1989

DRAFT WATER QUALITY MANAGEMENT PLAN

FOR

THE RIVER BLACKWATER CATCHMENT

ENVIRONMENTAL DEPT.,
CORK CO.COUNCIL,
COUNTY HALL,
CORK.

February 1989

DRAFT WATER QUALITY MANAGEMENT PLAN
FOR
THE RIVER BLACKWATER CATCHMENT

VOLUME 1
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INTRODUCTION,
GENERAL ASSESSMENT
and
RECOMENDATIONS.
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ENVIRONMENTAL DEPT.,
CORK CO.COUNCIL,
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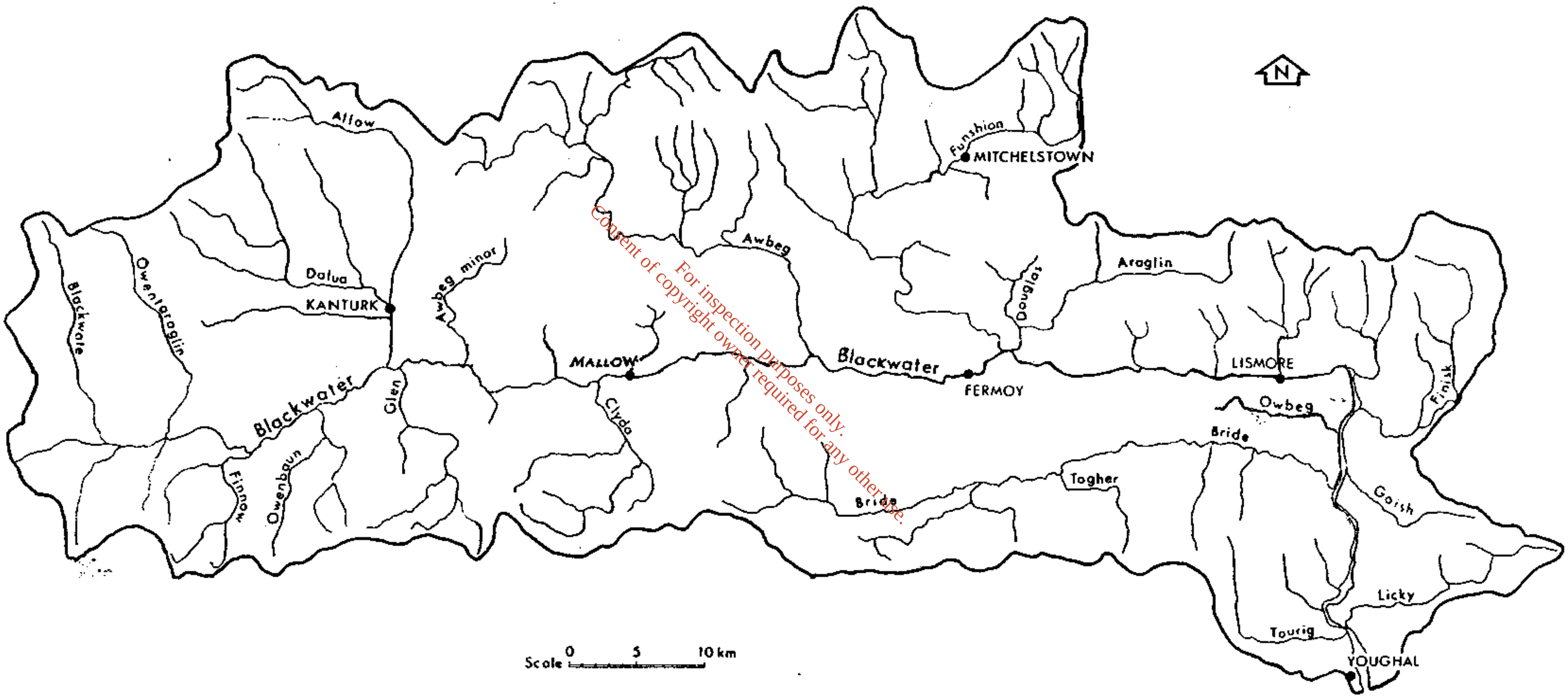
December 1988



RIVER BLACKWATER CATCHMENT

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LIST OF TABLES

The River Blackwater Management Plan is divided into 5 volumes as detailed below;

VOLUME 1 :- Introduction, General Assessment and Recommendations.

VOLUME 2 :- Summary of Water Resources.

VOLUME 3 :- Abstractions and Discharges.

VOLUME 4 :- Beneficial uses and Water Quality Criteria.

VOLUME 5 :- Water Quality in the Catchment.

DESCRIPTION OF RIVER BLACKWATER

The River Blackwater rises 6 km. to the north west of the village of Ballydesmond at Knockanefune (439m o.d.) in County Kerry.

It enters the sea at Youghal Co.Cork having passed through Co.Cork and Co.Waterford en route.

It is tidal for a distance of 33 km. to a point 5 km. u/s of Cappoquin.

Its catchment area is 3327 sq.kms. and its total length is 168 kms.

INTRODUCTION

Water Pollution Act 1977

Section 15 of the Water Pollution Act 1977 provided for the drawing up of Water Quality Management Plans by Local Authorities under the supervision of the Minister of the Environment.

Water Quality Management Plans

These plans shall contain objectives for the prevention and abatement of pollution and such other provisions as appear to the local authority to be necessary. The overall objective of the plan is to assure in the future an acceptable quality of water for specific uses at the time and at places where it is needed.

The plans may cover waters in an area adjoining the local authorities functional area. The act provided for two or more local authorities to prepare a joint plan where the catchment of a river includes parts of their functional areas.

E.E.C. Directive 78/659

The purpose of the above directive is to protect and improve waters capable of supporting freshwater fish of the Salmonid (sport fish such as trout and salmon) and Cyprimid (coarse fish such as pike and perch) species. It applies only to waters designated by member states of the E.E.C.

Article 5 of the directive states that member states shall establish programmes in order to reduce pollution and to ensure that designated waters conform to certain physical and chemical parameters as detailed in Annex 1 of the directive. (c.f. Appendix G, Vol. 4. Page 4.49)

Designation of Rivers

In 1980 the D.O.E. in consultation with the Department of Fisheries designated the main channel of the Munster Blackwater along with six other rivers as Salmonid rivers.

To attain the objectives of the Directive it was deemed necessary to draw up Water Quality Management Plans for the various designated rivers.

Taking the above into account the combined County Councils of Kerry, Cork and Waterford decided to proceed with the drawing up of a management plan for the river Blackwater. As the greater part by far (80%) of the catchment lay within the functional area of Cork County Council it was decided that they should draw up the Management Plan with adjoining counties providing data and other assistance where necessary.

Preparation of Plan.

The preparation of the plan involved the following :-

1. The definition of the Rivers in the catchment to which the plan should apply.

2. The definition of the present and potential future beneficial uses to be protected.

3. The gathering of all available data on water quality and water resources within the catchment.

4. Setting of Water Quality Standards in the catchment for the beneficial uses as identified in No.2 above, and the determination of a Control flow.

5. The compilation of estimates of existing waste loads discharged to the rivers in the catchment.

6. Estimating Assimilative capacity at the key locations.

7. The identification of those sections of rivers overloaded by discharges and the remedial action necessary to eliminate these problems.

8. The determination of the water quality requirements at selected control sections along the main channel and its tributaries.

9. Consideration was given to the following:-

   Population trends.
   Abstractions within the catchment.
   Future waste loads within the catchment.
   Waste load reductions.
   Water quality conditions at key locations taking into account present loads and estimated future loads.

10. The determination of sewage treatment facilities in need of investment and the drawing up of a priority list for same.

SCOPE OF PLAN

TABLE 1.1 Locations where estimated D.W.F. is less than or equal to that at Nohoval Bridge.(Est.DWF = 0.08m^3, Area = 89 sq.km.) River Araglin at Araglin Br. and River Finisk west of Cappagh being exceptions.

River	Location	Catchment Area Km2	Grid Ref
Allow	Freemount	61	R392 139
''	Johns Br.	86	R394 099
Araglin	Araglin Br.	104	R849 017
Awbeg	N.limb u/s conf	58	R522 151
''	W.limb u/s conf	55	R521 151
Awbeg Minor	d/s Kippagh	63	W780 897
Ballyclough	Ballyclough	23	R495 020
Bride	Maulane Ford	39	W780 897
Dalua	Allens Br.	88	R337 043
Douglas	Ballyderown	21	R847 023
Dubhglasha	Gortroe	19	W467 960
Finisk	Poulanhrone	75	X165 969
Finnow	d/s Millstreet	35	W264 902
Funshion	Ballyarthur	86	R806 142
Glen	Fr Murphys Br	70	W392 959
Glenshelane	Belleville	41	X118 996
Goish	Coolroe	24	X119 903
Gradoge	u/s Funshion Confl.	40	R797 136
Lickey	Clashganny	44	X136 829
Magama	Poulanhrone	22	X165 969
Owenbaun	Rathcool	58	W334 940
Owentaraglin	Ahane	76	W223 945
Rampart Stream	Liscongill	11	R341 046
Sheep	Ahaphuca	33	R738 168
Tourig	Clasheel	38	X050 803

Scope of the Plan

The Plan applies to the freshwater reaches of the main channel of the River Blackwater upstream as far as Nohoval Bridge. (Estimated D.W.F. = 0.08m^3/sec)

It also applies downstream of the points on the tributaries listed below:

River Name	Extent to which plan applies
Awbeg	1km. u/s Buttevant
Allow	50 m u/s Kanturk Bridge
Bride	Maulane Ford
Finnow	Dromascoolane Bridge
Funshion	Ballyarthur Bridge
Gradoge	Kilshanny Bridge

Revision of the scope of the plan will be considered if areas of particular signifance other than those already defined are identified.

TABLE NO.1 (facing) lists points on various tributaries of the River Blackwater where the catchment area is 90 sq.kms.or less.

The power available to the local authorities in the Water Pollution Act 1977 will continue to be used to control and eliminate the Agricultural Sources of Pollution wherever they occur in the Blackwater catchment.

Standards for River Water in the Blackwater Catchment.

The River Blackwater is a designated Salmonid River under E.E.C. Directive 78/659. The various beneficial uses of the resource are discussed in Volume 2. The main Beneficial uses as indicated in Volume 4 are as follows:-

Salmonid and Cyprinid Fisheries,
Water abstraction (Domestic & Industrial)
Recreational and amenity.

The beneficial uses of the resource have particular quality requirements which can be maintained by setting and applying specific sets of Water Quality Standards.

In the Blackwater catchment the water body is required to support several uses and the proposed standards are based on the most stringent of the criteria applying to these uses.

On this basis it is proposed that the standards laid down in the E.E.C. Directive (78/659) dealing with the quality of water for Salmonid rivers should apply for the most part to waters in the Blackwater catchment as already defined.

Additional or more stringent standards may be required in the matter of the abstraction of water for potable supply or use of water for bathing purposes. The standards concerned are those relating to the permitted levels of micro-organisms and nitrates.

TABLE 1.2 Standards in respect of B.O.D.and D.O.,set for rivers in the Blackwater catchment.
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Parameter	Standard		
B.O.D. (mg/l)	95% Samples	<=	3
DO (%Sat. mg/l O2)	50% "	>=	9
	95% "	>=	6

For more details of standards applicable see Page 4.19 et. seq. Vol.4 .

Determination of a "Control" Flow.

Setting of standards for water quality must inevitably be directly related to the water quantity or flow at which the standards apply.

The dilution available and the flow characteristics are of prime importance in achieving the desired quality.

The rearation rate of a stretch of river under flood will differ enormously from its rearation rate at very low flows.

Due to the wide variation in rearation rates consideration must be given to the minimum flow conditions at which the water quality standards will be satisfied.

Ideally, water quality standards should apply when the lowest dilution is likely to occur in the water body concerned. In rivers, this implies that the minimum flow value should be used in calculations.

However, in many cases this would severly restrict or even preclude the discharge of waste under low flow conditions.

It is usually the practice for the Standards to apply at a somewhat higher flow than the minimum flow value.

Critical Flows (c.f. Vol. 2 for more details)

Critical flows used for setting standards include:-

(a) 95 percentile flow
(b) D.W.F.
(c) 7 day sustained low flow
(d) Lowest measured flow (Drought Periods)

(a) 95%tile flow

This is the flow which is likely to be exceeded for 95% of a given period of time, usually the period of time for which the records are available. This measurement is subject to the length of record 10 to 12 years of record results being required.

(b) Dry Weather Flow.

This is already defined in Volume 2 as the minimum flow that might be expected to occur with a frequency of one in 50 years. As low flow measurements started in the seventies, sufficient hydrometric data is not yet available to accurately determine Dry Weather Flows in the catchment.

Using the information available extented low flows have been calculated which can be taken as Dry Weather Flows until more accurate values are available.(c.f. Vol.2 page 13)

(c) 7 day S.L.F.

This is the flow that is not exceeded for seven consecutive days in any year.

It can be represented by the average of the annual series of minimum seven consecutive day flows, or by the seven S.L.F. with a specified probability of reoccurrance (e.g. a return period of 10 or 15 years).

(d) Lowest Measured Flow (Drought Periods)

This is the flow which occurs at the end of a long period of drought and in theory should be the lowest flow ever experienced. Due to lack of records however it can only relate to the drought periods that have occurred in the time for which flow records are available. These years would include 1969, 1976, 1977 and 1984.

To date the critical flow for the purpose of setting a discharge licence and for setting standards for Water Quality Management Plans has been the 95% flow. (Technical Memo 1 Water Quality Guidelines).

95%tile flows in the south east of the country have been found to be about twice the minimum flow (L.C.Kelly A.F.F.)

It is recommended that the 95%tile flow should be the control flow at which the Water Quality Plan should apply.

In the absence of long term hydrological records and a value for the 95%tile flow,it is recommended that the control flows at which the Water Quality Standards apply should be based on the lesser of the following:

(a) Twice the D.W.F.

(b) Twice the lowest measured flows of the drought years 1969, 1976, 1977 and 1984.

Should this criterion not hold good for some rivers then a more stringent flow criterion for calculating minimum dilution may be necessary. The use of those flow criteria should be reviewed in two years and as more data is accumulated.

TABLE 1.3 (facing) lists Control Flows and estimated BOD assimalative capacities at various locations, assuming a control BOD of 3.Ø mg/l

CRITICAL AREAS IN THE RIVER BLACKWATER CATCHMENT

CRITICAL AREAS IN THE RIVER BLACKWATER CATCHMENT

Volume 5 Page 5.4 identifies 5 locations in the River Blackwater Catchment where water pollution is of significant dimensions.

These locations are listed below in Table 1.4

TABLE 1.4

Location of significantly polluted areas in the River Blackwater Catchment.

River Name	Location of Polluted Area	Source
Blackwater	Rathmore	Industrial
Blackwater	Mallow (Winter)	Industrial
Allow	Kanturk	Industrial and Kanturk S.T.W.
Gradoge	Mitchelstown	Industrial and Agri-cultural
Funshion	Mitchelstown	River Gradoge

Discussion

Volume 5 compares the BOD loading with the assimilative capacity of the receiving waters for a number of locations in the Blackwater Catchment. These are listed in Table No.5 below which compares assimilative capacity and BOD loads from various sources.

TABLE 1.5

Comparison of Assimilative Capacity with various loads.

River	Location	Control B.O.D.	Assimilative Capacity u/s (a)	Control Flow	B.O.D. load (b)	(b)/(a)
Blackwater	Rathmore	3	19	0.20	207	11
Allow	Kanturk	3	23	0.48	64	2.21
Funshion	Mitchelstown	3	88	0.68	128	1.45

Units used in the above table are as follows:

	Units Used
B.O.D.	mg/l
Assimilative Capacity	Kgs B.O.D./day
B.O.D. load	Kgs/day
Control Flow	m3/sec

WATER QUALITY AT INDIVIDUAL LOCATIONS

Rathmore

It can be seem from Table 1.5 (facing) that the potential for pollution is very high at Rathmore. In low flow situations the volume discharged by Fry Cadbury should be drastically reduced or else the quality of effluent improved. Another alternative would be to store the effluent in lagoons until sufficient dilution would be available.

Mallow

In Volume 5 it is shown that in terms of low flow the River Blackwater at Mallow has adequate assimilative capacity for the point loads from Ballyclough Co-op and Mallow S.T.W..

A potential source of pollution would seem to be the stream that runs through the Ballyclough Co-op factory, the B.O.D. of which has been measured at 33 p.p.m. on occasion (cf Volume 3). Low flow for the stream has been estimated at 2300 m3/day giving a load of 76 Kgs BOD/day. This is in excess of te load from Ballyclough Co-op treatment plant. Remedial work should be carried out by Ballyclough to prevent any polluting matter from entering the stream.

As already mentioned in Volume 5 the effluent from C.S.E.T. at Mallow in the winter causes elevated B.O.D.s but does not greatly effect the dissolved oxygen levels in the river.

A licence to discharge effluent to the Blackwater was granted to C.S.E.T. by Cork County Council in September 1987. The conditions specify a phased reduction in BOD levels for the effluent from 1987 to 1991. Compliance with the conditions should eliminate the pollution problem from C.S.E.T.

Kanturk

Regarding the Allow at Kanturk, the median BOD for the creamery in the calculations is 65 p.p.m. - however the minimum BOD value for the creamery effluent is 16 p.p.m. This means the BOD load from the creamery can be cut drastically.

The minimum BOD value for the S.T.W. is 106 p.p.m. which gives a daily load of 47 Kgs BOD. This is 78% of the control flow assimilative capacity. The treatment works is totally inadequate and is in urgent need of replacement.

The cost of replacing the S.T.W. has been estimated at £2,600,000 and a preliminary report has been forwarded to the D.O.E. for approval.

Mitchelstown

In Volume 5 it is shown that the combined load for the creamery effluent (at 20 p.p.m. BOD) and the S.T.W. (at 20 p.p.m. BOD) at 72 Kgs/day is approximately 82% of the assimilative capacity of the River Funshion. However, the additional load from the Gradoge increases the B.O.D. load to 1.75 times the assimilative capacity of the Funshion at a control flow of Ø.68 m3/sec.

Remedial work which has been being carried out recently by Mitchelstown Co-op on discharges to the 'Blue Stream' (Mill Stream) have reduced the B.O.D. load to the Gradoge considerably.

The elimination of pollution from Agricultural Sources in the Gradoge and Funshion catchments is essential for the improvement of the water quality of both rivers.

Necessity of Flow measuring equiptment.

Volume 3 of the plan considers the quality and quantity of various abstractions and discharged in the catchment.

Due to lack of definitive information, arbitrary values had to be assigned to a large number of abstractions and discharges.

To enable accurate assessment of B.O.D. loads etc., flow monitoring equipment should be maintained in working order at all effluent plants, both public and industrial. If necessary, standby systems should be installed.

In the case of septic tanks, accurate figures should be established for the number of persons served by the treatment facilities.

Necessity to update data on BOD loads etc.

Industrial discharge licences normally define the required frequency etc., of monitoring of the industrial effluent and thus provide an indication of how the treatment plant is operating.

However the majority of septic tanks and small treatment works are inspected and reported on only when a malfunction occurs.

In 1986 approx. 25% of 47 sewage treatment works in the County Cork area of the Blackwater catchment were monitored by the Environmental Department.

To reduce the risk of pollution from these works and to improve their performance they should be surveyed and reported on at least once a year. The survey would involve visual inspection of the plant, laboratory analysis of the effluent and an updating where necessary of the values for the volume discharged/number of persons served by the works.

Similarily, accurate figures are not available for a large number of water abstractions.

As in the case of discharges, where the system is not metered, an accurate account should be established and updated as necessary of the number of people/households etc., supplied by the scheme.

It will not be possible to give an accurate assessment of waste treatment facilities in need of investment until the gaps in information regrading same are filled.

Water Quality Monitoring Methods

The 1986 AFF Biological survey identified 84.3 kms of rivers in the Blackwater catchment as being moderately to seriously polluted.

In the same year the Chemico-Physical survey of the Blackwater catchment identified 37 kms of rivers as being significantly polluted when compliance with standards for Salmonid Waters was taken into account.

The polluted areas identified by the Physico-Chemial survey are also identified by the Biological surveys. The additional areas identified by the Biological survyes are mostly those affected by non-point sources of pollution.

Normally physico-chemical surveys relate strictly to discrete samples of water which only indicate the condition of the water at the time of sampling. Physico-chemical sampling may not detect pollution by non-point sources due to their intermittant discharge nature.

In contrast, Biological surveys give a measure of the average conditions which obtained for some time before sampling.

If carried out on an ongoing basis they serve to indicate a change in water quality which might not be observed in the analysis of a discrete physico-chemical sample.

The Physico/Chemical surveys are of most use when used to monitor the effect on water of a known point source of efflent. In this situation the constituents of the effluent will normally be known and the concentrations of the pertinent constituents can be monitored most effectively by Physico/Chemical assessment.

To ensure the effective monitoring of existing point sources the present level of Physico/Chemical surveying should be maintained.

Due to the fact that the biggest potential source of pollution in the catchment is agricultural, the level of Biological Surveying should be increased to establish and monitor the true extent of agricultural pollution in the catchment.

ASSESSMENT

Water pollution from point sources is of significant dimensions in five locations in the River Blackwater Catchment.

The cause of pollution at four of these locations arises from industrial sources and the fifth arises from an overloaded Sewage treatment works.

Pollution from agricultural sources gives rise to an extensive level of background pollution which in most cases is not discernable in the routine Chemico - Physical surveys but shows itself in lowered quality ratings in Biological and Macrophyte surveys.

The extent of pollution from agricultural sources is hard to quantify but in the farm surveys carried out in Spring 1988 by the special task force set up by the D.O.E. it was found that 35% to 40% of farms visited were medium to high pollution risks.

RECOMMENDATIONS
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1. That the scope of the plan, control flows and standards set be accepted.

2. That all remedial works necessary for the improvement of water quality be carried out as soon as possible.

3. That the present level of Physico-Chemical sampling be maintained.

4. That the level of Biological surveys should be increased to help establish and monitor the extent of background pollution in the catchment.

5. That the present level of surveying of existing and potential sources of agricultural pollution be increased if necessary with a rigorous follow up program of repeated prosecutions where required to eliminate the problem.

6. That the present level of sampling of Council Treatment Works be maintained and all treatment works (including Septic Tanks) to be sampled at least once a year with flow rates/number of persons served, being established and updated where necessary.

7. That all metering equipment at Effluent Plants (Public and Industrial) be maintained in working order and new equipment installed where necessary.

8. That flow curves be obtained for staff guages to enable immediate calculation of river flows where required. This facility could be used to establish assimilative capacity of a section of river when and as required.

9. That the river model developed by A.F.F. be used to model the critical sections in the catchment.

10. That steps be taken to avoid contamination of aquifers with potential sources of pollution being sited so as to have little potential for pollution the aquifers.

11. That well bore levels be surveyed to establish water level and direction of flow of the water in the aquifers.

12. That there should be liasion and collaboration with other organisations e.g. Universities, R.T.C. etc. regarding any Environmental Research Projects beneficial to water quality in the Blackwater catchment.

13. That a report on the State of the Environment with regard to the Blackwater River catchment be drawn up every year.

APPENDIX
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The Physico-Chemical surveys indicate the follwing areas as being significantly below the Salmonid Standards.

TABLE 1.6

Critical areas of Blackwater Catchment in terms of SALMONID STANDARDS

River	Location	Critical Parameters	Main Pollution Source
Blackwater	u/s Awnaskirtaun confluence	DO,PO4	Industrial
Blackwater	Shamrock Bridge	DO,PO4	Industrial
Allow	Riverview	PO4	Industrial & S.T.W.
Allow	Leaders Bridge	PO4	Industrial & S.T.W.
Funshion	Ø.5km d/s Gradoge confluence	DO, BOD, PO4,NH3	Industrial & Agricultural
Funshion	Killee Bridge	DO,PO4,NH3	" "
Funshion	Marshalstown	DO,PO4,NH3	" "
Funshion	Glenavuddig	PO4,NH3	" "
Funshion	Br. E. of Scart	PO4,NH3	" "
Funshion	Carrigdownane	PO4	" "
Funshion	Glanworth	PO4	" "
Funshion	Ballynahow	PO4,NO3	" "
Funshion	Downing Br.	PO4,NO3	" "
Funshion	Ballyfeane Br.	PO4,NO3	" "
Gradoge	Kilshanny	PO4	Agricultural
Gradoge	5Øm u/s Funshion confluence	DO,BOD PO4,NH3	Industrial & Agricultural

APPENDIX

TABLE 1.7

Critical Areas of Blackwater Catchment in terms of ABSTRACTIONS

River	Location	Source of Pollution
Allow	Freemount	Agricultural

TABLE 1.8

Critical Areas of the Blackwater in terms of DISCHARGES

River	Location	DISCHARGE Source	Type
Allow	Kanturk - Leaders Bridge	Creamery S.T.W.	Milk processing S.T.W.
Blackwater	u/s Awnaskintaun confl	Fry Cadbury Rathmore	Milk processing wastes
"	Mallow/Killavullen	C.S.E.T. (winter only)	Beet Processing wastes
Funshion	Mitchelstown	River Gradoge Co-op S.T.W.	Agricultural Industrial S.T.W effluent
Gradoge	Mitchelstown	Various	Agricultural Industrial

TABLE 1.9

Discharges requiring improvement

River	Location	Source	Comment
Allow	Kanturk	S.T.W.	Treatment of sewage is poor giving rise to high B.O.D. levels in effluent with elevated BOD and PO4 levels in river downstream sewerage treatment works.
Blackwater	Rathmore	Fry-Cadbury	Assimilative Capacity of River Blackwater at Rathmore critical control flows.
Blackwater	Mallow	C.S.E.T.	High BOD in effluent gives rise to sewage fungus in River Blackwater vicinity Mallow during November & December.
Funshion	d/s Gradoge confl.	River Gradoge	Assimilative capacity of River critical and at times of control flow elevated NH3 and PO4 levels.
Dalua	Newmarket	S.T.W.	Efficiency of treatment works is poor.

TABLE 1.10

Summary of Water Quality in River Blackwater and eleven of its tributaries based on A.F.F Biological surveys from 1981 to 1986.

RIVER	Channel Length in Class:			Length Examined Km
	A	B	C	
Allow	20.7	4.7		25.6
Araglin	13.7			13.7
Awbeg	22.7	29.6		52.3
Blackwater	73.4	45.5		118.9
Bride	56.3			56.3
Clydagh	8.8			8.8
Dalua	16.5			16.5
Finnow	8.7			8.7
Funshion	25.7	10.8		36.5
Glenafallia	2.2			2.2
Gradoge		1.5	2.0	3.5
Owenashad	4.6			4.6
TOTALS	253.3	92.3	2.0	347.6
Percentages	73%	26.5%	0.5%	

DRAFT WATER QUALITY MANAGEMENT PLAN
FOR
THE RIVER BLACKWATER CATCHMENT

VOLUME 2
****

SUMMARY OF WATER RESOURCES

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An Foras Forbartha
Water Resources Division

October, 1981
J.P.K. Horkan, M.Sc.

Revised October 1988

Environmental Dept.,
Cork County Council,
County Hall,
CORK.

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DESCRIPTION OF CATCHMENT

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8. The River Blackwater rises in the foothills of the Mullaghareirk Mountains at Knockanefune (439 m O.D.) in County Kerry. The river flows due south to Rathmore along the borders of Cork and Kerry. At Rathmore the river turns and flows due east passing through County Cork and into County Waterford. At Cappoquin the river turns to flow due south and enters the sea at Youghal. The river is tidal as far as 5 km.u/s Cappoquin, a distance of approximately 30 km. The Blackwater catchment is comprised of parts of Counties Cork, Kerry, Limerick, Tipperary and Waterford. The main tributary of the Blackwater is the Bride which joins in the estuary and is itself tidal to upstream of Tallowbridge. Other important tributaries are the Licky, Finisk, Araglin, Funshion, Awbeg, Allow and Owentaraglin which join on the left bank, and the Clyda, Glen and Owenbaun which join on the right bank.

9. **Topography** The river runs through a broad valley almost entirely bounded by mountain ranges, on the north by Knockmealdown, Kilworth, Galtee, Ballyhoura and Mullaghareirk Mountains, and on the south by the Boggeragh range. On the south, in east Cork and west Waterford, the watershed is comprised of a hilly range running in an east-direction. The watershed between the Blackwater and its main tributary, the Bride, is formed of the Nagles Mountains and a range of hills running in an east-west from Drum Hills near Villierstown to Fermoy.

10. **Towns and Population** The principal towns in the catchment are Mallow (population 6,572), Youghal (population 5,870) and Fermoy (population 3,106). Other centres of population are Mitchelstown, Kanturk, Millstreet, Lismore and Buttevant. The population figures quoted are of the relevant Urban District as contained in the Census of Population 1981.
Based on the 1981 Census of Population, the population of the following Urban Districts and environs is estimated as follows - Mallow 7,482, Youghal 6,145 and Fermoy 4,888.

11. **Geology** The Blackwater catchment is dominated by the prominent east-west orientated ridges composed of strongly folded grey grits and shales of Silurian age, and conglomerates, sandstones and shales of Devonian age. The ridges (anticlines) are separated by broad lowlands (synclines) of Dinantian Limestone which range in age from Tournasian to Visean and have a maximum thickness of 1700 m in the Buttevant area. The limestone succession is made up of shale beds at the base overlain by dark grey bedded bioclastic limestones, light grey non-bedded reef limestones with bedded limestones and sandstones at the top. Intense Hercynian folding gave the regional east-west trend and produced very strong patterns of both east-west and north-south faults and joints.

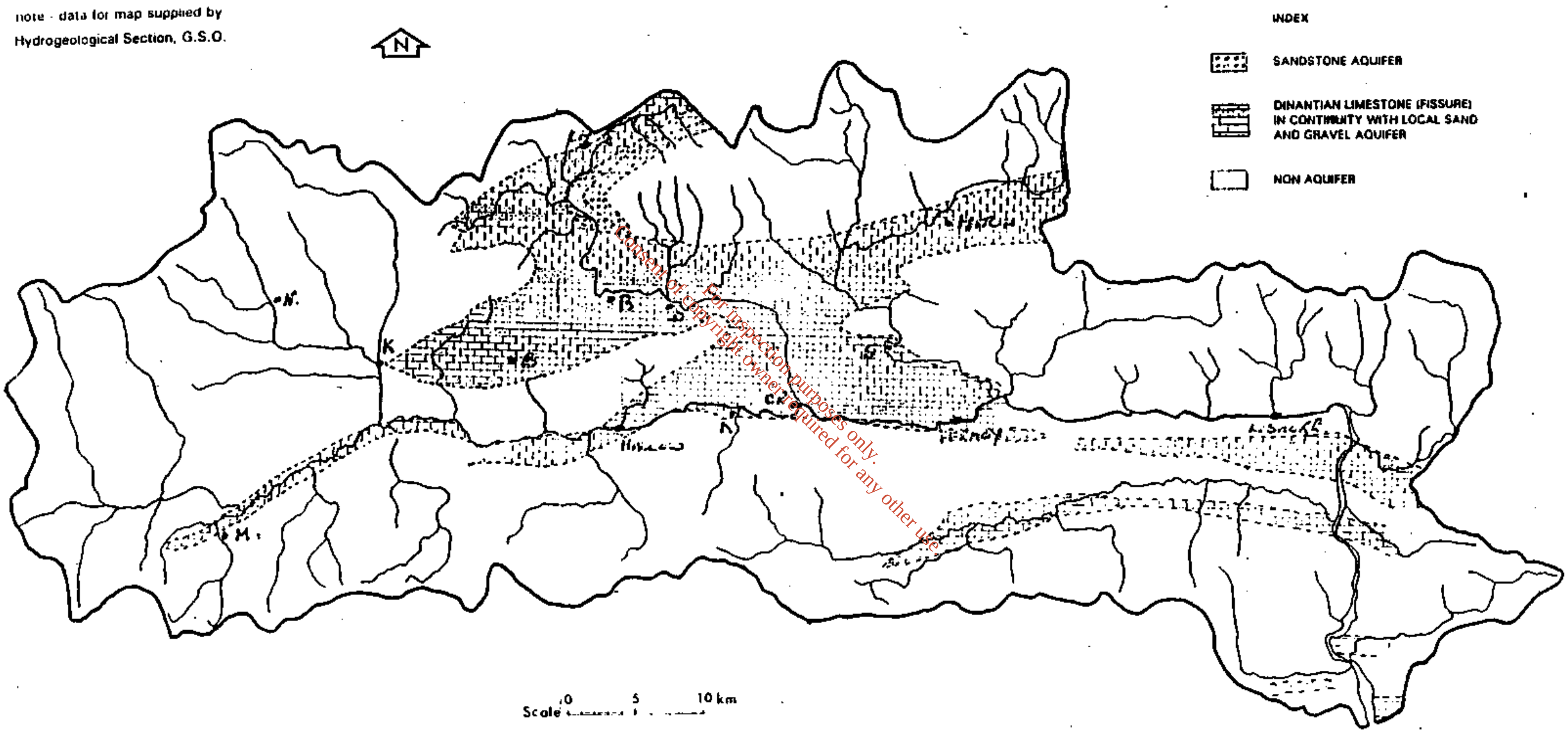

Figure 2.3 Hydrogeology in the Blackwater Catchment

Above the Dinantian Limestones are the Namurian shales, siltstones and flagstones which are found in the upper reaches of the catchment. They are a maximum of 110m thick. The youngest rocks in the catchment are the Westphalian Coal Measures found west of Liscarroll and Kanturk. They contain some beds of sandstone and lenses of coal. Much of the limestone outcrop in the synclinal valleys is obscured by Quaternary deposits which are composed mainly of coarse sands and gravels. The sands and gravels are lenticular in shape and interbedded with boulder clays, silty sands and peats. The deepest Quaternary deposits overlie the easily erodible Lower Limestone shales. Boreholes penetrating 20-30 m of Quaternary Deposits are common.

HYDROGEOLOGY

12.**Aquifers** The information on aquifers in the Blackwater catchment has been make available by the Groundwater Division of the Geological Survey Office. Figure 2.3 is based on a map supplied by the Hydrogeological Section of the Geological Survey. The aquifers are outlined according to the geology.

13.**The Dinantian Limestone (fissured aquifer).** The principal aquifer in the Blackwater catchment is found in the Dinantian Limestones. The entire limestone succession can be regarded as on aquifer. All the limestones are integrated into one hydraulically continuous aquifer by the fault and joint systems. Groundwater can move through the limestone which has been karstified to a depth of 100 m along bedding planes, faults and joints. Boreholes, drilled for creameries and industrial supplies, have reported yields which range from 200 - 1100 m^3 / day. Springs emerging from the limestone aquifers are common but because the synclinal aquifers tend to be elongated in shape, the catchments of the springs tend to be rather small and consequently the discharges from the springs are small. In the upper part of the Carboniferous succession there are sandstones from which yields, up to 800 m^3/day, have been recorded.

14.**Quaternary Sands and Gravel Aquifers** Fluvioglacial sands and gravels form important local aquifers and are found overlying the limestones. They are probably in hydraulic continuity with the limestones.

15. **Minor Aquifers** The upper part of the Devonian (Old Red Sandstone) succession in other areas is known to yield water in moderate amounts. In this region there are few records of well yields above 80 m^3 / day. (There are two boreholes, 100 m apart, in north Cork, near Buttevant, which each yielded over 3000 m^3 / day. These high yields could be explained by faulting). Sandstones in the Westphalian Coal Measures would be expected to contain aquifers but there is no data available for them in the Blackwater catchment.

POLLUTION OF AQUIFERS

16. Pollution of aquifers is caused by the introduction of material into the aquifer water which results in the quality of the water deteriorating. It should also be kept in mind that some groundwater on account of its natural constituents cannot be used as normal potable water, in some cases, even after treatment.

17. The polluting material generally enters the aquifer in an aqueous solution, either in suspension or in solution. The source of the pollution is in most cases either at ground level or just below ground level.

18. Pollution is transported to the quifer by infiltrating through the unsaturated zone to the water table. Polluted water has a tendency to remain at high level in the aquifer. In west Waterford the main aquifers are rock aquifers. The rock is usually overlain by overburden and the overburden protects the aquifer in that it slows down the rate at which the pollutant can enter the aquifer and allows attenuation by dilution, oxidation and chemical or physical sorption.

19. Aquifers are recharged from infilitration of rainwater through the unsaturated zone, recharge from rivers and they can also be artifically recharged from wells. Rock aquifer are particularly susceptible to pollution where the overburden is thin and the water table is near the ground surface. These are areas where aquifers are most vulnerable. Aquifers are also very vulnerable in the vicinity of wells, in particular disused wells. (Sink holes in the limestone would be in the same category as disused wells). Disused wells, in particular dug wells, are very convenient places to dispose of all sorts of unwanted material which may have the potential to pollute the aquifer.

20. The thickness of the unsaturated zone or zone of aeration is also very important in protecting aquifers, the nearer the water table is to the surface the easier it is to pollute the aquifer.
Unlike the pollution of surface water sources, polluted groundwater sources can take a long time to clear up. This could mean that an essential water source could be out of action for a very long time, months, even years. There is no published researched on the length of time it takes for aquifers to recover from pollution.

SOURCES OF POLLUTION

21. The sources of pollution or possible pollution of aquifers are domestic, agricultural and industrial developments.

A. Domestic Pollution

Domestic pollution is mainly caused by septic tanks which are poorly constructed and maintained or constructed below the water table. They can cause considerable problems as they often pollute the owners own well or neighbours wells. Domestic refuse is also another problem in that waste disposal sites historically have been selected at a convenient location and not on a scientific basis.

B. Agricultural Pollution

Agricultural pollution is caused by overuse of (a) fertilisers which is probably less common now due to cost increases, (b) pesticides and other chemicals improperly stored and disposed of, (c) petroleum products spilled on the land, (d) animal manures and silage effluent which may be disposed of in a improper manner. With the stricter policeing of surface water, much of the pollutants which were originally let off into the nearest river or stream has to be disposed of elsewhere. Much of it is spread on the fields and while this is satisfactory if carried out correctly, much of it is done with no scientific back up. The problem with many of the agricultural activities is that there is no control over them under the Planning Acts.

C. Industrial Development

22. This involves the disposal of industrial wastes and sewage sludges, and privately or publically owned waste disposal sites which may or may not have been properly located or supervised during operation. Care should be taken that industrial wastes, sewerage sludges etc., be disposed of in a manner that aquifer water is not contaminated. Aquifers can also be contaminated from sewers which have developed leaks.

ZONAL PROTECTION OF AQUIFERS

23. The protection of the quality of groundwater in aquifers should not be confined to existing sources but also to the total aquifers within the survey area as these are the sources that may be used in the future.

24. The protection of aquifer is provided by using existing legislations and administrative procedures under the Local Government (Water Pollution) Act 1977 and the Local Government (Planning and Development) Acts 1963 and 1976, to control activities which may cause pollution to groundwater. These acts will not protect aquifers unless they are applied effectively. There is often major conflicts of interest between developers of potentially polluting activities and those whose duty it is to apply the various acts. The activities which are potentially polluting are often very desireable developments such as improvements of agriculture land usage and Industrial developments and these activities often use large quantities of water.

25. In protecting the aquifers from pollution it is advisable as a first step to protect the exsisting sources. The Local Authority are in a position to protect their own sources, there is no doubt that they should endeavour to persuade the operators and owners of private supplies to protect their own sources.

26. The restriction of potentially harmful activities in the vicinity of groundwater sources in the catchment is recommmended.
To achieve this end Specific Zones of Protection for Aquifers as per Table 2 over are proposed which were first proposed by Daly and Wright of the Geological Survey of Ireland in 1981.

TABLE 2.2

SUMMARY OF AQUIFER PROTECTION SCHEME

Zone	Description	Sub-Zone	Description	Acceptable Pollution Sources	Unacceptable Pollution Sources
1	Source protection zone	1 A	Area within 10m radius of source	None	All
	Catchment area within 1km of source	1 B	Area between radii 10-300m	None	All
		1 C	Area between radii 300-1000m	(1), (2), (3a), and (4)	(3b), (5), (6), (7), (8) and (9)
2	Major Aquifers (Barren Limestone, Basal Sandstone, Kiltorcan type Sandstone)	2 A	High vulnerability area	(1), (2), (3a), and (4)	(3b), (5), (6), (7), (8) and (9)
		2 B	Medium vulnerability area	(1), (2), (3a), (4) and (8); and (6), (7) and (9) provided special precautions are taken to prevent pollution	(3b) and (5); and (6), (7) and (9) where special precautions to prevent pollution are not taken
		2 C	Low vulnerability area	All Care must be taken with (5), (6), (7) and (9)	(5), where the wastes are hazardous
3/4	Poor Aquifers and Non-aquifers	3/4 A	Medium vulnerability area	(1), (2), (3a), (3b), (4) and (8); and (6), (7) and (9) provided they are designed and managed properly	(5); and (6), (7) and (9) where the design and management are poor
		3/4 B	Low vulnerability area	All	None

NOTE: THE SCHEME IS INTENDED AS A GENERAL GUIDE FOR PLANNING PURPOSES. IT HAS NO STATUTORY AUTHORITY.

Potential Pollution Sources

(1) Septic tanks with percolation areas (soakage pits should be prohibited everywhere)
(2) The spreading of slurry, manure or sewage effluent
(3a) Well designed and managed farmyards
(3b) Poorly designed and managed farmyards
(4) Burial grounds
(5) Tip sites
(6) Intensive animal rearing and housing units, e.g. piggeries
(7) Industrial developments using, producing or storing potentially polluting material
(8) Main foul sewers
(9) Sewage and trade effluent treatment works

Four zones for aquifer protection are classified as follows;

Zone 1 : Area within 1km. radius of groundwater source
(This is sub-divided into 3 sub zones as below)
Zone 1A : Area within 10m. of source
Zone 1B : Area within 10m. and 300m. of source
Zone 1C : Area within 300m. and 1000m.of source

Zone 2 : Area within boundary of Major Aquifers

Zone 3 : Area within boundary of Minor Aquifers

Zone 4 : Area within boundary of Aquifers of no regional importance.

27. The areas that require immediate attention are the Zone 1 aquifers. The Zone 1 aquifers are divided into three sub-divisions Zone 1A, Zone 1B and Zone 1C.

Zone 1A

28. Zone 1A extends for a radius of about 10M from the source and this area should be fenced off so that access is only allowed to authorised personnel. Surface run-off channels should be provided around this area so that surface water is not allowed to enter the source.

Zone 1B

29. Zone 1B is the area between 10M and 300M of the source. In this area developments which would result in or would be likely to result in pollution of groundwater or derogation of groundwater sources should be prohibited or should be made subject to special precautions to protect the aquifer. These developments would normally include:-

(a) Residential Developments not connected to a public sewerage. i.e. Septic Tanks.

(b) Spreading of sewerage sludge, silage effluent and slurry.

(c) Establishment of Burial Grounds.

(d) Waste disposal sites.

(e) Any industrail development which would involve the use, production and storage of toxic or potentially polluting materials,unless adequate protection measures were agreed.

(f) Intensive agricultural activities such as intensive rearing or housing of livestock, the construction of silage clamps or chemical stores.

(g) Construction of main foul sewers.

(h) Construction of sewerage and trade effluent treatment works.

(i) Excavation for minerals which would require restoration by backfilling with imported material or would extend to within 3M or less of the maximum level of the local water table.

Zone 1C

30. Zone 1C is the area between 300 - 1,000M radius of the source. The developments that should be controlled in this zone are the same as for Zone 1B with the exception of a, b and c above.

31. It is recommended that a map of these areas be produced and also a detailed hydrogeological/geological map of each Zone 1 aquifer to ensure that the necessary safeguards are in operation to protect the source from pollution.

32. Zone 2 are the major aquifers which are capable of yielding a large proportion of the total public supply so a high degree of protection is required to ensure that neither their current use or their future development is needlessly effected. They exclude both Zone 1 and those areas whose major aquifers are overlain by thick drift cover or other impearmeable confining strata.
In Zone 2 all activities which, either individually or in continuation with other similar developments would result in or would be likely to result in pollution of groundwater, should be objected to. Activities which should be prohibited include:-

(i) Waste disposal sites constructed to receive domestic waste, industrial and chemical wastes or sewerage sludge.

(ii) Major industrial and agricultural developments which involve the use, storage or handling of potentially polluting materials unless protective measures are agreed.

33. Zone 3 comprises the minor aquifers which yield locally important quantities of water. It excludes both Zone 1 and areas where minor aquifers are overlain by thick drift or impermeable confining strata. The degree of protection depends on local conditions.

34. Zone 4 comprises the remaining areas where groundwater is not of regional importance. However, pollution or derogation of an existing groundwater source should not be allowed.

35. The practical methods of preventing pollution of groundwater must now be considered. Monitoring of the water quality in the aquifers is carried out on a regular and continuing basis and the samples taken are analysied for chemical and bacteriological content. These would assist in drawing up water quality maps and also monitor any change in the quality of the aquifer water. It should also act as an early warning system to any possible pollution problem and give time to rectify the cause of pollution or obtain an alternative source.

36. Protection of the aquifers can be assisted when applying the Planning Acts and Water Pollution Acts to new developments with any polluting potential in the zones as described above. To assist in evaluating potential problems a points system and explanatory memo is proposed which indicates what to look for on site and when precautions should be taken or where development should not be allowed. (c.f.Appendix 1)

Recommendations for Prevention of Pollution of Aquifers in the Blackwater Catchment.

37. The main potential sources of pollution are described for each Zone 1 aquifer and they fall into the broad categories of Industrial, Domestic and Agricultural.

a. Prevention of Pollution from Industrial Sources

38. These are basically the spillage of industrial contaminants on roads or rail lines in critical sections of the aquifers. Apart from illegal dumping to which recourse to the Courts is the only answer, the potential problem would be due to traffic accidents or train derailment, leading to the breaking of containers of polluting material and the pollutant flowing onto the nearby land and possible entering the aquifer through the zone of unsaturation.

39. The prevention of this type of pollution is to (a) minimise the risk of traffic accidents, imposing special speed limits, removing dangerous bends, etc., and (b) improving roadside drainage so that any run-off from the road will be directed away from the parts of the aquifer that have not good natural aquifer protection. This will help in minimising the risks from this source to the aquifer.

b. Prevention of Pollution from Agricultural Sources

40. The various potential sources of agricultural pollution have been divided into;

(a) point sources
(b) diffuse sources

In general groundwater contamination from agricultural activities can be prevented or minimised by a number of steps.

i. Farmers and agricultural advisors must be made aware of the presence of groundwater and its use as a major source of water supply.

ii. Farmers must be made aware of the potential of their activities to pollute groundwater as well as surface waters.

iii. Farming practices must take account of the risk of groundwater pollution. Farmyards must be well designed and managed so that the wastes and effluents are controlled and not allowed to enter aquifers.

iv. Appropiate regulations may need to be introduced if an increased awareness of groundwater and the pollution potential of agricultural activities does not result in better agricultural practices.

Point Sources of pollution.
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41. Point sources generally occur in or near the farmyard and pollution potential varies from farm to farm depending on their location from the aquifer and the water extraction points and also the natural protection afforded to the aquifer by ground conditions at the farm.

(a) Manure and Slurry.

42. If all the manure and slurry are collected and spread on the land during the growing season, at the rate which the plants can use, no pollution will occur. To do this the farm should have sufficient storage space to hold the waste generated in the winter. To minimise storage of the manure and slurry it is important and the liquid content be minimised i.e. rainwater and dirty water be separated from farm manure and slurry.

(b) Dirty Water.

43. Dirty water or soiled water can be a major problem in farmyards with uncovered self fed silage systems on concrete and where water is used for washing in milking parlours etc., it is too diluted to have much fertilizer value, but contains sufficient nutrients to cause serious pollution to surface water and groundwater. It would descrease the fertilizers value of slurry if allowed to enter slurry pits and it also increased the volume and spreading costs.

44. However, a number of recommendations can be made for minimising contamination.

b1. Dirty water must not be allowed to enter directly into groundwater or surface water. It can be collected in a soiled water tank and spread on suitable land using a submersible pump or a slurry tanker.

b2. To minimise dirty water, good design and management of the farmyard is critical.

b3. Rainwater from roofs and clean water from other sources should not be allowed to mix with dirty water or to enter animal holding areas.

b4. The uncovered areas to which the cattle have access should be reduced as much as possible and as much as the farmyard as possible should be roofed.

b5. Jet cleaning should be minimised as much as possible and the use of straw or other bedding be considered.

(c) Silage Effluent

45. Silage pits should have an impermeable base of concrete or asphalt with drainage channels to collect effluent. The effluent may be sprayed on land as a method of disposal but care should be taken where and when it is applied. Pre-treatment could be considered to reduce BOD if insufficient land for spraying is not available.

Diffuse Sources
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46. This concerns the spreading of organic and inorganic fertilizers. Fertilizers leached from the soil into groundwater or that which runs off into streams is wasted. This can be minimised by good farming practice which should include:-

i. Spreading artificial fertilizer at the correct rate. In calculating the rate of application of artificial fertilizer, farmers should take into account the approximate nitrogen content of any applied manures and slurries.

ii. Intensive production units should have sufficient land available to enable them to spread the slurry and effluent at rates which do not cause leaching to occur. If sufficient land is not available some form of biological treatment of the wastes is recommended to reduce the polluting matter in the wastes to an acceptable level.

iii. Manures, slurries and inorganic nitrate should only be spread during the growing season.

iv. One method of reducing residual nutrients in the soil is the growing of autumn crops. This helps to use up any nitrate left in soil after harvesting of the main crop, thereby reducing leaching during the winter months.

c) Domestic Pollution
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47. This is mainly caused by septic tanks due to lack of proper maintenance, faulty design in construction or siting the soakage area in an unsuitable location. The use of the Planning Act to reject unsuitable developements in the Protection Zones outlined above should be rigoursly adhered to. Permission should only be granted if alternative methods of treating the domestic effluent are used.

SUMMARY
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48. In general in the Blackwater catchment the main potential source of aquifer pollution is from agricultural activities.

49. An educational programme should be aimed at the agricultural advisors and the farming community and an investigation into the methods of farm waste treatment should be carried out. This should be a multi-discipline investigation carried out by agricultural specialists, hydrogeologists, environmentalists and engineers with specialised knowledge of waste disposal and treatment. The end result, to be successful, must be to the farmers advantage in safeguarding his water supply and cutting his fertilizer bill.

50. Apart from preventing pollution at potenial sources, it is also necessary to have an action plan available to minimise the detrimental effects of pollution caused by accident, ignorance, neglect or illegal dumping.

AQUIFER PROTECTION STUDIES
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51. Aquifer protection studies have been carried out in the following areas;

Waterford section of the Blackwater Catchment

Glenatlucky and Kiltrislane townlands (Mitchelstown W.S.S.)

Ballinatona townland (Kanturk W.S.S.)

Ballinagearagh Townland (Charleville W.S.S.)

Ketragh Springs (near Cecilstown)

These studies include reports on the following;

Geology of the area in question

Hydrogeology of the area in question

Protection of Aquifers

Maps showing: Aquifer zones
Areas of thin overburden
Groundwater Abstraction points
Geological features

Point Count System for site use (c.f. Appendix 2.1)

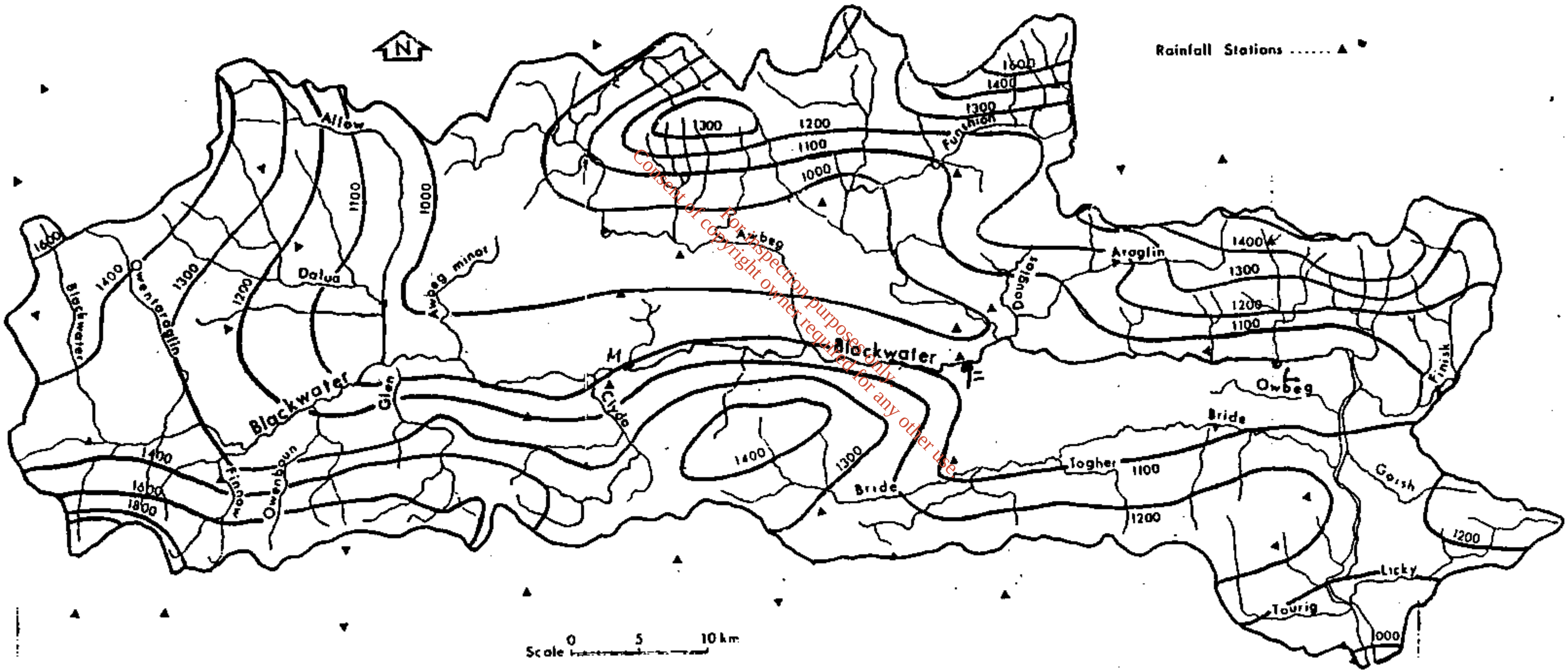

Figure 2.4 The Blackwater Catchment Isohyetal Map (period of record 1941 1970)

RAINFALL
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52. Records of rainfall, which go back much further than records of river flow, can be used to back up flow data in the assessment of the various aspects of water resources. In this report rainfall records are used for two purposes; firstly, to establish the long average run-off and hence the magnitude of the resource and, secondly, to establish climatic conditions prior to actual flow measurements and hence relate flow to known drought occurrences.

53. The long average rainfall has been calculated by drawing contours of equal precipitation (isohyets) on a suitable map, and taking off the areas between contours. Figure 2.4, which shows isohets of long average rainfall, is based on a map supplied by the Meteorological Service. Details of the long average rainfall on the catchment area to strategic points on the River Blackwater are given in Table 2.3 The long average rainfall varies from 980 mm per year at Doneraile to 2000 mm per year at Caherbarnagh.

RESOURCES
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54. **Average Flow** The long average run-off is a useful measure of the magnitude of the resource. It can be arrived at by processing records from the gauging stations or it can be estimated by taking the long average rainfall on a particular area and subtracting evapotranspiration losses. An estimate of the long average run-off at a number of points on the Blackwater River has been made by the latter method and details are given in Table 3 below. The long term average losses are taken to be 483 mm (19") over the whole catchment.

TABLE 2.3 : Long Average Run-off Based on Rainfall Records
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No.	Station Name	River	Area km2	Long Av. Rainfall mm	Long Av. Losses mm	Long Av. Runoff mm	Long Av. River Flow m3/s	Long Av. Specific Runoff l/s/km2
1801	Mogeely	Bride	335	1202	483	719	7.6	22.8
1802	Ballyduff	Blackwater	2338	1159	483	676	50.0	21.4
1803	Killavullen	Blackwater	1258	1216	483	733	29.2	23.2
1804	Ballynamona	Awbeg	324	1064	483	581	6.0	18.4
1805	Downing Br.	Funshion	363	1190	483	707	8.1	22.4
1806	Mallow	Blackwater	1058	1303	483	820	27.5	25.9

55. Records were processed by the Office of Public Works from their own recorders and from the Comhlucht Siuicre Eireann recorder at Mallow by An Foras Forbartha, giving values for average run-off as shown in Table 2.4. There are discrepancies in the results shown in Tables 2.3 and 2.4, the major discrepancy being at 1806 Mallow. These differences are not significant and can only be reconciled when improved quality of records is available over a long period of time.

TABLE 2.4 : Long Average Run-off Based on Hydrometric Records

No.	Station Name	River	Area km2	Long Av. Runoff m3/s	Specific Runoff l/s/km2	Period of Record Years Processed
1801	Mogeely	Bride	335	7	20.7	2
1802	Ballyduff	Blackwater	2338	56	23.9	24
1803	Killavullen	Blackwater	1258	29.8	23.7	18
1804	Ballynamona	Awbeg	324	5.0	15.4	2
1805	Downing Br.	Funshion	363	7.1	19.6	2
1806	Mallow	Blackwater	1058	33.7	31.8	3

56. **Low Flow:** Any assessment of the water resources of an area must take into account the availability of water for the various beneficial uses. When planning the abstraction of water from a river or stream, it is necessary to know the dry weather flow (d.w.f.) This is defined as the minimum flow that might be expected to occur with a frequencey of once in 50 years.

57. In order to make an accurate assessment of low flow, reliable records must be available at strategic points in the river catchment for a number of years. Of the forty-nine gauging stations in the Blackwater catchment, eight have automatic water level recorders. One of these eight has been in operation since July 1977. Two others commenced in 1981. The remaining five stations have water level records going back twenty-five years or more, but their purpose was to record flood flows and their reliability for low flow periods is open to question. Nevertheless, valuable information can be obtained from a detailed examination of these records together with actual flow measurements carried out during the period of the record. The quality of the data is being improved by regular and intensive flow measurement during drought periods. Because of the fact that accurate values of the lowest flow, that occurred each year at gauging stations, are not available, statistical analysis of extreme conditions is not possible. It is possible, however, to establesh the low flow in particular known drought years from actual measurements carried out and from water level records.

58. Table 2.5 gives the lowest flow measured at selected gauge sites in the Blackwater catchment and the date of measurement. The low flow in the Blackwater, which would have a frequency of one in 50 years, would be lower than the lowest measured flow as shown in Table No. 5. From Table 5 it can be seen that the lowest flows measured occurred in the years 1969, 1976, and 1977. Years 1969 and 1976 are widely recognised as drought years, while in 1977 low flows have been experienced but generally at higher levels than those of 1976. Charts from water level recorders have been processed and while results could not be used for accurate assessment of the magnitude of flow, they indicate, for the years 1969 and 1976, that the lowest water levels were generally recorded in September and that for 1977 lowest water levels occurred in the period July/September. For all stations procesed for the two years the lowest flow is less for 1976 than for 1977. Actual flow measurements were carried out during drought periods of 1969, 1976 and 1977 and these are shown in Table 2.6 together with results from 1975, another drought year.

TABLE 2.5 : Lowest Measured Flow at Selected Gauge Sites

Station No.	Station Name	River	Area km^2	Rate of Flow m^3/s	Date of Measurement
1801	Mogeely	Bride	335	0.59	7.9.76
1802	Ballyduff	Blackwater	2338	6.31	17.9.69
1803	Killavullen	Blackwater	1258	2.52	9.8.77
1804	Ballynamona	Awbeg	324	0.77	10.9.76
1805	Downing Br.	Funshion	363	1.46	16.8.76
1806	Mallow	Blackwater	1058	2.25	11.8.77
1810	Allen's Br.	Dalua	88	0.15	29.8.77
1811	Ballinterry	Bride	115	0.29	22.9.77
1812	Freemount	Allow	61	0.047	20.9.77
1815	Colthurst	Blackwater	354	0.94	21.9.77
1816	Duncannon	Blackwater	113	0.20	21.9.77
1817	Ahane	Owentaraglin	76	0.12	21.9.77
1818	Clyda	Clyda	110	0.33	21.9.77
1809	Riverview	Allow	316	0.35	3.8.77

TABLE 2.6 : Flow Measurements carried out during Drought Periods

No.	Station Name	River	Area km2	RATE OF FLOW (m3/s)				
				1969(Date)	1975(Date)	1977(Date)	1977(Date)	1984(Date)
1801	Mogeely	Bride	335	1.1 (27/8)		0.59(7/9)		
1802	Ballyduff	Blackwater	2338	6.31(17/9)		8.03(10/8)		
1803	Killavullen	Blackwater	1258	5.55(8/8)	5.95(9/7)	3.35(11/8)	2.52(9/8)	3.48(17/8)
1804	Ballynamona	Awbeg	324	1.44(27/8)	1.26(9/7)	0.77(10/9)	1.13(9/8)	
1805	Downing Br.	Funshion	363	1.95(28/8)	2.02(9/7)	1.46(16/8)	1.68(9/8)	
1806	Mallow	Blackwater	1058				2.25(11/8)	

TABLE 2.7: Lowest Measured Flows and Estimated Dry Weather Flows at Selected Gauge Sites

Station No.	Station No.	River	Area km2	Lowest Measured Flow		Estimated D.W.F.	
				m3/s	l/s/km2	m3/s	l/s/km2
1801	Mogeely	Bride	335	0.59	1.8	0.47	1.4
1802	Ballyduff	Blackwater	2338	6.31	2.7	5.2	2.2
1803	Killavullen	Blackwater	1258	2.52	2.0	2.2	1.8
1804	Ballynamona	Awbeg	324	0.77	2.4	0.62	1.9
1805	Downing Br.	Funshion	363	1.46	4.0	1.0	2.7
1806	Mallow	Blackwater	1058	2.25	2.1	1.7	1.6
1809	Riverview	Allow	316	0.35	1.1	0.28	0.9
1810	Allen's Br.	Dalua	88	0.15	1.7	0.08	0.9
1811	Ballinterry	Bride	115	0.29	2.5	0.16	1.4
1812	Freemount	Allow	61	0.022	0.8	0.036	0.6
1815	Colthurst	Blackwater	354	0.59	1.7	0.44	1.25
1816	Duncannon	Blackwater	113	0.15	1.3	0.10	0.9
1817	Ahane	Owentaraglin	76	0.12	1.6	0.07	0.9

59. It is apparent that flows, at some of the locations, would be of the same order of magnitude towards the end of the drought period in each of the drought years shown in Table 2.6. It would appear, from an examination of the records, that the lowest flow estimated to have occurred, during the period of record, is not much different from the lowest measured flow. **Sufficient information is not available to facilitate a statistical analysis of frequency of occurrence of low flows or to determine D.W.F.** Information gathered by the Department of Fisheries,on flows in the River Blackwater at Duncannon Bridge in 1967, 1968 and 1969, has been made available to An Foras Forbartha. Using this information and the flow measurements in Table 6, it is possible to estimate a low flow which, at this stage, can be taken as the Dry Weather Flows for planning purposes. Details of the estimated low flows are given in Table 2.7 for the gauging stations on the main channel and its major tributaries. Specific yield (l/s/km2) varies on the Blackwater from 0.9 l/s/km2 at Duncannon to 2.2 l/s/km2 at 1802 Ballyduff, and on the tributaries from 0.6 l/s/km2 at 1812 Freemount to 2.7 l/s/km2 at 1805 Downing. The wide variation in specific yields, given in Table 2.7, can be explained by studying the geology and hydrogeological aspects of the catchment. The Geological Survey of Ireland has provided information on the aquifers of the area and this is shown in Figure 2.3 and discussed in paragraph 12.

60. **Ninety-five Percentile Flow** This flow is a useful indicator, to decision makers, of the potential of a receiving water to assimilate the waste discharges from centres of population and from industry. It is a statistical figure and, therefore, it can only be quoted if records are available, or if it can be shown that there is a similarity between points where information is required and where records are available. The variation in the specific yield (Table 2.7) over the catchment and Figure 2.3, which shows the aquifers, are indicative of very dissimilar conditions at the various gauging stations. The gauging station at which long records exist are not sensitive enough to provide information on the frequency of occurrence of particular low flow rates. The records, as processed by the Office of Public Works from their stations, and by An Foras Forbartha from station 1806 Mallow, have been analysed and an estimate of the 95 percentile flow at the selected stations is shown in Table 2.8. From the data in Tables 2.7 and 2.8, the 95 percentile flow and the D.W.F. at the major centres of population have been estimated from the best information available at this stage are shown in Table 2.9.

TABLE 2.8: Estimated Ninety-Five Percentile Flow at Selected Gauge Sites

Town	Population	Catchment km2	Estimated 95 Percentile m3/s	Estimated D.W.F. m3/s	River
Mallow	7300	1196	3.7	1.8	Blackwater
Fermoy	3970	1795	6.8	3.6	Blackwater
Mitchelstown	3070	31	0.06	0.03	Gradogue
Kanturk	1850	274	0.48	0.24	Allow
Millstreet	1320	31	0.06	0.03	Finnow
Cappoquin	900	2492	11.4	5.5	Blackwater
Rathmore	420	113	0.2	0.10	Blackwater
Kilavullen	230	1258	4.8	2.2	Blackwater

TABLE 2.9 Estimated 95 percentile flows and Catchment Areas at selected towns in the Blackwater Catchment.

Station No.	Station Name	River	Area km3	Estimated 95% Flow m3/s
1801	Mogeely	Bride	335	0.9
1802	Ballyduff	Blackwater	2338	10.7
1803	Kilavullen	Blackwater	1258	4.8
1804	Ballynamona	Awbeg	324	1.2
1805	Downing Br.	Funshion	363	2.0
1806	Mallow	Blackwater	1058	3.5

PROGRAMME OF FUTURE INVESTIGATION
****

61. **Future Uses of Data** Up to now, data was collected and collated for the acquisition of a basic knowledge of the catchment and the building up of information for preliminary planning, research and other non-operational purposes. As water quality management plans are adopted and put into operation, data collection will have to be more refined and improved. More precise information will be required on river flows in relation to other needs such as abstraction of water, effluent disposal and water quality parameters.

62. **River Gauging Stations** Four of the gauging stations in the Blackwater catchment fitted with water level recorders were erected by the Office of Public Works for their own purposes, i.e. the design of an arterial drainage scheme. Records from these stations are such that it is not possible to be in any way precise when giving the flow rate especially during periods of low flow. Comhlucht Siuicre Eireann operate Station 18Ø6 Mallow for the study and control of effluent discharge from their plants. It is important that accurate records of river flow be maintained at certain key locations in the catchment for the purpose of water resources management. In order to achieve this, additional water level recorders will be required and controls will have to be constructed in order to overcome the effects of unstable channel bed and excessive weed growth. These control structures should be constructed at locations where water level records and flood flow rates can be related, i.e., at some of the existing gauging sites. The Office of Public Works and local authorities have in other catchments erected a number of such structures and a joint approach by the County Councils and the Office of Public Works for the construction of these controls would seem to be the best approach. Additional gauges, where less precise data and partial records would be sufficient, should be erected to provide data for operational purposes.

63. **Groundwater Monitoring** Surface and underground waters constitute a single hydrological system and should be managed as such in order to prevent uncontrolled pollution and depletion. There is very little information on groundwater behaviour in the Blackwater River catchment. If accurate information is available on surface water flow, rainfall and evapotranspiration, the groundwater component can be deduced. In addition, there is a need to monitor the variation in groundwater levels in areas which are identified as aquifers.

64. **Hydrometric Schemes** Locations for river and stream gauging in the Blackwater catchment have been recommended by An Foras Forbabtha after consultation with the County Councils concerned. These schemes took into account any locations where data was being collected by the Office of Public Works and other Public Bodies. An examination of the data, which is coming from the various gauging stations, shows that there is a need to improve the stability and sensitivity of gauging stations. Discussions should take place with the Geological Survey Office in order to prepare a scheme for collecting data on groundwater.

64. The feasibility of improving the collection of rainfall data, particularly at higher altitudes, should be investigated in conjunction with the Meteorological Service. The monitoring of water quality is part of the overall hydrometric scheme for the river catchment and the extent and variation of the water quality monitoring programme will have a bearing on the need for surface and groundwater grow data.

Appendix 2.1

1. Depth to Water Table.

The estimate of depth to the water table should be the average position of the highest water table level. As a rough guide the depth of the water table can be found by dipping the nearest well when the well is not being pumped i.e. is at rest. The presence of springs at the site would suggest that the water table is at the ground surface. Having obtained a depth of the water table at a location some distance away from the site, it can be taken, as a rough guide, that if the site is topographically higher than the well location, then the depth to water table is somewhat deeper and the opposite would apply if the site was topographically below the well.

2. Sorption.

Many contaminants are retained on earth materials by chemical or physical sorption and the extent to which sorption occurs is not easily determined. Clays tend to have a greater sorption capacity than sand and fractured rock has poor sorption capacity. The length of the column through which sorption occurs extends from the point of release of the pollutant to the point of water use. To get a good sorption value it is necessary to express the types of earth materials through which the contaminant is likely to move in segments or equal length. For example, if 30 ft. of clays underlie a septic tank 152 ft. from a well drawing water from coarse clean sands, the total moving distance is 180 ft., thus there are six segments of 30 ft. each, four 30 ft. segments in coarse sand (1½ points) and two segments in clay (6 points) or an average of about 3 points.

3. Permeability.

In this system only very rudimentary values are used. A sandy clay would be assigned 3 points but a light impermeable clay would be assigned 1 point. A coarse sand may be assigned no points and consolidated rock 1 point.

4. Water Table Gradient.

Both the direction and rate of flow of groundwater are important considerations in evaluating the possibility of contamination at a specific site. As water table maps are generally not available and a hypothetical water table map on the general gradient of the water table and general direction of water movement may be visualised.

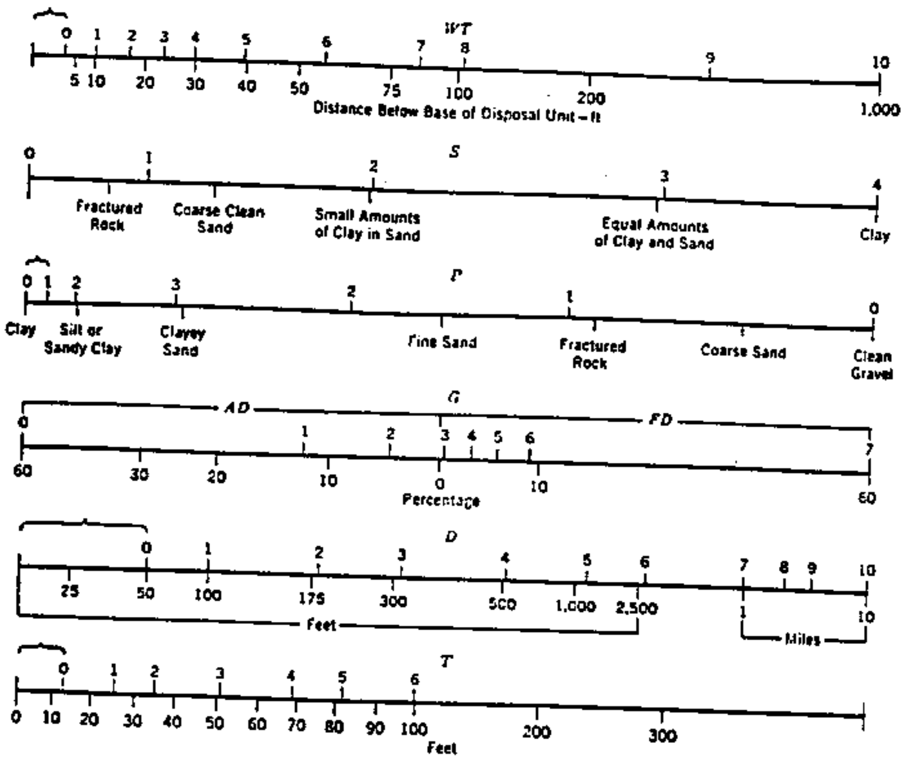
.../

4. The water table gradient can be assumed in most cases to follow the slope of the ground. It is however important to know if a contaminant is moving towards or away from a point of water supply. One can only average the gradient in a general way and select the point systems that seem proper.

5. <u>Distance to Point of Use.</u>

The chance of pollution decreases as the distance between the source of contamination and point of water use increases as (a) Dilution tends to increase with distance, (b) Sorption tends to be more complete with increase in distance, (c) Time of travel tends to increase with distance thus decay or degradation is more complete. (d) The water table gradient tends to decrease with distance so that the velocity of flow decreases with distance from disposal site.

The rating Chart for the various parameters is shown below.



Appendix 2.3

The scale for the various factors are labelled as follows; W T Water Table, S Sorption, P Permeability, G Gradient, D Distance, T Thickness of porous granular material below disposal point. On all scales the point values are indicated by the upper scale; the brackets indicate unacceptable ranges for any factor, excepting the two brackets on the gradient scale, one labelled Ad, which is for an adverse direction of flow (towards point of water use).

For each location, points for the various factors should be recorded and a record sheet kept on each development. A small map (6" Scale) showing salient features should also be included. The map should show location of possible pollutant (Septic Tank or whatever) slope of ground, any wells in locality and rock outcrop observed. The sample record sheet can be modified to suit the Councils Records and filing system.

DRAFT WATER QUALITY MANAGEMENT PLAN
FOR
THE RIVER BLACKWATER CATCHMENT

VOLUME 3
****

ABSTRACTIONS
and
DISCHARGES
****

ENVIRONMENTAL DEPT.,
CORK CO.COUNCIL,
COUNTY HALL,
CORK.

December 1987

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SCHEME NAME	COUNTY	RIVER CATCHMENT	SOURCE TYPE	LOCATION OF SOURCE	DAILY VOL.M^3
BALLYHEA	C	AWBEG	ARTESIAN WELL	SHINANAGH	772.00
JAMESTOWN	C	AWBEG	BORE	JAMESTOWN	1182.00
GRANGE - JOHNSTOWN	C	FUNSHION	BORE	DOWNING BR.	727.00
KILWORTH	C	FUNSHION	BORE	DOWNING BR.	545.00
KILDORRERY (2)	C	FUNSHION	BORE	GLENAVUDDIG	360.00
KILLAVULLEN	C	BLACKWATER	BORE	BALLYMACMOY	347.00
BALLYVINITER	C	BLACKWATER	BORE	BALLYVINITER & OLIVERS X	250.00
RATHMORE	K	ANNASKIRTAUN	BORE	GORTNAGANE	182.00
LAURENTUM	W	LICKY	BORE	LAURENTUM	115.00
TULLYLEASE	C	ALLOW	BORE	JONES X-ROADS	92.00
CAPPAGH	W	FINISK	BORE	CAPPAGH	40.00
PALLAS GROUP	C	BLACKWATER	BORE	CARRIGANE	36.37
MOANIG - BALLYDA	C	BRIDE	BORE	MOANIG	36.00
TOORANEENA	W	FINISK	BORE	TOORANEENA	25.00
AGLISH(GLENCAIRNE)	W	BRIDE	BORE	COOLYDOODY	23.00
MODDIGO	W	FINISK	BORE	NEWTOWN	23.00
GRALLAGH	W	LICKY	BORE	GRALLAGH	20.00
BALLYMOATE	W	BRIDE	BORE	BALLYMOATE	20.00
BOOLAVONTEEN	W	FINISK	BORE	BOOLAVONTEEN	20.00
CAMPHIRE	W	BRIDE	BORE	CAMPHIRE	16.00
STRANCALLY	W	BLACKWATER	BORE	STRANCALLY	14.00
BARRACK	C	CLYDAGH	BORE	BOTTLEHILL	14.00
BALLYCURRANE	W	LICKY	BORE	BALLYCURRANE	14.00
GEOISH	W	GOISH	BORE	GEOISH	14.00
UPPER QUARTERTOWN	C	CLYDAGH	BORE	UPPER QUARTERTOWN X	13.64
KILMORE-KILBEG	W	BRIDE	BORE	KILMORE	12.00
GLENAWILLIN	W	BRIDE	BORE	GLENAWILLIN	10.00
KEREEN	W	FINISK	BORE	KEREEN	10.00
LACKEN	W	FINISK	BORE	MOORE'S WELL	8.00
TINABINNA	W	BLACKWATER	BORE	TIKNOCK (KINSALEBEG)	7.00
LACKEN	W	FINISK	BORE	GLENSHELANE	7.00
UPR. DROMORE	W	GOISH	BORE	DROMORE	5.00
TAUR	C	ALLOW (DALUA)	BORE	TAUR	5.00
LISMORE-CAPPOQUIN-BLYDUF	W	BLACKWATER	BORE	LEFANTE	1.00
LISMORE-CAPPOQUIN-BLYDUFF	W	GLENSHELANE	BORE	SHANBALLY	1.00
GWEEING & MONKEY BRIDGE	C	CLYDAGH	BORE & INDIAN WELL	GWEEING	14.00
CHARLEVILLE	C	AWBEG	BORE (3 No.)	BALLYNAGERAGH	2300.00
KILTRISLANE-BALLYBEG	C	GRADOGE	BORE (PP)	KILLTRISLANE	3200.00
LABBANOLAGA	C	SHEEP RIVER	BORE (PP)	LABBAMALOGGA	60.55
KILMURRY	C	BLACKWATER	BORE (PP)	KILMURRY	60.00
KILCLARE	C	BRIDE	BORE (PP)	KILCLARE	55.00
KILMAGNER	C	BRIDE	BORE (PP)	KILMAGNER	50.72
MACRONEY	C	ARAGLIN	BORE (PP)	MACRONEY	46.00
GLENLEIGH	C	ANNASKIRTAUN	BORE (PP)	GLENLEIGH	45.66
MONEE - KNOCKBRACK	C	CLYDAGH	BORE (PP)	MONEE X	41.10
ROSKEEN	C	BLACKWATER	BORE (PP)	ROSKEEN	36.75
KNOCKNALOMAN	C	BLACKWATER	BORE (PP)	CAHERBARNAGH	36.29
GORTNASKEHY	C	ARAGLIN	BORE (PP)	ARAGLIN	31.44
BALLYELLIS	C	BLACKWATER	BORE (PP)	BALLYELLIS (UDC)	29.24
CASTLEWRIXON	C	AWBEG	BORE (PP)	CASTLEWRIXON	26.61

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TABLE 3.1	PUBLIC ABSTRACTIONS

SCHEME NAME	COUNTY	RIVER CATCHMENT	SOURCE TYPE	LOCATION OF SOURCE	DAILY VOL.M^3
GORTNAGRAIGA	C	CLYDAGH	BORE (PP)	GORTNAGRAIGA	26.40
BOHERASCRUB	C	AWBEG	BORE (PP)	BOHERASCRUB	23.33
CARRIGCLEENA MORE	C	CLYDAGH	BORE (PP)	CARRIG CLEENA	22.02
LYREVOICANE	C	FINNOW	BORE (PP)	DERRINAGREE	21.03
MOUNTAIN BARRACK	C	ARAGLIN	BORE (PP)	MOUNTAIN BARRACK	21.03
KNOCKSKAVANE	C	ALLOW	BORE (PP)	KNOCKSKAVANE	19.37
MONAPARSON	C	CLYDAGH	BORE (PP)	MONAPARSON	17.25
KILDINAN (1)	C	BRIDE	BORE (PP)	GLANNAGAUL	16.00
LAGHT	C	OWENBAUN	BORE (PP)	LAGHT	15.26
KNOCKDROMACLOGH	C	BLACKWATER	BORE (PP)	KNOCKDROMACLOGH	15.00
MOANABRICKA	C	MAIGUE	BORE (PP)	MOANABRICA	13.90
BALLYNAMONA	C	CLYDAGH	BORE (PP)	DROMORE	13.02
SCRAHAN	C	BLACKWATER	BORE (PP)	KNOCKNAGREE	11.82
MOYDILLIGA	C	BRIDE	BORE (PP)	BROWNSTONE CROSS	10.20
COOLNAGILLAGH UPPER	C	BLACKWATER	BORE (PP)	COOLNAGILLAGH	10.04
KNOCKERAGH	C	ALLOW	BORE (PP)	KNOCKERAGH	9.71
CASTLECOOKE	C	ARAGLIN	BORE (PP)	CASTLECOOKE	9.12
KILCASKIN	C	ALLOW	BORE (PP)	KILCASKIN	7.01
COOLE LOWER	C	BRIDE	BORE (PP)	COOLE	6.93
DROMCUMMER	C	BLACKWATER	BORE (PP)	DROMCUMMER	4.65
BALLYBROWNEY	C	BRIDE	BORE (PP)	BALLYBROWNEY MOUNTAIN	3.20
KNOCKANEVIN	C	SHEEP RIVER	BORE (PP)	KNOCKANEVIN	2.20
LYRE-ARAGLIN	C	ARAGLIN	BORE (PP)	LYRE	0.46
BALLYDESMOND	C	BLACKWATER	BORED WELL	U/S BALLYDESMOND BR.	90.00
ALLOW REGIONAL	C	ALLOW	RIVER	FREEMOUNT	2496.00
MALLOW URBAN	C	CLYDAGH	RIVER	CLYDAGH BRIDGE	2273.00
YOUGHAL	W	GLENDINE	RIVER	GLENDINE RIVER	1920.00
MITCHELSTOWN (2)	C	FUNSHION	RIVER	GALTEE MOUNTAINS	1020.00
LISMORE-CAPPOQUIN-BLYDUFF	W	OWENASHAD	RIVER	ROUGH GLEN, GLENAKEEFFE	820.00
CONNA REGIONAL	C	BRIDE	RIVER	BRIDE BRIDGE	780.00
YOUGHAL	W	GLENDINE	RIVER	GLENDINE RIVER	720.00
TALLOW	W	BRIDE	RIVER	KILBEG	200.00
BANTEER - KNOCKBRACK	C	BLACKWATER	RIVER & SPRINGS	KNOCKBRACK	360.00
KILDORRERY (1)	C	FUNSHION	RIVER (Stream)	BALLYVISTEEN	70.00
FERMOY URBAN	C	BLACKWATER	RIVER INFILTRATION	CREGG	3005.00
NEWMARKET - KANTURK	C	ALLOW (DALUA)	SPRING	BALLINATONA	5910.00
KETRAGH	C	AWBEG	SPRING	KETRAGH	3909.00
DONERAILE-SHANBALLYMORE	C	AWBEG	SPRING	SHANBALLYMORE	2045.00
MILLSTREET (1)	C	FINNOW	SPRING	TUBRID WELL	1500.00
CASTLETOWNROCHE	C	AWBEG	SPRING	CASTLETOWNROCHE	1306.00
MOUNTHNORTH	C	AWBEG MINOR	SPRING	MOUNTNORTH	830.00
GLANWORTH - BALLYENIHAN	C	FUNSHION	SPRING	BALLYKENLY	680.00
MITCHELSTOWN (1)	C	GRADOGE	SPRING	GLENATLUCKY	480.00
HEATHERSIDE	C	AWBEG	SPRING	BALLYHOURA HILLS	310.00
SCARTEEN	C	DALUA	SPRING	BALLINATONA	300.00
CONNA	C	BRIDE	SPRING	KILCLANE UPR.	273.00
GLANTANE	C	BLACKWATER	SPRING	LAHARN	182.00
BALLYDUFF-BALLYLEMON	W	FINISK	SPRING	GLENAVADDRA	115.00
MILLSTREET (2)	C	BLACKWATER	SPRING	CAHERBARNAGH	109.00
KNOCKNAGREE	C	BLACKWATER	SPRING	KNOCKNAGREE	90.92

TABLE 3.1 PUBLIC ABSTRACTIONS

SCHEME NAME	COUNTY	RIVER CATCHMENT	SOURCE TYPE	LOCATION OF SOURCE	DAILY VOL.M^3
CULLEN	C	OWENTARAGLIN	SPRING	MULLAGHROE	90.00
BALLYMAGOOLY	C	BLACKWATER	SPRING	DROMRAHAN	60.00
VILLIERSTOWN	W	BLACKWATER	SPRING	DROMANA WOOD	55.00
KILDINAN (2)	C	BRIDE	SPRING	SHANBALLY HOUSE	54.00
KISKEAM	C	OWENTARAGLIN	SPRING	KISKEAM BR.	41.00
CREGANE-GORTMORE	C	BLACKWATER	SPRING	CREGANE X	40.91
AGHLISH (DUNGARVAN)	W	GOISH	SPRING	BALLAILANE	40.00
WATERGRASSHILL	C	BRIDE	SPRING	WATERGRASSHILL	25.00
NEWCASTLE RD-MT MELLARY	W	GLENFALLIA	SPRING	GLENFALLIG BRIDGE	25.00
RAHAN	C	BLACKWATER	SPRING	FIDDANE	23.00
KILCOONEY	W	FINISK	SPRING	KILCOONEY	20.00
TALLOW HILL	W	BRIDE	SPRING	TALLOWBRIDGE	20.00
CARRAIGNAGOWER	W	OWENASHAD	SPRING	CARRIGNAGOWER	20.00
CLASHMORE	W	LICKY	SPRING	BALLYNAMULTINA	20.00
BALLYHEAPHY	W	GLENMORE	SPRING	KNOCKACULLEN	20.00
INCHINLLAMY	W	ARAGLIN (BW?)	SPRING	TOBERAHULLA	15.00
BALLYNOE	W	GLENFALLIA	SPRING	BALLYNOE	15.00
SHEAN	W	BLACKWATER	SPRING	SHEAN	10.00
BALLYSAGGART	W	GLENMORE	SPRING	FEAGARRID	10.00
LYRE	C	LYRE	SPRING	LYRE	9.10
NADD	C	GLEN	SPRING	NADD	9.10
MEELIN	C	ALLOW (DALUA)	SPRING	MEELIN	5.00
BALLYNOE	C	BRIDE	SPRING & BORE	BOOLADURRAGHA	90.82
DROMAHANE & KILCOLMAN	C	CLYDAGH	SPRING & BORE	DROMAHANE	60.00
BARTLEMY	C	BRIDE	SPRING & BORE	MOANIG	63.00
KILLALLY	C	DOUGLAS	SPRING(S)	KILWORTH (2km.N)	23.00
KILCORNEY	C	OWENBAUN	WELL	KILCORNEY	60.00

Abstractions and Discharges

Introduction

Three of the more important uses of a river resource are :

i) Abstractions for various uses including

Domestic,
Industrial,
Agricultural.

ii) Controlled disposal of wastes,ie. Discharges

iii) Fisheries, recreational and commercial

The use of a river for the disposal of effluent is important but this use can run counter to the use of a river as a potable water source if the necessary effluent standards are not defined and maintained.

A river management plan must include plans to conserve water supplies at the standards appropriate to the various reaches of the river having regard to present and potential future use.

Abstractions

In 1978 a national survey of Abstractions and discharges was carried out by local authorities on behalf of the DOE and co-ordinated by AFF.

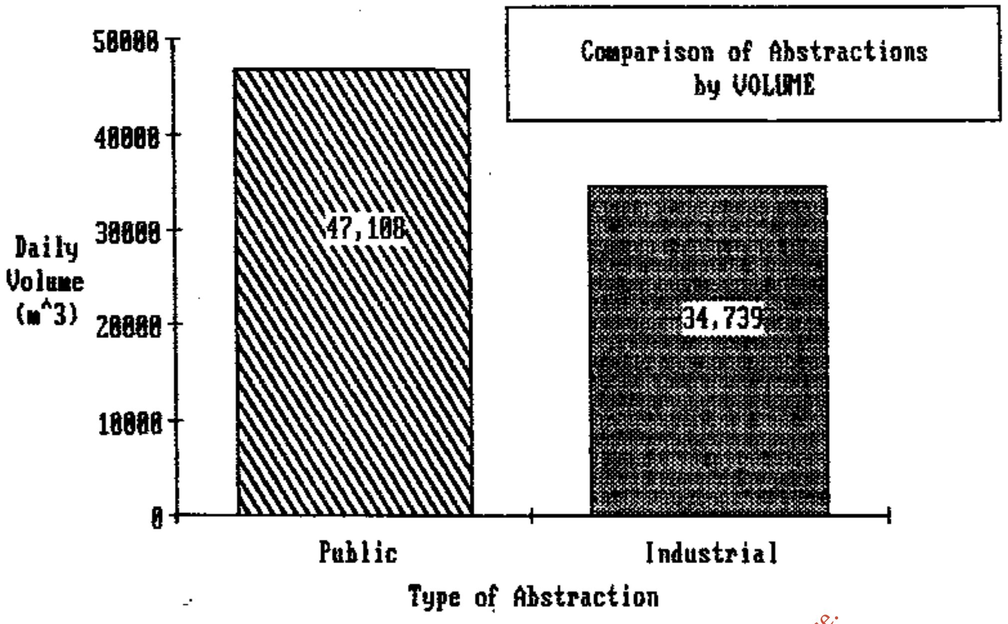
This information which was revised where necessary has been used in compiling Table 3.2 .

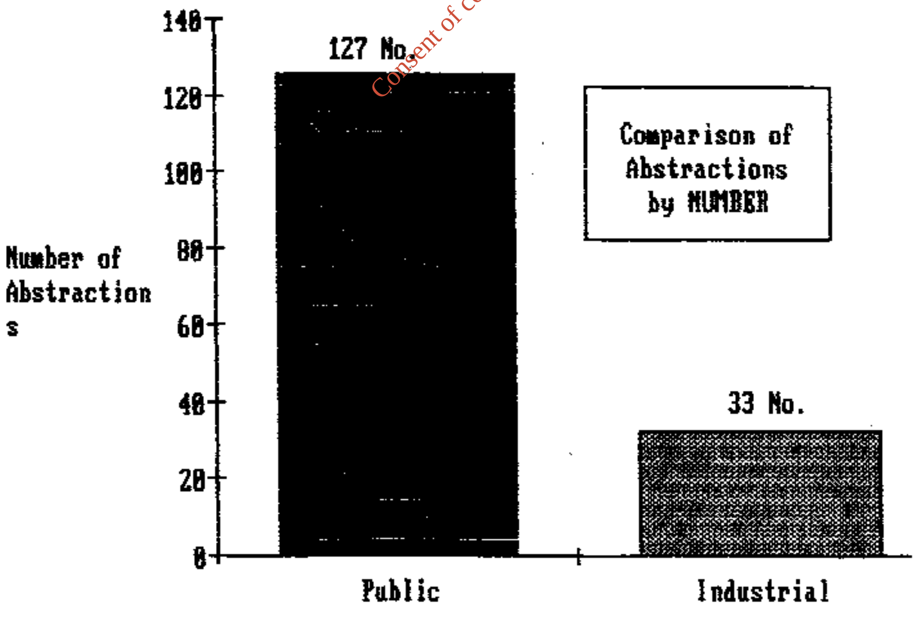
Table 3.2 shows and compares the Public and Industrial abstractions by volume and by number. Fig.3.1 compares these graphically.

TABLE 3.2 VOLUME OF PUBLIC AND INDUSTRIAL ABSTRACTIONS.

ABSTRACTION TYPE		VOLUME	%/Vol.	NO.	%/No.
Public		47,108	58	127	80
Industrial		34,739	42	31	20
	Total =	81,847		159	
Public	(River source)	14,464	31	10	8
Public	(Non river source)	32,644	69	117	92
Industrial	(River source)	21,084	61	4	13
Industrial	(Non river source)	13,655	39	27	87
		34,739		31	

FIGURE 3.1 Comparision of Abstractions by Volume and by Number





Type of Abstractions.

Table 3.2 and Fig 3.1 show the following:

The total volume of water abstracted per day is 81,847 m^3

The volume of Public abstractions is 1.36 times the volume of Industrial abstractions.

The ratio (by vol.) of non river to river sources is 2.2 to 1 in the case of public abstractions and the ratio is 1.5 to 1 in the case of industrial abstractions.

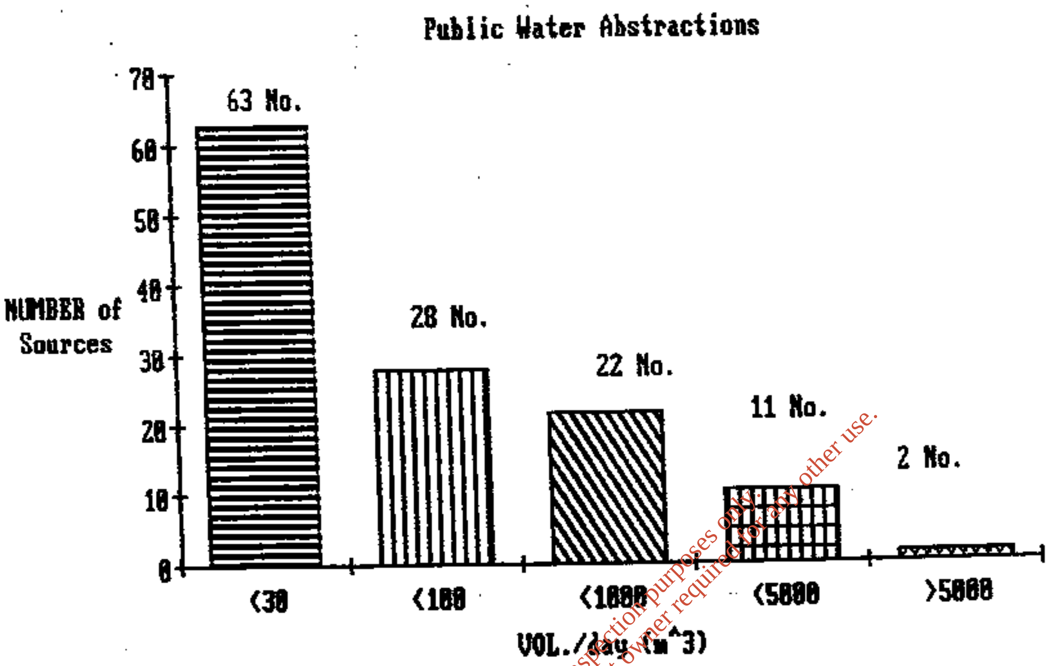
Table 3.3 lists and compares the Types and Volumes of Public sources.

Fig. 3.2 compares these graphically.

TABLE 3.3 Types of sources (PUBLIC) and vol/day for same

SOURCE	VOL. m^3	%/Vol.	NO.	%/No.
Springs	21,111	45	41	32
Rivers	11,459	24	10	8
Bores	10,608	23	73	58
Infiltration gallery.	3,005	6	1	
Others	832	2	2	2
Total	47,015		127	

FIGURE 3.2 Comparison of Public Abstractions by NUMBER and TYPE



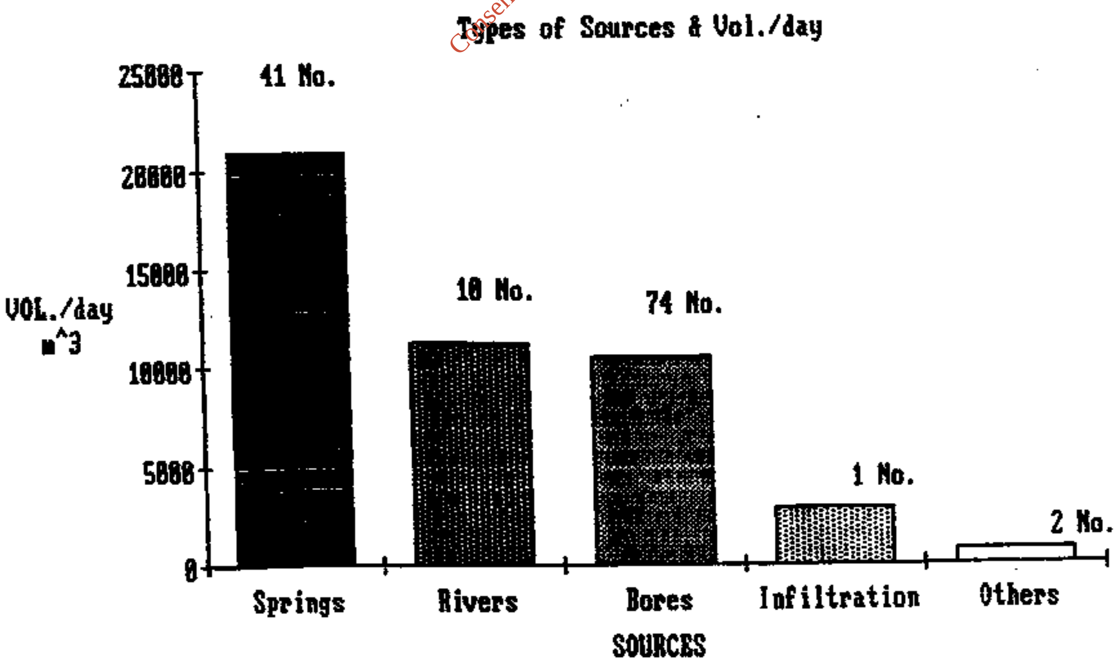


FIGURE 3.2 and TABLE 3.3 show the following;

Rivers account for 31% (14,464m^3) of the daily volume of public abstractions and groundwater sources account for the other 69%.

Groundwater sources are far more numerous than river sources accounting for 117 (92%) out of the 127 sources.

Table 3.4 below lists the River sources used for Public Abstraction:

SCHEME	CO	SOURCE	LOCATION	M^3/day
Allow Regional	C	Allow	Freemount	2496
Mallow Urban	C	Clydagh	Clydagh Bridge	2273
Youghal (2 No.)	W	Glendine	Glendine River	1920
Mitchelstown	C	Funshion	Galtee Mountains	1820
Lismore-Cappoquin -Ballyduff	W	Owenashad	Rough Glen, Glenakeeffe	820
Conna Regional	C	Bride	Bride Bridge	780
Tallow	W	Tallow	Kilbeg	200
Banteer-Knockbrack	C	Stream	Knockbrack	360
Kildorrery	C	Stream	Ballyvisteen	70

Potential sources of pollution to River abstractions are:

Direct contamination of the river upstream of the abstraction point

Surface water runoff from a contaminated area adjacent to the river upstream of the abstraction point.

The sources of contamination include chemical spillages on roads and agricultural sources.

It has been necessary to stop the abstraction of water for the Allow Regional water supply scheme on a number of occasions due to pollution of the river by slurry and other agricultural pollutants.

The use of Section 12 of the 1977 Water Pollution Act by Cork Co. Council has helped to reduce the incidence of pollution of the River Allow upstream of Freemount.

Pollution of Groundwater sources.

Careless and negligent storage and disposal of agricultural wastes pose the major threat to groundwater sources. This is especially so in the case of the Dinantian limestone areas (fissured aquifer) referred to in Volume 2.

Cork Co.Council and Waterford Co.Council have organised geological surveys of the more critical areas in the Blackwater catchment. These surveys have highlighted areas of major risk and have made various reccomendations and suggested precautions to minimise the danger to the groundwater sources from Agricultural Pollution.
(c.f. Volume 2 Page 2.6)

Table 3.5 below lists the number of abstractions within the daily volume ranges as shown.

TABLE 3.5 PUBLIC WATER ABSTRACTIONS (Vol.by number)

	m^3		NO.		m^3			m^3
	0	<	22	<	10		Volume =	140.56
	10	<	28	<	20		Volume =	443.58
	20	<	14	<	30		Volume =	338.66
Total			64			(50%)		922.80
	30	<	7	<	40		Volume =	216.85
	40	<	5	<	50		Volume =	214.75
	50	<	6	<	60		Volume =	334.72
	60	<	5	<	70		Volume =	329.55
	70	<	0	<	80		Volume =	000.00
	80	<	3	<	90		Volume =	262.00
Total			26			(20%)		1357.87
	90	<	3	<	100	(2%)	Volume =	272.74
	100	<	22	<	1000	(17%)	Volume =	9481.00
	1000	<	11	<	3300	(9%)	Volume =	23215.00
	5000	<	2			(2%)	Volume =	11819.00

Table 3.5 shows that the majority (64 No. = 50%) of public abstractions are less than 30m^day.

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INDUSTRIAL ABSTRACTIONS

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TABLE 3.6 INDUSTRIAL ABSTRACTIONS

INDUSTRY NAME	INDUSTRY TYPE	COUNTY	RIVER CATCHMENT	SOURCE TYPE	LOCATION OF SOURCE	DAILY VOL.M^3
MITCHELSTOWN CO-OP	CREM	C	FUNSHION	BORE	GROUNDS	7274.00
BALLYCLOUGH CO-OP (2)	CREM	C	BLACKWATER	BORE	GROUNDS	2273.00
CASTLELYONS CREAMERY.	CREM	C	BRIDE	BORE	GROUNDS	1820.00
KANTURK CREAMERY (N.CORK)	CREM	C	ALLOW	BORE	GROUNDS	456.00
HORGAN MEATS	MEAT	C	AWBEG	BORE	GROUNDS	252.00
NEWMARKET CREAMERY	CREM	C	ALLOW (DALUA)	BORE	GROUNDS	227.30
AGRA MEATS,WATERGRASSHILL	MEAT	C	BRIDE	BORE	GROUNDS	227.00
GALTEE BACON	MEAT	C	FUNSHION	BORE	GROUNDS	227.00
MALLOW MART	MART	C	BLACKWATER	BORE	GROUNDS	90.00
FERMOY MART,	MART	C	BLACKWATER	BORE	GROUNDS	90.00
LISMIRE CREAMERY (NM)	CREM	C	ALLOW	BORE	GROUNDS	69.00
ROWELS CREAMERY (NM)	CREM	C	ALLOW	BORE	GROUNDS	69.00
KISKEAM CREAMERY (NM)	CREM	C	OWENTARAGLIN	BORE	GROUNDS	60.00
LAKEVALE CREAMERY (NM)	CREM	C	BLACKWATER	BORE	GROUNDS	55.00
JOHN.A.WOODS,BALLYGIBLIN	CONC	C	AWBEG MINOR	BORE	GROUNDS	45.00
FREEMOUNT CREAMERY (GV)	CREM	C	ALLOW	BORE	FREEMOUNT	41.00
ARAGLIN CREAMERY (M)	CREM	C	ARAGLIN	BORE	GROUNDS	30.00
MITCHELSTOWN MART,	MART	C	FUNSHION	BORE	GROUNDS	20.00
NOEL C.DUGGAN,	CONC	C	ALLOW	BORE	GROUNDS	17.00
KANTURK MART	MART	C	ALLOW	BORE	GROUNDS	15.00
FRANK O'CONNOR,FERMOY.	CHEM	C	BLACKWATER	BORE	GROUNDS	14.00
MILLSTREET MART	MART	C	FINNOW	BORE	GROUNDS	10.00
J.O'CONNOR, KANTURK.	DRNK	C	ALLOW	BORE	GROUNDS	10.00
MICRO BIO,FERMOY.	CHEM	C	BLACKWATER	BORE	GROUNDS	10.00
CUMMER CREAMERY (NM)	CREM	C	ALLOW	BORE	GROUNDS	5.45
GLASLAKINLEEN (NM)	CREM	C	ALLOW	BORE	GROUNDS	5.00
RATHMORE CREAMERY (K)	CREM	K	BLACKWATER	BORE	GROUNDS	3.00
DROMTARIFFE (BC)	CREM	C	BLACKWATER	BORE	GROUNDS	3.00
OWEN BINCHY, KANTURK.	BAKE	C	ALLOW	BORE	GROUNDS	3.00
KILCORNEY CREAMERY (BC)	CREM	C	OWENBAUN	BORE	GROUNDS	1.00
C.S.E.T. MALLOW	BEET	C	BLACKWATER	RIVER	GROUNDS	14025.00
FRY CADBURY,RATHMORE.	CHOC	K	BLACKWATER	RIVER	GROUNDS	4860.00
BALLYCLOUGH CO-OP (1)	CREM	C	BLACKWATER	RIVER	GROUNDS	2727.00
AN FORAS TALUNTAIS	FARM	C	FUNSHION	RIVER	MOOREPARK,FERMOY.	682.00
*** Total ***						34915.75

INDUSTRIAL ABSTRACTIONS

The volume of water abstracted each day in the Blackwater catchment by Industry is approximately 34,739 m^3.

This is 73% of the volume abstracted for public use.

Table 3.7 and Fig. 3.5 below show the type ,number and volume of the various industrial abstractions.

TABLE 3.7 TYPE, NUMBER, AND VOLUME OF INDUSTRIAL ABSTRACTIONS

Industry	No.	Daily Volume m^3	% / Vol.
Bakery	1	3	
Beet Factory	1	14,025	40
Chemical	2	14	0.04
Chocolate Products	1	4,636	13
Creamery	17	15,116	44
Drink	1	10	0.03
Marts	5	225	0.65
Meat Processing	3	710	2
	31	34,739	

Table 3.7 above shows the following:

Creameries are the largest users of water with 44% by volume of the total Industrial Abstractions.

The C.S.E.T. factory at Mallow with an abstraction rate of 14,025 m3/day accounts for 40% of the Industrial Abstractions.

The rate of abstraction varies from 25,296 m^3/day during the beet campaign (October to January) to 9,456 m^3/day for the rest of the year.

This gives an average daily abstraction rate of 14,025 m^3/day calculated over one year.

This figure is used as a typical value in the statistical analysis of Abstraction Volumes.

FIGURE 3.3 INDUSTRIAL ABSTRACTIONS BY TYPE AND NUMBER
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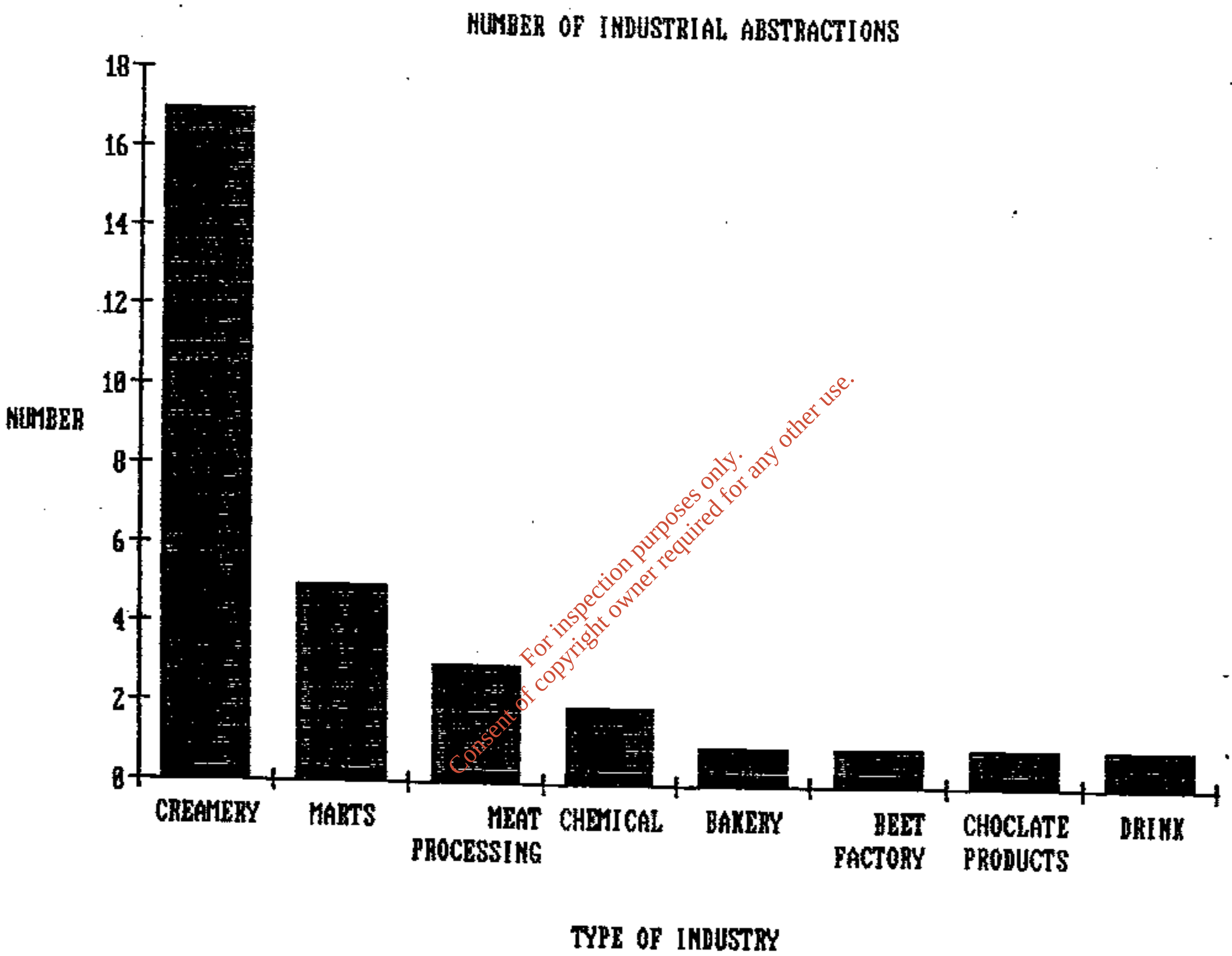

FIGURE 3.4 INDUSTRIALS ABSTRACTIONS - TYPES AND VOLUMES
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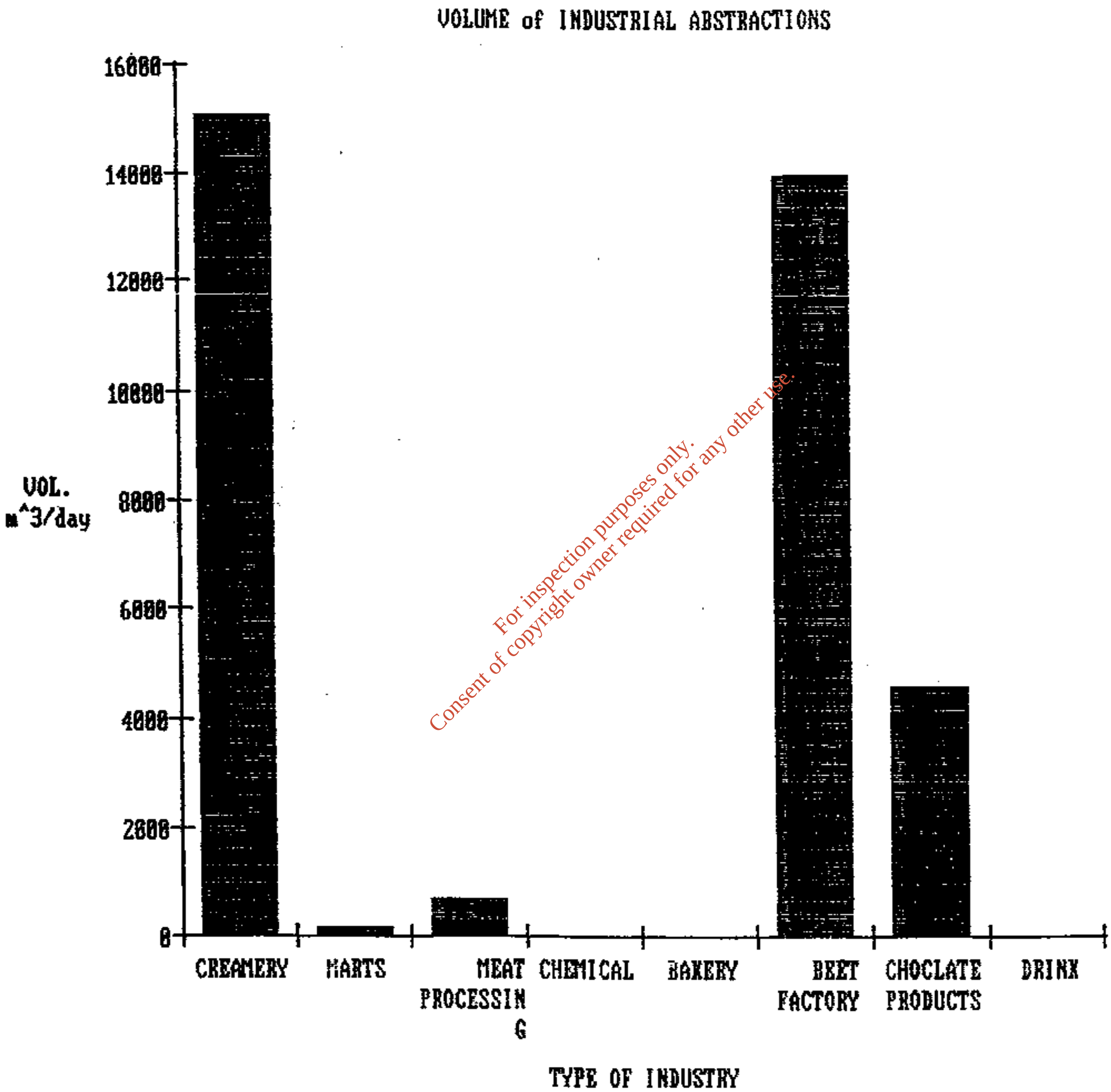


Table 3.8 and Fig. 3.5 compare the type, number and volume of Industrial Abstraction sources.

TABLE 3.8

Type and Volumes for the various sources of Industrial Abstractions.

Source.	No.	Vol/day (m^3)	%
Rivers	4	22,007	62
Bores	39	13,636	38
Springs	2	20	<1
		35,663	

There are 3 industries abstracting their water from the main channel of the Blackwater. Table 3.9 lists these.

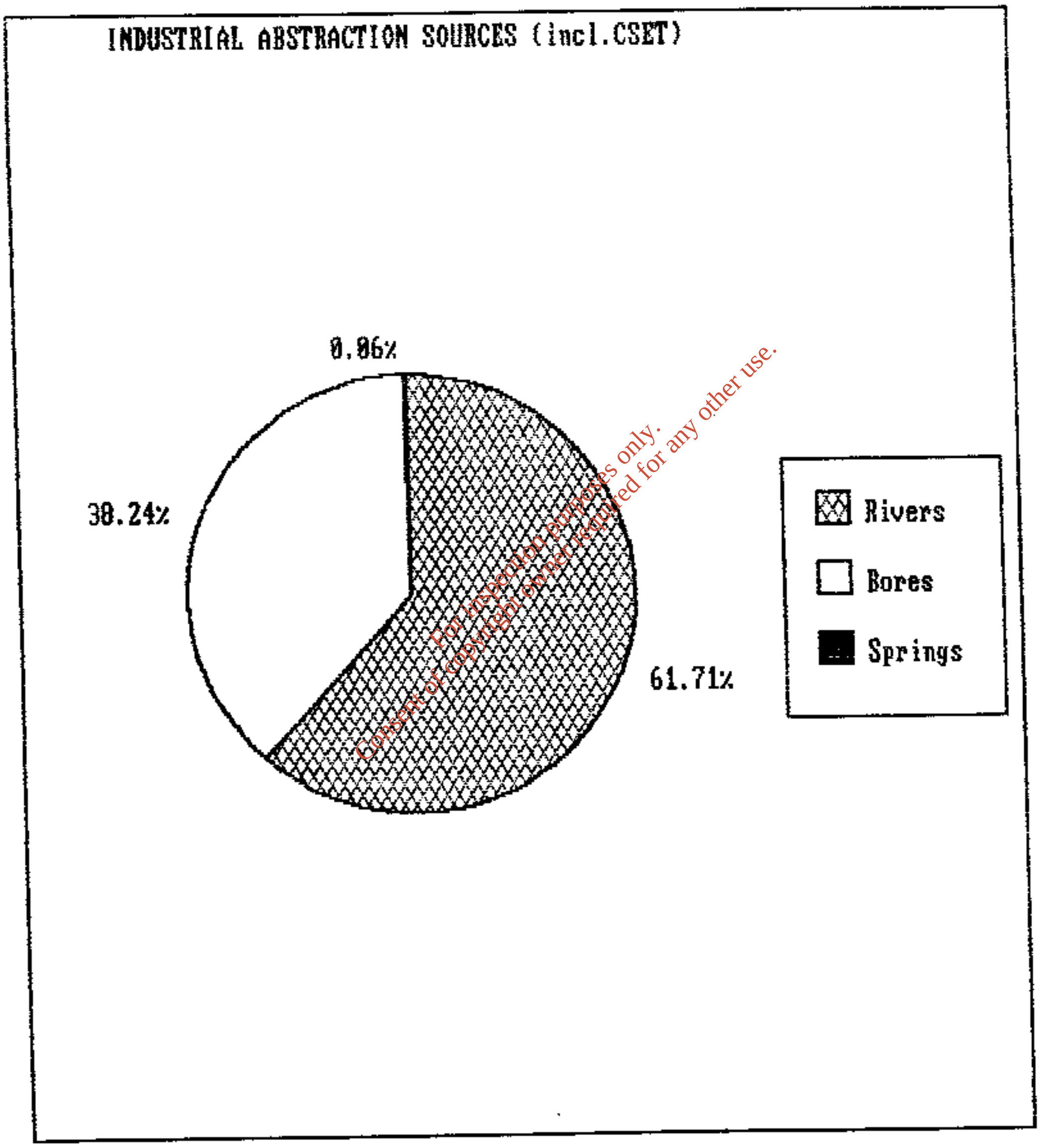
TABLE 3.9

Industries abstracting water from main channel of River Blackwater.

INDUSTRY	LOCATION	Daily VOL.
Fry Cadbury	Rathmore	4,636 m^3
C.S.E.T.	Mallow	14,025 m^3
Ballyclough Co-Op	Mallow	2,727 m^3
		21,388 m^3 total

The volume of 21,388 represents 60% of the volume of the daily industrial abstraction.

FIGURE 3.5 INDUSTRIAL ABSTRACTION SOURCES (PERCENTAGES)



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DISCHARGES

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TABLE 3.10 PUBLIC DISCHARGES

SCHEME NAME	COUNTY	RIVER CATCHMENT	DISCHARGE POINT	TYPE OF TREATMENT	DESIGN POPULATION	POPULATION SERVED	DAILY VOL.	BOD LOAD
LISMORE	W	BLACKWATER	RIVER B.WATER (d/s LISMORE BR.	E.A.	2400	1940	442	140.00
MILFORD	C	DEEL	DEEL	E.A.	500	264	60	1.20
CHURCHTOWN	C	AWBEG	STREAM	E.A.	120	107	27	0.59
CECILSTOWN	C	AWBEG MINOR	STREAM	E.A.	180	94	23	0.25
BALLYHEA	C	AWBEG	RIVER AWBEG	E.A.	125	60	14	0.21
MALLOW URBAN	C	BLACKWATER	RIVER BLACKWATER	O.D.	15000	7402	1701	39.40
FERMOY URBAN	C	BLACKWATER	RIVER B.WATER 1km d/s FERMOY	O.D.	9000	7000	2040	20.40
MILLSTREET	C	FINNOW	TRIB.TO FINNOW	O.D.	1600	1433	364	3.64
DONERAILE	C	AWBEG	RIVER AWBEG	P.F.	1000	1920	436	59.00
NEWMARKET	C	ALLOW (DALUA)	RIVER DALUA	P.F.	700	1025	233	34.00
MITCHELSTOWN	C	FUNSHION	RIVER FUNSHION	P.F.	11000	3200	800	19.20
CLONDULANE	C	BLACKWATER	TRIB.TO BLACKWATER	P.F.	200	202	46	13.80
BUTTEVANT	C	AWBEG	RIVER AWBEG	P.F.	1200	1161	264	6.86
BOHERBUE	C	ALLOW	RIVER BROGEEN	P.F.	400	600	136	4.36
WATERGRASSHILL	C	BRIDE	STREAM	P.F.	200	202	30	0.49
RATHMORE	K	BLACKWATER	RIVER BLACKWATER	P.F.	0	0	23	0.00
KANTURK	C	ALLOW	RIVER ALLOW	PRIMARY	2200	4475	441	60.42
TALLOW (300m d/s BRIDGE)	W	BRIDE	RIVER BRIDE	S.T.	360	777	336	45.00
KILDORRERY	C	FUNSHION	RIVER FUNSHION	S.T.	300	402	91	36.50
CAPPOQUIN (TWIG LANE)	W	BLACKWATER	RIVER BLACKWATER	S.T.	0	700	160	16.00
DROMAHANE	C	CLYDAGH	STREAM	S.T.	500	686	156	14.79
CULLEN	C	OWENTARAGLIN	RIVER OWENTARAGLIN	S.T.	120	124	28	11.20
TALLOW (500m d/s BRIDGE)	W	BRIDE	RIVER BRIDE	S.T.	86	160	70	10.00
DUNTAHANE	C	BLACKWATER	RIVER BLACKWATER	S.T.	400	400	91	9.10
CASTLETOWNROCHE	C	AWBEG	RIVER AWBEG	S.T.	470	455	103	7.21
KILWORTH	C	ARAGLIN	RIVER DOUGLAS	S.T.	300	402	91	6.92
BALLYDUFF (u/s BRIDGE)	W	BLACKWATER	RIVER BLACKWATER	S.T.	0	220	62	6.20
GLANWORTH	C	FUNSHION	RIVER FUNSHION	S.T.	300	335	76	6.08
CLASHMORE	W	BLACKWATER	GREGAGH STREAM	S.T.	0	240	55	5.50
VILLIERSTOWN	W	BLACKWATER	RIVER BLACKWATER (THE QUAY)	S.T.	0	0	50	5.00
BALLYHOOLEY	C	BLACKWATER	RIVER BLACKWATER	S.T.	100	104	24	4.70
BALLYCLOUGH	C	BLACKWATER	STREAM	S.T.	265	265	60	4.50
AGLISH	W	GOISH	RIVER GOISH (COOLROE)	S.T.	0	180	41	4.10
CAPPOQUIN (BY GAA FIELD)	W	BLACKWATER	RIVER BLACKWATER	S.T.	0	150	40	4.00
CAPPOQUIN (DANES FIELD)	W	GLENAFALLIA	RIVER GLENSHELANE	S.T.	0	150	40	4.00
KILLAVULLEN	C	BLACKWATER	RIVER ROSS	S.T.	250	199	45	3.60
RATHCORMAC	C	BRIDE	RIVER BRIDE	S.T.	200	247	60	3.00
KNOCKNAGREE	C	BLACKWATER	RIVER BLACKWATER	S.T.	200	285	74	2.66
SHANBALLYMORE	C	AWBEG	SOAKPIT	S.T.	120	100	25	2.50
TOORANEENA	W	FINISK	SOAKWAY	S.T.	0	100	23	2.50
PILLTOWN	W	BLACKWATER	SOAKWAY	S.T.	0	100	23	2.50
BANTEER	C	BLACKWATER	STREAM	S.T.	120	217	49	2.45
BRIDESBRIDGE	C	BRIDE	RIVER BRIDE	S.T.	150	170	39	1.95
RATHCOOLE	C	OWENBAUN	RIVER OWENBAUN	S.T.	150	150	34	1.70
BALLYDESMOND	C	BLACKWATER	RIVER BLACKWATER	S.T.	140	230	54	1.60
CASTLELYONS	C	BRIDE	STREAM (SHANOWEN)	S.T.	150	171	39	1.56

TABLE 3.10 PUBLIC DISCHARGES

SCHEME NAME	COUNTY	RIVER CATCHMENT	DISCHARGE POINT	TYPE OF TREATMENT	DESIGN POPULATION	POPULATION SERVED	DAILY VOL.	BOD LOAD
MEELIN (2 No.)	C	ALLOW	SOAKPIT	S.T.	100	110	30	1.50
BALLYDASOON	W	TOURIG	SOAKWAY	S.T.	0	60	15	1.50
SUNLAWN	W	FINISK	TRIB.TO FINISK	S.T.	0	50	12	1.25
FREEMOUNT	C	ALLOW	RIVER ALLOW	S.T.	118	122	28	1.10
BALLYDUFF	W	BLACKWATER	RIVER BLACKWATER	S.T.	0	40	10	1.00
BALLYDUFF (St.MARTINS)	W	BLACKWATER	RIVER BLACKWATER	S.T.	0	40	10	1.00
BALLYNOE	C	BRIDE	STREAM	S.T.	120	107	24	0.96
LISCARROL	C	AWBEG	STREAM	S.T.	200	276	63	0.91
CONNA	C	BRIDE	RIVER BRIDE	S.T.	100	93	21	0.84
KISKEAM	C	OWENTARAGLIN	RIVER OWENTARAGLIN	S.T.	150	132	30	0.84
LOMBARDSTOWN	C	BLACKWATER	RIVER DUBGLAISE	S.T.	50	40	9	0.63
LYRE	C	GLEN	SOAKPIT	S.T.	20	20	5	0.50
DERINAGREE	C	BLACKWATER	SOAKPIT	S.T.	0	20	5	0.50
TULLYLEASE	C	ALLOW	STREAM	S.T.	0	110	10	0.50
BALLINDANGAN	C	FUNSHION	STREAM	S.T.	20	20	5	0.50
CASTLEMAGNER	C	AWBEG MINOR	RIVER AWBEG MINOR	S.T.	100	50	11	0.33
NADD	C	GLEN	STREAM	S.T.	20	20	5	0.15

Discharges in the Blackwater Catchment

The principal discharges occurring in the Blackwater Catchment are generated from three sources:

Agricultural
Domestic
Industrial

The locating of the Agricultural discharges in the Blackwater catchment is mainly dependant on the general public reporting the existance of same to either Fisheries or the Local Authorities.

Unfortunately in a lot of cases the members of the public are unaware of whom to inform if and when they happen to observe the occurance of Agricultural discharges.

PUBLIC DISCHARGES

The 1978 national survey of discharges revised where necessary, has been used in compiling Table 3.10

Table 3.10 lists the Public discharges in the Blackwater Catchment.

Table 3.11 below lists the principal methods used by local authorities of treating domestic sewage and compares them by type, number and population served.

TABLE 3.11 Types of Sewage treatment use by local authorities

Treatment	No.	%	Population Served	
Extended Aeration	3	5	261	1%
Oxidation Ditch	3	5	8,917	27%
Percolating filter	7	12	6,822	21%
Primary (Imhoff)	1	2	4,475	14%
Septic Tank	43	73	7,004	21%
None	1	2	5,100	16%
	53		32,579	
* Private Septic tanks	9,246		36,984	
* No treatment	1,280		5,118	

* = figures for Co.Cork only.

Information on the number of persons served by the various sewerge schemes was supplied by the Sanitary Department of the authorities involved.

Quality of Effluent.

With both the domestic and industrial discharges the quality of the effluent varies enormously .

The estimation of BOD loads etc., for the various effluents is calculated using the median value of sampling results and the maximum rate of discharge of the effluent.

A number of factors may cause a bad quality effluent. These include the following:

- Overloading of the treatment works
- Mechanical fault at treatment works
- Lack of proper maintenance of the treatment works

The figures used for estimating domestic waste loads where no observed readings were available are shown below in Table 3.12.

TABLE 3.12 Factors For Estimating Domestic Loads.

Habitation factor = 4 persons / house

Water usage 227 litres / day / head.

Waste load = 0.054 kg BOD / day / head.

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INDUSTRIAL

DISCHARGES

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INDUSTRIAL DISCHARGES

The 1978 national survey of discharges with revisions where necessary has been used in compiling Table 3.13. (facing)

Monitoring of Industrial Discharges.

Effluent from the major creameries, C.S.E.T. and other industries such as meat processing plants are monitored regularily by local authorities and the daily waste loads were estimated from the results of these surveys.

Intermittent Discharge of Effluent by C.S.E.T.

C.S.E.T.'s system of discharging their effluent differs from other systems in that C.S.E.T. only discharge when the flow in the River Blackwater is equal to or greater than 55 m^3/sec. giving a dilution of more than 1 / 100 .

C.S.E.T. do not discharge during the summer months when critical low flows are most likely to occur.

Not withstanding this the daily waste load of 40,000 kg BOD from C.S.E.T. at a discharge rate of 50,000m^3 and a BOD of 800 mg/l is far in excess of daily waste load for the rest of the catchment.

Industries which are potential sources of pollution are dealt with in the next section.

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INDIVIDUAL EFFLUENT LOADS

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Individual Sources of Effluent in the Blackwater Catchment.

An analysis of river sampling results and the list of industries indicates the locations in Table 3.14 below as potential sources of pollution.

TABLE 3.14 Potential sources of Pollution.

River	Location	Potential Sources of Pollution
Blackwater	Rathmore	Rathmore Creamery Rathmore S.T.W. Fry Cadbury
Blackwater	Mallow	CSET Ballyclough Co-Op Mallow S.T.W.
Allow	Kanturk	North Cork Creamery Kanturk STW North Cork Creamery T.W.
Gradoge	Mitchelstown	Mitchelstown Co-Op T.W. Agricultural Sources u/s Mitchelstown
Funshion	Mitchelstown	Mitchelstown Co-Op T.W. Mitchelstown S.T.W. Agricultural Sources

The Mass Balance Formula can be used for determining the effect on receiving waters of effluent discharges.

$$\frac{FC + fc}{F + f} = \text{B.O.D. level of receiving waters d/s of discharge}$$

where

C = B.O.D. level of water u/s of discharge
c = B.O.D. level of effluent
F = River Flow u/s of discharge
f = Flow of discharge

Description of Individual Effluent Loads in the Blackwater Catchment.

RATHMORE DISCHARGES

Source	Vol. Discharged m3/day	BOD load kg/day
Rathmore Creamery	95	2
Rathmore S.T.W.	91	7.5
Fry Cadbury	15000	124

Rathmore Creamery (Kerry Co-Op)

Approximately 96m^3 of effluent is discharged from the creamery to the Cullavaw Stream at a point 650 metres u/s of it's confluence with the River Blackwater.

91 m^3 of this effluent is cooling water and the balance arises from the washdown of premises and the plant.

It is estimated that the BOD loading to the stream is approx. 2 kg BOD/day.

No sampling results area available for the effluent or the stream in the vicinity of the discharge point. However the stream was sampled just upstream of the confluence as part of a 24 hour survey in July 1985 and the average BOD (mg/1) was 3.02 with a peak value of 5.7.

Rathmore S.T.W.

The Rathmore Sewerage Treatment Works is a Percolating Filter type. It is located immediately d/s of the confluence of the Cullavaw Stream. at a point where the River Blackwater forms the county boundary between Cork and Kerry.

There are in the region of 100 houses connected into same. The treatment works discharges to the River Blackwater giving an organic loading of 7.5 kg BOD/day to the river.

Fry Cadbury

This company is engaged in the manufacture of chocolate. It's effluent is discharged to the River Blackwater at a point 400 m. d/s of Duncannon Bridge.

As in the case of the Rathmore S.T.W.(above), the River Blackwater forms the county boundary between Cork and Kerry at this point.

It's effluents include cooling water, treated domestic sewage (250 persons), treated washwater and cooling water. All these effluents are discharged through one pipe to the River Blackwater giving a load of 124 kg BOD/day (PE.2300).

In a low flow situation, any exceeding of the above loading could seriously effect the BOD and DO level in the river in the discharge point down to the Awnaskirtaun confluence.

NEWMARKET DISCHARGES

Scheme	Vol. Discharged m3/day	Kg BOD Load
Newmarket S.T.W.	270	18.0
Newmarket Creamery	227	3.0

Newmarket S.T.W

Approximately 270 m^3/day of treated effluent is discharged to the nearby River Dalua. The effluent is treated using a percolating filter system: the organic loading of the discharge is estimated at 18.0 kg. BOD/day. The plant is in need of overhaul as its mechanical state is only fair.

Newmarket Creamery

Approximately 227 m^3/day of effluent is discharged from a treatment works to the Rampart stream at a point 3 km u/s of its confluence with the River Dalua near Allens Bridge . The creamery produces milk, cheese and other dairy products. The organic loading of the discharge from the treatment plant to the stream is 3 kg. BOD/day. P.E. (60).

Kanturk Discharges

Scheme	Vol. Discharged m^3/day	Kg. BOD
Kanturk S.T.W.	441	47
North Cork Creameries	455	10

Kanturk S.T.W.

Approximately 441 m^3/day of effluent is discharged to the River Allow via a treatment works at a point 1 km. d/s of Kanturk town.

The efficiency of the treatment works is poor and this is reflected in the BOD values of the treated effluent.

In a 24 hour survey carried out in July 1985, the BOD of the effluent varied from a maximum of 100 ppm to a minimum of 21 ppm giving an average value of 65 mg/l BOD.

Spot samples taken in 1986 had BOD values ranging from a minimum of 106 ppm to a maximum of 160 ppm.

This treatment works needs to be replaced immediately as the loading on it far exceeds it's capacity.

North Cork Creameries

Approximately 455 m^3/day of effluent is discharged via a treatment works to the River Allow 20 metres d/s of the Kanturk S.T.W. outfall.

The creamery is the third largest in the Blackwater catchment and produces butter, cheese and milk.

The volume of effluent discharged to the river is 455 m^3/day and the organic loading is 10 kg BOD/day.

MALLOW DISCHARGES

Scheme	Vol. Discharged m3/day	Kg BOD/day
C.S.E.T.	50,000	40,000
Ballyclough Co-Op	3,182	89
Mallow S.T.W.	1,701	46
Mallow Mart	136	40

C.S.E.T.

This company is involved in the processing and refining of sugar beet. It is a seasonal industry being active from October to December inclusive.

It is located 3.5 km u/s Mallow and it's rate of discharge is in the region of 50,000 m^3/day. The effluent discharge point is located 1.0 km u/s of the factory on the River Blackwater.

The water is used for washing the beet and transporting same to the processing area. It is then pumped along with contaminated surface water to a sedimentation tank. Here the solids are settled out and are then pumped as "mudwater" to lagoons for storage and treatment. The effluent from the lagoons is discharged intermittently to the River Blackwater at a point 200 metres u/s Longfields Bridge when the flow in the river is greater than 55 m^3/sec.

FIGURE 3.2
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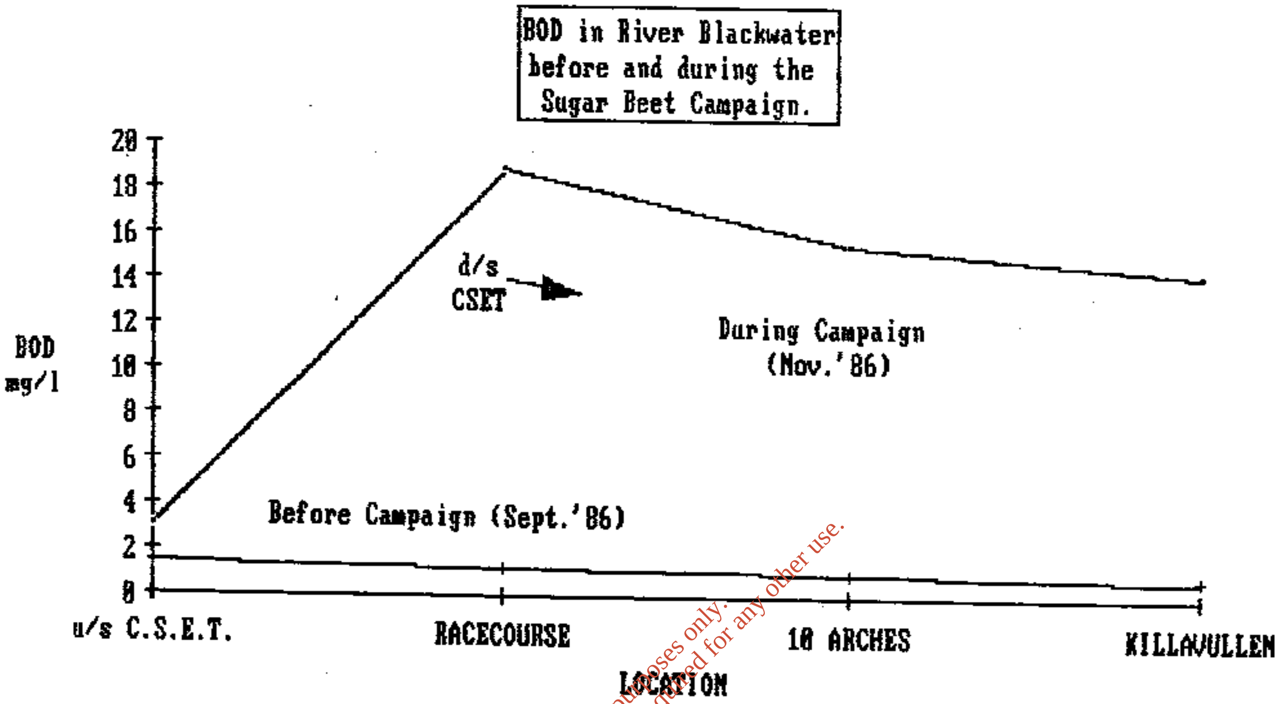
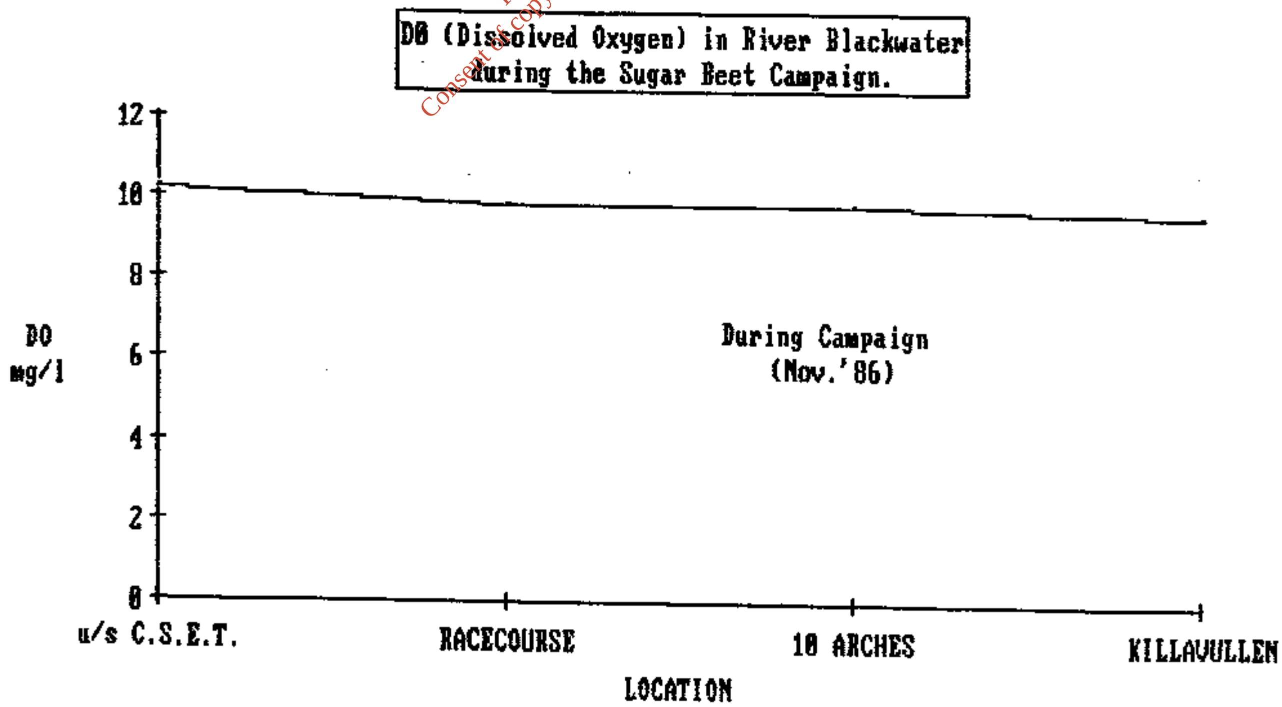
Variation in BOD and DO in the River Blackwater at Mallow before and during the Sugar Beet season.





The minimum dilution allowed is 1/100.

The BOD loading from the lagoons at a discharge rate of 50,000 m^3/day is in the region of 40,000 kg. BOD/day. This is equivalent to 26 times the BOD load for the rest of the catchment.(P.E. 500,000)

Even though the discharge can cause the BOD of the river to reach 20 ppm 4.2 km. d/s at the Ten Arches Bridge, the D.O. level is not greatly affected. This is probably due to the relatively low water temperatures and the increased reoxygenation caused by the turbulance in the river due to high flow.

The main effect of the C.S.E.T. discharge is the development of sewage fungus in the river below the outfall. This can be traced as far as Kilavullen (17 km. d/s) and beyond sometimes.
Sewage fungus (e.g. Sphaerotilus Natans) thrives on the nutrients available in the C.S.E.T. effluent and the reduced competition from other species during winter.

Due to high winter flows it is difficult to study the extent and effect of the sewage fungus cover on the river bed during the beet campaign.

The possible detrimental effects of sewage fungus on the Mallow stretch of the Blackwater would include a reduction of food organisms of fish and an increase in silting up of the river bed.

Experiments with the rate and period of dischargeing have been carried out in an effort to find the best discharge regime.

A licence to discharge effluent to the River Blackwater was granted to C.S.E.T. in September 1987. The licence consisted of eighteen conditions including a timetable for the improvement of the quality of the effluent.

To meet these conditions it may be necessary to extend the present effluent storage facilities to improve the quality of the final effluent through anaerobic action. Additional treatment of the effluent may also be necessary.

A stream that flows through the east end of the C.S.E.T. grounds is also a serious source of pollution to the main channel. Whilst the flow rate is not as great as that from the lagoons, it can exceed 4545 m^3/day. The BOD has been measured at 350 ppm, and the stream's temperature has at times been more than 10 degrees higher than the temperature of the river Blackwater into which it flows.

The stream has caused considerable fungus growth in the main channel before the start of the beet campaign at times of low to medium flows.

It has been the subject of a Section 12 notice in 1988.

Discharges from the vegetable processing plant adjacent to the sugar factory are thought to be a source of pollution to this stream, whilst leakages of cooling water from C.S.E.T. during the beet campaign add to the problem.

Ballyclough Co-Op

This firm is engaged in the processing of raw milk and in the production of various dairy products. These include milk, butter, dried milk powder and chocolate crumb. (Borden Company)

The treated effluent is discharged directly to the River Blackwater at a point 500 metres u/s Mallow Bridge.

The volume of effluent is 3182 m^3/day and the waste load is 89 kg BOD/day.

A small stream which runs through the factory grounds shows signs of occasional pollution; this stream receives cooling water from the factory as well as storm overflow from a section of the Mallow Urban drainage system.

Samples were taken of the stream u/s and d/s of the factory in June 1986 and September 1986. The results were as follows:

Date	Sample Point	S.S.	B.O.D.
11/06/86	u/s Ballyclough Factory	4.0	2.1
	d/s Ballyclough Factory	17.0	33.0
09/09/86	u/s Ballyclough Factory	2.0	1.6
	d/s Ballyclough Factory	10.0	8.0

It is to be noted that the d/s sample was u/s of the storm overflow outfall, and no flow was coming from same at the time.

The above results indicate that a considerable amount of polluting matter is being discharged to the stream in addition to the cooling water for which a licence was granted.

The sources of the above pollution will have to be located and steps taken to eliminate same by Ballyclough Co-Op.

Mallow S.T.W.

These treatment works are located 2 km d/s of Mallow town and were opened in 1984 with the present population served = 7,500. The volume treated is 1701 m^3/day. The waste load is 46 kg BOD/day. The treated effluent is discharged directly to the River Blackwater.

Mallow Mart

This mart is held on Friday each week. The animal wastes are screened and passed through a settlement tank before being discharged to the River Blackwater via the Spa stream. They have a detrimental effect on the stream. It's Q value drops to 2 in low flows.

It is intended to issue a licence to the mart which will permit them to discharge to the public sewer in Mallow. It is hoped that this will lead to a recovery in the quality of the stream.

FERMOY DISCHARGES

Scheme	Vol. Discharged (m^3/day)	Kg. BOD/day
Fermoy Sewage	1364	333
Fermoy Mart	40	12

Fermoy Sewage

The sewage effluent from Fermoy is at present discharged directly to the River Blackwater. The P.E. is 6000 and the BOD load is 333 kg/day.

The new treatment works opened in late 1987, and it's design population is 9000. It is located 3 km d/s of Fermoy Bridge. The BOD load of it's effluent is in the region of 40 kg/day.

Fermoy Mart

This mart is held on Tuesdays each week. The animal wastes are screened before being discharged directly to the River Blackwater at a point 1 km d/s of Fermoy Bridge. It's BOD load is estimated at 12 kg/day.

Despite the relatively high BOD level for the untreated sewage and the various industrial wastes, the quality of the River Blackwater at Fermoy is good due to the large dilution available.

MITCHELSTOWN DISCHARGES

Scheme	Vol. Discharged (m^3/day)	Kg.BOD/day
Mitchelstown S.T.W.	750	20
Mitchelstown Co-Op	5683	171

Mitchelstown S.T.W.

Mitchelstown S.T.W. was built in 1956. It's design P.E. was 11,000 to cater for the public sewage, and also to cater for the wastes from Mitchelstown Co-Op. It discharged to the River Gradoge at a point 800m u/s of the confluence with the River Funchion.

A new effluent pipe was laid in 1985 and the new discharge point is located on the River Funshion at a point 100 m d/s of the River Gradogue confluence.

The Co-Op constructed their own treatment works in 1985, and the present loading of the town's sewage works is about 20 kg BOD/day with a P.E. of 6000.

Mitchelstown Co-Op

As mentioned above the Co-Op constructed a new treatment works in 1985 and the effluent from this discharges to the River Funshion at the same location as the effluent from the town's sewerage works discharges.

The volume of effluent is 5683 m^3/day and the waste load is 171 Kg. BOD/day.

Despite the moving of the discharge point from the Gradoge to the Funchion, the River Gradoge remains in a seriously polluted condition (c.f. AFF 1986).

The pollution loading of the Gradoge seriously depresses water quality in the Funshion into which it flows. The effects of this pollution can be traced downstream for a distance of 10 km.

The main sources of pollution in the Gradoge u/s of Mitchelstown are agricultural and d/s of Mitchelstown the entry of a grossly polluted stream (Mill Race) to the Gradoge at a point 700 m from the confluence with the Funshion.

Large quantities of milk wastes and contaminated cooling water continue to escape into the Mill Race despite the Co-Op's efforts to prevent same.

The BOD in the stream has been measured at:

u/s Co-Op	d/s Co-Op
57	129
22	340

The Gradoge will remain in it's present condition until the industrial and agricultural sources of pollution are eliminated.

The Co-Op are continuing their efforts to eliminate their sources of contamination. It is hoped that their programme of improvements will be substantially complete for the 1988 season.

Figure 3.7 and Figure 3.8 over illustrate the variation in BOD and %Saturation that can occur in the River Gradoge due to the polluting effect of the Millrace stream.

The agricultural sources can be dealt with by the County Council using the powers available to them under the 1977 Water Pollution Act.

FIGURE 3.7 VARIATION OF BOD IN GRADOGE IN VICINITY OF MILLRACE
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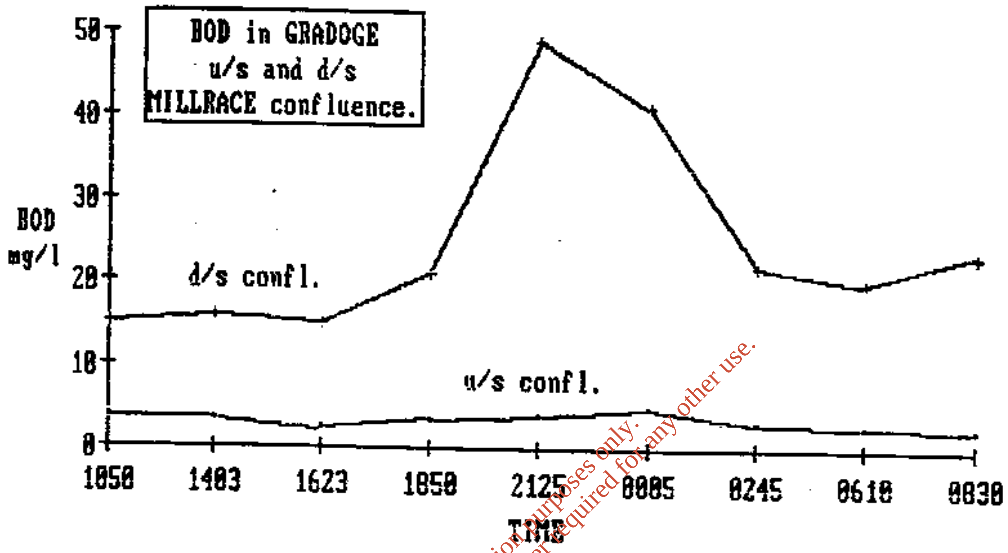


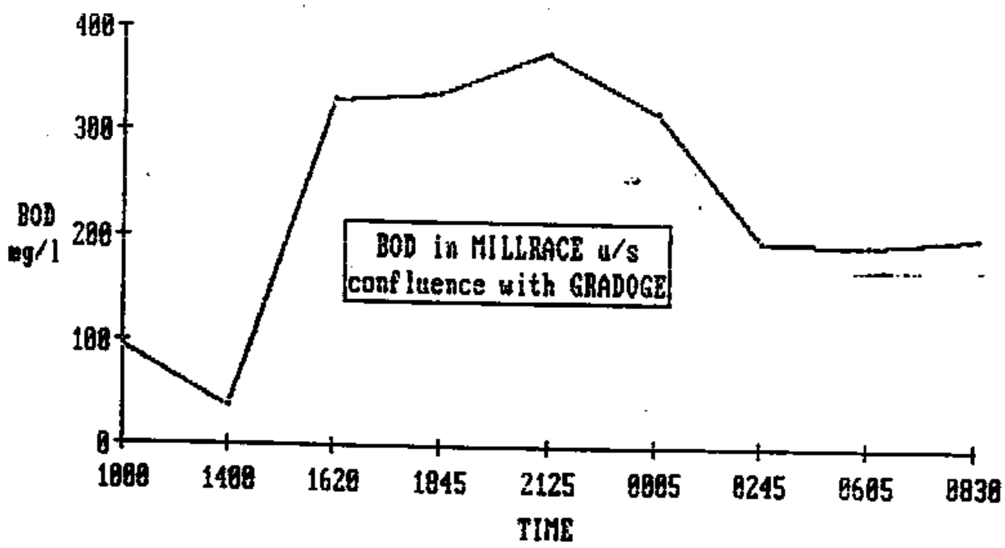
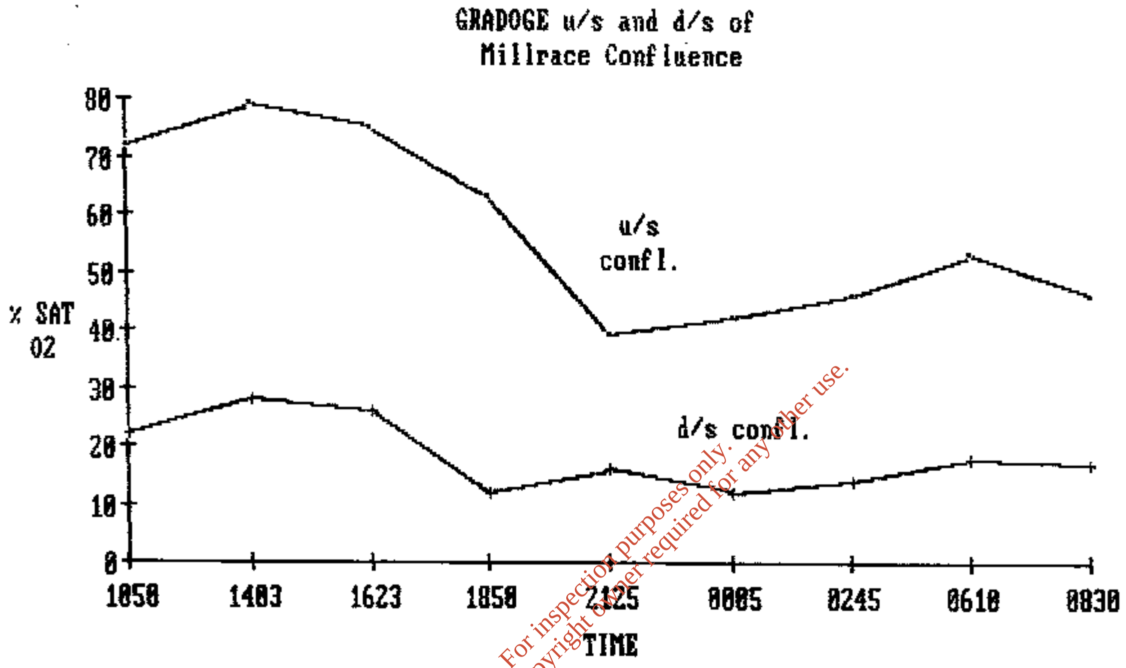
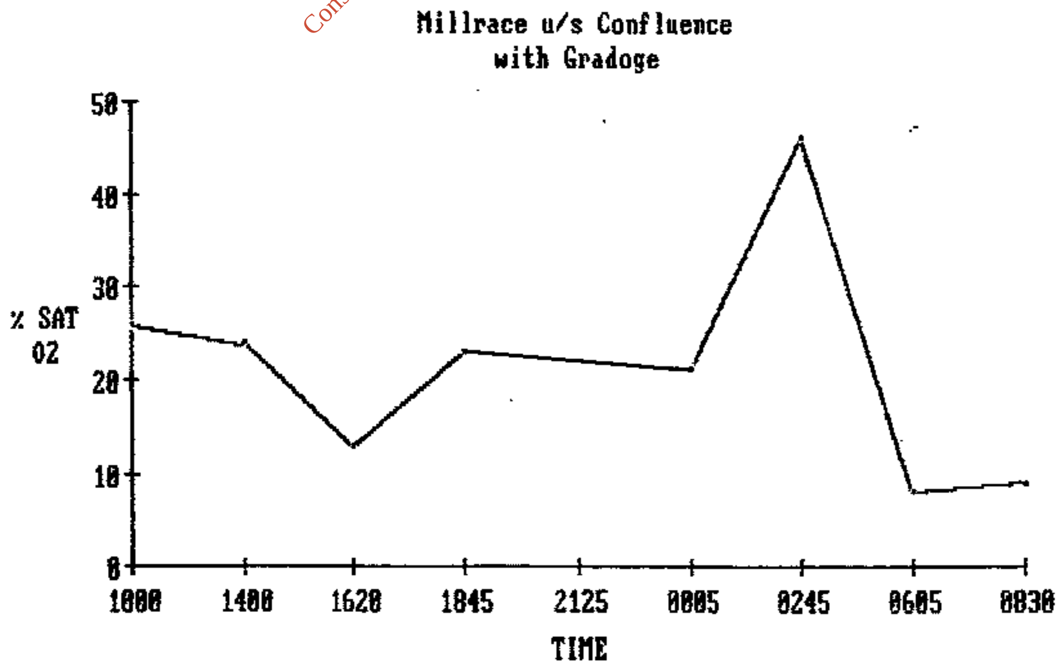


FIGURE 3.8 VARIATION OF % SATURATION OF GRADOGE IN VICINITY OF MILLRACE





DRAFT WATER QUALITY MANAGEMENT PLAN
FOR
THE RIVER BLACKWATER CATCHMENT

VOLUME 4

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BENEFICIAL USES

and

WATER QUALITY CRITERIA

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An Foras Forbartha
Water Resources Division

October, 1981
J.P.K. Horkan, M.Sc.

Revised October 1988

Environmental Dept.,
Cork County Council,
County Hall,
CORK.

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APPENDICES

List of Figures and Tables

Report Summary.

1. An account is given of the beneficial uses of water in the Munster Blackwater Catchment. The more important of such uses are abstraction of water for domestic and industrial purposes, fisheries and to a lesser extent livestock watering.

2. At present most of the surface water abstraction points are relatively remote ane are unlikely to be affected by pollution problems.

3. Assessment of future demands for domestic, industrial and agricultural uses suggests that by the year 2000 these will require a major increase in the present amount of water abstracted in the catchment. Most of this increased demand will have to be met from sources within the catchment.

4. The fisheries of the Munster Blackwater are based mainly on commercial and sports fishing for salmonids, commercial fishing for eels and shellfish and a sports fishery for coarse fish, particularly roach and dace. In addition there is some angling for bass and a small commercial fishery for mullet in the estuary while other fish including mackerel, flatfish and dogfish are also taken on a small scale. The shellfishery in the estuary has a good potential for expansion provided that water quality conditions are maintained at a satisfactory level.

5. Information on spawning grounds show that these are found extensively in many areas especially along the upper Blackwater and many of the tributaries. Serious impairment of water quality occurs in a number of areas especially below Mitchelstown and Mallow. Fish-kills are a problem at times and have been caused by agricultural and industrial wastes and pesticides.

6. Salmon angling revenue had a potential value in 1979 of IR 272,714. Official statistics for brown trout do not exist. However, making certain parallels with salmon angling, and basing numbers on recent club, syndicate and hotel records, such activity had a potential value in 1979 of IR 179,288 (IR 108,885 from visiting anglers and the remainder from local anglers). Using similar parallels in making calculations of expenditure by coarse fishermen the potential value is IR 1,079,000 (of which IR 1,008,900 arises from visitors and the remainder from locals) i.e. a total of IR 1,576,463 (1988 equiv.= IR 3,701,543) for all types of angling. A total of IR 44,800 was also spent by angling clubs in "angling development" in 1979.
Commercial fishing for salmon, sea-trout, shellfish and eels has a current market value of IR 0.3 million. Thus, the total estimated value of commercial fishing and angling IR 1.8 million. It should be pointed out in making this assessment that the salmon catches have been declining since the mid 1960's due to drift netting at sea and U.D.N. disease. Coarse fishing is developing rapidly and has a considerable potential for further expansion.

7. The only widespread agricultural use of water in the catchment is livestock watering. This type of use is now declining as farmers are being advised against using river water due to the possibility of their livestock contracting water borne diseases such as brucellosis. The present trend is towards watering animals from piped supplies and

on-farm boreholes. However, in dry summers direct watering of livestock may be continued on a wide scale.

8. Other uses considered include amenity and recreation. Canoeing and rowing are popular pastimes on the river. Wild fowling is common in winter. Summer activities in the catchment include swimming, camping, caravan and motoring holidays.

9. Floods cause serious problems at times in the Blackwater Valley from Mallow to Fermoy and also along the North Bride River.

10. Water quality criteria and standards applicable to the main uses identified in the Blackwater catchment are discussed and tabulated. The water quality standards which should be adopted in the designated areas of the catchment are those for the EEC designated salmonid waters. This would mean improving the Gradoge, for example. Such standards would provide adequate protection for most other uses also. There are some exceptions to this, particularly in respect of the microbiological quality requiremnts for water abstraction and for shell-fisheries; these extra measures could be dealt with on a local basis.

11. As the majority of waste discharges to the Munster Blackwater catchment are of the organic biodegradable type, the water quality criteria and standards of most importance are those of Dissolved Oxygen, Biochemical Oxygen Demand and Ammonia.

12. The standards recommended for Dissolved Oxygen in the River Blackwater are as follows:-

99.9 percentile value of >= 4 mg/l.

95 percentile value of >= 6 mg/l.

50 percentile value of >= 9 mg/l.

13. The standards recommended for Biochemical Oxygen Demand in the River Blackwater are as follows:-

99.9 percentile value of 5 mg/l

95 percentile value of 4 mg/l

50 percentile value of 3 mg/l

14. The standards recommended for Ammonia concentrations in the Munster Blackwater are:-

99.9 % of samples < 0.5 mg/l N total ammonia

95 % of samples < 0.02 mg/l N un-ionised ammonia

15. There are no specific standards for Oxidised Nitrogen in the E.E.C. Fishery Directive for Oxidised Nitrogen. However, as water is abstracted for potable use from several parts of the

catchment the following standards are recommended:-

95 percentile value of 23.Ø mg/l N

99.9 percentile value of 11.Ø mg/l N

16. The following, provisional, standards are recommended for Orthophosphate concentrations in the River Blackwater:-

95 percentile value of Ø.2 mg/l P

5Ø percentile value of Ø.1 mg/l P

Water Quality Management Plan for the Munster Blackwater Catchment.

BENEFICIAL USES AND WATER QUALITY CRITERIA

INTRODUCTION

1. This volume presents an account of the present and potential beneficial uses of the Munster Blackwater River and its main tributaries; water quality criteria and standards which are necessary to protect such uses are discussed. Information of this nature constitutes an important input to the formulation of a water quality management plan for the river in that it provides a basis for decision making with respect to the correct strategies to be adopted for effluent controls. These controls must be adequate to ensure that river conditions are capable of supporting all designated uses. As most, and probably all, river stretches have several uses, the controls will have to be adapted to the most stringent of the river conditions required by these uses. A more detailed discussion of these and related topics is given in Appendix A.

2. Of the established beneficial uses the most detailed data are available for fisheries and abstractions. These and other uses are discussed with special reference to the E.E.C. Directives dealing with water quality requirements for fisheries and abstractions. Attention is also paid to the recent recommendations given in Memorandum No. 1 (Technical Committee on Effluent and Water Quality Standards, 1978).

BENEFICIAL USES OF WATER IN THE MUNSTER BLACKWATER

General Comments.

3. In terms of water quality criteria and standards, two main uses of water in the Munster Blackwater catchment need special attention, viz. the abstraction for potable purposes and fisheries. For other uses one would expect that water quality standards applicable to the two previously mentioned would be generally satisfactory.
Other uses include livestock watering (now being discouraged by agricultural advisers to help control diseases such as brucellosis, general agricultural uses (such as washing farmyards), amenity and recreation.
The discharge of waste is a further important use of the river system but the relationship of this activity to water quality requirements differs in character to that of the other uses mentioned above. Waste discharges are dealt with in the other uses mentioned above. Waste discharges are dealt with in detail in Volume 3 and this particular aspect will only be discussed where relevant to particular uses outlined above.

4. Information on the present public and private abstractions of water in the Munster Blackwater has been obtained through the National Survey of Abstractions and Discharges carried out by the local authorities and co-ordinated by An Foras Forbartha. These data are discussed more fully in Volume 3. Only surface water abstractions are considered in this report (although the number of groundwater sources is listed in Table 4.1) as they are the sources which are directly affected by river water quality. Groundwater quality is less likely to be influenced by waste discharges to surface waters. The situation with regard to possible further abstractions

and their locations (where known) is based on discussions with local authority officials and on consideration of population projections.

5. The discussion on the fisheries of the Munster Blackwater Catchment is based on information given in the Annual Sea and Inland Fisheries Reports (in particular 1965, 1975, 1979 and 1985), discussions with fishery statisticians, Central and Southern Regional Fisheries Board personnel, members of angling clubs and tourism representatives was obtained by interviewing relevant officials and by completing questionnaries in the case of angling clubs. Other information has been obtained from Chief Agricultural Officers, agricultural advisers, pollution offecers, from A.C.O.T. and other relevant local officials.

ABSTRACTION OF WATER FOR PUBLIC AND PRIVATE USE.

6. Details of the 186 abstractions in the catchment are set out in Table 4.1. Figures in the table show 24% of public abstractions and 62% of industrial abstractins come from surface waters. surface waters.
A total of 45% of the total public abstraction arises from springs, but Industrial abstractions from this source are insignificant.' Boreholes yield 19.6 per cent of the private abstractions but are a less important source of water for public use. Boreholes account for the greater number of public abstractions (73 out of 127) and boreholes are also the most numerous sourcetype for Industrial abstractions. (30 out of 34)

7. Most of the abstaction sites are located in relatively remote areas and are unlikely to be affected by point sources of wastes.

8. The most important of the Industrial abstractions in the catchment are those from boreholes for Michelstown Co-Op (7,274 m3 day -1). and those from the main river channel for C.S.E.T.
C.S.E.T. abstraction rate are as below;

Maximum daily abstraction (Oct. to Jan. incl.) = 25,296 m^3

Minimum daily abstraction (Feb. to Sept. incl.) = 9,456 m^3

Average daily abstraction over the year = 14,025 m^3

9. The extent of the future demand for water in the catchment is an important consideration. The main factors which will determine this demand are (a) the human population increase, (b) the expansion of the agricultural industry, particularly dairy and livestock farming, and (c) future industrial development, particularly the agriculture particularly the agriculture related industries such as cheese and other dairy products.

FISHERIES
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General Comments
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10. The fisheries of the River Blackwater and its tributaries are largely based on salmonids (the salmon Salmo salar, sea trout Salmo trutta, and non-migratory brown trout S. trutta; coarse fish including roach (Rutilus rutilus), dace (Leuciscus leuciscus), pike (Esox lucius),eels (Anguilla anguilla), and shellfish (lobsters and crayfish). Twaite shad (Alosa fallax) enter the river to spawn but do not provide good angling such as they do in the River Barrow.

11. Roach (Rutilus rutilus) and dace (Leuciscus leuciscus) were accidentally introduced into the River Blackwater in 1889 (Went, 1950) and spread rapidly throughout the catchment. Since that time they have thrived particularly at Cappoquin where they were caught until recently in large numbers below the outfall from a bacon factory. This fishery has now declined perhaps because of the closing down of this industrial premises. The coarse fishery in the Fermoy area is now a very important tourist attraction and is an important source of revenue to the area. Also recorded are Flounders (Platichthys flesus) and smaller fish such as minnow (Phoxinus phoxinus), 3-spined stickleback (Gasterosteus aculeatus), gudgeon (Gobio gobio) and stone loach (Noemacheilus barbatulus). In the estuary there is some good angling particularly for bass (Dicentrarchus labrax), flatfish and mullet (Chelon labrosus), (the latter are are also fished commercially on a small scale in Youghal Bay .

12. Shellfish landings at Youghal consist largely of lobsters and cray fish. A feasibility study on the possibility of clam culture is being carried out and the signs are promising.

Eels are fished in the lower freshwater reaches of the river and landings are small. Some eel fishing is carried out in the estuary and this could be developed further.

There is some potential for the developement of a autumn fishery in the freshwater system for silver eels migrating downstream to spawn but to date flooding problems in the river have discouraged any attempts to do so.

The Salmonid Fishery Resources of the Munster Blackwater Catchment.

13. Commercial fishing for salmon and sea-trout is confined to the tidal reaches of the river. These fish also provide excellent angling along the freshwater stretches and also some of the tributaries. Brown trout fishing is also good. Salmon fishing was badly affected by the U.D.N. disease (Ulcerative Dermal Necrosis) during the late 1960s (see trends in Figs.4.2 and 4.3). Catches by commercial fishermen then improved because of the increased use of drift nets but rod and line catches recovered only to a slight extent before reaching their lowest ever level in 1981 (Fig.4.2 and Table 4.2). Some improvement in rod catches occurred in 1982 and again in 1983 but anglers returns are nowhere near the level reached in the early to mid-1960s (see Fig. 2.2 and Table 4.3). The main reason for the overall decline in salmon catches is pollution of the river system and drift netting at sea .

However, the Blackwater does contribute substantial amounts of fish to drift netting on the south coast based on tagging data (Royal Irish Academy, Twomey & O'Riordan, October 1963). Cork Blackwater accounted for approximately 50 % of the catch on the South West Coast and approximately 51.6 % from the tagging to the east. (Royal Irish Academy, McCarthy, 1978)

14. Sea-trout catches on rod and line fluctuate considerably (Fig. 4.2). In 1969 catches reached a peak and declined to low levels in the early 1970s before increasing again until another peak occurred in 1978 followed by a serious decline in 1979.

15. Eel catches are small with no landings reported before 1975 (apart from a tiny catch of 13 kg recorded in the Sea and Inland Fisheries Report, 1966). Catches are confined to freshwater and eel fishing is mainly a summer occupation. Some potential exists for netting the autumn "Silver" eel migration but has not yet been developed due to problems such as severe flooding which can be dangerous for the operators and might also wash away the fyke nets.

16. Shellfish landings are based on figures for Youghal and are showing signs of increasing. The present catch includes lobsters crayfish and mussels .
There is good potential for future development of a shellfish industry in the estuary using modern methods.
The Youghal Fishermans Co-op are currently involved in the expansion of some of the mussel beds in the inner harbour and the harvesting of mussels from same.

In 1985 a total of 15,000 hatchery reared Manila clams were planted in Youghal Harbour. Their growth and developement is being monitored.

17. There are two fish farms currently in operation in the catchment. One is at located 2km. d/s Araglin on the Araglin river, and the other is on the Douglas river near Kilworth. Another fish farm is being considered for the Glen river.

18. Angling Problems

In 1987 a total of 10 fish kills was recorded ranging from minor in the Gradoge and Funcheon to major at Fermoy.

Nine prosecutions for various offences were all successful.

Sources of pollution in the catchment include piggery wastes, agricultural wastes, sewage, industrial wastes and gravel abstractions and washings.

River poaching and drift netting at sea cause considerable damage to fish stocks.

19. However, some areas are relatively unpolluted in the catchment. Regular restocking is carried out by many clubs. Stiles, footbriges, bank clearance and other improvements are carried out in many areas with the help of Central Fisheries Board personnel, local angling interests and with the co-operation of local landowners. In general, the long term prospects for anglers and tourism are good provided remedial measures are carried out in those areas where water quality is seriously impaired.

The Financial Value of the Salmonid, Shellfish and Eel Fisheries

20. The sport and commercial fisheries on the Munster Blackwater are correctly regarded as an income generating industry which provides employment, exports, income, recreation and also provides spending power in the region. O'Connor and Whelan (1973), O'Connor et al (1974), and Whelan et al (1974) carried out an economic evaluation of visiting salmon anglers, Irish anglers and commercial fishermen, respectively, by a "Gross Output" method which is defined as the total value of all sales by the industry. This method is applied here using five basic components:-

(a) Sales of salmon (and sea-trout) by commercial fishermen.
(b) Sales of shellfish by commercial fishermen.
(c) Sales of eels by commercial fishermen.
(d) Sales of angling services to Irish anglers.
(e) Sales of angling services to visiting anglers.

Value of Commercial Fisheries (Values updated from '79 values using NPI.)

21. A total of 115 net licences (89 drift, 7 snap, 7 draft, 1 stake, 1 box or crib and 10 eel trap permits) were issued in 1987 in the Lismore District by the Southern Fisheries Board.
In addition to these licenced net fisherman there are also an unknown number of unlicenced nets operating. Therefore, reported fish catches are an underestimate of the true catch. Rod and line catches are underestimated also as many anglers fail to make returns of their catches.

22. The quantity and value of the commercial catches of salmonids, shellfish and eels are based on the official statistics published for Lismore Fishery District (includes Ardmore and Ballycotton)in the Sea and Inland Fisheries Reports (1965, 1975, 1979 and 1985) These values are set out in Table 4.4 and the commercial fishery was valued at IR 315,440 in 1979 (Table 4.6); the bulk of this sum is realised from salmon netting. Shellfish catches are confined to estuarine reaches and the small eel fishery (only 10 eel trap licences issued in 1979) is carried out in the freshwater reaches of the Blackwater.

Salmon, Trout and Coarse Anglers' Spending

23. To estimate revenue generated by tourist anglers some assumptions have to be made. According to O'Connor and Whelan (1973) in 1970, 155 visiting salmon anglers (out of a total of 369 licensed anglers) spent IR 27,500 (1988 equivalent = IR 193,200) in the Lismore Fishery District (i.e. the Munster Blackwater Catchment) or approximately IR 177 each. (1988 equivalent = IR 1250) In 1979 a total of 906 licences were issued in this district to all salmon anglers (brown trout and coarse fish anglers did not then require a licence.) Assuming the same ratio of visitors to home anglers as in 1970, then 381 of these licences would have been issued to visitors. Increasing the C.P.I. since 1970, the 1988 expenditure by visiting salmon and sea-trout anglers is IR 473,800 and the spending by local salmon anglers would amount to IR 165,300 (IR 44.7 average amount spent by local anglers in 1970 x 525 licences). Therefore, estimated total expenditure by salmon anglers in 1979 was IR272,714. (Table 4.5.)
(1988 equivalent =IR 640,350)

24. No reliable statistics are available for brown trout angling. However, it is known that good brown trout angling is found throughout the catchment apart from one or two localised areas where severe pollution occurs, e.g. on the Gradoge.
Brown trout catches tend to be consumed by the anglers, their families and friends and hence, little revenue is generated at the market place from this source. However, money is spent in the catchment by fishermen on rods, flies, bait, food, petrol and, in some cases accommodation. Detailed information was obtained from ten sources and is outlined in Table 4.3. As can be seen from the data supplied, anglers are most interested in brown trout fishing in the tributaries and upper to middle reaches of the main channel, salmon in the middle to lower stretches, sea-trout near the sea and coarse fish from Fermoy to Cappoquin.

25. Statistics are not available on spending by trout anglers and the assumption is made here that this is similar to the amount spent by anglers fishing for salmon. Thus, taking the number of visiting trout anglers at a very conservative 205 (which equals the number of permits issued by trout angling clubs listed in Table 4.3) the potential total in 1979 for this group was IR 108,885 (1988 equivelant = IR255,700).

Assuming that the number of local trout anglers was at least equal to the number of local salmon anglers fishing the Munster Blackwater then their expenditure would come to IR 70,403 (906 - 381 = 525 x 3 x IR 44.7). The 1988 equivalent for this would be IR 165,300.
Therefore, estimated total expenditure by brown trout anglers in 1979 is IR 179,288 (1988 equivalent = IR 421,000). This is undoubtedly an underestimate as a large number of anglers would

fish freely in this river without either joining or getting permits from local angling clubs (according to reliable comments from various angling representatives).

26. Coarse angling is well developed from Mallow to Cappoquin. A further assumption is made that coarse fish anglers spending is similar to that of salmon anglers. Taking the number of coarse fish (based on available statistics) at approximately 1900, the potential total current expenditure by outsiders on this type of angling is IR 1,008,900 (1900 x 177 x 3). 1988 eqv.= IR 2,368,900.
Assuming also that the number of local coarse anglers fishing the Munster Blackwater is equal to the number of local licensed salmon anglers then their expenditure would come to IR 70,403 (525 x 44.7 x 3). 1988 eqv. = IR 165,306.
Thus, estimated total expenditure by coarse fish anglers in 1979 was IR 1,079,303. (1988 equivalent = IR 2,534,209)

27. The total spent by all anglers was estimated in 1979 was IR 1,531,305 (1988 eqv. = IR 3,595,13).
Combining these values with the values for commercial returns gives an Annual Gross Output Value for the Blackwater catchment fisheries of approximately IR 1.8 million (1988 eqv. = IR 4,226,500) ; of this 85.3 per cent is generated by anglers and the remaining 14.7 % is generated by commercial interests.

To summarise, the 1988 equivalent values are listed below;

Anglers.............IR 3,605,204

Commercial..........IR 621,296

Locations of Fisheries and Spawning Areas in the Freshwater Reaches of the Munster Blackwater.

28. There are no detailed statistics available on the distribution and density of the salmonid stocks in the freshwater reaches of the Munster Blackwater. However, it is still regarded as a good salmon river although catches have declined since the 1960s (due to overfishing at sea and pollution in the upper reaches).
Many of the angling club reaches are actually privately owned but the clubs are allowed to fish there.

29. Salmon and trout spawn in the whole catchment whereever there is appropriately clean gravel. It is likely therefore that young (parr) stages of salmon and trout occur in most stretches.

30. In conclusion, the River Blackwater has been recognised by the D.O.E. as a salmonid river and is now a 'designated' water which must achieve the water quality standards laid down by the E.E.C. Directive (1978) for salmonid waters.

Other Activities in the Catchment

General Comments

31. The Munster Blackwater catchment is predominantly a very rich agricultural area. Apart from the extreme upper reaches of the catchment the river flows through a valley which includes some of the richest farmland (much dairy and beef farming) in Ireland with small towns on its route the most important of which are Fermoy (pop.3106), Mallow (pop. 6572), Michelstown (pop. D.E.D. 4390) and Youghal (pop. 5870). Agriculture related industries are located in the first three towns, beet sugar processing, cheese and dairy production and meat products being the more important. Carpet manufacturing is the most important industry in Youghal but this type of industry is suffering badly because of the recession. Small manufacturing industries are also found in these towns and chocolate crumb is produced at Rathmore (pop. 1506). Youghal is a popular tourist centre with nearby amenities including caravan and camping parks, beaches, sea angling and sailing. Guesthouses and hotels are found in the other towns and generally cater for salmonid and coarse fish anglers.
Motoring holidays are popular in the more scenic areas especially around Lismore and Cappoquin and from there to the sea. Angling in the freshwater reaches of the river has been discussed in detail above.

Farming Practices in the Munster Blackwater Catchment

(see Appendices B-D).

32. The Munster Blackwater rises in a rugged sparsely populated area on Knockanefune hill (440 m) in Co. Kerry. Rough grazing suitable mostly for sheep farming is practised there. The land improves steadily as the river flows eastwards through Co. Cork. A sizeable quantity of the sugar beet processed at Mallow is grown in the catchment. Much of the land is pasture (Appendix C) because of the large numbers of both beef and dairy cattle in the county. Large numbers of pigs are also reared in the catchment. The most widely grown cereal in the area is barley (Appendix B). There are some stud farms in the catchment particularly around Mallow and some of these have extremely valuable bloodstock.

33. It has been stated elsewhere in this report that there are agriculture related pollution problems in this catchment (see Table 4.3). These are mainly caused by run off into the streams from piggeries, farmyards, slurry, pesticides and herbicides.
The over application of slurry and artifical fertilizers and the use of soakways for the disposal of soiled water can lead to the raising of nutrient levels of the groundwater and the river system to above acceptable concentrations.
In addition to the contamination of the river system, wells have been found to be affected by seepage from silage pits and septic tanks. It is clear that tighter control is needed to ensure that offending farmers dispose of farming wastes well away from the rivers and from drinking water supplies arising from wells or boreholes. (see Chapter 2 page **)

34. Farmers have made a number of complaints in relation to effects of the river on their land. In some areas erosion is a problem that needs further investigation. Floods are a frequent occurrence and are

sometimes severe and cause serious damage (e.g. autumn 1980, damage in excess of IR 1.2 million say press reports), particularly in the Mallow to Fermoy region and along the North Bride at Tallow. Hence, the farmers are looking for a drainage scheme that will reduce flood risks and erosion problems. Should such a scheme be implemented as part of a long-term water management plan great care will be needed in carrying out the work to ensure minimal disturbance to the very important angling asset that this catchment provides.

Boating in the Munster Blackwater River

35. The non-tidal reaches of the Munster Blackwater are not navigable by larger boats such as barges. There are two active rowing clubs in the catchement at Fermoy and Cappoquin. The estuary is somewhat silted and is little used for shipping although fishing boats (trawlers and deep sea angling craft) use the harbour there regularly. In the days of sailing boats this was a very busy port.

Weed Clearance in the Munster Blackwater River

36. Weed growths do not appear to be a major problem in this catchment.

WATER QUALITY CRITERIA AND STANDARDS

37. In this section, the water quality criteria and standards appropriate to the uses of the river defined in the foregoing are discussed. At this stage it is necessary to make a distinction between criteria and standards. Criteria, in this context, are objective scientific assessments, based on experimental and/or observational data, of the water quality conditions which are consistent with full exploitation of a particular use of the river. Water quality standards, which must be identical to the relevant criteria or may be more stringent depending on the particular circumstances.

38. An authoritative and comprehensive list of water quality criteria has been drawn up by the Environmental Protection Agency (E.P.A.) in the U.S. (E.P.A. 1972 and 1976) covering most of the uses of fresh and marine waters and is widely used as a basis for setting standards. In Ireland, a recent report on 'Water Quality Guidelines' by a Department of the Environment (D.O.E.) technical committee (1978) constitutes a local source of water quality criteria.

National water quality standards have not been specified to date though these are allowed for under Section 26 of the Local Government (Water Pollution) Act, 1977. In this connection, reference should be made to the recent directives on water quality issued by the EEC. In specified circumstances,these are legally binding on the member countries and may be regarded, therefore, as water quality standards. To date, directives have been issued in respect of four water quality requirements, i.e. abstractions of raw water for potable supply, bathing waters, fisheries and shellfisheries (EEC. 1975, 1976, 1978 and 1979). It should be pointed out, however, that these directives do not preclude the setting of more stringent standards where local conditions or circumstances warrant such a course; indeed, in the case of many paramerers, guideline values, which represent the ideal level of quality, are indicated in these directives, in addition to the basic, mandatory values.

39. It has been shown in the previous section that the more important beneficial uses of the River Blackwater and its tributaries comprise abstraction of water for potable and industrial use, salmonid and coarse fisheries (commercial and sports), shellfisheries, recreational and agricultural uses. It has been seen also that it is not practical to divide up the river channel on the basis of these uses since all (except shellfish and eels) occur or are likely to occur in most parts of the system. Some uses, e.g. amenity and recreation, may have a more confined distribution in the system but, as will be shown, the water quality requirements of these would be adequately catered for by those applicable to the main uses identified.

40. The question which must be considered is whether it is justified to classify the entire Blackwater catchment as a salmonid water. At present coarse fish are more important than salmonids in a few parts of the lower reaches of the river.
The available evidence shows clearly that salmonid fish are widely distributed in the system and that important spawning areas occur on both the main channel and tributaries. The occurrence of the latter indicates that migratory movements of salmon in particular, must occur throughout the whole river and in the estuary. In view of this situation it is not practicable to contemplate any zonation of the river on the basis of the resident fish populations and the system must be regarded, in toto, as a salmonid river.

41. Thus, for the purpose of setting water quality standards for the River Blackwater it is considered appropriate that these should meet, in the parts of the river system defined in Vol.1 and not merely in the main channel, the requirements for salmonid and coarse fisheries and abstractions for potable supply. (Standards required for agricultural use are less stringent). Clearly, in the case of any particular parameter, the most stringent of the limits applicable to the uses mentioned, will form the standard.

42. In Appendix H, details have been given of the criteria or standards applicable to the abstraction of water for potable supply, fisheries and livestock watering, in respect of some fifty parameters representing the bulk of those commonly used to assess water quality. These data are taken from the sources referred to above and, in addition, criteria used by a U.K. water authority have been shown as further illustration (Price & Pearson, 1979). An examination of data in Appendix H shows that in the case of most parameters the most stringent values are those applicable to salmonid fisheries alone or to two uses, one of which is salmonid fisheries. Exceptions to this are the parameters which are not usually of concern, e.g. Arsenic, Cobalt, Manganese and Selenium. Total Coliforms, Faecal Coliforms and Nitrates, the requirements for which are the most stringent in the case of abstraction of water for potable supply are, however, examples of a small number of important paramerers which cannot be controlled adequately by employing fishery limits.

43. In consideration of the fact that the dominant type of water pollution in the Blackwater catchment is due to organic, biodegradable matter,such as farmwastes, sewage, sugar beet effluent and food processing

wastes, it is, perhaps, more appropriate to focus particular attention on those parameters, viz. Dissolved Oxygen, Biochemical Oxygen Demand and Ammonia, which are the main indicators of this form of pollution. Criteria and standards for these paramerers are summarised in Table 4.7. It is clear from the data in Table 4.7 that the limits set for these parameters in respect of fisheries would be adequate also for abstraction of water for potable supply and livestock watering. Nitrates and phosphates also may increase to undesirable levels in water subject to organic pollution. In case of nitrates, the data in Table 4.7 show that the fishery limits would not be adequate to protect the use for abstraction of water for potable supply. The main problem with excess phosphates is eutrophication. The data shown in Table 4.7 are tentative since the relationship between phosphorus and eutrophication, at least in rivers, is difficult to establish. It is probable, however, that eutrophication would be at least as undesirable where fisheries are concerned as it would be for other uses so that any limits set for fishery waters may be regarded as giving adequate protection for all uses.

44. Turning to the uses of the River Blackwater which, if not less important than those treated above, are confined to limited areas, two sets of data should be considered. Appendix E summarises the recommendations of the E.P.A. as to water quality criteria for the protection of recreational uses of water. Appendix F lists the limits set in the EEC directive on the quality requirements of bathing waters. The most important of the parameters listed in these tables are those concerned with the microbiological condition of the river or lake, particularly in the case of those activities involving direct body contact with water is not reliable. However, the E.E.C. directive on bathing water does specify limits for five microbiological parameters, requiring the virtual absence of Salmonella and enteroviruses.

45. The other parameters shown in these tables are concerned mainly with aesthetic aspects. The requirements in this respect for the recreational uses of water would be largely satisfied by the application of the criteria and standards shown for fisheries (Appendix H). While it is conceivable that fish populations could exist without stress in areas affected by conditions which detract from the aesthetic or recreational enjoyment of water, e.g. floating solids, dumped rubbish or turbidity, in most cases these conditions would be accompanied by poor water quality having a direct detrimental effect on fish. Thus, the presence of normal, healthy fish populations would, in general, reflect conditions that are acceptable on aesthetic grounds.

46. In neither the E.P.A. recommendations nor the EEC directive are there specific limits for toxic substances in recreational or bathing waters. This arises from the lack of suitable informationin regard to the danger to humans of contact with waters containing toxic substances, since this depends mainly on the amount of water ingested in the course of such contact. However, it is likely that the human body can tolerate greater concentrations of toxicants during the brief contacts with water experienced in recreation than those which must be maintained in the same water to protect aquatic life. Thus, it is quite certain that the presence of toxic substances such as heavy metals and pesticides in recreational and bathing waters, in concentrations which pose no threat to fish and other aquatic life, is of no significance where human recreational use is concerned.

47. One further use must be considered in the context of water quality criteria and standards. The presence of shellfisheries in the estuary may require strict control of quality conditions in this part of the river, particularly in view of the potential for expansion in this fishery, mentioned in the previous section. Of particular concern in water containing shellfisheries organisms, such as Salmonella. Because of the large volumes of water filtered by bivalved molluscs when feeding, large concentrations of toxicants and microorganisms may build up in the tissues making them unfit for human consumption. The recent directive of the Council of the European Communities dealing with the quality of waters favourable for shellfish growth makes specifications in regard to these and other parameters. These are summarised in (Appendix G). However, this would not hold in respect of the microbiological parameters and, as in the case of water abstractions in freshwater, the extra provisions of the specific directive dealing with shellfisheries would have to be taken into account when setting standards in the areas concerned.

48. The above discussion indicates that as a basic measure to ensure the protection of all the beneficial uses of the entire catchment, the general adoption of the water quality criteria and standards applicable to game fisheries would be satisfactory. In practice, this implies that the standards laid down in the E.E.C. directive dealing with the quality of freshwater needed to protect fish life, or standards more stringent than these, would have to be adhered to throughout the system. In the case of abstractions, bathing areas and shellfisheries, the additional requirement of limits for the microbiological, nitrites and metal parameters would arise; however, such uses relatively restricted and such a requirement would be unnecessary over the greater part of the river channel. Livestock are unlikely to be affected by the normal levels of micro-organisms in surface waters, or even the increased numbers found in organically polluted waters. The main danger to livestock drinking untreated surface waters, is the possibility of their incurring diseases due to the contamination of such waters by infected animals. Brucellosis and some forms of T.B. are known to have been spread by the drinking of contaminated water by livestock. There is also the danger of the spread of parasitic infections, e.g. fluke and roundworms, when animals congregate in streams. Prevention of such occurrences requires that livestock be keptout of contaminated water and this is, perhaps, a matter for agricultural rather than water pollution control authorities. As mentioned previously, agricultural advisers are now actively discouraging livestock farmers from directly watering their animals with untreated water. Already, reduction in desease levels is being noted because of improved farm management practices and this trend should continue in the future according to several of the chief agricultural officers and advisers interviewed.

49. General recreational use should be satisfactorily protected also by the fishery limits with the possible exception of the visual impact of non-polluting solid wastes, e.g. plastic containers, paper or metal objects, thrown into streams. Such abuses, which would have little or no harmful effect on fish, would require a separate basis for control.

50. In view of the fact that the most common form of waste discharged to the River Blackwater and its tributaries is organic in nature, the

main implication of the standards recommended above will arise in respect of B.O.D. and dissolved oxygen levels. An Foras Forbartha National River Reports show that there are some tributaries, particularly parts of the Gradoge, Allow and Funshion and a stretch on the main channel where the present levels of dissolved oxygen, especially in summer, may fall below those levels set out below those levels set out in the E.E.C. directive. The adoption of the limits in this directive for the sections of the catchment as defined in Volume 1 will therefore, require an improvement in water quality conditions in these stretches to the extent that they are able to support permanent populations of salmonid fish. As the main channel has been declared a salmonid fishery under the general provisions of the directive such improvement will be required irrespective of any considerations being discussed.

SPECIFIC RECOMMENDATIONS ON WATER QUALITY STANDARDS

51. This section is concerned with the specific format of the water quality criteria or standards which must be adopted in the Blackwater system if the present beneficial uses are to be maintained now and improved, where necessary, in the future. These standards may be regarded as water quality objectives which must be met within a time span to be decided on by the local authorities. As stated, the main channel of the River Blackwater has been designated as a 'salmonid water' in accordance with Article 4 of the Directive of the Council of the European Communities dealing with 'the quality of freshwaters needing protection or improvement in order to support fish life'.

52. It is now generally accepted that, because of the stochastic or random nature of water quality variations in rivers and of effluent quality in treatment plants, the setting of standards requiring 100 per cent compliance is unrealistic. Current practice is to require that the specified standard be adhered to for a proportion only of any time span defined. Generally, this proportion is set at 95 per cent so that the standard laid down in this manner for a particular parameter is termed the 95 percentile value, being the value which may be exceeded for only 5 per cent of the time.
For some parameters, particularly Dissolved Oxygen, it is usual to define other percentile values, e.g. the 50 percentile (or median) value.

53. In practice, the time-based percentiles must be assessed on the basis of data arising from a discrete number of samples taken at intervals over a specified period. In the E.E.C. Directive referred to above, a simplified approach has been adopted whereby 95 per cent of samples taken over a year must comply with the standards given for the various parameters.

54. In general, it is probable that the allowed for occurrences of parameter values above (or below, in the case of Dissolved Oxygen) the 95 percentile standard will coincide with periods of relatively low flow and poor dilution. This coincidence would be reinforced in situations where the setting of effluent standards was based on the dilution afforded by the 95 percentile flow, a practice often adopted in water quality management.

55. The use of the 95 percentile flow to calculate the dilution appropriate to specific waste discharges is an adequate basis on which to determine effluent standards in the Blackwater catchment. In some cases the requirements for waste load reduction, which such a constraint would impose, could be reduced if it were possible to store some or all of the waste for discharge at periods when flows higher than the 95 percentile values of the parameters in question; however, this is considered as too restrictive on the discharger (Casapieri, 1977) and characterisation of upstream quality conditions in terms of the 50 percentile values seems a more reasonable basis for determining effluent standards. A further point in regard to such standards is that they should be specified as 95 percentile values as in the case of those for the receiving water. This allows, again, for the random nature of the variation in the quality of effluents produced from treatment plants, particularly those employing biological processes.

56. In the following paragraphs the more important parameters for the River Blackwater catchment (Dissolved Oxygen, B.O.D., Ammonia, Oxidised Nitrogen and Phosphate) are considered in detail and a specific recommendation made in regard to the water quality standard to be adopted. In doing so the requirements for water quality laid down in the E.E.C. Directive dealing with freshwater fish (EEC. 1978) and abstraction for drinking water (EEC. 1975) have been used as a reference since the standards adopted for the Blackwater cannot be less stringent than such requirements.

Dissolved Oxygen (D.O.)

57. Undoubtedly, dissolved oxygen is of major importance in the context of water quality in Irish rivers. This is particularly so in salmonid bearing rivers, such as the River Blackwater, because of the relatively well aerated waters required by healthy populations of these fish. A major difficulty in setting standards for dissolved oxygen is that, in summer particularly, marked diurnal variations in concentrations may occur due to the effects of photosynthesis and respiration.

Since the lower values occur at night-time, normal monitoring programmes may not reflect the full situation with respect to dissolved oxygen levels and may not reflect the full situation with respect to dissolved oxygen levels and may, indeed, give a misleading optimistic picture. The only fool proof methods to circumvent this difficulty are the use of continuously recording instruments or to undertake detailed 24 hour grab-sampling surveys. The first of these approaches presents problems of expense and maintenance while the second is very time-consuming and may be impracticable on logistical grounds. As a compromise, it would be sufficient, perhaps, that early morning (05.00-07.00) sampling surveys be undertaken during summer months so that the minimum dissolved oxygen values will be obtained at least, and a better assessment of the situation made. Where the minimum value was low enough to be of concern (less than 50 per cent saturation), a more detailed survey could be carried out to determine the duration of deoxygenation where the survival of fish is concerned. Compliance with the standard laid down for dissolved oxygen should be assessed, therefore, in the short term (over 24 hour periods in summer months, particularly) as well as over a year or during the sugar beet campaign in an affected reach of the river.)

58. The following standards are recommended for Dissolved Oxygen in the River Blackwater:

99.9 percentile value >= 4 mg/l

95 percentile value >= 6 mg/l

50 percentile value >= 9 mg/l

Biochemical Oxygen Demand (B.O.D.)

59. The B.O.D. concentrations in a river are an indication of the extent of pollution by organic biodegradable waste and of the likelihood of deoxygenation. However, there is no straightforward relationship between B.O.D. concentrations and the scale of deoxygenation because in many cases other factors such as reaeration, plant photosynthesis and respiration or sediment oxygen uptake have a much greater effect on the dissolved oxygen regime. However, B.O.D. is a very useful general indicator of water pollution and the potential of an adverse effect on beneficial uses. While advantage can be taken of high reaeration rates to allow discharges to give rise to high B.O.D. concentrations such concentrations may be undesirable where there are water abstractions or because of the slime growths which may be stimulated. Thus, the full benefit of high reaeration rates cannot be taken up in most cases and it is preferable to keep B.O.D. concentrations at relatively low levels.However in setting standards it must be borne in mind that relatively high concentrations may occur naturally during floods due to run off from land surface. In some cases these concentrations exceed 10 mg/l.

60. The following standards are recommended for B.O.D. concentrations in the River Blackwater:

95 percentile value of mg/l .

50 percentile value of mg/l.

Ammonia (NH3 N)

61. The presence of high ammonia concentrations in river water is of concern on two counts. Ammonia in the un-ionised form (NH3) is directly toxic to fish and other aquatic life. In addition ammonia reacts with the chlorine used in water treatment plants and if present in sufficiently high concentrations may lessen the effectiveness of the disinfection process.

62. It has been shown from long-term experiments that the maximum level of un-ionised ammonia which would be compatible with the presence of healthy fish population is of the order of 0.02 mg/l N. The fraction of the total ammonia concentration which is present in the un-ionised form depends on pH and temperature, this fraction increasing as temperature increases and the pH becomes more alkaline. Examination of pH and temperature data for the River Blackwater and its tributaries suggests that, on average, the most favourable conditions occurring for the formation of the un-ionised form of

ammonia would be a pH of 8.0 and a water temperature of 20 o^C, such conditions occurring in summer months. In these conditions, the value of 0.02 mg/l N of un-ionised ammonia, indicated above as the limit for long term survival of healthy fish stocks would correspond to a total ammonia concentration of about 0.5 mg/ l N. This is well below the level (0.8 - 1.0 mg/l N) at which reactions with chlorine would result in an adverse effect on the disinfection step in water treatment.

63. In the light of the above the following standards are recommended for ammonia in the River Blackwater:

95 percentile value of 0.02 mg/l N un-ionised ammonia

Oxidised Nitrogen (mostly Nitrate)

64. The main concern with high oxidised nitrogen levels in water is in relation to water supplies for human constumption. The levels found in the most polluted waters are usually well below those likely to be directly injurious to fish or other aquatic organisms. Excess levels of oxidised nitrogen may contribute to the development of eutrophication but such a development is more likely to be triggered by excess phosphorus input, at least in fresh-waters.

65. It has been generally accepted in recent years that a nitrate concentration of mg/lN would give adequate protection in water supplies in respect of the disease methaemoglobinaemia in infants which may be caused by nitrate levels in excess of 20-50 mg/l N in bottled feed. (Since nitrate normally accounts for only an insignificant fraction of oxidised nitrogen in most surface waters these values for nitrate may be assumed to apply to oxidised nitrogen). There seems to be little reason for setting a more stringent standard than this value.

66. There are in fact no specific standards recommended for Oxidised Nitrogen concentrations in the E.E.C. Fishery Directive. However, as water is abstracted in a number of locations for potable use along the main channel the following standards are recommended:

99.9 percentile value of 23.0 mg/l N.

95 percentile value of 11.0 mg/l N

Phosphate (P04 P)

67. The main significance of phosphorus in freshwater is in regard to eutrophication and the development of excessive weed and algal growths. The relationship between phosphorus input and plant growth response is fairly well understood in relation to freshwater lakes and a reasonable scheme of criteria has been proposed by several groups of workers. Due to the more complex nature of factors influencing primary production in running waters it is much more difficult to establish a straightforward relationship between phosphorus and plant growth response in these ecosystems.

68. One approach to setting standards for phosphate in rivers is to use the values typical of unpolluted reaches as a reference. Data from some seventy rivers and streams sampled in the south-eastern area of the country between November 1978 and November 1979 have been

examined for this purpose (An Foras Forbartha, unpub. data). This examination shows that virtually all of these reaches have mean orthophosphate concentrations less than 0.1 mg/l P and maximum values less than 0.2 mg/l P. In other reaches where B.O.D. and ammonia concentrations indicated polluted conditions, orthophosphate means and maxima were considerably greater than the above values. (A value of 0.07 mg/l P for total phosphorus is given in the Fisheries Directive (1978) for salmonid waters (Table 4.7). It seems reasonable, therefore, to suggest that these values for orthophosphate should be used as the basis of water quality standards for the River Slaney. However, these should be regarded as provisional only as information available is not sufficient to assess the extent to which these orthophosphate concentrations would have to be exceeded before excessive weed and algal growths occurred. Research on river eutrophication being carried out by An Foras Forbartha should help to elucidate this relationship.

69. The following standards are recommended for Orthophosphate concentrations in the River Blackwater:

95 percentile value of 0.2 mg/l P.

50 percentile value of 0.1 mg/l P.

Other Parameters
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70. It seems unlikely that pollution, other than the type represented by the foregoing parameters, will be of major importance in the River Blackwater catchment. However, if it is considered necessary to set specific standards at this stage for substances such as heavy metal or biocides these standards should be set with reference to the information given in Appendix H. The values chosen should be regarded as 95 percentiles in line with the above recommendations. One possible rider to be added here is that the use of herbicides and pesticides has, on one or two occasions, caused a serious fish-kill and therefore, some monitoring should be carried out during operations to detect potential problems and also oversee spraying operations to ensure that this is being practised in a satisfactory manner.

71. In addition, it must be noted that, as the River Blackwater is a designated water, several other parameters will also have to be complied with in accordance with the Directive (E.E.C., 1978).

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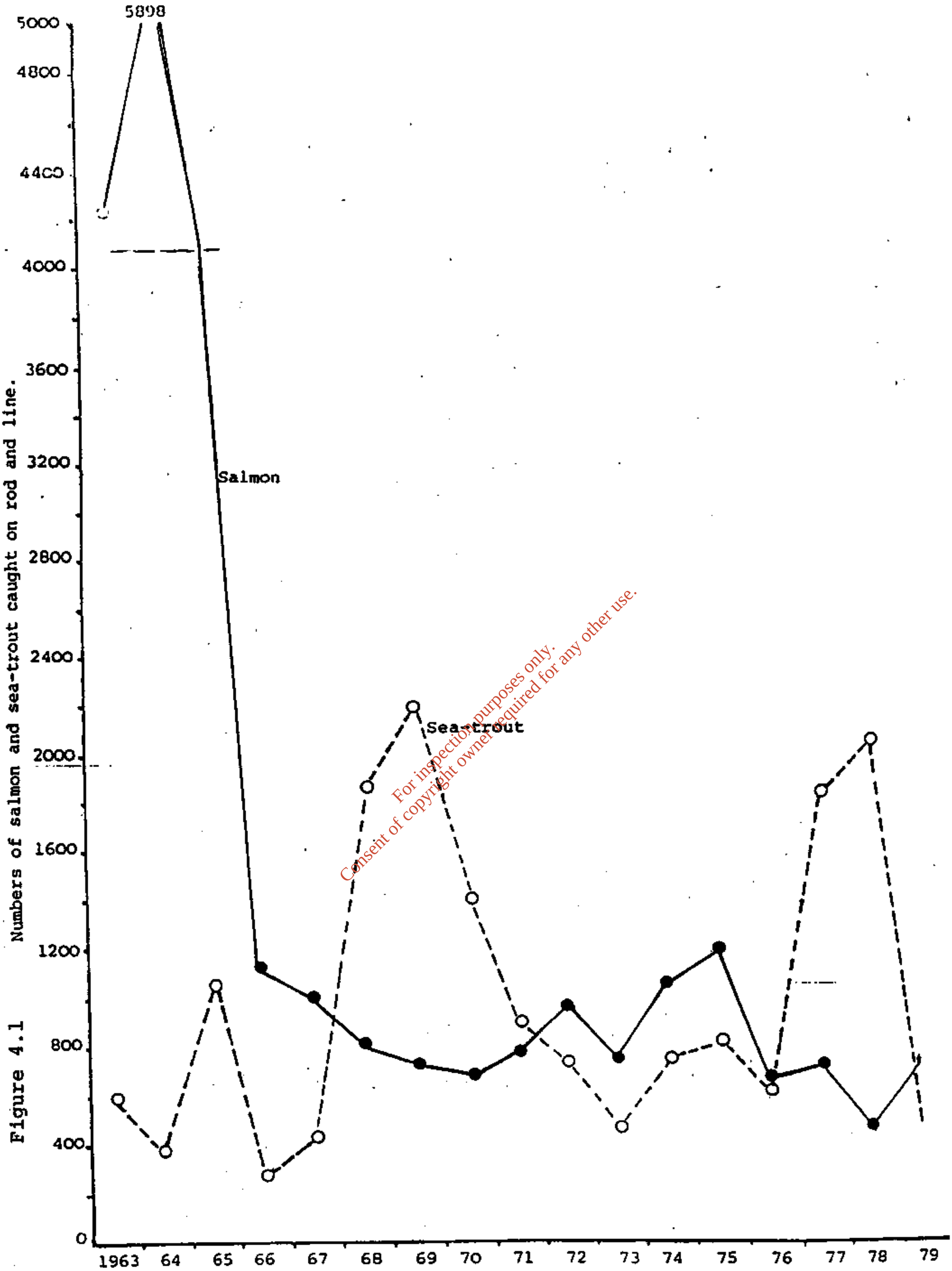

Figure 4.1

. Lismore Fishery District. Catches on rod and line of salmon and sea-trout from 1963 to 1979

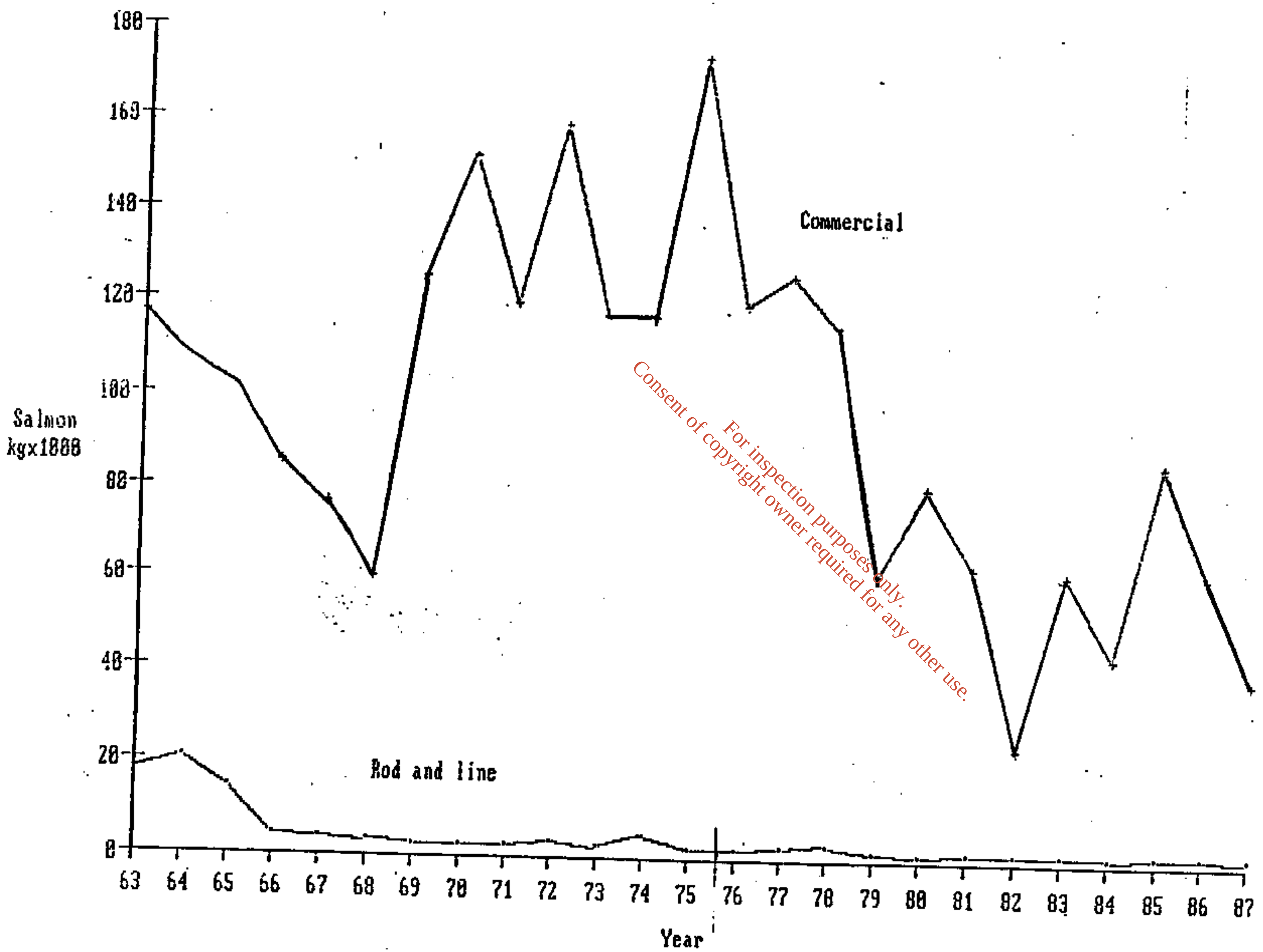

Fig. 4.2

Lismore Fishery District. Landings of salmon by commercial and rod and line fishermen from 1963 to 1979.

Table 4.1 Public and Industrial Abstraction of water in the Munster Blackwater Catchment showing the numbers of each type of source used, the total volume abstracted from each source type and the range of volumes abstracted under each type of source. Percentage of total abstraction in catchment by source type is also shown.

TYPE OF SOURCE	PUBLIC ABSTRACTIONS			INDUSTRIAL ABSTRACTIONS			PERCENTAGE OF TOTAL ABSTRACTION OF WATER IN CATCHMENT		
	Numbers of each type of source	Total Volume Abstracted in Catchment m3 / day	Range of Volumes Abstracted in Catchment m3 / day	Numbers of each type of source	Total Volume Abstracted in Catchment m3 / day	Range of Volumes Abstracted in Catchment m3 / day	Public	Industry	Total
SURFACE WATERS: Rivers/Streams	10	11,459	70 - 2,496	4	21,494	682 - 14,025	24	62	40
GROUND WATERS:									
Boreholes	73	10,608	1 - 3,200	30	13,422	1 - 7,274	23	38	29
Springs	40	21,089	5 - 5,910	NIL			45	-	26
Wells	2	832	60 - 772	NIL			2	-	1
Infiltration Gallery	1	3,005		Nil			6	-	4
Totals	127	47,015	1 - 5,910	34	34,916	1 - 14,025	100	100	100

Table 4.2 Details of the Catch of Salmon by single rod and line and weight of Commercial Salmon Landings in the Lismore Fishery District in the years 1965-1979.

Year	Number Caught (Rod and Line)	Weight kg (Rod and Line) 1,000's	Weight kg (Commercial) 1,000's
1963	4,261	17.94	116.92
1964	5,898	20.52	107.43
1965	4,124	14.54	101.74
1966	1,171	4.45	85.36
1967	1,033	4.01	76.30
1968	856	3.24	59.92
1969	760	2.66	124.66
1970	704	2.58	151.31
1971	784	2.56	119.03
1972	991	3.55	158.32
1973	752	2.36	116.53
1974	1,092	3.63	116.70
1975	1,210	4.78	173.34
1976	691	2.09	119.24
1977	721	2.24	125.43
1978	473	2.45	114.62
1979	869	3.13	61.23
1980	519	1.81	80.35
1981	349	1.18	62.73
1982	508	1.71	23.93
1983	541	1.65	61.60
1984	427	1.47	43.49
1985	410	1.32	86.22
1986	472	1.79	61.48
1987	492	1.58	38.64

Table 4.3 Some details of Irish and visiting salmon, brown trout and coarse fish anglers fishing club, hotel or syndicate waters on some regions of the River Blackwater (Munster) and its tributaries (data for 1980). Fishery rentals and rates have not been included.

Club, Hotel or Syndicate (Area fished)	No. of Members (local)	No. of Angling Permits issued	No. of visiting anglers (origin if known)	Approx. Value IR (including salmon licences, permits, membership fee, Ghillies and stocking)	Salmon Catches	Brown trout Catches	Coarse Fish Catches	Comments	Other Activities
Castletownroche Trout Anglers (Awbeg and part of Blackwater	40	20 approx.	20 approx. (Germany, Holland)	IR 400 approx.	few, but increased numbers being caught	good catches - stocking regularly	few eels - little else	"one-off" fish kill due to spraying accident near Doneraile - Floods in winter - flow drops too low around Buttevant in summer - remedy required. Some farmers preventing access to anglers.	winter shooting for duck pheasant and grouse.
Kildorrery and Mitchelstown Angling Clubs (Funshion, Gradoge and Tributaries)	144	100 max.	100 (Britain and Germany)	IR 7,200 (largest cost involves restocking programmes due to compensation paid for recent fish kill)	few - not fished for in this region	very good prior to severe fish kill in June, 1980	large number of dace in lower reaches	severe fish kill due to deliberate emptying of truck carring toxic factory wastes; latter also denuded river of weeds for several km. Gradoge badly polluted by creamery wastes.	part of area is preserved as a game santuary by local gun club.
Rathcormack Trout A. C. (North Bride River)	20	40 approx. (entry fee for competitions only)	10	IR 250	few - not fished for in this area	fairly good (some re-stocking being carried out)	few dace around Tallow	some pollution problems due to piggeries and silage pits especially near Glenville. Bank clearance needed due to bushes but farmers unwilling to permit club to remove or reduce these	Duck shooting by local gun club.
Castlelyons Trout A. C. (North Bride River)	40	Nil	Nil	IR 250	fair	fairly good but declining (some restocking every 2nd or 3rd year)	Not important	some pollution problems. Restocking may be insufficient to replenish catches	-
Mallow Game and Coarse Angling Association	21	(30-40/week) 400 approx.	(30-40/week) 400 approx.	IR 100	not fished for.	no details supplied	large catches of dace and roach.	river overstocked with coarse fish. Pollution severe	-
Peter Dempster Ltd. (Middle Blackwater Valley)	(Paying customers total 700 rod days approx. @ IR 12 per day per person for salmon) plus IR 12 per day per ghillie (if required)			IR 11,500 4,200 --------- IR 15,700	Good. 270 recorded by paying customers in 1980; but catches in 1960s and earlier about 3-4 times present returns. Reduction to present levels attributed to netting & poaching	not fished for	not fished for - see under other activities	complaints about pollution include town sewage, piggeries, slurry, intensive cattle units; gravel washings; sugar beet wastes; wastes from chocolate crumb factory. Severe floods in autumn, 1980 caused >IR 1,000,000 damage in Mallow area.	Small fresh-water eel fishery value approx. £2,000 (907 kg caught June-Sept.) Potential for development of fishery in winter for silver eels if winter floods can be controlled

Table 4.3 Contd.

Club, Hotel or Syndicate (Area fished)	No. of Members (local)	No. of Angling permits issued	No. of visiting anglers (origin if known)	†Approx. Value IR (including salmon licences, permits membership fee, Ghillies and stocking)	Salmon Catches	Brown trout Catches	Coarse Fish Catches	Comments	Other Activities
Fermoy Coarse Angling Federation and Salmon Angling (Fermoy area)	16 (in federation)	500 approx. (Competitions very important here! World Championship for coarse anglers held in region, anglers from Britain and Europe	500 (Britain, France, Holland, Belgium) Mostly coarse anglers	IR 7,000	good. No specific number given. Sea-trout taken up to Cappoquin	good. No details some stocking carried out.	excellent roach, dace, perch, few pike but declining perhaps because of overfishing.	complaints about pollution by town sewage and sugar beet wastes. Severe floods in autumn 1980 caused approx. £200,000 damage in Fermoy. Stiles, stands, footbridges constructed to improve anglers facilities.	canoeing and rowing popular here
(i) Lismore Trout A.C. and (ii) Lismore Salmon A. Syndicate (Blackwater & tributaries including Araglin, Owenshed and Glenmore)	(i) 25) (ii) 20)	45 min.	not here - Fermoy and Cappoquin areas used by visitors	IR 800	very good 220 fish (11 salmon/angler) larger fish up to 7 kg being caught recently rather than 2-3 kg fish typical of recent years - possibly because of netting effects.	not good, not stocked, some good sea-trout	dace and roach at Cappoquin but in decline since "food" from bacon effluent stopped	complaints about pollution from sewage, creameries, piggeries; some spills occur pre-dawn at weekends, definitely illegally. Heavy poaching - near epedemic. Complaints about wild mink (Lismore-Ballyduff area)	game sanctuary Large quantities of Anodonta in river - may have commercial potential
Cappoquin Coarse Anglers Club (Blackwater as far as Finisk confluence)	40	1000 approx. (competitions very important here; at least eight to be held in 1981)	1000 (Britain, Europe)	IR 4,600	not fished for by anglers here. Commercial nets in region.	variable - catches generally small	very good. 10-15 kg per angler/day; Dace good in April, May, July, August, September; Roach best in March June, August and September	plans for development in 1981 include cleaning up banks and improving access, construction of 50 new fishing stands to prepare for angling competitions in conjunction with Southern Regional Tourist Board.	-
Blackwater Lodge Hotel (manager Mr. H. Martin, 24 km of river from Mallow to Ballyduff.	(paying customers range 500-800 per season at £10/day per person for salmon.			IR 8,500	500-700 very good but reduced catches in recent years due to excessive netting and probably because of UDN disease.	1000 approx.	good - up to 90 kg per day caught	complaints about pollution from farms, creameries and town sewage. Some spawning areas lost due to gravel works	rough shooting in region

Table 4.4 Current Market Value of the1965, 1975, 1979 and 1985 commercial and sport fish landings of salmon, sea-trout eels and shellfish, in the Munster Blackwater Catchment

(Salmon IR 4.85 kg-1; sea-trout IR2.86/kg; eels IR2.37/kg; lobster IR5.13/kg; crayfish IR4.79/kg. (1979)

	1965		1975		1979		1985	
	Value IR	Weight kg	Value IR	Weight kg	Value IR	Weight kg	Value IR	Weight kg
							'85 Prices	
Salmon (rod and line)	70,540	14,540	23,183	4,780	15,181	3,130	6,827	1,318
Sea-trout (rod and line)	1,573	550	1,439	503	358	143	N/A	N/A
Total	72,023	15,090	24,622	5,283	15,539	3,273	6,827	1,318
Salmon (net)	493,493	101,740	840,699	173,340	296,966	61,230	445,656	86,034
Sea-trout (net)	1,390	486	5,654	1,977	143	50	N/A	N/A
Total	494,829	102,226	846,353	175,317	297,109	61,280	445,656	86,034
Total value and weight of salmon and sea-trout catches (all methods)	566,822	117,316	870,975	180,600	312,648	64,533	452,483	87,352
Eels (nets only)	-	-	242	102	3,474	1,466	N/A	N/A
*Shellfish	N/A	N/A	9,378	1,828	14,857	2,913	N/A	N/A
Total value and weight of all catches.	566,822	117,316	880,595	182,530	330,979	68,932	452,483	87,352

* Landings at Youghal. (1965 values not available but assumed to be negligible; 1975, lobsters only; 1979, lobsters and crayfish).

TABLE 4.5 Estimated expenditure on salmon, trout and coarse fishing by local and visiting in the River Blackwater (Munster) Catchment, 1979.

Expenditure by visiting salmon anglers	IR 202,311
Expenditure by local salmon anglers	70,403
Total spent by all salmon anglers	IR 272,714
Expenditure by visiting trout anglers	IR 108,885
Expenditure by local trout anglers	70,403
Total spent by all trout anglers	IR 179,288
Expenditure by visiting coarse anglers	IR 1,008,900
Expenditure by local coarse anglers	70,403
Total spent by all coarse anglers	IR 1,079,303
Total spent by all anglers	IR 1,531,305

TABLE 4.6 The Munster Blackwater Fisheries. Total estimated current Gross Output Value (1979 data).

	Commercial Fisheries	Angling
Salmon	IR 296,966	IR 272,714
Sea-trout	143	358
Brown trout	Assume Nil.	IR 179,288
Coarse fish	Assume Nil.	IR 1,079.303
Eels	IR 3,474	Not important, assume nil.
Shellfish (lobster and crayfish)	IR 14,857	Not applicable
*Money spent to develop angling	Assume Nil.	IR 44,800
Total	IR 315,440	IR 1,576,463
Overall value of Fisheries	IR 1,891,903 1988 equivalent = IR 4,441,087	

*Including bank clearance, construction of stiles, fences, footbridges, restocking, permits, licence fees and ghillies (for some anglers).

TABLE 4.7 CRITERIA AND STANDARDS OF VARIOUS AGENCIES IN RESPECT OF DISSOLVED OXYGEN, AMMONIA, BIOCHEMICAL OXYGEN DEMAND, NITRATE AND PHOSPHORUS FOR WATER ABSTRACTION, SALMONID FISHERIES AND LIVESTOCK WATERING. VALUES SHOWN ARE THE MAXIMA PERMITTED OR RECOMMENDED, UNLESS OTHERWISE STATED.

Parameter	Abstraction for Potable Supply			Salmonid Fisheries				Livestock Watering	
	E.P.A. (Criteria)	E.E.C.[1,2] (Directive)	Anglian W.A.[3] (Criteria)	E.P.A. (Criteria)	E.E.C.[2] (Directive)	Anglian W.A. (Criteria)	DoE.IRL (Guidelines)	E.P.A. (Criteria)	Anglian W.A. (Criteria)
Dissolved Oxygen sat./mg/l O_2	No Proposal	'G' values: A1: >70% A2: >50% A3: >30%	≮50%	≮5mg/l Interstitial water in salmonid redds to contain ≮5mg/l	50% samples >9mg/l	≮5mg/l	≮9mg/l in 50% of samples ≮6mg/l in 95% of samples No sample with ≮4mg/l	No proposal	≮30%
Ammonia[4] mg/lN	0.5	A1: 0.04 (G) A2: 1.2 A3: 3.0	1.0	0.02 (un-ionised)	0.02 (un-ionised) 0.8 (Total)	0.2 (unlionised)	0.2 (un-ionised	No proposal	No proposal
Biochemical Oxygen Demand mg/l	No proposal	'G' values A1:<3 A2:<5 A3:<7	6.0	No proposal	<3('G')	Fast flow (>50mm/sec) 6.0 Moderate Flow (20-50mm/sec) 5.0	4.0	No proposal	No proposal
Nitrate mg/lN	10.0	A1,A2,A3: 12.0	22.6	No proposal	No proposal	100	No proposal	100 (incl. nitrites)	100
Phosphates mg/lP	No proposal	'G' values A1: 0.2 A2: 0.3 A3: 0.3	No proposal	No proposal	0.07[5]	No proposal	see Note 5	No proposal	No proposal

TABLE 7. CONTD.

1. In the case of the E.E.C. Directive on Abstraction Water, standards are set for three types of sources: A1 waters are those requiring only preliminary treatment: A2 waters are those requiring conventiondal treatment and A3 waters are those requiring extended treatment.

2. For some parameters, only guideline values are given. These are indicated by the letter 'G'.

3. Values given for waters going direct to treatment.

4. In the case of ammonia, toxicity to fish is associated with the un-ionised species (NH_3). This increases as a fraction of total ammonia with increase in pH and temperature.

5. In the case of lakes of average depth between 18m and 300m the E.E.C. directive and the D.O.E. Guidelines indicate that the phosphorus loading relationships with trophic status derived by Vollenweider should be referred to for guidance. (see references to Appendix A).

APPENDIX A.

SOME ASPECTS OF THE MANAGEMENT OF WATER QUALITY

Introduction

In recent decades, the increasing pressures on water resources arising from the conflicting demands of activities such as water abstraction and fisheries on the one hand and waste disposal on the other have highlighted the need for management strategies based on scientific methods of assessment and prediction. A further stimulus to undertake such measures is the recent and growing awareness among the public at large of the benefits of a clean environment, a development which is recognised in the current Environmental Action Programme of the European Economic Community.

The development of strategies for the control and management of water quality in rivers and other water bodies is not wholly a recent trend. The deliberations of the Royal Commission on Sewage Disposal in England, around the beginning of the century, amount to the essentials of a water quality management plan for rivers in general and its well known effluent standard (20 mg/1 BOD and 30 mg/1 suspended solids) for sewage treatment plants is still used widely. This standard was related to a dilution minimum and derived from observations on the conditions to be expected in rivers depending on their B.O.D. and suspended solids contents. As such, the approach of the Commission was essentially similar to the present preference for 'water quality objectives' as a guide to effluent standards (Young, 1979). The increasing 'on stream' and multi-purpose uses of rivers and the greater expectation of good water quality despite such increased pressures have, however, presented problems to the responsible agencies which cannot be handled adequately by the relatively simple, albeit basically sound, mechanisms suggested by the Royal Commission. Since the 1950s, a more sophisticated approach to water quality management has developed, particularly in the U.S. and in the U.K. and this trend has accelerated so much in the environment-conscious seventies that the subject of water quality management has become virtually a distinct scientific discipline. At the most advanced level the techniques of systems analysis are used together with mathematical modelling of the dynamics of water quality and of the economic factors which are involved in its control (Beck, 1976; Lettenmaier and Burges, 1975).

Water Uses

It is now accepted generally that the basic requisite in a system of water quality management is a use classification for the particular water body under consideration. The beneficial uses (to the community) of a river or lake may include sport and commercial fisheries, water abstraction for potable or industrial purposes, general amenity and recreation and agricultural uses such as irrigation and livestock watering. The controlled disposal of wastes arising from domestic, industrial or agricultural sources may be regarded as a further important use even though it is a potential constraint on the foregoing uses.

While it is possible that proper controls would permit the exercise of all of these uses simultaneously in one stretch of river it is more often the case in the heavily industrialised countries such as the

U.K., Germany or the U.S. that certain sections of the watercourse are designated for a particular use or uses. Such catergorisation usually derives from the past history of pollution in the resource, i.e. it recognises a de facto situation such as the absence of game fish populations from certain reaches where large inputs of industrial waste occur. However, categorisation on this basis does not preclude a future change in designation by the regulatory agency to permit a greater variety of uses or for that matter a more restricted use.

Water Quality Criteria

To a large extent the beneficial uses of a water body are determined by its quality. With the exception of waste disposal, the various uses of water resources have particular requirements in this respect. These requirements refer in most cases to the levels of impurities introduced artificially, i.e. as a direct result of human activities though in some cases, particularly for industrial and potable purposes, there may be requirements in respect of the levels of naturally occurring constituents. The particular requirements for each use, in this context, are referred to as Water Quality Criteria. Warren (1971) has defined a water quality criterion as '---any definite limit of variation or alteration of water quality expertly judged, on the basis of scientific data, not to have some specified, usually adverse effect on the use of the water by man or on organisms inhabiting the water'. As such water quality criteria indicate the range of conditions in which a particular use can be exercised whether it be abstraction for potable purposes or the maintenance of a viable fishery. Most criteria have been derived from observations made over a large number of years on water bodies subject to a variety of uses and the effects of quality changes, particularly those due to waste discharges, on such uses. However, in recent years there has been a realisation that such observations needed to be backed up by experimental data, a need which is particularly true where toxic substances such as heavy metals and synthetic organic chemicals are concerned. The bulk of this experimental work has been concerned with fish and other aquatic organisms; while this may be due to reasons of practicability it is accepted that the tolerances of such organisms give a good general guide to other water uses (Price, 1978). This arises from the intimate contact between fish and other aquatic organisms and their water environment and the great sensitivity of many of them to relatively small induced changes. There is a vast literature dealing with the effects of specific toxic pollutants on fish and aquatic invertebrates (Wilber, 1969; several authors, 1978) and there is no sign of this sort of endeavour decreasing. An important reason for continuing such research is the need to determine long term and non-lethal effects of such pollutants. Earlier experimental work dealt mainly with the acute or lethal effects on fish and criteria adopted from the results of such word had to be based on somewhat arbitrary 'safety' factors (Eaton, 1973). Experimental determination in the laboratory of the effects of pollutants on aspects such as growth and reproduction present much greater difficulties than do acute tests, but some success has been obtained using artificial channels and other simulations of the aquatic environment. It is clear that the continuing availability of more detailed information on the effects of specific pollutants will allow the parallel refinement of the water quality criteria.

There are several sources for water quality criteria, perhaps the best known being those published by federal and state environmental agencies in the U.S. The Environmental Protection Agency (E.P.A.) has published a comprehensive set of water quality criteria applicable to a wide range of uses (National Academy of Sciences - National Academy of Engineering, 1972) and this source has been used widely as a guide (Hart, 1977; Price and Pearson, 1979). A specific set of water quality criteria for freshwater fish has been recommended by the European Inland Fisheries Advisory Commission in a series of recent publications (E.I.F.A.C., 1964-77). The recommendations of the World Health Organisation in regard to the composition of drinking water are also well known in this context (W.H.O., 1977). While sources such as these are of sufficient general relevance to serve as a guideline in most situations, many countries are now adopting criteria which take account of their specific circumstances (Hart, 1977). The document recently issued by the Department of the Environment entitled 'Water Quality Guidelines' is such an example from thes country (Technical Committee on Effluent and Water Quality Standards, 1978). Such local modifications in setting criteria often result from the feedback of data arising from surveillance of receiving waters where water quality standards, derived from existing criteria, have been set in order to protect defined uses.

Water Quality Standards

Once the uses of a particular water body have been defined and the relevant water quality criteria have been established, the protection of such uses is then provided for by the introduction, by the regulatory agency, of Water Quality Standards. To refer again to Warren (1971), a water quality standard may be defined as '---any more or less permanent and widely applicable rule authoritively establishing for regulatory purposes the limit of some unnatural alteration of water quality that is to be permitted or accepted as being compatible with some particular use or uses of water'. Thus a water quality standard has the status of a legal requirement in contrast to a water quality criterion which is purely a scientific assessment. Water quality standards may be identical in their requirements to the relevant criteria or they may be more stringent depending on the scientific soundness of the latter. In certain cases they may be less stringent where for economic or political reasons, a degree of interference with the beneficial use is to be tolerated. In most situations, the water body concerned is required to support several uses and the standards will be based on the most demanding of the criteria applicable to these several uses (e.g. dissolved oxygen as applicable to abstracted water). In contrast, if one of the defined uses were a game fishery it is likely that few criteria, other than those applying to this particular use, would need to be considered, because of the stringency of those applying to game fish waters.

It has been suggested that the term water quality standard be reserved for those regulations which are applicable on a wide geographical basis and that more local regulations in regard to receiving water quality be referred to as 'requirements' or 'objectives' (Warren, 1971). An example of the former type is the series of directives and decisions on water uses issued by the Council of the European Communities in recent years (Council of the European Communities, 1975, 1976, 1978 and 1979). These documents have a legal status in all member countries and lay down the standards to be adhered to in respect of the quality of water for fisheries, shellfisheries, abstractions for potable purposes and bathing. Further directives are being drafted to deal with the water quality of water for fisheries, shellfisheries, abstractions for potable purposes, certain industrial undertakings and for freshwater flora and fauna. In addition to a mandatory value for each parameter listed in these directives ('I' values) more stringent guidelines ('G' values) are given which represent a desirable condition. Any member country may choose to set standards which are more stringent than either of these. Except for the effects of unusual circumstances, e.g. floods, standards less stringent than the 'I' values cannot be adopted. The member countries are also required to monitor the waters designated under each directive and to communicate the resulting data to the Commission of the E.E.C., where requested. It is interesting to note that, in addition to the community, these directives also have the declared aim of eliminating any imbalance in trade competition which might arise from the use of different standards in member countries.

There are very few examples of such general water quality standards to be found elsewhere in the world, except perhaps in the U.S. which has standards for interstate transfer water and drinking water (Wells, 1978). At a more local level the reorganised water authorities in the U.K., in embarking on comprehensive water quality management plans in recent years, have set 'water quality objectives' for particular stretches, these being based on the recommendations of the National Water Council in regard to criteria for different uses (Young, 1979; Montgomery, 1979) or on criteria drawn up by the water authority from its own considerations (Price and Pearson, 1979). A similar approach is used in France (Lefrou, 1977). In Ireland, the setting of standards for water uses is anticipated in the recent Local Government (Water Pollution) Act, 1977.

Assimilative Capacity and Effluent Standards

When the appropriate water standards have been selected, one may proceed to the final step in the process of controlling water quality, viz. the drawing up of effluent standards. This is an extremely complex issue since it embraces several factors which are difficult to define precisely and must take into account also economic and, perhaps, sociological considerations. The primary aim of effluent standards is to regulate waste discharges so that the water quality standards set for the particular receiving water are not contravened. Although there have been proposals in recent years to control waste discharges by a system of uniform emission standards, at least for certain pollutants (see below), it is now generally accepted that the most pragmatic approach is to take into account the assimilative capacity of the receiving water when setting limits for the quantities and discharge rates of wastes.

This capacity is a measure of those quantities of waste which, when added to the receiving water under a particular set of circumstances, do not lead to any deviations from the designated water quality standards. The chief factor concerned in assimilation capacity is the dilution afforded to the waste by the receiving water (particularly if conditions upstream of the discharge are good). This dilution capacity will vary quite considerably over a year and it has become the practice to determine effluent standards on the basis of the dilution afforded under relatively low flow conditions, usually the 95 percentile value. In some cases, where adequate storage capacity is available, it is possible to regulate the rate of discharge so that the input of waste can be increased at higher river flows thereby making use of the greater dilution capacity available under such conditions. The discharge of waste to tidal or static waters presents special problems with respect to dilution and waste dispersal. This is a subject which has received much attention in recent years and a large number of mathematical modelling techniques are now available which allow reasonable prediction of the behaviour of waste, particularly in estuarine situations. (Gallagher and Hobbs, 1978).

Dilution is the only factor to be considered when assessing the assimilative capacity for conservative waste substances such as chloride or fluoride. Pollutants of this nature go into solution in the receiving water and behave like other natural solutes such as potassium and sodium so that effluent standards may be calculated on the basis of simple mass balance equations. The situation becomes more complex where the pollutants are likely to react chemically in the receiving water e.g. the precipitation of some heavy metals in hard waters or the effect of pH on the formation of toxic forms of ammonia and cyanide. Of particular importance in this respect are the biochemical reactions in receiving waters which lead to the oxidation of the organic matter in waste discharges and to the release of plant nutrients such as phosphates and nitrates. These self purification processes, which characterise pollution by organic biodegradable wastes, have both beneficial and adverse effect on receiving waters. The oxidation of the organic matter completes the process of waste elimination which commences in the treatment plant but this can lead to serious deoxygenation of the receiving water if the input of waste is not controlled properly. In addition to dilution, the reaeration capacity of the river or stream will have a major influence on the degree of deoxygenation which occurs. Where this capacity is relatively high, e.g. in shallow, fast flowing streams, large concentrations of biodegradable waste may result in little deoxygenation whereas in the poorly reaerating conditions of deep and slow flowing rivers, the same concentrations could result in complete anoxia. Further complicating factors are the respiration and photosynthesis of algae and aquatic weeds which can lead to wide diurnal fluctuations in dissolved oxygen and markedly alkaline pH may occur during the afternoon of warm sunny days to be followed in the hours of darkness by a severe loss of oxygen and a return of pH to normal values. In some cases, the deoxygenating effects of the B.O.D. of wastes carried in the water and of the respiration of plants and algae may be further added to by the uptake by microorganisms in organic sludges deposited on the substratum under low flow conditions.

Thus a complex of factors influences the dissolved oxygen regime in organically polluted rivers and the prediction of the effects of particular waste inputs is made very difficult. The well known equations of Streeter and Philps (1925) developed several decades ago for the Ohio River in the U.S. allow reasonable predictions of dissolved oxygen deficits to be expected below waste discharges. However, since these take into account only the processes in the water column (B.O.D. and reaeration) they have proved invalid for smaller rivers and streams where the influence on the dissolved oxygen regime of bottom deposits and of weed and algal growth is of comparable or even greater importance than that of the B.O.D. and reaeration (Ministry of Technology, 1962; Owens and Edwards, 1963). More complex mathematical models have been developed in recent years to accommodate the situation in small revers and streams and have been used in some rivers in the U.K. (Owens et al, 1978). However, most of these models require some access to a computer facility and also they necessitate the measurement of a number of biological and chemical variables in the receiving water. Such measurements present difficulties for non-specialist laboratories, though solution of the model equations can be attempted using the values reported for similar situations elsewhere. Subsequent comparison of the observed and predicted behaviour of the parameters being studied may then indicate the correct values to be used for these variables. More generalised relationships have been developed in the U.S. and U.K. for the prediction of reaeration capacity from hydraulic characteristics such as stream velocity and mean depth (Churchill et al, 1964; Owens et al, 1964). The prediction of the effects of organic pollutants in lakes, particularly the development of eutrophication, has also received much attention in recent years and has given rise to a variety of modelling approaches both simple and complex (Vollenweider, 1976; Tapp, 1978). Most of these are related to the control of nutrient inputs, particularly that of phosphorus.

A more simplified approach to the prediction of the assimilative capacity in the case of organic pollutants is to refer to the B.O.D. concentration specified in the quality standards for the particular stretch. This value, in combination with the flow specified for the purpose of setting effluent standards, will give an estimate of the total B.O.D. load which can be accommodated by the river stretch. It is then a relatively simple matter of mass balance calculation to divide this between the different waste sources. Such an approach may well underestimate the capacity of a river to assimilate waste loads and it takes no account of the probable effects of nutrients. However, the B.O.D. values typical of clean waters are known from an extensive series of observations on river conditions and it is unlikely that serious mistakes would be made by using them to calculate the assimilative capacity as described above. This is particularly so if the wastes to be catered for are subjected to secondary treatment and do not contain large amounts of particulate organic matter. There is the further consideration that even though large increases in B.O.D. concentrations may cause little deoxygenation in rivers with rapid reaeration rate, they would greatly enhance the growth of saprobic organisms such as the slime bacteria ('sewage fungus'). Such growths interfere with many of the uses of a river and may cause secondary deoxygenation when decaying in backwaters and slow flowing reaches.

The apportionment of the waste assimilation capacity of a river reach must take into account not only the present discharges but also allow for future developments. These developments may be known relatively accurately in terms of planning at a regional level and an order of magnitude estimate of the future waste loads may be a fairly arbitrary matter. This uncertainty may be compensated for by the fact that it is always open to the regulating agency to modify effluent standards as the need arises so as to allow further discharges to be made in future. However, it is clearly inadvisable that the total assimilative capacity should be allotted to existing discharges when a water quality management plan is formulated in the manner discussed above.

Another consideration in setting effluent standards is the need to protect downstream uses. This may entail setting standards for the upstream reach which are more stringent than those actually required by the designated uses at that point so that only a part of the assimilative capacity is used. Where there are a number of towns along a reach of river, each abstracting water and discharging wastes, the management of water quality may be a complex matter requiring the use of relativily sophisticated modelling techniques (Warn, 1978).

The mechanism of waste discharge may be a further consideration in setting effluent standards. The receiving water standards apply at the edge of the 'mixing zone' i.e. the point at which waste and receiving water are uniformly mixed. It may be necessary to control the effluent composition so that conditions in the mixing zone itself are not offensive to observers or toxic to aquatic life. The length of the mixing zone may be attenuated by discharging effluent through an efficient diffusing system or it may be possible to 'stream' waste along one side of the river channel, leaving a clean passage for fish. The efficiency of the mixing process in a particular stretch of river may be assessed from sampling. However, techniques have been developed which allow predictions to be made of the characteristics of the mixing process, based on hydraulic factors (Sanders et al, 1977).

The determination of effluent standards on the basis of waste assimilation capacity, where the latter is, in turn, based on the designated receiving water standards or objectives, has received wide acceptance in recent years both for its pragmatism and flexibility. Nontheless, proposals have been made in the same period for a system of uniform discharge standards, at least for certain types of effluents. The original Royal Commission standards or objectives for rivers affording a certain level of dilution.

In the U.S. a comprehensive control system for domestic, industrial and agricultural effluents was proposed under the Federal Water Pollution Control Act Amendments of 1972 (Environmental Protection Agency, 1976). The main requirement of this legislation is a phased degree of reduction of effluent produced by different types of industry and other waste sources in line with improving waste treatment technology. These improvements are monitored by the Environmental Protection Agency which issues effluent limitation guidelines; these guidelines are the basis for discharge permits.

Two main goals were established by the 1972 Act viz. the attainment by industries discharging to navigable water of 'the best technology economically achievable' and the complete elimination of industrial effluents by 1985. Not surprisingly these proposals, which change the emphasis from the control of receiving water quality to that of effluents arising from different types of industry, have caused much difficulty and some confusion in practice (Lettenmaier and Burges, 1975). The National Water Commission has urged the dropping of the 1985 nil discharge goal and the Act has been critisized, generally, on economic grounds (Whipple, 1976).

In the European Economic Community, a recent Council Directive (Council of the European Communities, 1976b) has favoured the use of uniform emission standards for the reduction or elimination of the discharge of certain dangerous substances to the aquatic environment. These are distinguished in two categories; List 1 (the 'black' list) includes substances of known toxicity some of which may be persistent in the environment and undergo bioaccumulation, while List 11 (the 'grey' list) are substances which have a more confined effect than those on List 1 or on which full information in respect of their polluting potential is not yet available. The Directive requires member states to lay down uniform emission standards for the types of pollutant specified in List 1, basing these standards on limits decided by the Council. Such limits may stipulate maximum concentrations of a particular pollutant to be allowed in an effluent and also the total amount of such pollutant which may be disposed of from some specified unit of the industrial operation, e.g. per unit of raw material processed. However, there is an allowance for a more flexible approach where the member state can show compliance with water quality objectives which will be stipulated for each of the pollutants, by the Council. The Directive specifies the latter approach for the control of List 11 substances.

The initial drafts of this directive led to many objections, particularly from U.K. industries (Biggs, 1979), and the provision for the control of List 1 substances by means of water quality objectives was introduced at a later stage to meet such objections. However, it is clear from of uniform limits for the List 1 substances even though these may be less stringent in some cases than those derived from water quality objectives.

There may well be a case for the enforcement of uniform emission standards for certain types of pollutants, particularly those which are of high toxicity and which have a tendency to persist in the environment. This case is strengthened by the uncertainty which exists in regard to the long term effects of very small increases in the concentrations of these pollutants in the environment. As mentioned above, research on this aspect of toxicity has intensified in recent years and it is not unlikely that this will show that for some substances at least the best approach will be to reduce the amount disposed of to the environment to the lowest technically possible if not to zero. However, for other waste substances, particularly those of an organic biodegradable nature, it is clear that the regulation of the amounts discharged in line with the assimilative capacity of the receiving water is the most practical approach and one which allows the greatest flexibility both from a regulatory and and economic point of view.

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Appendix B. Estimated area (hectares) under cereal crops in counties Cork, Kerry and Waterford, 1976. (Courtesy, Central Statistics Office).

County	Wheat	Oats	Malting Barley	Other Barley	Potatoes
Cork	3,966	4,235	4,452	49,373	4,492
Kerry	121	1,295	486	3,602	2,024
Waterford	1,781	2,469	364	9,470	809

APPENDIX C. Estimated area (hectares) under non-cereal crops, fruit, hay (including grass for silage), pasture, woods and plantations, and rough grazing in counties Cork, Kerry and Waterford, 1975 (Courtesy C.S.O.).

County	Rye	Maize	Beans and Peas	Turnips	Sugar Beet	Vegetables for sale	Vegetables for home use	Apples	Other Fruit	Hay	Pasture	Woods & Plantations	Rough Grasing in use	Other land
Cork	64	52	1,493	2,456	9,102	708	70	154	39	130,754	325,755	37,423	110,414	58,122
Kerry	4	-	1	827	373	176	33	22	3	58,062	148,427	14,734	160,626	79,336
Waterford	5	62	89	580	1,238	116	14	193	8*	26,652	86,280	16,290	24,566	12,967

* 27 hectares of soft fruit grown in Co. Waterford in 1979 and there are signs that further increases will occur in future (Annual Report, 1980).

APPENDIX D. Numbers of cattle, sheep, pigs, horses, ponies and poultry in Counties Cork, Kerry and Waterford in June, 1977 (Courtesy, C.S.O.).

(Figures are rounded off to the nearest hundred).

County	Cattle	Sheep	Pigs	Horses and Ponies	Poultry				Poultry Total
					Turkeys	Geese	Ducks	Fowl Ordinary	
Cork	956,100	177,200	204,700	9,000	38,800	4,600	6,300	722,500	772,200
Kerry	363,100	270,000	31,400	4,400	13,600	2,600	4,600	162,700	183,600
Waterford	239,200	67,700	43,000	3,400	8,200	600	900	559,400	569,000

Appendix E. E.P.A. Recommended Criteria for Recreational and Bathing Waters.

(From: Water Quality Criteria 1972).

1) <u>General Recommendations for all Recreational Waters.</u>

a) Aesthetic Considerations - Waters should be free of the following substances attributable to waste discharges.

Material that will settle to form objectionable deposits.

Floating debris, oil, scums and other matter.

Substances producing objectionable odour, colour, turbidity or taste.

Substances and conditions in concentrations or intensities which lead to the production of undesirable aquatic life.

b) Chemical Concentrations.

Waters that contain chemicals in concentrations toxic to man if ingested in small amounts should not be used for recreation.

Waters that contain chemicals in concentrations which cause irritation to skin or mucous membranes should not be used for recreation.

c) Microbiological Considerations

None recommended in the absence of reliable data. Waters subject to gross microbiological pollution will be so affected by other foreign substances as to be aesthically unacceptable.

2) <u>Special Requirements for Bathing Waters.</u>

Microbiological	:	No recommendation because of the absence of reliable data.
Temperature	:	Thermal characteristics should not cause any appreciable change in the deep body temperature.
pH	:	6.5 - 8.3 preferable; 5-9 tolerable in poorly buffered waters.
Clarity	:	Should be such as to allow the detection of submerged objects and hazards.
Chemical	:	Water should be non-toxic and non-irritating to skin and mucous membranes.

<u>Water Quality Considerations for Specialized Recreation.</u>

Boating : As for Aesthetic Considerations under (1) above.

Aquatic Life and Wildlife : As for Fisheries (see Appendix).

Appendix F. Quality Requirements for Bathing Waters in the European Community, (Council Directive of 8 December 1975, 76/160/CEC).

Parameter	Guideline Limit (G)	Mandatory Limit (1)
Total Coliforms, nos/100ml	500	10,000
Faecal Coliforms, nos/100ml	100	2,000
Faecal Streptococci, nos/100 ml	100	-
Salmonella, nos/100ml	-	zero
Enteroviruses, PFU/10 litres	-	zero
pH	-	6-9
Colour	-	No abnormal change in colour.
Mineral Oils, mg/l	- (<0.3 - see Note 1)	No visible film on water surface and no odour
Methylene Blue Reactive Substances, mg/l laurylsulphate	- (<0.3 - see Note 1)	No lasting foam
Phenols, mg/l C_6H_5OH	- (<0.005 -see Note 1)	No specific odour (0.5 - see Note 1)
Transparency, m	2	1
Dissolved Oxygen % sat.	80-120	-
Tarry residues and floating debris	Absent	-

Notes:

1) Concentrations to be checked when an inspection in the bathing area shows that the substance may be present or that the quality of the water has deteriorated.

2) The following parameters are considered relevant in this context but limits have not been defined: Ammonia, Kjeldahl Nitrogen (these two where eutrophication is suspected); Pesticides (parathion, HCH, dieldrin), heavy metals (As, Cd, Cr(VI), Pb, Hg), Cyanides, Nitrates, Phosphates.

Appendix G. The Quality Required of Shellfish Waters (Council Directive of 30 October 1979, 79/923/CEC).

Parameter	Guideline Limit ('G' value)	Mandatory Limit ('I' value)
pH		7-9
Temperature	A discharge affecting shellfish waters must not cause the temperature of the waters to exceed by more than 2°C the temperature of waters not so affected.	
Colouration		A discharge affecting shellfish waters must not cause the colour of the waters after filtration to deviate by more than 10mg Pt/l from the colour of waters not so affected.
Suspended Solids		A discharge affecting shellfish waters must not cause the suspended solids content of the waters to exceed by more than 30 per cent the content of the waters not so affected.
Salinity	12-38‰	- 40‰ - Discharge affecting shellfish waters must not cause their salinity to exceed by more than 10 per cent the salinity of waters not so affected.
Dissolved Oxygen	80% sat.	- 70% sat. (average value) - should an individual measurement indicate a value lower than 70% sat., measurements shall be repeated - an individual measurement may not indicate a value of less than 60% sat. unless there are no harmful consequences for the development of shellfish colonies.
Petroleum Hydrocarbons		Hydrocarbons must not be present in the shellfish waters in such quantities as to : - produce a visible film on the surface of the water and/or a deposit on the shellfish - have harmful effects on the shellfish.

(Contd.)

Parameter	Guideline Limit ('G' value)	Mandatory Limit ('I' value)
Organohalogenated Substances	The concentration of each substance in shellfish flesh must be so limited that it contributes in accordance with Article 1*, to the high quality of shellfish products.	The concentration of each substance in the shellfish water or in shellfish flesh must not exceed a level which has harmful effects on the shellfish and larvae.
Metals(e.g. Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn).	The concentration of each substance in shellfish flesh must be so limited that it contributes in accordance with Article 1*, to the high quality of shellfish products.	The concentration of each substance in the shellfish water or in shellfish flesh must not exceed a level which gives rise to harmful effects on the shellfish and larvae. The synergic effects of these metals must be taken into consideration.
Faecal Coliforms/100 ml	$\leqslant$ 300 in the shellfish flesh and intervalvular fluid**.	
Substances affecting the taste of shellfish		Concentration lower than that liable to impair the taste of the shellfish.
Saxitoxin (Produced by Dinoflagellates)***		

* This states : 'This Directive concerns the quality of shellfish waters and applies to those coastal and brackish waters designated by the Member States as needing protection or improvement in order to support shellfish (bivalve and gasteropod molluscs) life and growth and thus to contribute to the high quality of shellfish products directly edible by man'.

** However, pending the adoption of a Directive on the protection of consumers of shellfish products, it is essential that this value be observed in waters in which live shellfish directly edible by man.

*** Limits may be set for this parameter at a future date.

Appendix H.

WATER QUALITY CRITERIA, STANDARDS AND GUIDELINES ISSUED BY VARIOUS AGENCIES FOR THREE TYPES OF WATER USE. VALUES SHOWN FOR EACH PARAMETER ARE THE MAXIMA PERMITTED OR RECOMMENDED, UNLESS OTHERWISE STATED.

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE. IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian W.A. (Criteria)
Aluminium, mg/1 Al	No Proposal			No Proposal				5	
Ammonia[6], mg/1 N	0.5	A1:0.04(G) A2:1.2 A3:3.0	1.0	0.02 (un-ionised)	0.02 (un-ionised) 0.8 (total)	0.02 (un-ionised)	0.02 (un-ionised)	No Proposal	
Arsenic, mg/1 As	0.05	A1, A2 : 0.05 A3:0.1	0.05			Salmonid 0.75 Cyprinid 0.15		0.20	0.20
Bacteria, nos/100ml a) Total Coliforms	20,000	"G" Values only A1 : 50 A2 : 5,000 A3 :50,000		No Proposal				No Proposal	
b) Faecal Coliforms	2,000	"G" values only A1 : 20 A2 : 2,000 A3 :20,000							
Barium, mg/1 Ba	1.0	A1 : 0.1 A2 : 1.0 A3 : 1.0		No Proposal				No Proposal	
Beryllium, mg/1 Be	No Proposal			Soft Water 0.011 Hard Water 1.100 (See note 7)				No Proposal	

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian W.A. (Criteria)
B.O.D. mg/l O_2		'G' Values: A1 :<3 A2 :<5 A3 :<7	6.0		'G' values: Salmonid : ≤3 Cyprinid : ≤6	Fast flow (>50mm/sec) Salmonid : 6 Cyprinid : 8 Mod. flow (20-50mm/sec) Salmonid : 5 Cyprinid : 6 Slow flow (< 20mm/sec) Cyprinid : 4	Salmonid: 4 mg/l Cyprinid 5 mg/l	No Proposal	
Boron, mg/l B		A1,A2,A3 1.0 (G)	1.0	No Proposal				5.0	5.0
Cadmium,mg/l Cd	0.01	A1,A2,A3 0.005	0.01	Soft Water Salmonid: 0.0004 Other: 0.0012 Hard Water Salmonid 0.004 Other: 0.012 (See Note 7)		Salmonid 0.002 Cyprinid 0.005	0.005	0.05	0.05
Chloride, mg/l Cl	250	A1,A2,A3 200 (G)	300			Salmonid 1,500 Cyprinid: 2,000		1,800	3,000
Chlorine,mg/l Cl (Total residual)	No Proposal			Salmonids: 0.002 Others: 0.010	0.005		0.005	No Proposal	
Chromium,mg/l Cr	0.05	A1,A2,A3: 0.05	0.05	0.10		0.10 (hexavalent)	0.05	1.0	1.0

Note: the Cadmium row also has a second "No Proposal" entry under Livestock Watering.

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian W.A. (Criteria)
Cobalt, mg/l Co								1.0	
C.O.D. mg/l O_2		'G' Value A3 : 30		No Proposal				No Proposal	
Colour, Hazen	75	A1: 20 A2: 100 A3: 200	200	In combination with turbidity should not change photo-synthetic compensation point by more than 10 percent from seasonal norm				No Proposal	
Copper, mg/l Cu	1.0	A1:0.05 A2:0.05 (G) A3:1.0 (G)	0.05	0.1x96 hr LC50	'G' values for waters of different hardness: 10mg/l$CaCO_3$ 0.005 50mg/l$CaCO_3$ 0.022 100mg/l$CaCO_3$ 0.04 300mg/l$CaCO_3$ 0.112 (dissolved copper)	Salmonid: 0.05 Cyprinid: 0.03	0.025 (where the hardness is greater than 50mg/l$CaCO_3$	0.5	0.5
Cyanide, mg/l CN	0.2	A1, A2, A3: 0.05	0.05	0.005		0.01	0.01		0.05

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian W.A. (Criteria)
Dissolved Oxygen % sat./mg/l O_2		'G' values: A1: >70% A2: >50% A3: >30%	$\nless$50%	$\nless$ 5mg/l Interstitial water in salmonid redds to contain $\nless$ 5mg/l	Salmonid: 50% samples >9mg/l Cyprinid: 50% samples >7 mg/l	Salmonid: $\nless$5mg/l Cyprinid: $\nless$4mg/l	Salmonid: $\nless$9mg/l in 50% of samples $\nless$6mg/l in 95% of samples; No sample with <4 mg/l. Cyprinid: $\nless$7mg/l in 50% of samples; $\nless$ 4 mg/l in 95% of samples; No sample with <3mg/l		$\nless$ 30 percent
Dissolved Solids, mg/l			1000	Nature of biological communities should not be altered by any change in content.		Salmonid: 2,500 Cyprinid: 3,300		3,000	5,000

Parameter	Abstraction for Potable Supply: E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	Fisheries[1]: E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	Livestock Watering: E.P.A.[2] (Criteria)	Anglian W.A. (Criteria)
Fluoride, mg/l F	1.4-2.4 with decrease in annual average max. daily air temp in range from 32°C to 10°C	A1: 1.5 A2: 0.7-1.7(G) A3: 0.7-1.7(G)	1.5			2.0	1.5	2.0	2.0
Iron, mg/l Fe	0.3 (soluble)	A1: 0.3 A2: 2.0 A3: 1.0(G) (soluble)	1.0 (soluble)	1.0				No Proposal	
Lead, mg/l Pb	0.05	A1,A2,A3: 0.05	0.1	0.03 or 0.01x96 hr LC 50			0.05	0.1	0.1
Manganese, mg/l Mn	0.05 (soluble)	'G' Values: A1: 0.05 A2: 0.10 A3: 1.0	0.50 (soluble)	No Proposal					10.0
Mercury, mg/l Hg	0.002	A1,A2,A3: 0.001	0.001	0.00005		0.0002	0.00005	0.010	0.010
Methylene Blue Reactive Substances mg/l	0.5	'G' Values: A1 : 0.2 A2 : 0.2 A3 : 0.5	0.2	0.2 (Linear alkylate sulphonates- L.A.S.)		0.3		No Proposal	

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	E.P.A[2] (Criteria)	Anglian W.A. (Guidelines)
Nickel, mg/l Ni				0.01 x 96hr LC50		1.0	0.5		
Nitrates, mg/l N	10.0	A1,A2,A3: 12.0	22.6			100		100 (incl. nitrites)	100
Odour/Taste	Unobjectionable	Odour : Threshold dil. factor at 25°C ('G' values) A1 : 3 A2 : 10 A3 : 20	Unobjectionable	Tainting substances should not exceed concs which lower acceptability of fish and other edible organisms				No Proposal	
Oils and Grease	Should be absent	Dissolved at emulsified hydrocarbons (after extract with petroleum ether), mg/l: A1: 0.05 A2: 0.20 A3: 1.0		a) no visible oil on surface b) Emulsified oils should not exceed 0.01 of 96 hr LC 50 c) Conc. of hexane extract. substances (excl. elemental S) should not exceed 1000mg per kg dried sediment	a) no visible film on surface b) concs present should not impart taste to fish c) concs. present should not produce harmful effects in fish		Quantities present should not a) form visible films b) form coatings on stream bed or biota c) cause deleterious effects to biota d) Impart taste or odour to edible aquatic species	No Proposal	

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian W.A. (Guidelines)
Organics-Carbon Adsorbable, mg/l a) Carbon-chloroform extract (CCE)	0.3	'G' values A1 : 0.1 A2 : 0.2 A3 : 0.5			No Proposal			No Proposal	
b) Carbon-alcohol extract (CAE)	1.5								
Pesticides	Organo-chlorines (mg/l) Aldrin : 0.001 Chlordane: 0.003 DDT : 0.05 Dieldrin: 0.001 Endrin: 0.0002 Heptachlor: 0.0001 do.Epoxide: 0.0001 Lindane 0.004 Methoxy-chlor 0.1 Toxaphene: 0.005 Organo-Phosphorus and carbamate insecticides 0.1 mg/l (in toto)	Total Pesticides (Parathion +BHC+dieldrin) (mg/l) A1: 0.001 A2: 0.0025 A3: 0.005		Organo-chlorines (µg/l) Aldrin 0.003 DDT 0.001 TDE 0.006 Dieldrin 0.003 Chlordane 0.01 Endosulfan 0.003 Endrin 0.004 Heptachlor 0.001 Lindane: 0.01 Methoxy-chlor 0.03 Toxaphene: 0.005 Organo-Phosphorus insecticides (selected) (µg/l)				Should comply with abstraction water criteria in order to prevent unacceptable residues in animal products	

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian W.A. (Guidelines)
Pesticides, contd.				Dichlorvos 0.001 Dursban: 0.001 Malathion: 0.1 Parathion: 0.04					
pH	5-9	'G' values: A1: 6.5-8.5 A2: 5.5-9 A3: 5.5-9	6.5 - 9.2	6.5 - 9 No change >0.5 units outside natural max. or min. (high level of protection)	6-9 artificial charge within these limits not to exceed 0.5 units	6 - 9.5	6-9 (but no change more than 0.5 units from the natural)		6-9
Phenols, mg/1 C_6H_5OH	0.001	A1: 0.001 A2: 0.005 A3: 0.10	0.0015	Protection of aquatic life: 0.1 To prevent tainting of edible species: 0.001	Should not be present in concs which impart a taste to fish.	Salmonid: 0.5 Cyprinid: 2.0	0.001	No Proposal	
Phosphates, mg/1 P		'G' Values A1 : 0.2 A2 : 0.3 A3 : 0.3			Salmonid: 0.07 Cyprinid: 0.13 (See note 8)		(See note 8)	No Proposal	
Polychlorinated Biphenyls, (PCBs) µg/1	No Proposal			0.001				No Proposal	
Selenium, mg/1 Se	0.01	A1,A2,A3: 0.01	0.01	0.01x96hr LC 50				0.05	0.05

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian W.A. (Guidelines)
Silver, mg/l Ag	0.05			0.01x96 hr LC 50			0.01	No Proposal	
Sulphides, mg/l H_2S	No Proposal			0.002 (undissociated)			0.002 (undissociated)	No Proposal	
Sulphates, mg/l SO_4	250	A1,A2,A3: 250	350				250		500
Suspended Solids, mg/l		A1 : 25 (G)		25 (high level of protection) (See also Colour)	$\leq$25 (average conc)	Salmonid : 40 Cyprinid: 80	a) Any artificial increase in turbidity should not decrease depth of light penetration by more than 10% b) scums or floating solids should not be present in unsightly or deleterious amounts c) Deposition of solids should not be such as to affect	No Proposal	

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian W.A. (Guidelines)
Suspended Solids, mg/l (Contd)							benthic flora or fauna or to form putrescrible or otherwise objectionable sludge deposits		
Temperature, °C	No change in temp. of source should adversely affect potability or treatment process.	A1,A2,A3: 25	25	a) In spring, summer and autumn, Max. weekly average should not exceed 1/3 range between opt. temp and upper incipient lethal temp. of species, nor should temps above weekly average exceed criterion for short-term exposure b) max weekly average temps during winter should not exceed the acclim-ation	a) Increase in temp. should not be more than: 1.5 (salmonid waters) 3.0 (cyprinid waters) b) Thermal discharges should not result in temps. greater than: 21.5 (salmonid waters) 28.0 (cyprinid waters) c) During the breeding season in those reaches inhabited by species which reproduce in cold water, temp should not exceed 10°C	Salmonid: 22 Cyprinid: 26	a) Summer thermal max. shpuld not be increased artifically or where natural max. temps. are not known, following max. to apply: Salmonid: 21.5 Cyprinid: 28 b) In cold season following max. to apply: Salmonid: 10 Cyprinid 12 c) subject to a) and b) artifical increase in temp. should not	No Proposal	

Parameter	Abstraction for Potable Supply			Fisheries				Livestock Watering	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C.[4] (Directive)	Anglian W.A. (Criteria)	DoE IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian W.A. (Guidelines)
Temperature, °C (Contd.)				temp. (minus a 2°C safety factor) that raises the lower lethal threshold temp. above the normal ambient water temps. In addition the criterion for short term exposure should not be exceeded			exceed 1.5 (salmonid) or 3.0 (cyprinid)		
Vanadium mg/l V		No Proposal		0.01				0.1	
Zinc mg/l Zn	5.0	A1 : 3 A2 : 5 A3 : 5	5.0	0.005 x 96 hr LC50	'G' values for water of different Hardness (H) (as $CaCO_3$) H= 10mg/l Salmonid: 0.03	Salmonids: 0.3 Cyprinids: 1.0	0.1 (where the hardness is greater than 50mg/l $CaCO_3$	25	25

Parameter	Abstraction for Potable Supply			Fisheries[1]				Livestock Watering W.A.	
	E.P.A.[2] (Criteria)	E.E.C.[3,4] (Directive)	Anglian W.A.[5] (Criteria)	E.P.A.[2] (Criteria)	E.E.C[4] (Directive)	Anglian W.A. (Criteria)	DOE IRL (Guidelines)	E.P.A.[2] (Criteria)	Anglian (Guidelines)
Zinc mg/l Zn (Contd.)					H=10mg/l Cyprinid 0.3 H=50 mg/l Salmonid: 0.2 Cyprinid: 0.7 H=100 mg/l Salmonid: 0.3 Cyprinid: 0.7 H=500mg/l Salmonid: 0.5 Cyprinid: 2.0				

Notes:

1. In most cases values appropriate to salmonid fisheries (i.e. those dominated by salmon and trout) and to coarse fisheries (i.e. those dominated by species such as perch, dace, rudd or bream)are given separately.
2. Based mainly on the document Water Quality Criteria 1972 (EPA. R3.73.033) but amended in line with the more recent Quality Criteria for Water (EPA-440/9-76-023).
3. In the case of the E.E.C. Directive on Abstraction Water, standards are set for three types of sources: A1 are waters requiring only preliminary treatment; A2 waters are those requiring conventional treatment and A3 waters those requiring extended treatment.
4. For some parameters only guideline values are given. These are indicated by the better 'G'
5. Values given are for waters going direct to treatment.
6. In the case of ammonia, toxicity to fish is associated with the un-ionised (NH_3) species. This species increases as a fraction of total ammonia with increase in pH and temperature.
7. In these cases, 'soft' water is defined as having less than 75mg/l $CaCO_3$ and 'hard' water more than 150 mg/l Ca CO_3.
8. In the case of lakes of average depth between 18m and 300m the E.E.C. Directive and the DoE 'Guidelines' indicate that the phosphorus loading relationships with trophic status derived by Vollenweider, should be referred to for guidance.

DRAFT WATER QUALITY MANAGEMENT PLAN
FOR
THE RIVER BLACKWATER CATCHMENT

VOLUME 5
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Water Quality
in the
Blackwater Catchment.

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ENVIRONMENTAL DEPT.,

CORK CO.COUNCIL,

COUNTY HALL,

CORK.

December 1987

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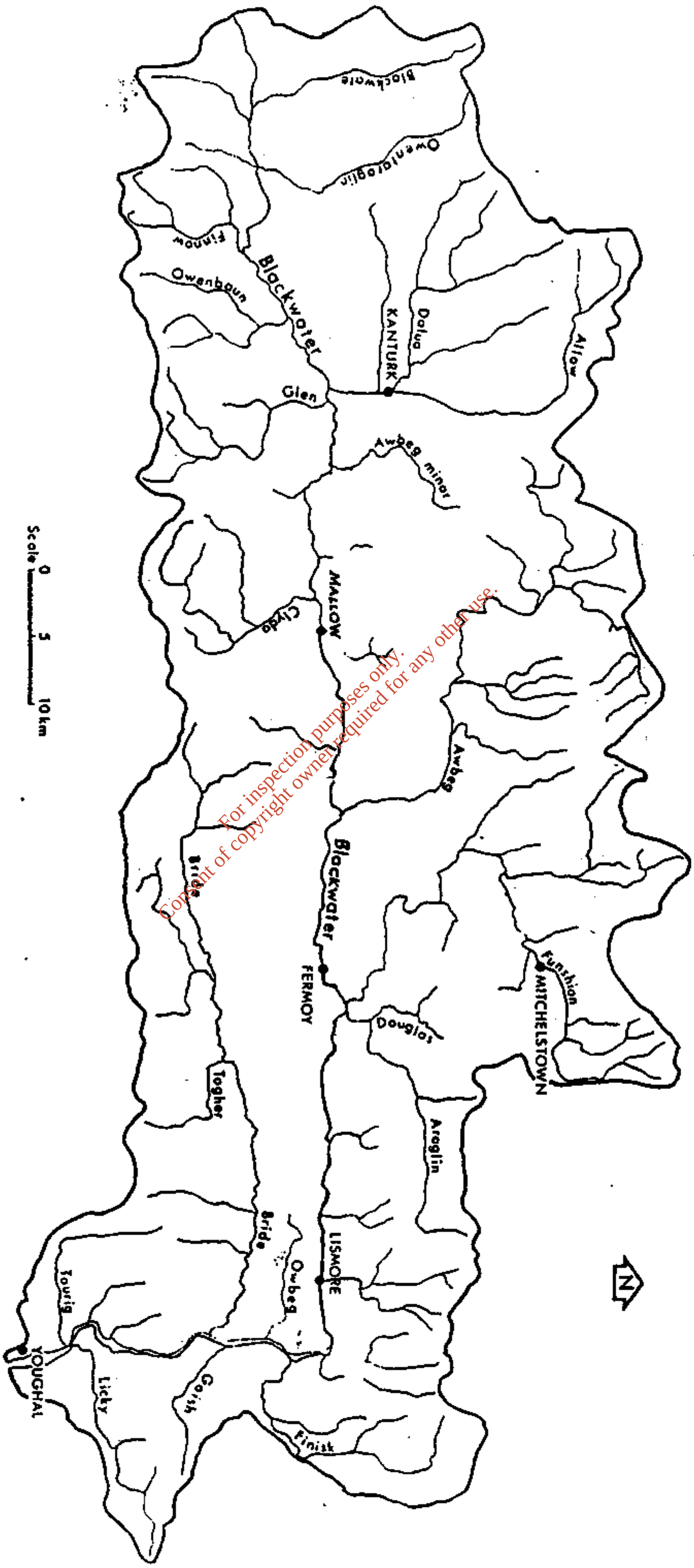


VOLUME 5

Water Quality
in the
Blackwater Catchment.

INTRODUCTION

An account is given of the Water Quality of the main channel, tributaries and part of the estuary of the River Blackwater based on information arising from surveys carried out by A.F.F. and the Environmental Department of the Cork Co.Council.

These Surveys measured both physico-chemical and biological characteristics at some 130 stations in the river reaches of the catchment and at some 5 stations in the freshwater section of the estuary.

Map 5.1 (facing) shows the Rivers in the Blackwater Catchment. A listing of same is given in Table 5.1.

Physico-Chemical Data Sources

In all, 36 rivers are listed as having been sampled. The earliest data available is from 1966 when Mr.Paul Toner B.Sc. and Ms.Clodagh O'Connell B.Sc. carried out surveys at some selected points for the Fisheries Department of the Department of Agriculture and Fisheries.

The earliest date in which data is available from A.F.F. is 1971 when they carried out surveys at a number of sections in the catchment.

A.F.F. were mainly responsible for water quality monitoring in the catchment up to 1981.

In 1981 Cork Co Council started a programme of river sampling with a series of sampling in the months of August and September of that year.

Currently Cork Co Council officials monitor the Catchment within Cork County and the Regional laboratory in Kilkenny monitors the Waterford end of the catchment.

A.F.F. sample the Blackwater at Killavullen Bridge on a monthly basis in compliance with E.E.C. regulations.

Map 5.2 below shows the location of the various sampling stations in the River Blackwater catchment.

Table 5.2 below lists the sampling stations in the Catchment.

TABLE 5.1 LIST OF RIVERS IN BLACKWATER CATCHMENT

RIVER CODE	RIVER NAME
18000	Blackwater
18005	Owentaraglin
18006	Brogeen
18007	Rampart Stream
18008	Owenkeale
18009	Dalua
18010	Allow
18012	Awbeg Minor
18013	Ballyclough River
18014	"Ballyclough Stream"
18015	Spa Stream
18020	Awbeg
18024	Sheep
18025	Funshion
18026	Gradoge
18027	Blue Stream
18029	Douglas (Araglin)
18030	Araglin
18035	Owennashad
18040	Glennafallia
18045	Finisk
18050	Goish
18055	Lickey
18059	Cullavaw Stream
18060	Awnaskirtaun
18065	Finnow
18070	Owenbaun
18075	Glen
18080	Dubhglasha
18081	C.S.E.T. Effluent Stream.
18083	Lyre Stream
18084	Athnaleenta Stream
18085	Clyda
18090	Bride
18091	Flesk (Bride)
18093	Douglas (Bride)
18095	Glendine

TABLE 5.2 LIST OF SAMPLING STATIONS IN BLACKWATER CATCHMENT

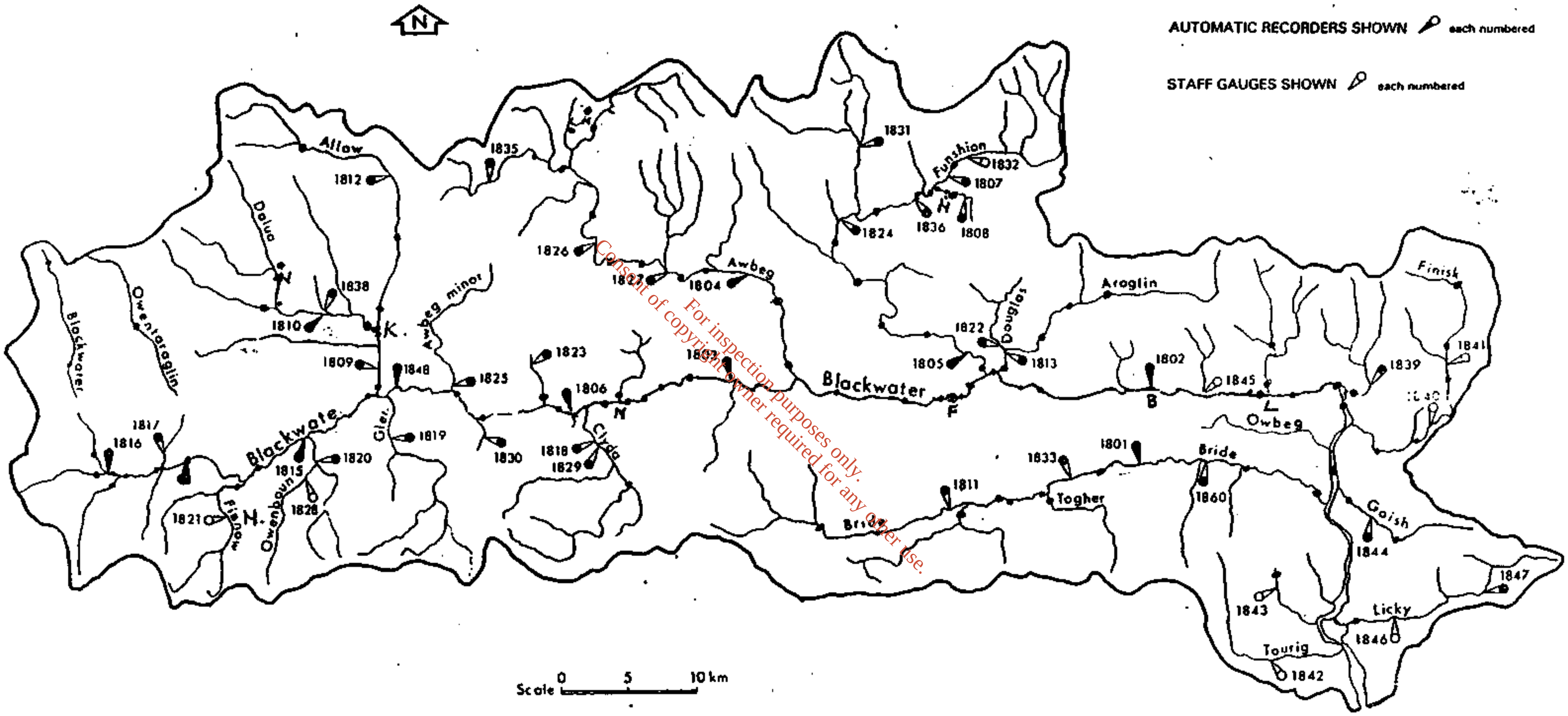
STATION CODE	SAMPLING STATION	GRID REFERENCE
18000005	Doctors Hill Bridge	R144066
18000008	1st bridge d/s Ballydesmond	R154009
18000010	Lisheen Bridge	W159974
18000020	Nohoval Bridge	W172942
1800002A	Rathmore S.S. Effluent	W174934
18000030	Duncannon Bridge	W179931
1800003A	Fry-Cadbury Effluent	W182928
18000040	u/s Awnaskirtaun confl.	W185930
18000050	d/s Awnaskirtaun confl.	W190929
18000055	2.5km d/s Awnaskirtaun confl.	W195931
18000060	Shamrock Bridge	W220934
18000070	Charles Bridge	W247942
18000080	Keale Bridge	W293935
18000090	Colthurst Bridge	W328954
18000100	Ballymaquirke Bridge	W381988
18000110	Dromcummer A/G Station	W391990
18000120	Roskeen Bridge	W442987
18000130	Lombardstown Bridge	W463969
18000138	50m u/s C.S.E.T discharge pt.	W514978
18000140	Longfields Bridge	W516975
18000145	C.S.E.T. Mallow	W527974
18000150	Mallow Railway Viaduct	W549979
1800015A	Effluent from Ballyclough Coop	W555981
18000160	Mallow Bridge	W560980
18000170	1.5km d/s Mallow Bridge	W579980
1800017A	Effluent from Mallow S.T.W.	W579980
18000180	Ballymagooly	W593990
18000185	1.0 km u/s Killavullen Br.	
18000190	Killavullen Bridge	W648991
18000200	Ballyhooley Bridge	W728986
18000210	Cregg Castle	W778983
18000220	250m u/s Fermoy Bridge	W811984
18000225	300m d/s Fermoy Bridge	
18000227	915m d/s Fermoy Bridge	W820988
1800022C	Sewer 50m d/s Br. Nth.Bank	W812985
18000230	1.5km d/s Fermoy Bridge	W824994
18000235	d/s Funcheon u/s Aragin confl.	R841005
18000237	Careysville Weir	W848997
18000240	3km d/s Funshion confl.(Kilmur	W875994
18000250	Ballyduff Bridge	W965991
18000260	Lismore Bridge	X045988
18000270	2km d/s Lismore	X065988
18000280	Cappoquin Bridge	X097995
18000290	1km d/s Cappoquin	X097989
18000300	Dromana Ferry	X093926
18005010	Kiskeam Bridge	R201035
18005018	Cullen Bridge	W222958
18005020	Ahane Bridge (u/s confl.BW)	W223945
18006005	Brogeen Bridge	
18007020	Liscongill	R341046
18008010	Long's Br. (u/s confl.Dalua)	R297048
18009010	Anne's Bridge	R309069
18009020	Allen's Bridge	R337043
18009030	u/s confl. Allow in Kanturk	R381031
18010004	Bridge east of Rowels creamery	

TABLE 5.2 LIST OF SAMPLING STATIONS IN BLACKWATER CATCHMENT

STATION CODE	SAMPLING STATION	GRID REFERENCE
18010008	Ballinaguilla Bridge	
18010010	Raheen Bridge	R364155
18010020	Allow Bridge (nr. Freemount)	R392139
18010030	John's Bridge	R394097
18010040	Kanturk u/s confl.Dalua	R381032
18010045	u/s Kanturk S.S. outfall	R384025
1801004B	Rere of Creamery	R382029
1801004C	Kanturk S.S. effluent	R384024
1801004D	Kanturk Creamery T.W.effluent	R384024
18010050	Riverview (1.5km d/s Kanturk)	R383007
18010060	Leaders Bridge (u/s confl.BW)	W384990
18012010	Kippagh Bridge	W440996
18013010	Ballyclough (d/s village)	R495020
18013020	Bridge d/s Longueville	W506981
18014030	d/s Ballyclough Co-op	W554985
18015030	Bridge Street (Mallow Town)	W560981
18020010	Bridge due E of Ballynoran	
18020020	Farran Bridge (E.limb)	
18020025	Scart Br.(E.Limb)	R522152
18020030	Bridge SE of Sunfort (W.limb)	R461137
18020040	Annagh Bridge (W.limb)	
18020050	Scart Bridge (W.Limb)	R521151
18020060	Bridge just N of Buttevant	R541097
18020070	Buttevant Bridge	R545095
18020080	1.5km d/s Buttevant Bridge	
18020090	Bridge N of Cahirmee House	
18020100	Doneraile Bridge	R599077
18020110	Ballynamona Bridge	R656076
18020120	Bridge NW of Ballywalter Hse.	
18020130	Kilcummer Bridge	
18024010	Ahaphuca Bridge	R738168
18025005	Ballaghderg Bridge	R808149
18025010	Ballyarthur Bridge	R806142
18025015	d/s Gradoge u/s decharge pipes	
1802501A	Mitchelstown S.T.W.Outfall	R795137
1802501B	Mitchelstown Co-op T.W.outfall	R795137
18025020	0.5km d/s confl.Gradoge	R792133
18025030	Kilee Bridge	R779125
18025040	Marshalstown Bridge	R749118
18025050	Glenavuddig Bridge	R724118
18025060	Bridge E of Scart	R720094
18025070	Carrigdownane,br.NE of x-rds	R737067
18025080	Glanworth Bridge	R757039
18025090	Ballynahow Bridge	R791030
18025100	Downing Bridge	R822020
18025110	Bridge u/s confl.Blackwater	R835005
18026010	Kilshanny Bridge	R824129
18026015	u/s confl. Blue Stream	R804131
18026020	50m u/s confl.Funshion	R796137
18027030	Blue Stream	R807132
18029010	Ballyderown	R847023
18030010	Bridge in Araglin	R926060
18030020	Bridge at Araglin Cottage	
18030030	Bridge W of Knockatrasnane	R874027
18030040	Araglin Bridge	R849017

TABLE 5.2 LIST OF SAMPLING STATIONS IN BLACKWATER CATCHMENT

STATION CODE	SAMPLING STATION	GRID REFERENCE
18030050	Br.on T30 (2nd.u/s confl.BW)	R850006
18030060	1st bridge u/s confl. B.water	W845005
18035010	Carrignagower Bridge	
18035020	Ballyvin Bridge	
18040010	Bealickey Bridge	
18040020	Little Bridge	
18045010	Ballinamult Bridge	
18045020	1.5km u/s Millstreet W of Wood	
18045030	Modelligo Br. 2km d/s Millstre	
18045040	Whitechurch Bridge	
18045050	Kilmolash Bridge	
18050010	Goish Bridge	
18050020	Bridge near Coolroe	
18050030	Bridge 2km NW of Aglish	
18055010	Glenlickey	
18055020	Lickey Bridge	
18059010	u/s Creamery discharge point	W167933
18059030	u/s confl. Blackwater	W174935
18060010	u/s confl.Blackwater	
18065010	Bridge nr Drishane Castle	
18070010	Bridge E of Rathcool	W334940
18075010	Bridge E Banteer Village	
18080010	Br. at Lombardstown(u/s confl)	
18081040	u/s confl. with Blackwater	
18083030	d/s bridge near Creamery	
18084030	Bridge south of Athnaleenta	
18085020	100m u/s Jordans Bridge	
18085030	d/s Jordans Bridge	
18085040	Bridge d/s UDC W.S.intake	W542956
18090010	Bride Bridge(NNE of Glenville)	
18090020	Bridge S of Glanreagh Bridge	
18090030	Bridge S of Rathcormack	W812906
18090040	Bride Bridge(SSW Castlelyons)	
18090045	1.5km d/s Bride Bridge	
18090050	Bealacoon Ford	
18090055	Aghern Bridge	W895928
18090060	Conna Bridge	
18090070	Mogeely Bridge	W956942
18090080	Tallowbridge	W998944
18090090	Janeville Quay	
18090100	Bridge u/s confl.Blackwater	
18091050	Bridge u/s confl.Bride (L188)	W818907
18093030	u/s confl. Bride	
18095010	Browns Cross Roads	



MAP NO.2 SAMPLING STATIONS IN THE RIVER BLACKWATER CATCHMENT

Physico Chemical Survey Parameters.

Some of the parameters describe the general nature of the river water (Table 5.3,Col A) whilst others are a measure of Water Quality (Table 5.3 Col B) and serve to indicate the presence and degree of pollution in the water from organic point sources such as sewage, milk processing, etc.

TABLE 5.3 Different types of Parameters used.

Column A	Column B
pH	BOD
Colour	DO
Conductivity	PO4
Alkalinity	NH3
Hardness	NO2
	NO3

Biological Data

A.F.F. have done a number of surveys at selected points in the catchment. These are updated on a continuing basis. They are normally carried out in Summer when water quality is most at risk.

Biological Parameters

Biological assesments of water quality are based on the examination of benthic - macroinvertabrate fauna at points in the vicinity of the physico-chemical sampling stations.

The Water Quality (Q) at each point examined is noted with reference to an arbitrary five point scale as detailed below in Table 5.4.

TABLE 5.4 Value of "Q" (Quality) Ratings.

"Q"value of Sample	Water Quality Rating
Q5	Good
Q4	Fair
Q3	Doubtful
Q2	Poor
Q1	Bad

Table 5.5 below shows the Classification scheme derived from the above five point scale.

TABLE 5.5 Biological Classification Scheme

Degree of Pollution	Pollution Category	Quality Ratings	Condition		Alternative Q. Ratings
No Pollution Clean Waters	A	4 - 5	Satisfactory	(Good)	5,4-5,4
Eutrophic or enriched waters	B	3 - 4	Borderline	(Fair)	3-4
Moderate Pollution	C	3	Unsatisfactory	(Doubtful)	3,2-3
Heavy Pollution	D	2 - 3	Unsatisfactory	(Poor)	2,1-2
Very Heavy or Gross Pollution	E	1 - 2	Unsatisfactory	(Bad)	1

The suffix "O" is sometimes used (e.g. 2/O or 1/O) in conjunction with the Q values in cases where interference by toxic pollution is suspected.

This may be caused by pollution from heavy metals, pesticides or poisons - the degree of pollution being denoted by the prefixes.

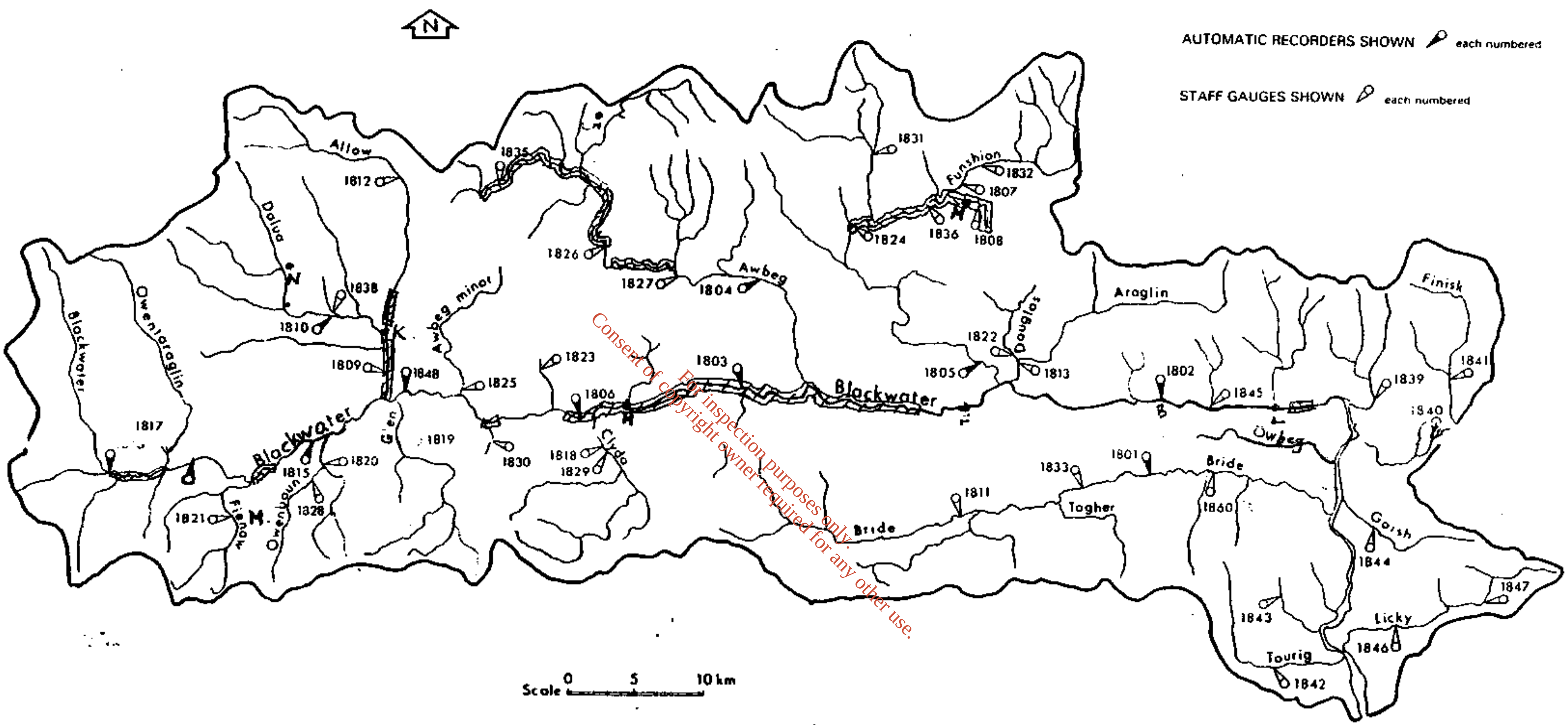
Macrophyte Surveys

These are based on surveying the types of plants on the river bed and their percentage presence and cover.

A Macrophyte survey of 6 River sections in the Catchment was carried out in the summer of 1985.

A macrophyte and bacteriological survey was carried out on the Funshion and Gradogue in the Summer of 1986.

BIOLOGICAL SURVEY RESULTS FOR RIVER BLACKWATER



MAP NO. 3A SECTIONS OF BLACKWATER CATCHMENT AFFECTED BY POLLUTION AS INDICATED BY GEOLOGICAL SURVEYS

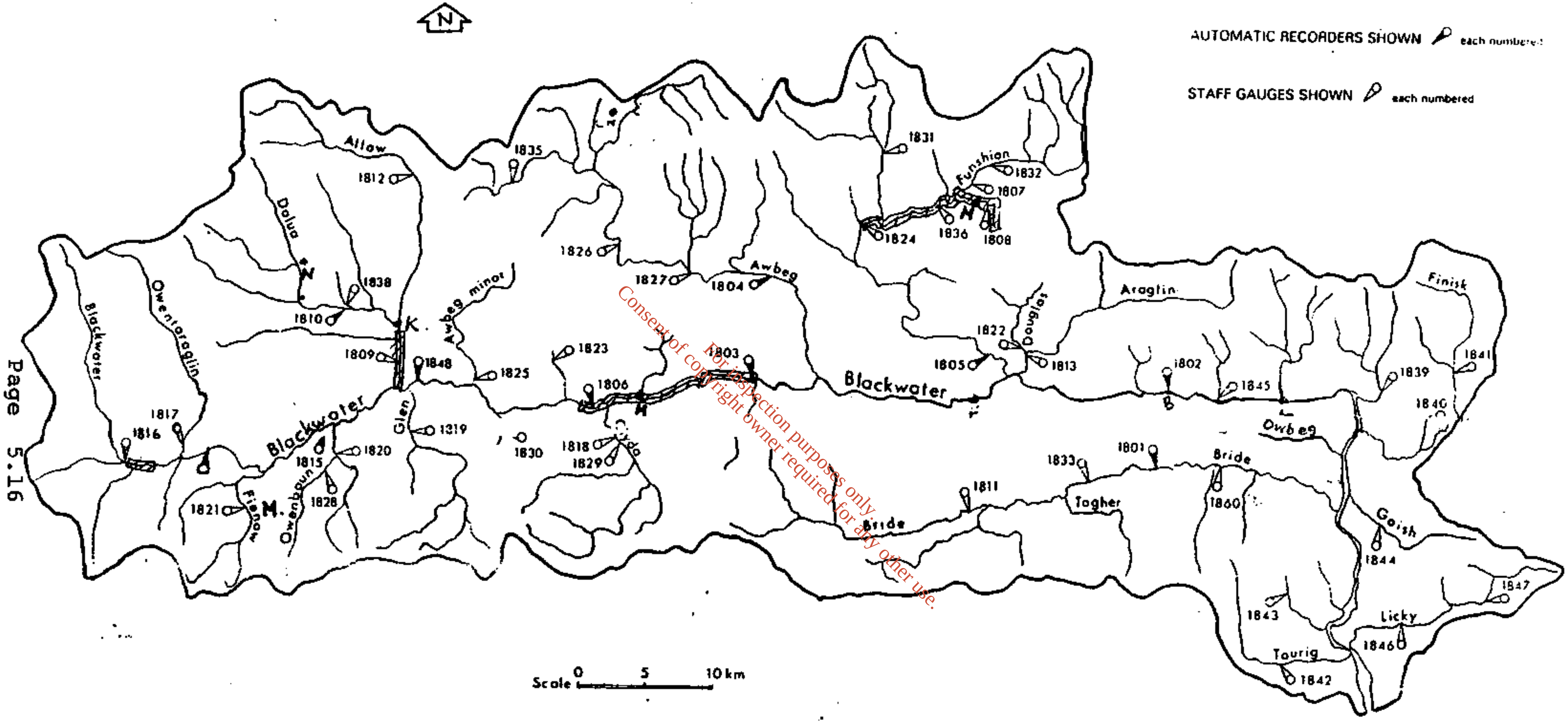
QUALITY RATINGS (Q)
BLACKWATER

scode	sname	sgrid	1971	W71	71	73	74	75	77	78	79	80	81	82	84	86
18000005	Doctors Hill Bridge	R144066			5											
18000008	1st bridge d/s Ballydesmond	R154009		5	5											
18000010	Lisheen Bridge	W159974														
18000020	Nohoval Bridge	W172942		5	5											4
18000030	Dunncannon Bridge	W179931	4	5	4-5		4-5	4		4-5		4-5		4-5	4-5	4-5
18000040	u/s Awnaskirtaun confl.	W185930		3	3-4		3	1		3		4		3-4	2-3	3
18000050	d/s Awnaskirtaun confl.	W190929					3-4	3-4		2-3						
18000055	2.5km d/s Awnaskirtaun confl.	W195931														
18000060	Shamrock Bridge	W220934		4-5	4-5		4-5	4		4					4	4
18000070	Charles Bridge	W247942		5	5											4
18000080	Keale Bridge	W293935		5	5											3-4
18000090	Colthurst Bridge	W328954														4
18000100	Ballymaquirke Bridge	W381988		6	5											4-5
18000110	Dromcummer A/G Station	W391990														4-5
18000120	Roskeen Bridge	W442987		4-5	5											4-5
1800013A	Lombardstown Bridge	W463969			5											3-4
18000140	Longfields Bridge u/s CSET	W516975		4-5	5		5	5		4-5		5		4-5	4-5	4
18000145	CSET Mallow	W527974										3-4		4/3	(4) (3)	3-4
18000150	Mallow Railway Viaduct	W549979		3-4	4		3	4		3-4		3-4		3	3	3-4
1800015A	Effluent from Ballyclough Co-op	W555981														
18000160	Mallow Bridge	W560980														
18000170	1.5km d/s Mallow Bridge	W579980														3
18000180	Ballymagooly	W593990		2-3	3-4		3	2-3		3		3		3	3	3
18000190	Killavullen Bridge	W648991		3-4	4		3	3-4		3-4		3		3-4		
18000200	Ballyhooley Bridge	W728986		4	4-5			4				4		4	3	3
18000210	Cregg Castle	W778983		4-5	4-5			4				4		3-4		3-4

BLACKWATER (contd.)

scode	sname	sgrid	1971	W71	71	73	74	75	77	78	79	80	81	82	84	86
18000220	250m u/s Fermoy Bridge	W811984														3-4
18000222	360m d/s Fermoy Bridge	W815988														
18000225	915m d/s Fermoy Bridge	W820988														
18000230	1.5km d/s Fermoy Bridge	W824994		4	4			4						3-4		
18000235	d/s Funcheon u/s Aragin confl.	R841005														
18000237	Carysville Weir	W848997														
18000240	3km d/s Funshion confl. (Kilmur	W875994		4-5	5			5				4		4		4
18000250	Ballyduff Bridge	W965991			5			5				3-4		4		4
18000260	Lismore Bridge	X045988						5				3-4		4		4
18000270	2km d/s Lismore	X065988			5											3-4
18000200	Cappoquin Bridge	X097995														
18000290	1km d/s Cappoquin	X097989			4											4
18000300	Dromana Ferry	X093926														

REPORT FORMAT AND CONSIDERATION OF RESULTS



MAP NO. 5.3A SECTIONS OF RIVER BLACKWATER CATCHMENT AFFECTED BY POLLUTION AS INDICATED BY CHEMICO PHYSICAL SURVEYS.

ALLOW

scode	sname	sgrid	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
18010010	Raheen Bridge	R364155	5	5			5			5								4-5
18010020	Allow Bridge (nr. Freemount)	R392139	3-4	3-4		3-4	4			3								4
18010030	John's Bridge	R394097	4-5	4-5		3	4			3-4								4
18010040	Kanturk u/s confl. Dalua	R381032	5			4-5	4											3-4
18010050	Riverview (1.5km d/s Kanturk)	R383007	2			2	1-2			1								3-4
18010060	Leaders Bridge (u/s confl.BW)	W38499	2	2		3	2-3			3-4								3-4

AWBEG

scode	sname	sgrid	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
18020010	Bridge due E of Ballynoran																4	
18020020	Farran Bridge (N. limb)																3	
18020030	Bridge SE of Sunfort (W.limb)	R461137									3						3	
18020040	Annagh Bridge (W.limb)										3						3-4	
18020050	Scart Bridge			4-5							3							
18020060	Bridge just N of Buttevant	R541097	4-5	4-5			4				2-3						3	
18020070	Buttevant Bridge	R545095																
18020080	1.5km d/s Buttevant Bridge		4	4			4				3-4						4	
18020090	Bridge N of Cahirmee House		4-5	4-5			4				4						3-4	
18020100	Doneraile Bridge	R599077		4-5							4						3-4	
18020110	Ballynamona Bridge	R656076	4-5	4-5			4				4						4	
18020120	Bridge NW of Ballywalter Hse.										4						4	
18020130	Kilcummer Bridge		4-5	4-5			4-5				4						4	

FUNSHION

scode	sname	sgrid	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
18025005	Ballaghderg Bridge	R808149	5	5		5	5			5		4		4-5			4-5	4-5
18025010	Ballyarthur Bridge	R806142																
18025020	0.5km d/s confl. Gradoge	R792133	1	1		1	1-2			3		3		2			2-3	3
18025030	Kilee Bridge	R779125	1-2	1-2		1-2	2			3				3			2-3	2-3
18025040	Marshalstown Bridge	R749118	2-3	2-3		3	2-3			4				3-4			3	
18025060	Bridge E of Scart	R720094									4-5			4			4	
18025080	Glanworth Bridge	R757039									3-4			4			4	
18025090	Ballynahow Bridge	R791030	5	5			5				4			4-5			4	
18025100	Downing Bridge	R822020									4-5			4			4	
18025110	Bridge u/s confl. Blackwater	R835005	4-5	4-5			4				4-5						4	

GRADOGE

scode	sname	sgrid	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
18026010	Kilshanny Bridge	R824129															3	3
18026015	u/s confl. Blue Stream	R804131																
18026020	50m u/s confl. Funshion	R796137		1		1	1			1		2		1			1	1

BRIDE

scode	sname	sgrid	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
18090010	Bride Bridge (NNE of Glenville			5							5				5			5
18090020	Bridge S of Glanreagh Bridge			5							5				5			5
18090030	Bridge S of Rathcormack	W812906	5	5			4-5				5				4-5			4-5
18090040	Bride Bridge (SSW Castlelyons)		5	5			4				5				4-5			4-5
18090045	1.5km d/s Bride Bridge			4														4-5
1890050	Bealacoon Ford										4-5							4-5
18090055	Aghern Bridge	W895920																
18090060	Conna Bridge		5	5			4-5				4-5				3-4			4
18090070	Mogeely Bridge	W956942									4-5				3-4			4-5
18090080	Tallowbridge	W998944	4	4			4				4				3-4			4
18090090	Janeville Quay																	
18090100	Bridge u/s confl. Blackwater																	

REPORT FORMAT

In the accounts given in the following pages, different stretches of the main channel are dealt with firstly and then the tributaries are dealt with.

The bulk of the data is concerned with the sections listed in Table 5.6 below.

TABLE 5.6 Sections of Rivers in the River Blackwater Catchment most affected by pollution.

River Name	River Section
Blackwater	Main Channel
Allow	Kanturk
Gradogue	Mitchelstown
Funshion	Mitchelstown

Because these stretches are most affected by pollution, they are treated in greater detail than the remaining parts of the system.

A summary is given for the latter.

A outline map of the system is shown in Map 5.3 which indicates the locations of the above sections of the catchment.

PRESENTATION OF RESULTS

A list of the available Chemico-Physico data and Biological Ratings is given in the results supplement.

The former consists of a computer printout of a summary of sampling results and gives the maximum, minimum, average and standard deviation for each parameter.

Where applicable, the percentile limit values and percentage compliance are listed for some parameters .

The abbreviations and units of measurement for each Parameter are listed in Table 5.7 over.

TABLE NO.7 UNITS USED AND ABBREVIATIONS FOR SAME

PARAMETER	UNITS	TEST
Time	24 hour clock	
Conductivity	uS/cm	Meter
pH	pH units	Meter
Colour	Hazen	Meter
Turbidity	N.T.U.	Meter
Parameter	Unit	Test
Alkalinity	mg/l $CaCo_3$	Titration
Hardness total	mg/l $CaCo_3$	Titration
Temperature	°C	Thermometer

WATER QUALITY
****

Parameter	Unit	Test
Dissolved Oxygen	mg/l O_2	Winkler Titration/meter.
Biochemical Oxygen	mg/l O_2	5 day incubation test at 20°C.
Ortho-Phosphate	mg/l PO_4-P	Ascorbic Acid spectrophotometer
Suspended solids	mg/l	Gravimetric
Ammonia	mg/l N	Ion Selective Electrode
Nitrite	mg/l N	Spectrophotometer
Nitrate	mg/l N	Ion Selective Electrode
Zinc	mg/l Zn	Atomic Absorption.
Copper	mg/l Cu	Atomic Absorption.
% Saturation	mg/l D.O.	
Total Phosphate	mg/l P	
Unionised Ammonia	mg/l NH_3 - N	

Table 5.8 below illustrates the variation in River Characteristics from the upper to the lower reaches of the Blackwater.

TABLE 5.8 VARIATIONS IN RIVER CHARECTERISTICS IN RIVER BLACKWATER

Location	pH	Alk	Hard	PO4	NH3-N	NO3-N	%Sat
Nohoval Br.	6.50	19	29	0.06	0.050	1.5	96
Mallow	7.65	58	77	0.07	0.038	2.5	101
Ballyduff	7.85	91	115	0.08	0.058	5.5	95

For the purpose of considering the quality of water in the main channel of the Blackwater it is divided into the sections listed below in Table 5.9

TABLE 5.9 Sections of Main Channel of River Blackwater.

SECTION NUMBER	SECTION NAME	EXTENT OF SECTION		
1	u/s Rathmore	Doctors Hill Br.	-	Nohoval Br
2	Rathmore	Nohoval Br.	-	Shamrock Br.
3	u/s Mallow	Shamrock Br.	-	Lombardstown Br.
4	Mallow	Lombardstown Br.	-	Killavullen
5	u/s Fermoy	Killavullen	-	Cregg Castle
6	Fermoy	Cregg Castle	-	Kilmurray
7	Lismore	Kilmurray	-	Dromore Ferry

The sampling stations that are relevant to the above sections are listed in Table 5.10 over.

TABLE NO.5.10 Sampling stations on main channel of River Blackwater.

STATION CODE	STATION NAME	GRID REFERENCE
18000005	Doctors Hill Bridge	R144066
18000008	1st bridge d/s Ballydesmond	R154009
18000010	Lisheen Bridge	W159974
18000020	Nohoval Bridge	W172942
1800002A	Rathmore S.S. Effluent	W174934
18000030	Duncannon Bridge	W179931
1800003A	Fry-Cadbury Effluent	W182928
18000040	u/s Awnaskirtaun confl.	W185930
18000050	d/s Awnaskirtaun confl.	W190929
18000055	2.5km d/s Awnaskirtaun confl.	W195931
18000060	Shamrock Bridge	W220934
18000070	Charles Bridge	W247942
18000080	Keale Bridge	W293935
18000090	Colthurst Bridge	W328954
18000100	Ballymaquirke Bridge	W381988
18000110	Dromcummer A/G Station	W391990
18000120	Roskeen Bridge	W442987
18000130	Lombardstown Bridge	W463969
18000138	50m u/s C.S.E.T discharge pt.	W514978
18000140	Longfields Bridge	W516975
18000145	C.S.E.T. Mallow	W527974
18000150	Mallow Railway Viaduct	W549979
1800015A	Effluent from Ballyclough Coop	W555981
18000160	Mallow Bridge	W560980
18000170	1.5km d/s Mallow Bridge	W579980
1800017A	Effluent from Mallow S.T.W.	W579980
18000180	Ballymagooly	W593990
18000185	1.0 km u/s Killavullen Br.	
18000190	Killavullen Bridge	W648991
18000200	Ballyhooley Bridge	W728986
18000210	Cregg Castle	W778983
18000220	250m u/s Fermoy Bridge	W811984
18000225	300m d/s Fermoy Bridge	
18000227	915m d/s Fermoy Bridge	W820988
1800022C	Sewer 50m d/s Br. Nth.Bank	W812985
18000230	1.5km d/s Fermoy Bridge	W824994
18000235	d/s Funcheon u/s Aragin confl.	R841005
18000237	Careysville Weir	W848997
18000240	3km d/s Funshion confl.(Kilmur	W875994
18000250	Ballyduff Bridge	W965991
18000260	Lismore Bridge	X045988
18000270	2km d/s Lismore	X065988
18000280	Cappoquin Bridge	X097995
18000290	1km d/s Cappoquin	X097989
18000300	Dromana Ferry	X093926

A summary of the Water Quality Data for various sections of the river Blackwater is given below:

CONSIDERATION OF RIVER SAMPLING RESULTS

TABLE 5.11 Sampling Stations u/s Rathmore Section of River Blackwater

SECTION NO.1 RIVER BLACKWATER (River Code = 18000)

u/s Rathmore — Sampling Stations: 005 - 020

Station Code	Station Name	Distance d/s (km)
005	Doctors Hill Bridge	0
008	1st Bridge d/s Ballydesmond	7.0
010	Lisheen Bridge	13.5
020	Nohoval Bridge	18.0

The Water quality in this section is of a satisfactory nature with no point sources of pollution.

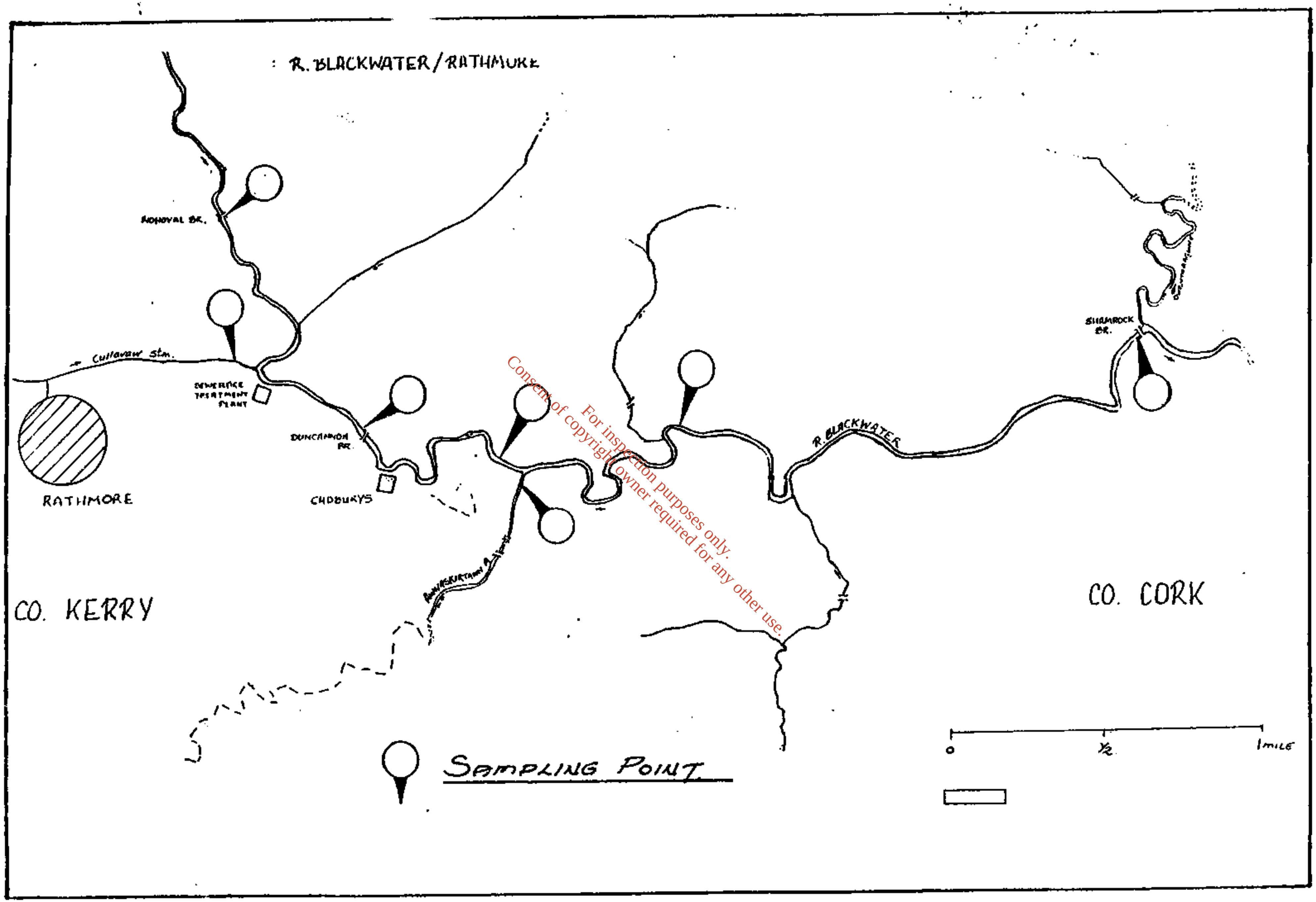
TABLE 5.12 Sampling Stations on Rathmore Section of River Blackwater

Section 2 River Blackwater (River Code = 18000)

Rathmore — Sampling Stations: 020 - 060

Station Code	Station Name	Distance d/s (km.)
020	Nohoval Bridge	0
030	Duncannon Br.	1.5
040	u/s Awanashirtaun Confluence	2.5
050	d/s Awanashirtaun Confluence	3.0
060	Shamrock Bridge	7.0

Map 5.4 below shows locations of sampling stations and discharge points in the Rathmore section of Blackwater.



MAP NO.4 RIVER BLACKWATER - RATHMORE SECTION

RATHMORE SECTION

The point sources of effluent in the Rathmore Section of the River Blackwater are listed in Table 5.13 below.(c.f. Vol.3)

TABLE 5.13 Effluent sources at Rathmore Section of River Blackwater.

SOURCE	EFFLUENT TYPE
Rathmore Creamery	Creamery Washings
Rathmore S.T.W.	S.T.W. effluent
Fry Cadbury	Chocolate processing waste and cooling water.

The effluent from the Fry Cadbury Plant forms the bulk of polluting matter discharged to the Blackwater in the Rathmore section.

The low flow in the river at this point is small with an estimated 95 percentile flow of 0.2 m3/Sec (c.f. Vol 2). In this extreme situation the waste assimilative capacity would be as below, assuming the following conditions:-

If u/s BOD = 1.9 mg/l (median value) and control BOD = 3.0 mg/l

Then Assimilative capacity = 19 kgs BOD/day

If Control BOD = 5.0 mg/l

Then assimilative capacity = 53.6 kgs BOD/day

In a 24 hour survey of the Rathmore section in August 1987 flow averaged 707 m3/hour and BOD averaged 12.2 p.p.m. giving a loading of 8.6 kgs BOD/hour or 207 kgs BOD/day. As this load far exceeds the 95% tile capacity of the river, the potential for pollution is great.

In the same survey polluting aspect of the effluent was reflected in the raising of BOD's in the river from an average of 2.2 p.p.m.at Duncannon Br. to 3.93 p.p.m. at the next sampling point 1.5 km d/s ie. just upstream of the confluence with the Awanaskirtaun River.

The results listed in the supplement show pollution occurring in the form of reduced D.O. levels, elevated BOD level, sewage fungus growths and a doubtful to fair Biological Quality Rating (A.F.F.)

A macrophyte study of the section was undertaken by Mr. Liam O`Sullivan B.Sc. in 1985.

He noted a marked deterioration in the macrophyte community from Nohoval Br. to u/s Awnaskirtaun confl.with the community showing signs of recovery at Shamrock Br.

The improvement of quality and recovery of the river noted at Shamrock Br.is due to the rearation caused by the river flow characteristics and the dilution due to the inflow of clean water from the Awnaskirtaun and Owentaraglin rivers.

TABLE 5.14 DIURNAL VARIATION OF %SATURATION AT RATHMORE

Sampling Stations	Max.	Min.	(% max)	% Sat.	(% drop)
Nohoval Br.	107	79	(74)	28	(26%)
u/s Awnashirtaun	86	61	(71)	25	(29%)

It is to be noted from above that whilst the actual drop in value was greater at Nohoval the % drop was greater at the u/s Awnashirtaun Sampling point.

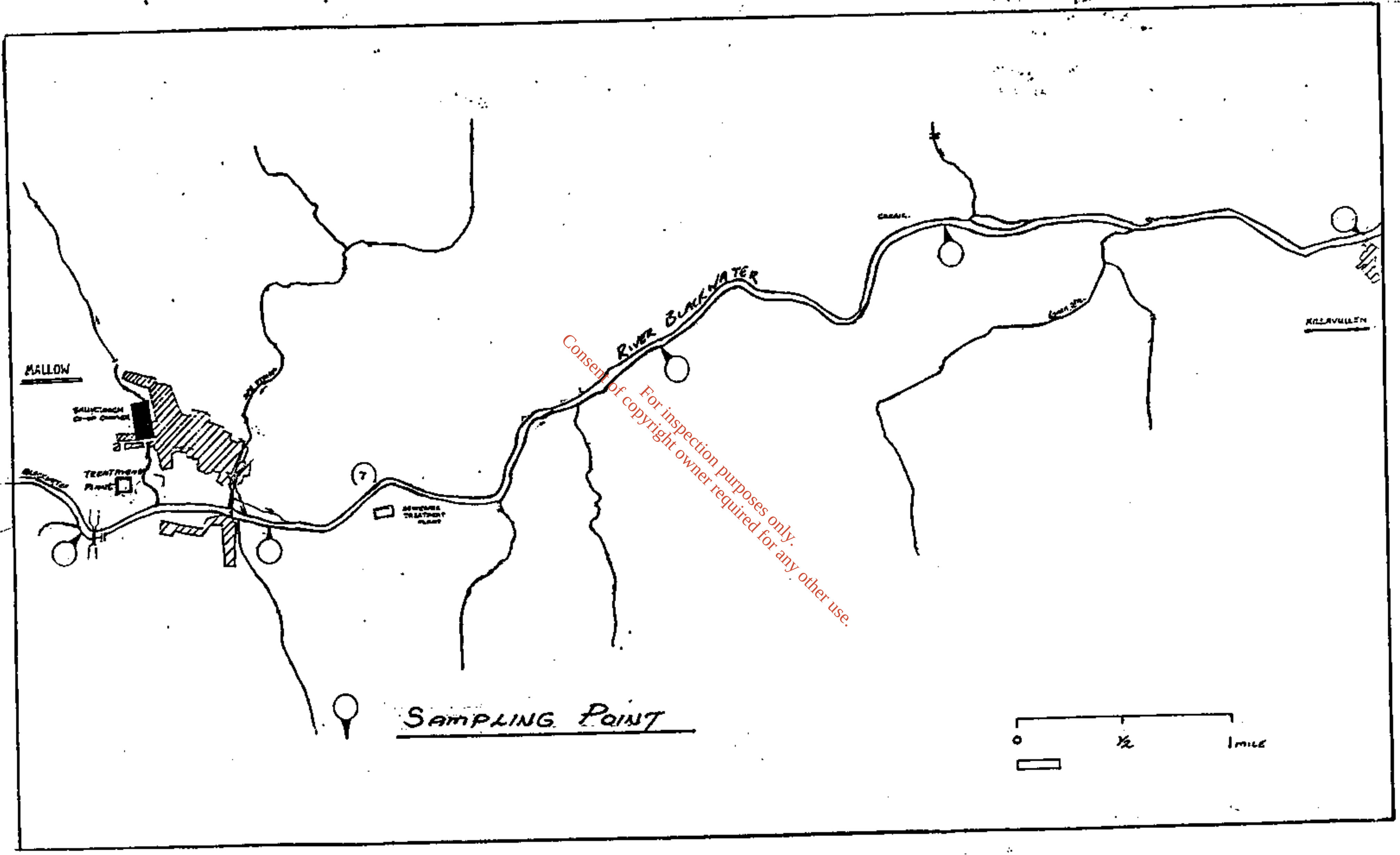
Due to the present BOD loading in the Blackwater at Rathmore no further effluent producing development should be allowed until the load on the river is reduced to below the recommended level.

TABLE 5.15 Sampling Stations on the d/s Rathmore section of the River Blackwater

Section No.3 River Blackwater (River code = 18000)

d/s Rathmore to u/s Mallow Sampling Stations 060 - 130

Station Code	Station Name	Distance d/s (km)
060	Shamrock Br.	0
070	Charles Br.	3.0
080	Keale Br.	10.0
090	Colthurst Br.	14.5
100	Ballymaquirke Br.	23.0
110	Dromcummer A/G St.	25.0
120	Roskeen Br.	30.5
130	Lombardstown Br.	34.5



MAP NO.5 RIVER BLACKWATER - MALLOW SECTION

In the Shamrock Bridge to Lombardstown Bridge section there are no point sources of pollution and the moderate pollution revealed in the 1986 A.F.F. Biological Survey would appear to result solely from Agricultural Sources.

TABLE 5.16 — Sampling Stations on the Mallow section of the River Blackwater

SECTION NO.4 — RIVER BLACKWATER (River code = 18000)

Mallow — Sampling Stations: 130 - 190

Station Code	Station Name	Distance d/s (km.)
130	Lombardstown Br.	0
138	50m u/s C.S.E.T.discharge pt.	5.5
140	Longfields Br.	6.0
150	Mallow Railway Viaduct	10.0
160	Mallow Br.	11.5
170	1.5km d/s Mallow Br.	13.0
180	Ballymagooly	15.0
185	1.0 km u/s Killavullen Br.	20.0
190	Killavullen Br.	21.0

Map 5.5 below shows location of sampling stations and discharges in the Mallow Section of the River Blackwater.

MAP 5.5 — MALLOW SECTION OF RIVER BLACKWATER

The point sources of effluent in the Mallow Section are as listed below in Table 5.17. (c.f. Vol.3).

TABLE 5.17 — Effluent sources at Mallow Section of River Blackwater.

SOURCE	EFFLUENT TYPE
C.S.E.T.	Beet washings,beet processing wastes, cooling water.
Ballyclough Co-op Creamery	Washings, milk processing
Mallow Mart	Yard washings.
Mallow U.D.C.	S.T.W. effluent.

C.S.E.T. process beet from October to December inclusive.

The volume of water used per day at the factory during the beet processing season is in the region of 25,296 m^3.

The effluent form C.S.E.T. is stored in a series of lagoons and discharge intermittently to the river Blackwater when flow in the river is sufficient to provide a dilution of 1/100 at least.

The discharge point is located at mid-stream 200 m u/s Longfields Bridge.

Analysis of results of surveys carried out while C.S.E.T. are discharging, indicate elevated Anmonia and BOD levels and sewage fungus growths.

However, due possibly to the low water temperatures and turbulence from high winter flows the DO level is not greatly affected.

As already mentioned in Section 3, a small stream at the east end of the C.S.E.T. factory grounds is seriously polluted. Maximum and minimum values of BOD, suspended solids, and ammonia for samples taken in the winter of '87 - '88 are listed in Table 5.18 below.

TABLE 5.18 SAMPLING RESULTS FROM STREAM AT EAST END C.S.E.T. GROUNDS

	BOD	S.S.	NH3
Maximum	550	107	45
Minimum	52	15	3.5

It has caused considerable fungus growth in the main channel of the Blackwater in the winter of 1987 with the fungus being traced to the 10 Arches Bridge in Mallow 4 km. d/s of the stream's confluence with the Blackwater.

Winter river flows hinder Biological and Macrophyte surveys so data from same is sparse.

A licence to discharge effluent was granted to C.S.E.T. by Cork Co.Council in September 1987.

The licence lays down certain conditions governing rates of discharge, required dilution in river, duration of discharge, quality of effluent, sampling regime etc, plue a time scale for compliance with the conditions.

The main discharges to the river Blackwater in the vicinity of Mallow town are milk wastes, storm overflow and mart washings.

It is intended to issue a licence to Mallow Mart and connect their sewer to the towns sewerage system.

BALLYCLOUGH CO-OP

The effluent from Ballyclough Co-op treatment works normally complies with the required standards.

The control flow of the river at this point is 3.6 m^3/sec

If control BOD = 3.0 mg/l and u/s BOD = 1.9 mg/l

Assimilative capacity = 342 kgs BOD/day

The load from Ballyclough Co-op at 22 mg/l BOD (1987 median value) is 70 kgs BOD / day, which is well below the assimilalative capacity of the river.

However, as mentioned in Section 3, a stream that flows through the Ballyclough factory grounds is frequently polluted by factory wastes and by a storm overflow from the Mallow Urban drainage system.

The BOD of the stream has been measured (u/s of the storm overflow) at 33 mg/l BOD on occasion. Low flow for the stream is estimated at 2300 m^3 / day giving a load of 76 kgs BOD /day which is greater than the loading from the treatment works.

MALLOW S.T.W.

The Mallow U.D.C. S.T.W. discharges effluent to the River Blackwater 1.5 km d/s Mallow Town.

The control flow at this point is 3.8 m^3 / sec.

If control BOD = 3.0 mg/l and u/s BOD = 2.1 mg/l

Assimilative Capacity = 296 kgs BOD / day .

As the load from the S.T.W. is 46 kgs BOD / day there is ample reserve capacity available in the river at this point.

Its effect on the river is neglible with a slight increase in phosphate level downstream.

TABLE 5.19 Sampling Stations on the d/s Killavullen section of the River Blackwater

SECTION NO.5 RIVER BLACKWATER (River code = 18000)

d/s Killavullen to u/s Fermoy Sampling Stations: 200 - 210

Station Code	Station Code	Distance d/s
190	Killavullen Br.	0
200	Ballyhooley Br.	11.0
210	Cregg Castle	17.0

This section of river has no point sources of pollution and the moderate pollution referred to the in the 1986 A.F.F. Biological Survey would appear to result from agricultural sources. The routine sampling carried out by Cork County Council does not indicate any pollution in this stretch.

TABLE 5.20 — Sampling Stations on the Fermoy section of the River Blackwater

SECTION NO.6 — River Blackwater (River Code = 18000)

u/s Fermoy to d/s Fermoy (Kilmurray) — Sampling Stations 210 - 240

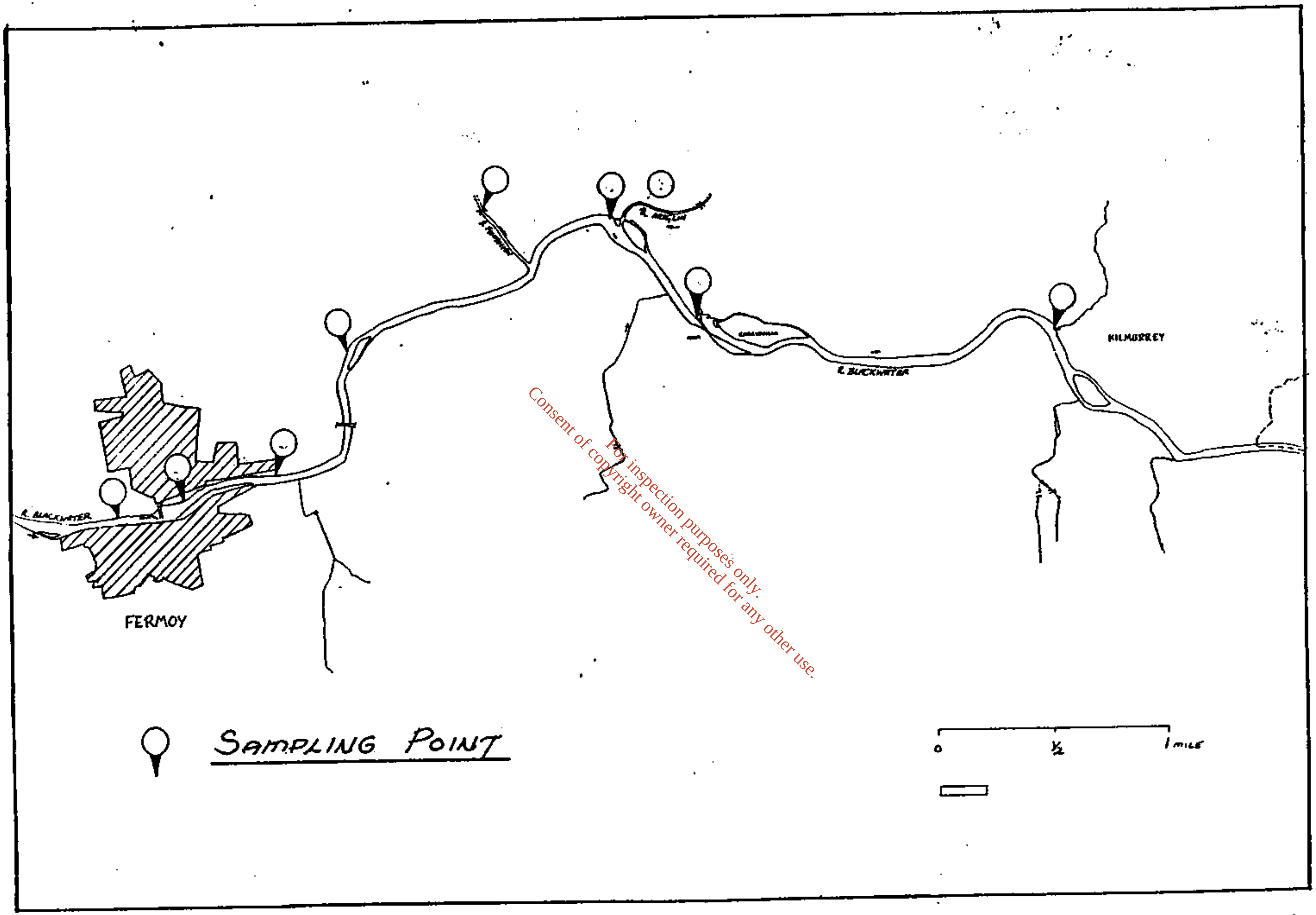
Station Code	Station Name	Distance d/s (km)
210	Cregg Castle	0
220	250m u/s Fermoy Br.	3.7
222	360m d/s Fermoy Br.	4.4
225	915m d/s Fermoy Br.	4.9
230	1.5km d/s Fermoy Br.	5.5
235	d/s Funcheon u/s Aragin Confl.	9.1
237	Careysville Weir	10.2
240	3km d/s Funshion Confl. (Kilmurray)	12.0

Map 5.5 (over) shows the sampling points and discharges on the Fermoy section of Blackwater.

The point sources of effluent in the Fermoy Section of the River Blackwater are listed below:

TABLE 5.21 — Effluent sources at the Fermoy Section of River Blackwater.

SOURCE	EFFLUENT TYPE
Micro Bio	Manufacture of Chemicals
Silver Pail	Ice Cream manufacturing wastes.
Fermoy Mart	Yard washings.
Fermoy S.T.W.	S.T.W. effluent.



MAP NO.6 RIVER BLACKWATER - FERMOY SECTION

Physico - Chemical sample results of the Fermoy reach of the river Blackwater do not indicate any pollution occurring.

The source of a serious fish kill which occurred in the summer of 1987 was never traced.

The S.T.W. started operation in November 1987 and as yet sufficient survey data is not available to measure the effect of its discharge on the river.

The mart discharges to the Blackwater via a mill race at a point 600 m d/s Fermoy Bridge. However, river surveys have not indicated any pollution in the river as a result of their discharge, probably due to the large dilution available in the river where the mill race joins it.

A licence to discharge to the public sewer has recently been granted to the Mart.

Both Micro Bio and Silver Pail formely discharged their effluent to a U.D.C. sewer which in turn discharged to the river Blackwater at a point 50 m d/s Fermoy Bridge.

However, the new sewerage system provides both storm sewers and foul sewers and licences to discharge to same have been granted to Micro Bio and Silver Pail in 1987.

These licences contain conditions which define quantities, quality etc, of effluent to be discharged to the storm sewer and/or the foul sewer by the two companies.

TABLE 5.22 Sampling Stations on the d/s Kilmurray section of the River Blackwater

SECTION NO.7 River Blackwater (River code = 18000)

Kilmurray - d/s Dromana Ferry Sampling Stations 240 - 300

Station Code	Station Name	Distance d/s (km)
240	Kilmurray	0
250	Ballyduff Bridge	9.0
260	Lismore Bridge	17.0
270	2km d/s Lismore	19.5
280	Cappoquin Bridge	22.8
290	1km d/s Cappoquin	23.8
300	Dromana Ferry	31.0

The point sources of effluent in the Kilmurry - Dromana Ferry section of the River Blackwater are listed in Table 5.23 below.

TABLE 5.23 Effluent sources on the d/s Kilmurray Section of the River Blackwater.

SOURCE	EFFLUENT TYPE
Ballyduff S.T.W.	Septic Tank effluent.
Ballyduff Creamery	Milk washings
Lismore	S.T.W. effluent.
Cappoquin	Septic Tank effluent.
Cappoquin Chickens	Chicken Processing Wastes

At Ballyduff the control flow is 10.7 m^3 / sec.

If control BOD = 3.0 mg/l and u/s BOD = 2.1 mg/l

Assimilative Capacity = 832 kgs BOD / day .

Estimated load from Ballyduff Septic Tank = 6.2 kgs BOD/day.

Estimated load from Ballyduff Creamery = 6.5 kgs BOD/day.

At Cappoquin the control flow is 11.4 m^3 / sec.

If control BOD = 3.0 mg/l and u/s BOD = 1.67 mg/l

Assimilative Capacity = 1310 kgs BOD / day .

Estimated load from Cappoquin Septic Tank = 6.2 kgs BOD/day.

Estimated load from Cappoquin Chickens = 27.5 kgs BOD/day.

All survey results indicate little or no pollution occurring in this stretch of the River Blackwater. This is probably due to the fact that the effluent quantities are very small in comparison with the dilution available in the river.

The effect of the tidal movement 1km d/s Lismore complicates the analysis of survey results.

NOTE:

The distance from the source of the Blackwater to Dromana Ferry is 150 km. The various survey results show that for most of its length, the main channel of the River Blackwater is unpolluted and has an appreciable reserve capacity of BOD.

The areas where potential BOD overloading might occur would appear to be a stretch 5 km. long at Rathmore and in the winter a stretch 15 km. long at Mallow during the C.S.E.T. beet procesing season.

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TRIBUTARIES

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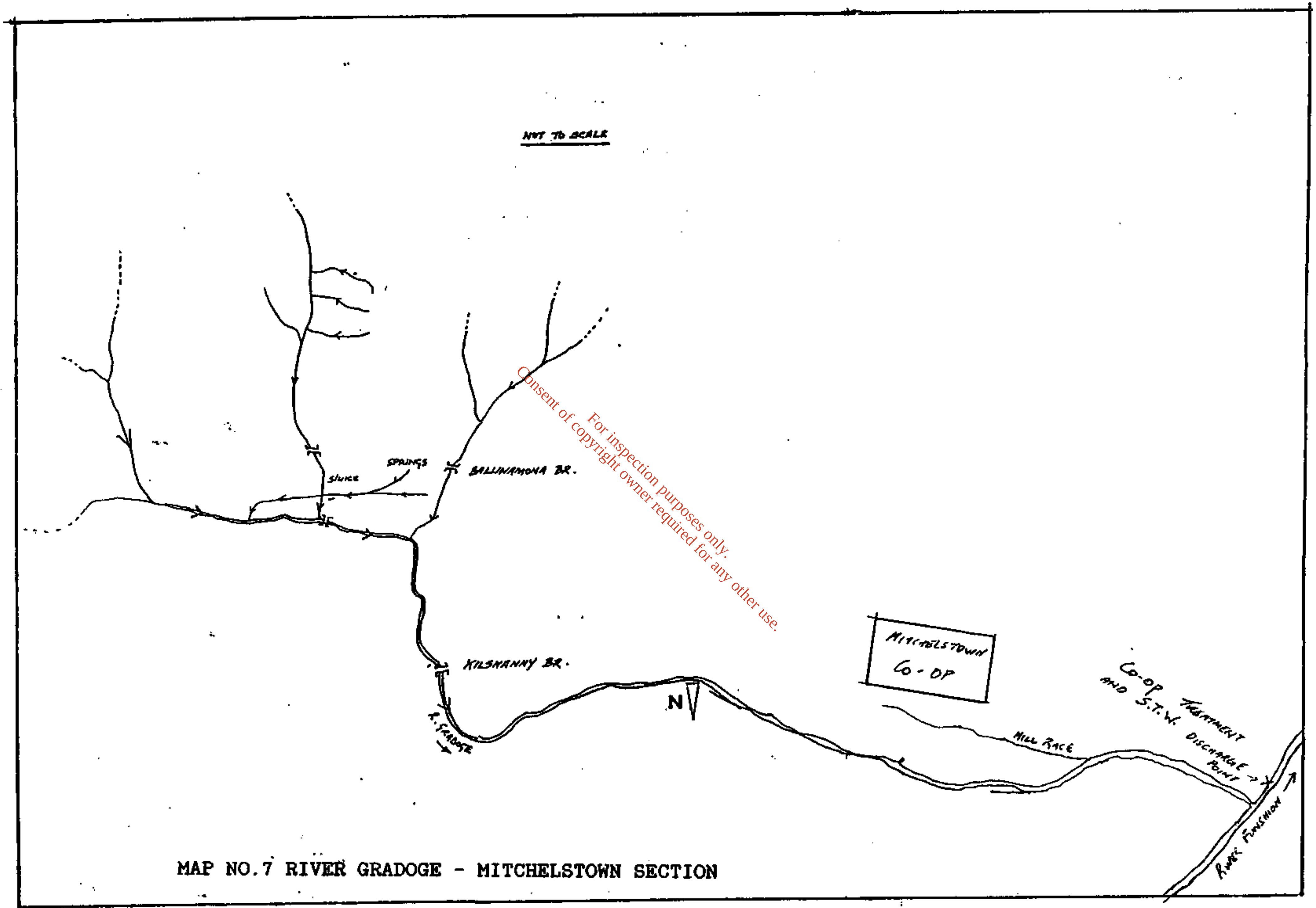


MAP NO.7 RIVER GRADOGE - MITCHELSTOWN SECTION

TRIBUTARIES

TABLE 5.24 — Sampling Stations on the River Gradoge at Mitchelstown.

RIVER GRADOGE (River Code = 18026)

Mitchelstown Section — Sampling Stations: 010 - 020

Station Code	Station Name	Distance d/s (km)
010	Kilshanny Bridge	0
015	u/s Confl.Blue Stream	2.2
020	50m u/s River Funshion	3.2

Map 5.7 (facing) shows location of sampling stations and discharges in the Mitchelstown Section of the River Gradoge.

The sampling station 50m u/s confl. with the River Funshion (code no.= 020) has the doubtful distinction of having been listed in every A.F.F. survey since 1972 as being seriously polluted.

The Chemico-physico surveys carried out by Cork Co Council all show low DO's, high BOD's and high Ammonia levels for this sampling point.

No fish kills have occurred in the lower reaches of the Gradoge for some time, mainly because there are very few fish in that section.

Industrial and Agricultural sources are the cause of pollution in the River Gradoge.

The main source of industrial pollution at this point would appear to be milk processing wastes.

There are a number of potential sources of agricultural pollution u/s and d/s of the town. Spillages of effluent from some of these sources have in the past caused fish kills in the River Gradoge and in the River Funshion on occasion.

The identity and location of polluters will have to be established and advice given regarding remedial work to be carried out to prevent further pollution occuring.

If the remedial work is not carried out then the polluters should be repeatedly prosecuted under the Water Pollution Act until the necessary steps are taken to prevent the pollution recurring.

TABLE 5.25

Sampling Stations on the River Funshion at Mitchelstown.

RIVER FUNSHION (River Code = 18Ø25)

Mitchelstown Section Sampling Stations: ØØ5 - Ø5Ø

Station Code	Station Name	Distance d/s (km)
Ø1Ø	Ballyarthur Bridge	Ø
Ø2Ø	Ø.5km d/s confl.Gradoge	2.3
Ø3Ø	Kilee Bridge	4.3
Ø4Ø	Marshalstown Bridge	7.3
Ø5Ø	Glenavuddig Bridge	11.0
Ø6Ø	Bridge E of Scart	12.Ø
Ø7Ø	Carrigdownane, Br.NE of x-rds	16.Ø
Ø8Ø	Glanworth Bridge	24.Ø
Ø9Ø	Ballynahow Bridge	28.Ø
1ØØ	Downing Bridge	32.Ø
11Ø	Ballyfeans Bridge.	34.5

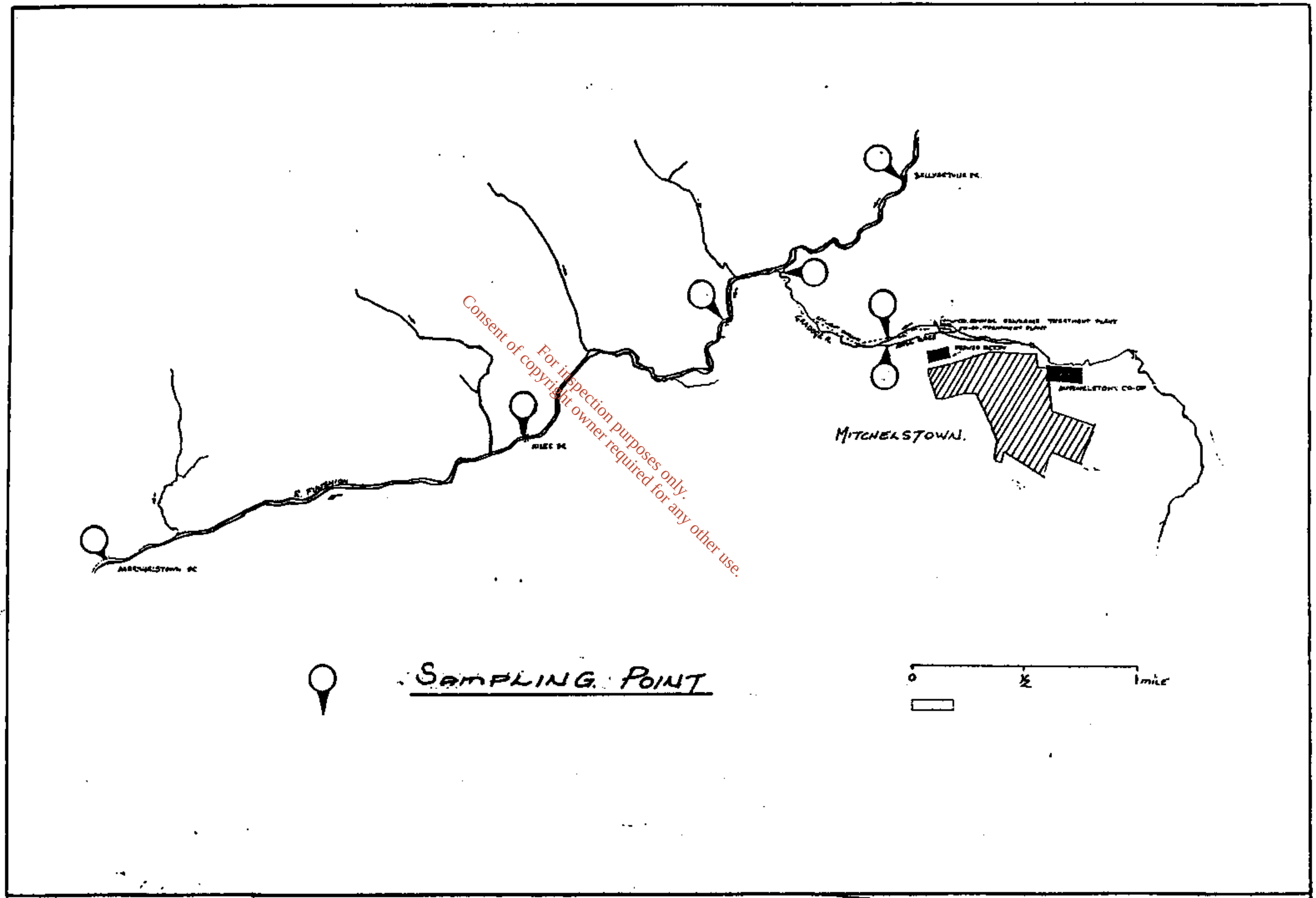
TABLE 5.26

Effluent sources on the Mitchelstown section of the River Funshion.

The point sources of effluent on the Mitchelstown section of the River Funshion are as below.

SOURCE	EFFLUENT TYPE
Mitchelstown S.T.W.	S.T.W. effluent.
Mitchelstown Co-op	Washings,milk processing wastes,bacon factory wastes.

Map 5.8 below shows location of sampling stations and discharges on the Mitchelstown Section of the River Funshion.



MAP NO.8 RIVER FUNSHION - MITCHELSTOWN SECTION

The section of the River Funshion from its confluence with the River Gradoge d/s to Glenavuddig Bridge has been subject to pollution on and off since records began in 1971.

The results listed below show high BOD levels, low DO's and high phosphate and Ammonia levels occurring over the years.

The effluents from the Mitchelstown S.T.W. and the Co-op now discharge to the River Funshion at a point 100m d/s of its confluence with the River Gradoge.

A survey carried out in 11th August 1987 indicated significant deoxygination from d/s Gradoge confl. to Glenavuddig Bridge with a minimum value of 38% saturation at Kilee Bridge.

No fish kill occurred on that occasion but one did occur the following week when the % saturation at Kilee Bridge was 44 and an Ammonia value of 0.47 p.p.m.was recorded.

The control flow at this point in the River Funshion is estimated to be 0.68 m^3 / sec.

If u/s BOD = 1.5 mg/l and the control BOD = 3 mg/l

Assimilative capacity = 88 kg BOD/day.

If control BOD = 5 mg/l

Assimilative Capacity = 206 kg BOD/day.

The load from Mitchelstown Co-op at 20 mg/l BOD and 2800 m^3/day is 56 kg BOD/day.

The load from Mitchelstown S.T.W. at 20 mg/l BOD and 800 m^3/day is 16 kg BOD/day.

Excluding the BOD load from the Gradoge it can be seen that at control flows 82% of the assmimlative capacity of the river is used if control BOD = 3 mg/l

If one takes into account the 95% flow of the Gradoge at 0.06 m^3/sec and a median BOD value of 16.5 mg/l then the load to the Funshion is 86 kg.

Thus the total BOD load = 56 + 16 + 86 = 158 kg BOD/day, which is 1.75 times the 3 mg/l BOD control figure.

Fish kills occurred on the river Finshion on two occasions in 1987. No source was found for either of the fish kills.

Both occurred after periods of heavy rain and were possibly caused by polluting matter being washed in by heavy runoff or by deliberate discharging of polluting materials to the River System.

At the first sampling station d/s Gradoge Confl. the only percentile limits that are satisfied are the 95% and 99.9% figures for Nitrates.

The River Funshion starts to show some sign of recovery at Glenavuddig with percentile limits for DO, BOD being complied with.

At this sampling station the ammonia loads are approaching 95%tile values but only 8.3% of the phosplate results comply with the 50%tile value.

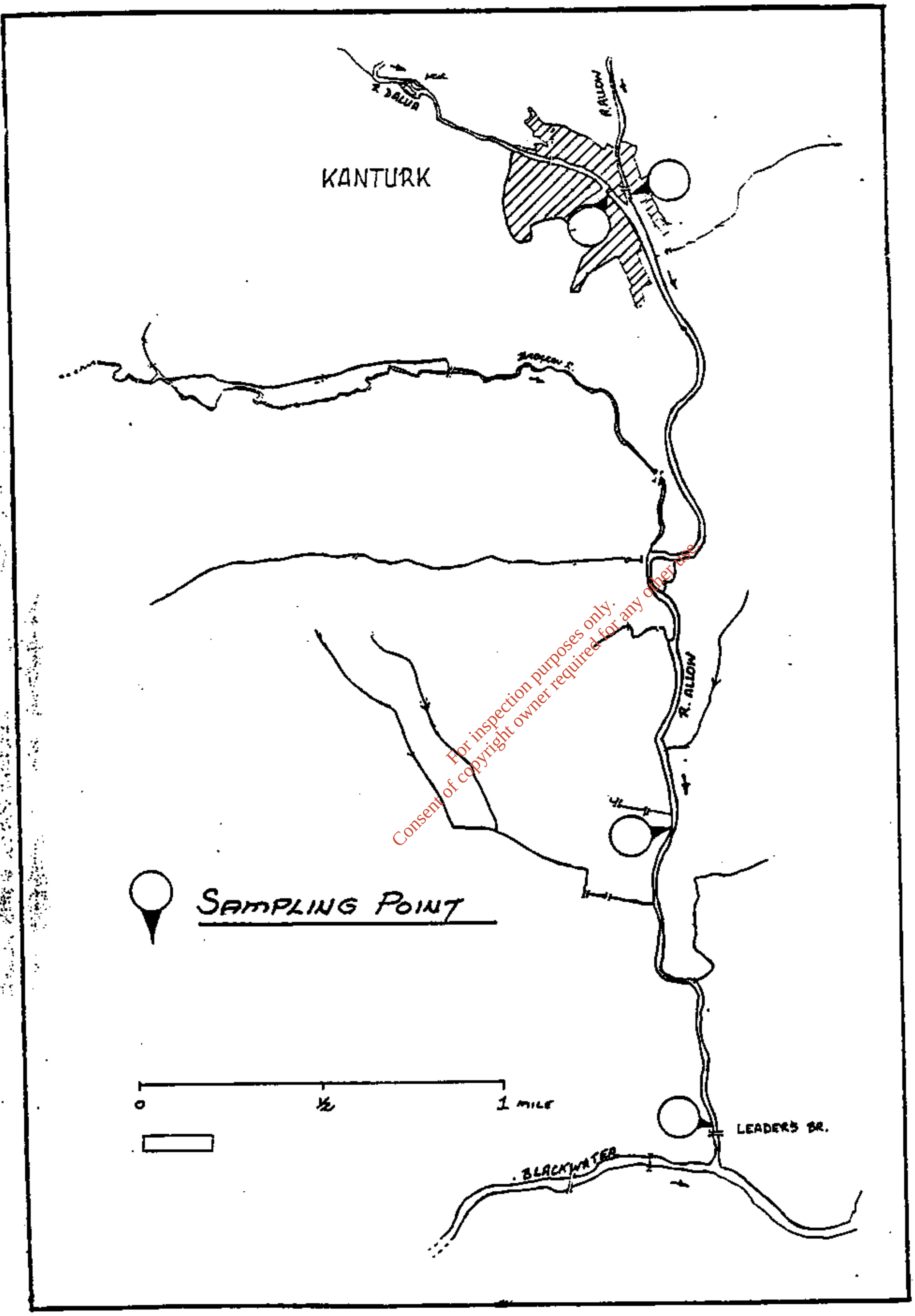
The phosphate levels remain high down as far as the Bridge u/s of the confluence with the Blackwater. At this point the Nitrate levels are such that 72.7% of the sample results comply with the 95% value.

Comments:

The stretch of the Funshion from its confluence with the Gradoge to its confluence with the Blackwater is the second most heavily polluted stretch of river in the Blackwater system.

This situation is attributable to the discharge to the river of Agricultural and Industrial effluents and the detrimental effect of the Gradoge which itself is the most polluted river in the whole Southern region.

Until the Gradoge and Funshion are cleaned up by reduction of Industrial and Agricultural loading, no further effluents should be discharged to the River Funshion or to the River Gradoge.



MAP NO.9 RIVER ALLOW - KANTURK SECTION

TABLE 5.27 — Sampling Stations on the River Allow at Kanturk

River Allow (River Code = 18Ø1Ø)

Section from Raheen Br. to Leaders Br.

Sampling Stations: Ø1Ø - Ø6Ø

Station Code	Name	Distance d/s (km)
Ø1Ø	Raheen Bridge	Ø
Ø2Ø	Allow Bridge	5
Ø3Ø	Johns Bridge	11
Ø4Ø	u/s Kanturk	21
Ø5Ø	Riverview	24
Ø6Ø	Leaders Bridge	26

The point sources of effluent on the Kanturk section of the River Allow are listed in Table 5.28 below.

TABLE 5.28 — Effluent sources on the Kanturk section of the River Allow.

SOURCE	EFFLUENT TYPE
Kanturk S.T.W.	S.T.W. effluent.
Kanturk Creamery	Milk processing wastes.

Map 5.9 (facing) shows location of sampling stations and discharges on the Kanturk Section of the River Allow.

The sampling results for the River Allow show moderate fluctuations in BOD and ammonia levels, though for the most part these parameters comply with their respective percentile limits.

The average level of NH3 is high at the sampling station at Riverview (Av. = Ø.43 ppm) and at the Leaders Bridge sampling station (Av = Ø.4Ø ppm).

The main deviation from the recommended percentile values occurs in the PO4 values (Table 5.29). These show a steady decline moving d/s from Raheen Bridge, going from 100% compliance at Raheen Bridge to 18.1% compliance at Leaders Bridge.

The average value for phosphate at the sampling station u/s Kanturk is 0.20 ppm. As there are no point sources u/s Kanturk the source of the high phosphate level must be agricultural.

A possible source of phosphates could be agricultural fertilizers being spread in unsuitable weather conditions or on soils with a high run off nature.

Downstream of Kanturk the main source of phosphate is the effluent from the towns sewage treatment works and the effluent from Kanturk Creamery.

In a 24 hour survey carried out in August 1987 the loading from the two treatment works were as below.

SOURCE	FLOW (m^3/day)	PO4 (kgs/day)
Kanturk S.T.W.	440	2.16
Kanturk Creamery.	255	3.85

Assuming a 95% tile flow in the River Allow at Kanturk of 0.480 m^3/sec the effect of the above on the river would be as follows.

Location	Flow u/s (m^3/sec)	PO4 u/s	PO4 d/s	Increase
Kanturk S.T.W.	0.480	0.20	0.25	25%
Kanturk Creamery	0.485	0.25	0.34	36%

The NH3 and BOD values for the effluents from the S.T.W. and the Creamery in August 1987 were as below.

Location	Max. NH3	Daytime Av. NH3	Max.BOD	Daytime Av. BOD
Kanturk S.T.W.	35.0	17.0	185	128
Kanturk Creamery	3.5	2.0	180	55

The effect of the above effluents is indicated in the high average BOD, NH3 and PO4 levels at Riverview and u/s Leaders Bridge.

Table 5.29 below shows how the PO4 levels vary in the River Allow from Raheen Bridge to Leaders Bridge.

TABLE 5.29 % Compliance of PO4 Levels in River Allow

Site	50%tile	95 %tile	Average Value
Raheen Bridge	100	100	0.07
Allow Bridge	76.92	100	0.10
Johns Bridge	91.67	100	0.08
u/s Kanturk	47.06	82.35	0.20
Riverview	28.26	80.43	0.35
Leaders Bridge	18.18	54.55	0.36

The estimated 95 %tile flow at Kanturk is 0.48 m^3 / sec.

If control BOD = 3 mg/l and u/s BOD = 2.3 then

Assimilative capacity = 29 kgs BOD / day.

BOD load from creamery (Median BOD=66) = 17 kg BOD / day.

BOD load from S.T.W. (Median BOD=105) = 47 kg BOD / day.

Thus the combined load from the Creamery and the S.T.W. at 64 kgs BOD / day is over twice the assimilative capacity of the river.

If max BOD from Creamery is 20 mg/l then load = 5.1 kg BOD/day.

If max BOD from S.T.W. is 20 mg/l then load = 8.8 kg BOD/day.

The sources of agricultural pollution u/s of Kanturk will have to be established and advice given regarding remedial work to be carried out to prevent further pollution occuring.

If the remedial work is not carried out then the polluters should be repeatedly prosecuted under the Water Pollution Act until the necessary steps are taken to prevent the pollution occurring.

Approval has been sought for the replacement of the Kanturk S.T.W. from the D.O.E.

A BOD of 15 mg/l has been recorded for the Creamery which indicates that the BOD load from same can be drastically reduced.

Measures should be taken to lower the input of phosphates to the River Allow from the two treatment works d/s of Kanturk.

Other Tributaries:

River Bride (River Code 18090)

This river rises to the NW of Glenville and flows through rich agricultural land to its confluence with the Blackwater estuary 10 km d/s Cappoquin.

Nitrate levels in the lower reaches are slightly elevated otherwise the water quality is satisfactory.

The raised nitrate levels are probably caused by leachate from the surrounding land and isolated sources of agricultural pollution.

River Awbeg (River Code 18020)

This river rises 3km to the N.E.of Freemount and joins the Blackwater d/s Castletownroche at a point 5 km u/s Ballyhooly Bridge.

The biological survey carried out by A.F.F in 1985 found that the upper reaches of the river were slightly or moderately polluted with the quality of the section d/s Doneraile satisfactory.

A survey carried out by Cork County Council staff in August 1987 revealed low DO values and elevated phosphate levels.

The west limb of the River Awbeg flows through agricultural land and is prone to pollution from agricultural sources such as land leachate,runoff, farmyard effluent and the practice of watering livestock in the river itself.

The slow flowing nature of this section of the river gives rise to sedimentation and a poor capacity for natural rearation.

Arterial drainage has been carried out on a number of bog systems in the western links of the river. This has given rise to massive weed growth and an environment hostile to fish life in the drained sections.

A.F.F.'s quality rating of moderate pollution for this section has not changed since 1971 and unfortunately does not look like improving in the near future.

The following tributaries are sampled on a regular basis by A.F.F. staff in the regional laboratory in Kilkenny.

TABLE 5.30 Tributaries of the River Blackwater in County Waterford sampled by A.F.F..

RIVER NAME	AFF CODE	BMP CODE	NO.OF SAMPLING POINTS	QUALITY ASSESMENT
Finisk	18/F/02	18045	5	Satisfactory
Glendine	18/G/07	18095	1	Satisfactory
Glenafallia	18/G/10	18040	2	Satisfactory
Goish	18/G/12	18050	3	Satisfactory
Lickey	18/L/01	18055	2	Satisfactory
Owenashad	18/O/08	18035	2	Satisfactory

The Chemico-Physico and Biological data for the above rivers has indicated satisfactory quality down through the years.

Some isolated pollution cases have occurred but these have not impaired the quality of the rivers to any permanent extent.

OTHER TRIBUTARIES

Summary of Water Quality in the Blackwater Catchment.

RIVER BLACKWATER

The freshwater reaches of the river Blackwater were sampled on and off in the seventies and have been extensively sampled since 1981.

The length of the River from its source to the last survey point is approximately 150 kms.

The results of the sampling show that the overall quality of the River Blackwater has not changed greatly since 1966.

The river remains in a predominantely clean condition with moderate pollution affecting 16.2 km and slight pollution affecting 25.7km.

Water quality in the upper 24 kilometres is satisfactory but it deteriorates in the section dowmstream of Rathmore where the river shows evidence of organic pollution over a length of 5 km.

The next location downstream where sampling results indicate pollution is in the Mallow section during the winter months. The discharge of effluent from C.S.E.T.'s lagoons at Dromaneen still tend to give rise to elevated BOD and Ammonia levels and sewage fungus growths in the river.

The effect of C.S.E.T.'s discharge can be observed downstream as far as Killavullen Bridge and sometimes beyond.

The stream at the east end of C.S.E.T.'s grounds occasionly gives rise to sewage fungus in the river downstream to the 10 Arches Bridge.

The quality of water in the Mallow section has been improved with the introduction of the U.D.C.'s sewage treatment works and the the requirement that C.S.E.T. should discharge their effluent to the River Blackwater only when a minimum dilution of 1/100 is availablein the river.

The quality of the water in the Mallow - Killavullen reach improves in the summer months with only slight pollution occurring.

Downstream of Killavullen Bridge the quality improves to 'Satisfactory', and stays that way for the rest of the sampled freshwater section downstream to Dromana Ferry.

TRIBUTARIES (Summary)

RIVER GRADOGE

The most seriously polluted river in the Catchment is the River Gradoge. Continual heavy pollution has meant that a section of it has had a "Bad" quality rating since 1971.

Its overall length is 9.5 km and 1.5 km(16%) of this is of doubtful quality and 2 km (22%) is of bad quality.

The 22% of "Bad" quality river contrasts with a figure of 2% in the Southern Region and a figure of 2% for the national level.

RIVER FUNSHION

The River Funshion is in a clean condition until joined by the Gradoge. It remains in a polluted condition for a distance of 10 km. downstream of the confluence.

The dilution by the clean waters of the Sheep and Farahy rivers help it recover to a satisfactory quality.

However, it occasionly shows traces of pollution downstream to is confluence with the Blackwater.

River Allow

Like the river Awbeg, the river Allow flows through agricultural land and thus is prone to pollution from leachate ,runoff and occasional farmyard effluent discharges.

These give rise to the elevated phosphate levels at Kanturk.

Kanturk S.T.W. and Kanturk creamery increase the phosphate loading to the River Allow downstream of Kanturk.

There are a number of slow flowing sections in the River Allow between Kanturk and its confluence with the River Blackwater 6 km. downstream. These could be subject to eutrophication in extreme low flows.

River Awbeg

The west limbs of the River Awbeg flow through agricultural land and is thus prone to pollution from agricultural sources.

The rivers capacity for rearation is poor due to its slow flowing nature. Its biological survey quality rating of moderate pollution has not changed since 1971.

Summary