

RURAL SANITATION IN THE LOUGH ERNE CATCHMENT:

HISTORY AND INFLUENCE ON PHOSPHORUS LOADING

by

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The Influence of Sanitary and Other Social Changes on the
Eutrophication of Lough Erne Since 1850

ABSTRACT

This paper traces historical changes in the disposal of sewage effluent from the non-sewered population of 3 sub-catchments of Lough Erne, N. Ireland, and considers the importance of effluent from these areas as a source of phosphorus to the lake. A questionnaire survey approach is used and the data gathered are compared to the results of a similar survey of a small river catchment in Gloucestershire.

Comparisons between the two show that more households in the Gloucestershire catchment have septic tank sanitation than in Ireland (Glos. 98%: Ir. 80%) and that septic tank sanitation became common at an earlier time in Gloucestershire (Glos. 1920-1930: Ir. 1950-1960). Comparisons between all catchments show that whereas 95% of septic tanks in the Belturbet and Gloucestershire catchments discharge their waste to the soil rather than to a water-course, 85% of tanks in the Colebrooke and the N.E. catchments discharge effluent directly to watercourses.

Discharge to watercourses is likely to cause a P loading on L. Erne but since the practice appears to be regionally variable more data need to be collected before whole catchment values can be estimated.

LIST OF ABBREVIATIONS USED IN THE TEXT

B.L.	Bye Law Applications
B.S.C.B.	British Standard Code of Practice
Corresp.	Correspondence files
E.	Department of the Environment
E.B.C.	Enniskillen Borough Council
F.C.C.	Fermanagh County Council
F.D.D.C.	Forest of Dean District Council
I.I.R.S.	Institute for Industrial Research and Standards
I.R.D.C.	Irvinestown Rural District Council
L.R.D.C.	Lisnaskea Rural District Council
Mins.	Minutes
N.I.	Northern Ireland
S.D.W.	Sewage Disposal Works
P.R.O.	Public Records Office

INTRODUCTION

The eutrophication of Lough Erne has been attributed to increases in the input of phosphorus from domestic and industrial rather than agricultural sources. P from these sources is likely to have increased most over the last 100 years following the development of sanitary provision in the catchment and the introduction and spread of phosphorus detergents (Battarbee 1977). Gibson et al (1980) have described the contemporary limnology of the lake and have calculated a modern phosphorus budget. The aim of this study funded by the SSRC is to examine how point source P loading on the lake has changed since 1850. The study area is outlined in Fig. 1.

In an earlier paper in this series Patrick and Battarbee (1981) has examined the influence of dietary and demographic change on the potential domestic phosphorus loading. It was found that despite major changes in type of diet from 1850 to the present there was no evidence for a significant change in per capita phosphorus excretion. The output was estimated at 1,200 mg P person⁻¹ day⁻¹. The most important demographic changes observed in the study were a large decline in total population from 1850 to the present and a post-1950 shift from predominantly rural (non-sewered) to urban (sewered) population.

The present paper seeks to evaluate the importance of sewage effluent from non-sewered rural areas as a potential source of phosphorus to L. Erne. The role of non-sewered rural sources in contributing phosphorus to watercourses has been infrequently documented although Vollenweider (1980) recognized that nutrient contributions from these

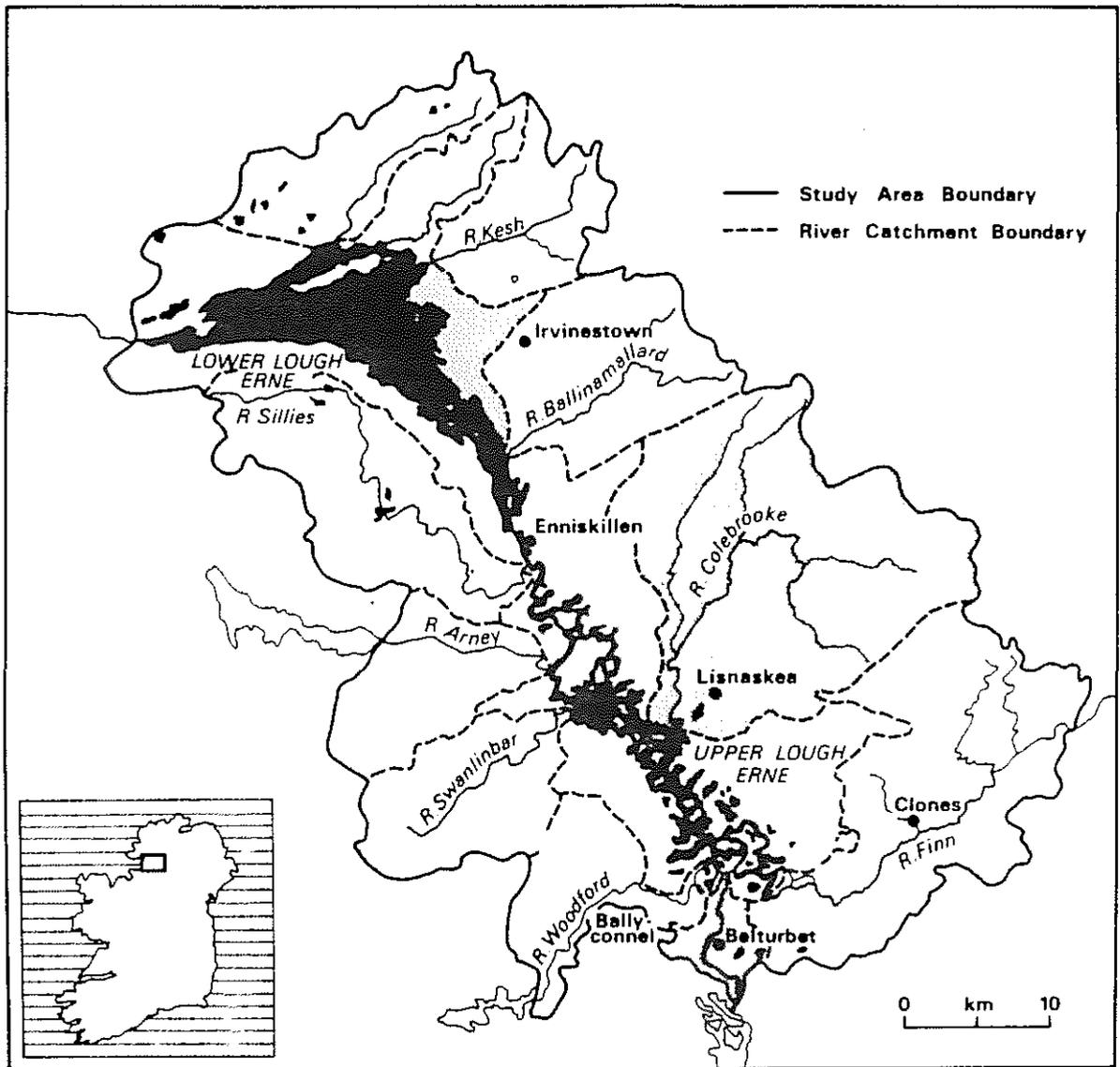


Fig. 1. Map of Lough Erne and its catchment showing the extent of the study area and the location of the sub-catchments surveyed.

sources should be carefully assessed. Smith (1977) predicted that 23% of the soluble orthophosphate load to Lough Neagh derives from the non-sewered population and Phillips-Howard (1982) suggests that the rural population adds about 15% of the phosphorus to the drainage network in Northern Ireland. Since sanitary provision and sewage disposal in rural areas has changed considerably over the last 50 years these contemporary figures are not applicable to past conditions.

Here, we use a questionnaire survey approach to compile data that will eventually allow the changing output of phosphorus from non-sewered areas of the Lough Erne catchment to be estimated. So far 3 sub-catchments in L. Erne (Fig. 2a-c) and, for comparison, a small river catchment in Gloucestershire have been surveyed (Fig. 2d).

METHODS OF DOMESTIC SEWAGE DISPOSAL IN NON-SEWERED AREAS AND THEIR EFFECTS ON PHOSPHORUS LOADING TO WATERCOURSES

In non-sewered areas domestic sewage facilities include septic tanks, cesspools, and various kinds of bucket, earth or chemical closet. The amount of phosphorus reaching a lake from these sources is related to the methods of effluent and sludge disposal. In this section we describe rural sanitation facilities and their respective importance in the calculation of phosphorus loadings to lakes.

1. Primitive forms of sewage disposal

Primitive forms of sewage disposal (cf. Vollenweider 1968) encompass a range of household facilities from a bucket to various types of dry, earth, or chemical closet. Such methods of sanitation prevailed

in non-sewered areas prior to the general availability of water closets, and can still be found in more remote rural areas without piped water.

The generally approved method of disposing of such wastes, by burying them in field or garden, ensures that their phosphorus content, being immobilised in the soil (see (3) below), will be largely lost to surface water. However, watercourses are likely to receive an unknown but probably small phosphorus load from these sources through the illicit practice of depositing the contents of dry closets directly into streams. Sanitary authority minutes record instances of such practice in the towns of Fermanagh prior to the installation of water closets.

In houses with only primitive forms of sewage disposal sink and washing waste waters are disposed separately. Since the 1950's these can be expected to contain significant amounts of phosphorus derived from synthetic detergents. How much phosphorus is eventually received by surface waters depends on whether the waste is allowed to soak away on land or is piped to the nearest ditch.

2. Cesspools

The modern cesspool is not to be confused with the 'open cesspools' that were to be found in town and countryside in the past and until well into the 20th century. It consists of a closed tank with no effluent outlet. No treatment is given, and the contents are periodically tankered away. It may be used where ground conditions do not permit the use of septic tanks, or where wastes are too large or varied to be thus treated. Any effect cesspool wastes have on surface water phosphorus depends on their mode of disposal.

3. Septic tanks

The simplest form of septic tank is a water-tight container with an inlet and outlet, within which biological decomposition of solids occurs by anaerobic bacteria. Part of the solids are retained and a partially treated effluent is discharged. Phosphorus, primarily from excreta products and detergents, is retained to some extent within the sludge, the remainder passing out in the settled effluent. Ideally, modern septic tanks discharge effluent into the soil via various forms of soak pits or tile drains. The interests of public health require that receiving soils meet predetermined standards in terms of permeability and watertable level (e.g. British Standard Code of Practice, CP 302: 1972 on Small Sewage Treatment Works). In some cases, however, effluent may be discharged directly to a surface watercourse and may add to the P loading of the lake.

Evidence from studies of agricultural fertilizer (e.g. Cooke and Williams 1973) has shown that phosphorus and its compounds are rapidly immobilized in all but the coarsest sandy soils. An extensive literature review together with a four-year study of a septic tank system discharging to soils in Wisconsin (Jones and Lee 1977), confirms that very limited phosphorus transport occurs. Even in coarse sands and gravels substantial phosphorus removal may be expected within short distances of tile fields. They conclude that phosphorus contamination of groundwater and surface waters via re-charge from septic tank effluence is minimal.

There is evidence that many soils maintain their ability to adsorb

phosphorus over long periods of continuous application (e.g. Kao and Blancher 1973). However, surface water contamination may occur if soils receiving septic tank effluent become saturated, creating surface flow. Evidence from Virginia, USA, suggests that properly constructed septic tank systems installed under suitable conditions, have a life expectancy of 20-30 years (Clayton 1975).

Phosphorus entering surface waters via septic tank soil systems may thus be considered as a relatively unimportant diffuse source within a lake catchment. Estimates of the contribution of such a source to total phosphorus budgets are low e.g. 2% for Lake Mendota, Wisconsin (Corey et al. 1979). On the other hand, where septic tanks discharge effluent directly to a watercourse a much higher phosphorus load to the lake can be expected.

The fate of phosphorus in the sludge periodically emptied from septic tanks may also be important. The amount of phosphorus retained in this highly liquid sludge is uncertain, but if the assumptions and measurements of Brink (1968) are reliable, it may be in the region of 50% of total phosphorus input to the tank. However, the amounts are likely to vary according to the frequency of sludge collection and the speed at which phosphorus compounds break down in a septic tank. Sludge may be collected by local authorities, private contractors or farmers and deposited in landfill sites, at sea, or spread on agricultural land. In all these cases the phosphorus contained in it may be considered lost to surface waters. However, where sludge is treated at a local Sewage Disposal Works (S.D.W.) it may add significantly to the phosphorus loading of watercourses (cf. Wood and Gibson 1973).

RURAL SANITATION SURVEY: METHODOLOGY AND AREAS SURVEYED

Comprehensive details concerning the installation and modification of unsewered sanitary facilities are to be found in planning applications to local authorities in both Northern Ireland and the Republic of Ireland. However, few such records are preserved from before the mid-1970s, and the volume of material associated with the existing applications would require a prohibitive amount of time to conduct even a sample survey. Therefore, to assess the role of phosphorus from non-sewered areas in the Lough Erne basin a questionnaire survey, including questions of a contemporary and retrospective nature, was designed for use in selected river catchments (cf. Fig. 1). This section describes the structure of the survey and the areas included.

1. The questionnaire survey

Questions included in the survey include the following:

- (i) Type of sewage disposal facility
- (ii) Age of facility
- (iii) Previous method of sewage disposal
- (iv) Method of effluent disposal
- (v) Method of sink/washing water disposal (dry closets only)
- (vi) Periodicity of septic tank/cesspool emptying
- (vii) Agency responsible for septic tank/cesspool emptying
- (viii) Number of people using the facility in the age groups 0-9, 10-14, over 15, respectively.
- (ix) Brand of washing powder used
- (x) Quantity of washing powder used

For each catchment concerned the non-sewered population was estimated, and then a representative sample was surveyed on a random basis, although in the case of the Gloucestershire catchment, a survey of the total non-sewered population was attempted. The Colebrooke survey was conducted originally by post but owing to a poor response it was followed up in the summer of 1981 by household visits. The other three catchments were surveyed in the field between April and June 1982. The Gloucestershire survey formed part of an undergraduate fieldclass project in March 1981.

2. The catchments

North-East direct drainage (Fig. 2a)

This area of 4296 ha is drained by small streams to the eastern shore of Lower Lough Erne, and contains an estimated non-sewered population of 202 households, of which a survey of 40 houses represented a 20% sample. Again, a relatively high no-response rate brought the sample population down to 25 houses or 12.4 per cent of the estimated non-sewered population (Table 1).

Belturbet (Fig. 2b)

Unlike the other two Lough Erne catchments which lie in Northern Ireland, the sub-catchment of the Lower River Erne (3390 ha), is entirely within the Republic. No official figures are available concerning the sewered population. Maps held by Cavan County Council indicate that the sewered area and the boundaries of Belturbet Urban District are virtually coterminous. By subtracting the population of Belturbet town from that of the whole catchment (Census of Republic of Ireland 1979), an estimated non-sewered population of 169 households was arrived at, of which a

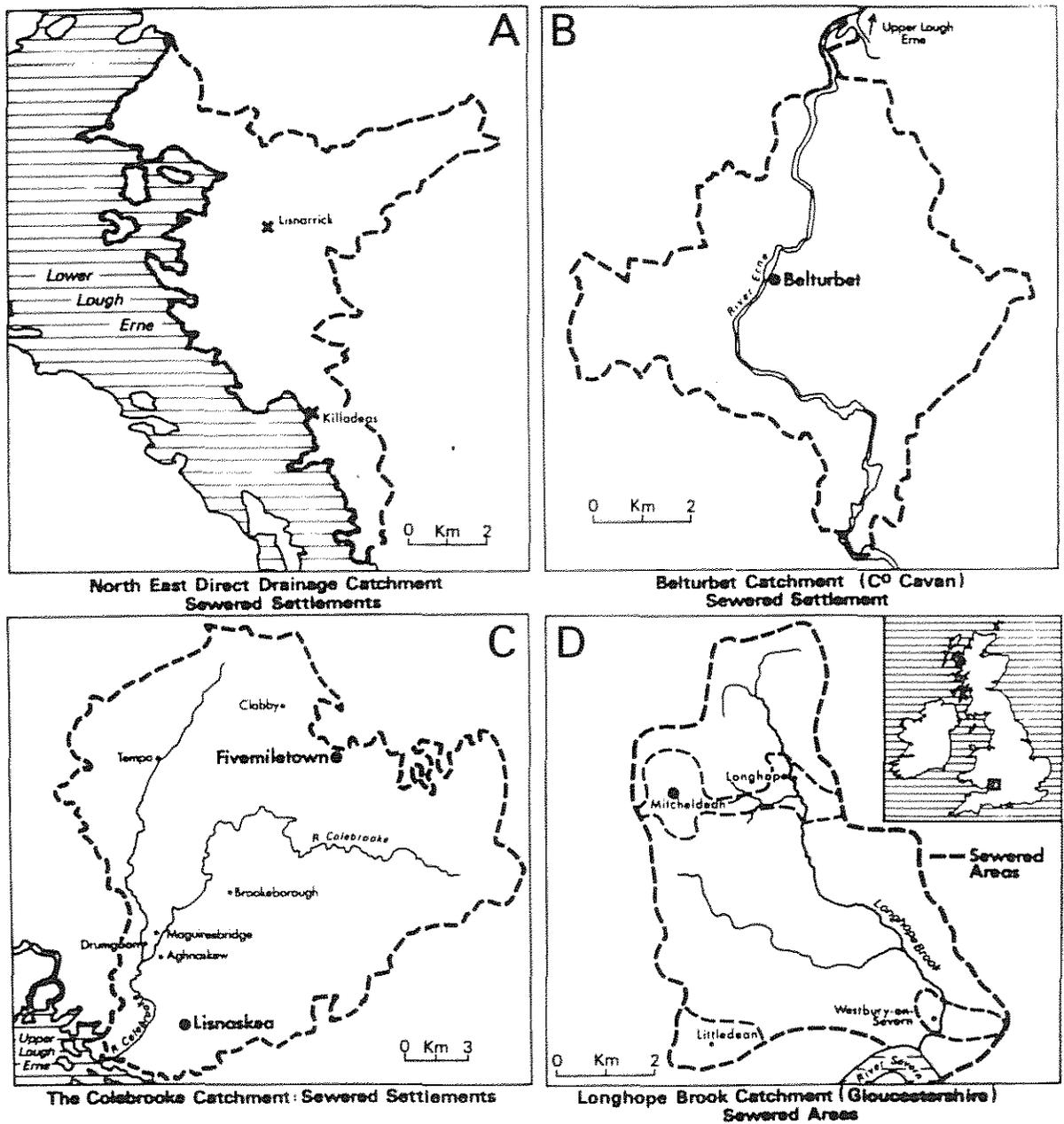


Fig. 2. Maps of sub-catchment areas included in the rural sanitation survey; a, b, & c and sub-catchments of Lough Erne (see Fig.1); d is the Longhope catchment (Gloucestershire, England) and is tributary to the R. Severn.

survey of 34 houses formed a 20% sample. No response from 8 households brought the sample down to 15.4% of the estimated non-sewered population (Table 1).

The Colebrooke (Fig. 2c)

The Colebrooke is one of the largest river catchments draining into Lough Erne with an area of 37,000 ha. Using statistics for population (1971 Northern Ireland Census) and for the sewered population (D.O.E., N.I. 1973), it was estimated that 1,508 households were non-sewered, giving a 10% sample of 150 houses (Table 1). A relatively high no-response rate gave an actual sample of 119 households or 7.9% of the estimated non-sewered population.

Longhope Brook, Gloucestershire (Fig. 2d)

For comparison with rural Ireland the catchment of Longhope Brook, a small west bank tributary of the River Severn was selected for study. The non-sewered population of the catchment was estimated from contemporary Severn-Trent Water Authority figures for the sewered population of the region. A total population survey was attempted which, after considering the no-response rate, represented 87.8% of the estimated non-sewered population (Table 1).

TABLE 1. SEWERAGE CHARACTERISTICS OF THE STUDY CATCHMENTS

	<u>Estimated Sewered Population households</u>	<u>Estimated Unsewered Population households</u>	<u>Designated Sample households</u>	<u>No Response households</u>	<u>Actual Sample households</u>
Colebrooke	1254	1508 (54.6%)	150 (10%)	31	119 (7.9%)
North East	49	202 (80.5%)	40 (20%)	15	25 (12.4%)
Belturbet	353	169 (32.4%)	34 (20%)	8	26 (15.4%)
Longhope					
Brook	a	311	311 (100%)	38	273 (87.6%)

a - Data not computed

3. Sources of error

A number of error sources must be taken into account considering the results of the survey. First, non-sewered populations were estimated from data recorded between 1971 and 1982 and thus cannot represent the precise situation at a point in time. It is safe, however, to assume that during this period the proportion of non-sewered households can only have declined in these river catchments, so that these surveys may well represent a larger sample of the non-sewered population than is apparent from Table 1.

A second source of error may derive from a degree of interviewer bias. In all catchments it was observed that many respondents were unclear about the precise nature of their sanitary facilities and required to be led by the interviewer in answering certain questions. Third, a certain degree of antipathy and suspicion towards the interviewer and the nature of the survey partly accounts for the no-response rates, and in some cases there were problems of access to remote dwellings.

RURAL SANITATION SURVEY: RESULTS AND DISCUSSION

The importance of considering the role of non-sewered areas is emphasized by the high proportion of the total population that such areas are estimated to represent within each of the three Lough Erne catchments (Table 1). Indeed, it was estimated that in 1981 some 50% of households in the Enniskillen sub-division of the Northern Ireland Water Services, within which most of the northern section of the Lough Erne study area falls, were not connected to mains sewerage (D.O.E. corresp. 1981). However, the importance of this factor to the phosphorus loading on Lough Erne depends mainly on the introduction and spread of septic tank sanitation in rural areas and the extent to which effluent from septic tanks is piped to surface watercourses. The results of the survey illustrate regional differences between type of sanitary facility used and the methods of sludge and effluent disposal.

1. Type of facility

Table 2 shows the present-day importance of septic tank systems in all catchments and especially in the Gloucestershire catchment. 23.5% and 17% of households in the Colebrooke and Belturbet catchments respectively, had no water-borne sanitation. These are high figures in terms of the British context (1.1%, cf. Table 3), but low in relation to the value for the Republic of Ireland as a whole. The high proportion of dry closets in the Colebrooke and Belturbet catchments may be related to the lack of piped water in some of these areas. There is a continuing programme of rural water schemes in Fermanagh and the border counties of the Republic. However, a simple relationship is unlikely. Whilst all

households with septic tanks also had mains water supply, some households with water supply had retained dry closets. In other cases septic tanks may pre-date public water supply, as is apparent from the statement that "septic tanks were less effective than formerly because of the increased flow when houses were connected to public water mains" (F.C.C. Mins. 1970). Similarly, Lund (1972) reports that the increased use of water associated with the introduction of piped water to the main village of a drainage area of Blelham Tarn, Cumbria in 1951, caused the overloading of septic tanks.

It is of little surprise to find that few households in the study catchments are provided with cesspools since these require frequent emptying and are generally discouraged for logistical and economic reasons by sanitary and planning authorities.

TABLE 2. TYPE OF SANITARY FACILITY (Percent of households)

	<u>Septic Tank</u>	<u>Cesspool</u>	<u>Dry Closet etc.</u>
Colebrooke	76.5	0	23.5
North East	88	4	8
Belturbet	73	0	17
Longhope			
Brook	94.1	3.7	2.2

TABLE 3. REGIONAL DIFFERENCES IN SANITARY PROVISION
(Percent of households without water closets)

	<u>1971</u>
England and Wales	1.1*
Northern Ireland	10.5**
Republic of Ireland	30.5***
County Fermanagh	40.7**
County Cavan	43.4***
Enniskillen Urban District	3.0**
Enniskillen Rural District	37.4**
Irvinestown Rural District	43.9**
Lisnaskea Rural District	56.7**

- * Census of Population, England and Wales (1971)
- ** Census of Population, Northern Ireland (1971)
- *** Census of Population, Republic of Ireland (1971)

2. Methods of sewage disposal

Dry closets

The number of properties served by dry closets in the four catchments is shown in Table 2. Table 4 reveals that in accordance with recommended practice virtually all dry closet wastes (Colebrooke 96.6%, Belturbet 100%) are disposed on soil. In terms of phosphorus contributions to watercourses, therefore, this source is of negligible importance. Questions concerning the disposal of kitchen waste-water from properties served by dry closets were only asked in the Belturbet survey. The number of properties concerned is small (7), but the results suggest (Table 4) that a majority of such wastes may be disposed of direct to a watercourse, and thus form a potential source of phosphorus due to their content of synthetic detergents.

TABLE 4. METHOD OF WASTE AND WATER DISPOSAL IN PROPERTIES SERVED BY 'PRIMITIVE' SANITARY FACILITIES (Percent of households)

	<u>CLOSET WASTE</u>		<u>WASTE WATER</u>	
	<u>To Soil</u>	<u>To Water Course</u>	<u>To Soil</u>	<u>To Water Course</u>
Colebrooke	96.4	3.6	a	a
Belturbet	100	0	28.6	71.4

a - Question not asked

Septic tanks

(i) Effluent The most important results of these surveys are shown in Table 5. Among the Lough Erne catchments a marked dichotomy is apparent between the Belturbet catchment where 94.7% of septic tanks discharge their effluent to the soil, and the Colebrooke and North-East catchments where the corresponding figures are 15.4% and 13.6% respectively. The direct inference from these figures is that the effluent from the septic tanks in the Colebrooke and North-East catchments must be considered as a potentially important source of phosphorus to surface waters. In the Belturbet catchment (and the Gloucestershire catchment) septic tank effluent is a diffuse and theoretically unimportant source of phosphorus.

TABLE 5. METHOD OF DISPOSAL OF SEPTIC TANK EFFLUENT (PERCENT OF HOUSEHOLDS)

	<u>To Soil</u>	<u>To Water Course</u>
Colebrooke	15.4	84.6
North East	13.6	86.4
Belturbet	94.7	5.3
Longhope Brook	82.2	17.8

It is not easy to explain the striking difference between the

figures for the Lough Erne catchments. In general, surface conditions over most of the Colebrooke and North-East catchments are dominated by gley and peat soils and high water tables, conditions in which disposal of effluent to soil may be considered to be impracticable. However, soils in the Belturbet catchment are very similar, gley soils dominate and surface water is common yet most septic tanks discharge to soil. Subtle differences in the soils and hydrology of these catchments may exist but a more likely explanation lies in the field of local sanitary practice.

The Belturbet catchment falls entirely within County Cavan and is subject to different planning and building legislation than those areas in the North that are covered by Department of the Environment (N.I.) guidelines. The recommendations in the Republic (I.R.S. 1975) recognize that in certain circumstances disposal of septic tank effluent into a watercourse may be acceptable, but stress that the most widely applicable method for good practice is by means of soil percolation systems. It was emphasized by the officer of Cavan County Council responsible for vetting the sanitary aspects of planning applications (Leddy personal communication), that these guidelines are firmly adhered to, and that under very few circumstances would the discharge of effluent to a watercourse be permitted. Similarly, the Forest of Dean District Council, the relevant authority in the Gloucestershire catchment, issue a standard septic tank design plan which provides for effluent to discharge through land drains. The results in Table 5 suggests that this practice has been generally followed.

The policy of the Western Group Public Health Committee for County

Fermanagh on septic tank design (B.S.C.B. 1972) is also firm on the matter of effluent disposal, but it is conceivable that, for local reasons, such guidelines are less rigidly enforced. In fact, inspection of several applications submitted to the Sanitary Authorities for approval under Building Byelaws in the 1950'ss and 60's include many instances where the planning officer has directed that septic tank effluent should drain direct to a watercourse and not to the soil (e.g. E.B.C.(B.L.) 1960: I.R.D.C.(B.L.) 1965). The explanation of the Public Health Inspector is that disposal to watercourses in Fermanagh is practised because of locally unfavourable soil conditions (Murphy personal communication).

Whatever the reason for the difference, it would seem that the respective practices have been consistently followed since in no catchment is there a significant relationship between age of septic tank and method of effluent disposal.

(ii) Sludge Questions were asked concerning the frequency of septic tank de-sludging, and the agency responsible for that work. Providing that the method of disposal utilized by different agencies is known, these questions are intended to permit estimates of phosphorus from sludge that is periodically deposited at S.D.W's in the area.

On the basis of the results derived from the surveys to date reaching such conclusions is difficult. With exception of the North-East catchment high proportions of respondents claimed that their tank is either never emptied, or emptied so infrequently that they were unable to state a representative period. An attempt to derive mean figures for the

frequency of the emptying of those tanks for which periods were stated, produced figures of little statistical significance. It would seem likely that too many variables affect the frequency with which septic tanks are de-sludged for the question to be satisfactorily examined by means of such a survey. It is feasible that a septic tank in good working order can go many years without the need for de-sludging, depending on the number of people in the household and individual differences in the use of water. The age of the facility must also be considered. Tanks may be too new to have required emptying, and it is probable that newer tanks require less frequent attention than older ones.

If tanks are emptied by their owner, or a local farmer, and provided that accepted practice is adhered to, sludge should be disposed on to or into the soil, and the phosphorus content consequently immobilized. On the other hand contractors and councils may dispose of sludge in a variety of ways that may include its export outside the catchment area. Council practice may be discovered from council and sanitary authority records, and as private contractors require licences to discharge to a S.D.W., this practice will also be apparent from such records.

Table 6 shows the agencies responsible for desludging septic tanks in the four catchments. The data must be treated cautiously because of the low positive response rate. It would seem, however, that Cavan County Council play no role in servicing septic tanks in the Belturbet catchment, and as its files contain no records to the licensing of contractors, it may be assumed that no S.D.W. in the Belturbet catchment receive septic tank sludge.

Results from the two northern catchments differ not only from Belturbet but from each other, which, given their close geographical proximity again suggests that caution is necessary in extrapolating the values in Table 6 to the whole catchment. Department of the Environment (N.I.) records indicate no example of a contractor being licensed to deposit sludge at a S.D.W. in the region. The water service disposes of septic tank sludge at one or two of the S.D.W's in the region able to cope with strong septic slurry. Further evidence suggests that the infrequency of septic tank de-sludging intimated by the results in Table 6 does hold true. In the financial year 1980-81 the Enniskillen sub-division received requests to empty only 330 septic tanks, which in itself stretched resources (D.O.E. corresp. 1981). In the Gloucestershire catchment where private contractors play the major role in disposing of sludge, it is found that no S.D.W. in the catchment receives such material. The indication therefore is that septic tank sludge does not play a major role in the contribution of phosphorus to S.D.W's in the Lough Erne region, and that at least for recent years, a clearer picture may be obtained through examining local authority sanitary records, than from the results of the questionnaire survey.

TABLE 6. AGENCY RESPONSIBLE FOR DESLUDGING SEPTIC TANK

(Percent of households)

	<u>Council</u>	<u>Contractor</u>	<u>Farmer</u>	<u>Owner</u>	<u>Don't Know/ Never Emptied</u>
Colebrooke	18.7	15.3	5.5	8.8	51.6
North East	72.7	4.5	0	4.5	18.2
Belturbet	0	10.5	0	21.0	68.4
Longhope Brook	2.3	58.7	2.7	2.3	33.9

3. Age of facility

As an indication of a general trend the figures in Table 7 may reveal a disparity in the diffusion of septic tanks in the Lough Erne region compared to an area of south-west England. However, as absolute values for the mean age of septic tanks in the Lough Erne region, the results in Table 7 carry little statistical significance as attested by their high standard deviation.

TABLE 7. MEAN AGE OF SEPTIC TANKS (Years)

	<u>Mean Age</u>	<u>Standard Deviation</u>
Colebrooke	10.2	# 7.1
North East	10.7	# 10.5
Belturbet	9.6	# 9.4
Longhope Brook	22.6	# 16.7

However, it is clear from Figs. 3 and 4 that the general provision of septic tanks in the Lough Erne region is a relatively modern phenomenon. The majority date from within the last 15-20 years, whereas in the Gloucestershire catchment not only are a greater number of households supplied with septic tank sanitation (see Table 2) but also septic tanks become common at an earlier time viz. 40-50 years ago (Fig. 4).

That septic tanks were a new but increasingly important aspect of the rural building scene around Lough Erne in the early 1960's is confirmed by a request from the Association of Rural District Councils in Northern Ireland for the inclusion of septic tanks as eligible for grant

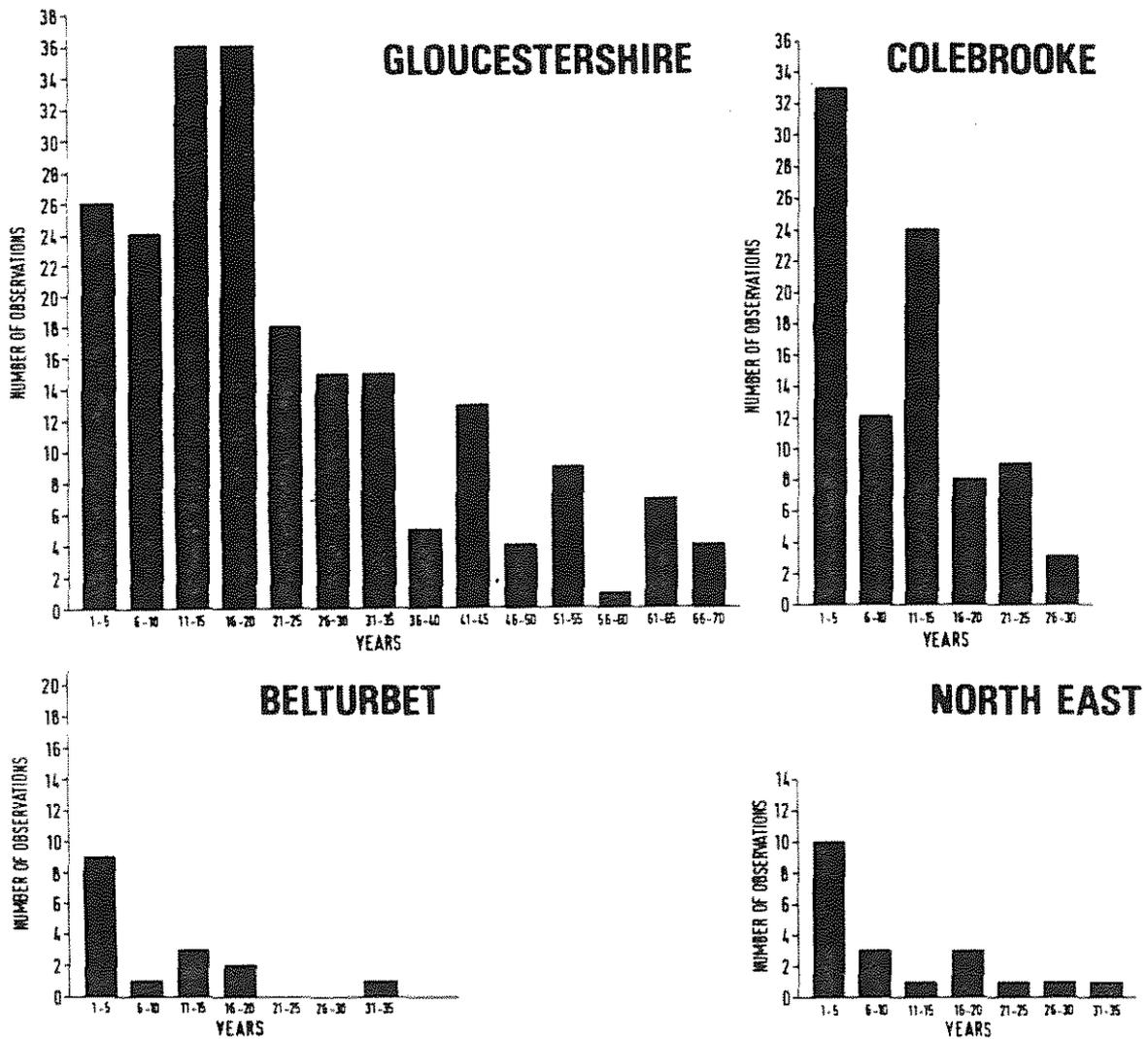


Fig. 3. Histograms showing ages of septic tanks in 5-year age classes for each catchment.

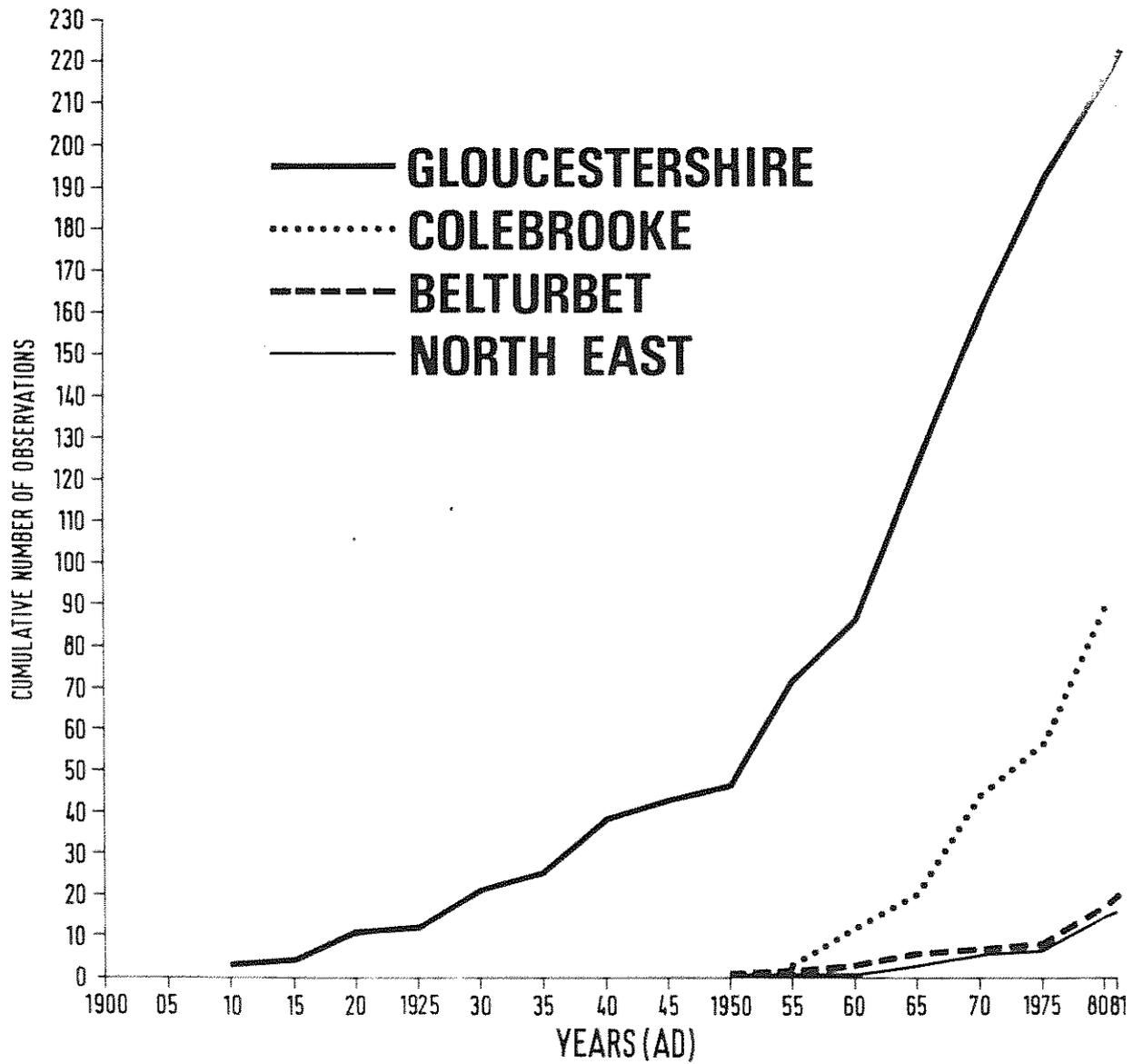


Fig. 4. Graph of septic tanks (cumulative total) against time from 1910-1918 for each catchment.

in the new Housing Bill (L.R.D.C. mins. 1963).

4. Facility prior to septic tank installation

Table 8 indicates that prior to septic tank installation the great majority of households in the Lough Erne catchments were provided with either a primitive form of sanitary facility (Colebrooke 75.6%, Belturbet 66.7%, North-East 50%), or that the question is inapplicable in that the septic tank was constructed at the same time as the house. In either case the important conclusion is that the potential export of phosphorus from non-sewered domestic sources occurs only with the constructing of existing septic tanks.

TABLE 8. TYPE OF FACILITY PRIOR TO SEPTIC TANK INSTALLATION

(Percent of households)

	<u>'Primitive'</u> <u>Facility</u>	<u>Not Applicable</u>	<u>Septic Tank</u>	<u>Cesspool</u>
Colebrooke	75.6	19.5	3.7	1.2
North East	50.0	45.5	4.5	0
Belturbet	66.7	33.3	0	0
Longhope Brook	72.5	14.8	9.7	3.1

CONCLUSION

Although septic tanks are the dominant form of sanitary provision in the rural areas of the three Lough Erne river catchments surveyed to date, their potential role as a source of phosphorus to the lake is regionally variable. In the two northern catchments the tendency is to discharge effluent directly to a watercourse, whereas in the Belturbet

catchment and in the Gloucestershire example, effluent is discharged primarily to the soil, minimizing the input of phosphorus to surface waters. Clearly, there are different opinions in the region about the suitability of local soil types for waste disposal of this kind, and, since the pattern of disposal from septic tanks is not clear from the present data a more extensive sample survey is required if the results are to be validly extrapolated throughout the study area.

The role of septic tank sludge is not directly clear from the survey results. The confusion engendered in response to the question concerning frequency of septic tank de-sludging in itself highlights the infrequency of this event. It would appear, therefore, that local and sanitary authority records comprise a better means of investigating this aspect. However, such records, or the lack of them, suggest that such sludges play a minor role in the phosphorus budget of Lough Erne.

The historical data gathered from the survey of the Lough Erne catchments show that septic tanks are predominantly a feature of the last 20-30 years, and were preceded by primitive forms of sanitary facility that contributed little to the phosphorus budget. It is clear that the introduction and spread of septic tank sanitation occurs during the period of rapid eutrophication as inferred from sediment core data (Battarbee 1977). If disposal of septic tank effluent to watercourses prove to be the rule in the region, and the example of the Belturbet catchment the exception, it may be that contemporary non-sewered domestic effluents from rural areas are an important additional source of phosphorus to Lough Erne. However, the quantities involved can only be estimated when additional catchment data have been obtained and when data

on synthetic detergent usage are added to the values already available for per capita phosphorus excretion (cf. Patrick and Battarbee 1981). Consideration also needs to be given to the significance of delays and losses in the delivery of phosphorus from septic tank effluent to the lake.

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