry out statutory functions, including land drainage, the prevention of pollution, the maintenance of salmon and freshwater fisheries and the abstraction of water, and not necessarily to assist the determination of pollution load. In consequence, flow gauging stations and water quality measuring stations did not always coincide with, nor were they necessarily situated near to, the highest point reached by the tide. However, where possible, estimates of the pollution load carried by rivers and streams have been evaluated at the highest point reached by the tide. When information was not directly available, the figures which were available were extrapolated to give approximate values at the tidal limit. The determination of the composition of the various sources of pollution load is largely limited to those parameters which are most likely to be of significance for the Authority's work. These are dissolved oxygen, biochemical oxygen demand (BOD), ammoniacal and nitrate nitrogen and phosphate. Of these parameters, all except dissoved oxygen have been considered here.

Pollution load due to streams

The pollution load discharged from the streams in each of the five sub-areas are set out in Table 1. The analytical data used to calculate these loads have been derived from samples taken at stations which are nearest to the highest point reached by the tide in each stream. The results are expressed as daily means for the period 1971-1973. In some cases monthly figures were available for the whole period, whilst in other cases only scanty records could be obtained. The loads are due partly to effluents discharged to non-tidal waters and partly to the natural composition of the waters. However, they are not absolute figures because part of the pollution loads are eliminated by self purification before the streams discharge into tidal waters. Unfortunately, it is not possible at the present time to determine with any degree of confidence the extent to which self purification takes place in inland waters. Hence, it is impossible to assess directly the pollution load on the Solent system from the prementioned streams.

Table 1 Pollution load discharged from streams (expressed as kgd^{-1})

	BOD	Ammoniacal N	Nitrate N	Phosphate P
Area 1	4,543	198	8,445	300
Area 2	346	28.5	187	42.6
Area 3	273	9.90	237	21.1
Area 4	213	25.9	116	5.18
Area 5	7.60	3.01	3.24	3.64

Table 2 Pollution load discharged from industrial sources (expressed as kgd^{-1})

	BOD	Ammoniacal N	Nitrate N	Phosphate P
Area 1	10,480	2,675	654	82.4
Area 2	-	-	-	-
Area 3	-	-	-	-
Area 4	2,037	169	2.46	12.0
Area 5	-	-	-	-

Table 3 Pollution load discharged from sewage sources (expressed as kgd^{-1})

	BOD	Ammoniacal N	Nitrate N	Phosphate P
Area 1	3,984	1,803	542	517
Area 2	4,473	671	0.08	238
Area 3	6,410	961	-	343
Area 4	1,664	309	304	144
Area 5	19,088	3,038	886	1,344

Table 4 Total pollution load from all sources considered (expressed in kgd^{-1})

	BOD	Ammoniacal N	Nitrate N	Phosphate P
Area 1	18,917	4,676	9,641	899
Area 2	4,819	700	187	281
Area 3	6,683	971	237	364
Area 4	3,914	504	422	161
Area 5	19,096	3,041	889	1,347

Trade effluent and sewage pollution loads

Since it is an offence under Section 12 of the Rivers (Prevention of Pollution) Act 1961 to divulge information derived from the analysis of a sample of effluent without first obtaining permission to do so from the discharger, data which could be used to identify individual discharges have been omitted. The pollution loads arising from trade effluent and sewage sources are given in Tables 2 and 3 respectively. The data represent the mean values computed for rates available for the period 1971-74 for the industrial sources and 1971-73 for the sewage sources. These figures only include discharges directly to tidal waters.

It has not been possible to determine the heavy metal loads discharged into each of the five sub-areas due to lack of comprehensive data for the period 1971-73. However, a recent estimate for the metals cadmium, chromium, copper, nickel, lead and zinc of 9,890kg y^{-1} has been computed from the rivers Itchen and Test.

Total daily mean values

The total daily mean values for the pollution loads discharged into each of the five sub-areas have been calculated by summating the mean values of pollution load from the stream, trade effluent and sewage discharges. These data are summarised in Table 4.

Conclusions

The results would seem to suggest that most of the nitrate nitrogen concentrations are due to natural phenomena and not to man's activities. With respect to BOD, which is the major component of the total pollution load, sewage discharged into tidal waters seems to be of most importance. However, it should be remembered that no natural or background levels of self-purification processes have been considered for these tidal areas. In fact, other rather scanty data suggest that the levels of nitrogen and phosphor us, have not altered drastically since the 1950s and possible the 1920s. Additional work is clearly required to establish the validity of the above data especially with respect to direct and indirect sources of pollution load and heavy metal levels.