

ANNEX 7

SCOTTISH ENVIRONMENT PROTECTION AGENCY

ADRS ESTUARY CLASSIFICATION SCHEME 1994

1 Introduction

The purpose of the scheme described below is to classify Scottish estuarine waters. A classification scheme is required both for national reporting purposes and also to measure performance and compliance with Estuarine Water Quality standards. The scheme described below was developed and revised by the ADRIS (Association of District River Inspectors Scotland) Marine and Estuarine Section in 1994 and adopted by SEPA for use between 1996 and 2006.

2 Basis of the Scheme

It was agreed that a revised Estuary Classification Scheme was required because of the inadequacies of the current scheme (e.g. by its lack of sensitivity, the inappropriate balance between parameters and the absence of certain important features). It was further agreed that the revised scheme should be modelled on the ADRIS Coastal Scheme as far as possible and that the scheme should:-

- a) be as simple as possible
- b) be readily applicable to all Scottish estuarine waters
- c) comprise four class categories for compatibility with the existing Coastal classification scheme
- d) recognise areas affected by existing developments
- e) recognise areas and discharges subject to EC Directives.

3 Application of the Scheme

Estuary boundaries listed under the EC Urban Waste Water Treatment Directive should be used at all times.

It was also agreed that the classification scheme should:-

- a) embrace all parameters and effects, regardless of whether SEPA was empowered to control them (e.g. effluent discharges) or not (e.g. marine garbage and debris), but excluding the effect of Eutrophication.
- b) for compatibility with the coastal scheme and to increase sensitivity, be 'default based'.

A relatively small unit of resolution of 0.01 km² (100 m x 100 m) is proposed. This may result in some small areas of class C or D around outfalls, but this is considered reasonable and matches the unit of resolution used in the coastal scheme. It is also considered reasonable to ignore affected areas smaller than 0.01 km². Where an impact is greater than this then the whole 0.01 km² is downgraded.

It is also considered appropriate to assume the presence of intermediate zones between for example, Class C areas and Class A areas even if no actual data exists to substantiate this. Therefore an appropriate buffer zone may be added according to local knowledge.

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It may be that Class A estuarine waters abut Class B or C coastal waters. This is a consequence of the few parameters included in one scheme but not in the other (i.e. microbiology in the coastal scheme, migratory fish in the estuary scheme). Abrupt transitions between estuary and coastal classification were therefore considered to be inevitable but acceptable.

When using colours to depict coastal and estuary classifications it was agreed to follow the convention adopted by the Scottish Executive for other classification schemes.

Class A	Blue
Class B	Green
Class C	Orange
Class D	Red

The main provisions of ADRIS's Estuary Classification Scheme are tabulated below. For each of the four quality classes (A, B, C and D) there are criteria covering aesthetic condition, biological condition and chemical condition. Guidance notes and tables are provided to aid the application of these criteria.

A given area of estuary is classified by allocating it to the highest class to which all of its condition criteria conform. An estuarine area satisfying Class B aesthetic and chemical criteria but which is Class C on the basis of one of the biological criteria would be classified as Class C overall.

Where only limited data on chemical and biological quality are available, estuaries will be classified according to that data together with information on, for example, known discharges, pollution complaints, etc and additional survey work may not be required. Where no discharges occur, no pollution complaints have been substantiated and other pollution sources are absent, an estuary will normally be Class A.

Estuary Classification Notes

- (1) Occasional = Presence observed on less than 20% of visits or samples.
- (2) Frequent = Presence observed on 20% or more of visits or samples.

Aesthetic Conditions

- (3) Sewage and petroleum residues absent, but traces of items in Section B of Table 1 may be present.
- (4) Presence of **traces** of sewage derived solids or petroleum residues, or conspicuous accumulations of other materials. See Table 1.
- (5) Presence of **conspicuous** accumulations of sewage derived solids or petroleum residues, or smell nuisance, or gross accumulations of other materials. See Table 1.
- (6) Gross, **offensive** accumulations of sewage solids or petroleum residues, or smell nuisance.

Fish Migration

- (7) The absence of a physical barrier to migration is assumed. Infrequent restriction of passage or isolated minor fish kills directly attributable to prolonged drought/low river flows should be ignored in classifying an estuarine area.
- (8) Evidence for the migration of salmonids and eels will be sufficient provided there is no reason (see below) to suspect fish migration problems. Data on the migration of other species should be used if available and should be collected if this is thought to be necessary by the RPA.
Reasons include:-

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- (a) The presence of substantial discharges or other sources of pollution.
- (b) Reliable observations of migratory problems for any appropriate fish species, (excepting note 7).
- (c) Absence of spawning fish in most of the suitable spawning areas in catchment.

Resident Biota

- (9) Fauna and flora consistent with physical and hydrographical conditions (e.g. level on shore or sub-tidal location, sediment characteristics, tidal and other currents and salinity), and unaffected by organic enrichment or toxic pollution.

For data analysis methods, etc see Rees et al (1990), MAFF (1993 a & b) and Elliott and O'Reilly (1991).

Estuarine biotic indices are currently (1994) under development.

- (10) Modified fauna and flora characterised by a decline in numbers of species, a faunal distortion or a clearly defined toxic or sublethal response but, in the case of organic enrichment, accompanied by extremely abundant populations of opportunistic species (see Pearson & Rosenberg 1978).

- (11) Fauna or flora absent or poor in expected species, abundance or biomass;

AND/OR

Beggiatoa mats present.

- (12) The sediment bioassay using the amphipod *Corophium sp* is the recommended method. The protocol is described in ICES (1994). The following guidelines apply (taking account of the frequent high mortality in controls):-

<30% mortality = Class A & B
30-70% mortality = Class C
>70% mortality = Class D

- (13) Where there are known or suspected sources of TBT (tributyltin), or the degree of imposex in dogwhelks has been measured, then the following guidelines will apply:-

<10% imposex = Class A
10-40% imposex = Class B
>40% imposex = Class C

Persistent Substances (Biota)

- (14) The appropriate component of the biota should be used, as circumstances dictate and bearing in mind the comments of Bryan et al (1985) with regard to the indicator ability of various taxa. In view of the year on year variability of single site samples a 5 year running mean should be used where possible. Where there is information on the adverse effects of chemicals or biota not cited in Table 3, this should be applied using the best knowledge currently available.

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Water Chemistry

- (15) Normally depth averaged values (at given locations) should be used.
- (16) If 20 or more samples are collected then a 95%ile daily mean, taken over a calendar year, applies to the lower limit of each class. If less than 20 samples are collected then all must be over the lower limit.
- (17) The testing of substances listed under the UK Red List EC Dangerous Substances Directive is not necessary if there is no reason to suspect their presence.

Note:-

100% compliance means **all** samples must be below the EQS.

Annual compliance means only the annual average must be below the EQS.

References

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- Elliott M and O'Reilly M G (1991). The Variability and Prediction of Marine Benthic Community Parameters. In Estuaries and Coasts: Spatial and Temporal Intercomparisons. Ed by M Elliot and J-P Ducrottoy. Pub by Olsen & Olsen.
- GESAMP (1992) Scientific Criteria for the Selection of Waste Disposal Sites at Sea. Reports and Studies. 16, 1-60.
- ICES (1994 in press) Biological Effects of Sediment-Bound Contaminants: Corophium sp Sediment Bioassay and Toxicity Test. In Techniques in Marine Environmental Science.
- MAFF (1993a) analysis and Interpretation of Benthic Community Data at Sewage Sludge Disposal Sites. Aquat. Environ. Monit. Rep. MAFF Direct. Fish Res., Lowestoft 37. 1-80.
- MAFF (1993b) Fifth Report of the Group Co-ordinating Sea Disposal Monitoring. Aquat. Environ. Monit. Rep. MAFF Direct. Fish Res., Lowestoft 39. 1-42.
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- Rees H.L., Moore D.C., Pearson T., Elliott M., Service M., Pomfret J. and Johnson D. (1990). Procedures for the Monitoring of Marine Benthic Communities at UK Sewage Sludge Disposal Sites. Dept. of Agric. & Fisheries for Scotland. Fisheries Info. Pamphlet 18. 78pp.
- Water Authorities Association (1989). National Water Classification Scheme for Estuaries. WAA Estuarine Working Party. (Unpublished).

Other Documents Consulted

- a) ADRIS Coastal Waters Classification Scheme (Revised 1991)
- b) Letter from W Halcrow (FRPB) related to WAA (1989)
- c) Current Estuary Classification Scheme (First used in 1980)
- d) Estuary Classification System: A Critique & Proposal by A Henderson (CRPB) (1993)

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TABLE 1

Aesthetic Criteria

Section A - Sewage and Petroleum derived solids and materials

Human faeces
Animal faeces
Grease, scum of sewage origin
Sanitary towels
Contraceptives, tampon applicators
Other sewage debris (hair, toilet paper, sludge, floc, etc)
Sewage smells
Oil
Tar
Smell of petroleum

Section B - Other Materials (Refuse and other solid wastes)

Fishing gear
Plastic wastes
Refuse from ships
Refuse from terrestrial sources
Builders waste
Mineral waste

TABLE 2

Resident Fish

Class A - Resident fish fauna consistent with physical and hydrographical conditions and not restricted in usage of estuary by water quality.

Class B - As Class A.

Class C - Resident fish fauna not consistent with physical and hydrographical conditions with a reduction in species richness. Evidence of occasional restriction in usage of estuary by water quality factors.

Class D - Resident fish fauna showing marked reduction in species richness which is not consistent with physical and hydrographic regime. Evidence of frequent restriction in usage of estuary by water quality factors.

Notes

The major water quality factor limiting usage of estuaries by fish is usually dissolved oxygen. Where DO falls below 4 mg l⁻¹ for extended periods, effects on resident fish populations can be expected. Where industrialised estuaries have a history of poor water quality, reductions in species richness have commonly been observed. In upper estuarine areas, fish species indicative of good water quality can include sparring (*Osmerus eperlanus*) and twaite shad (*Alosa fallax*). In lower estuarine areas, the presence of range of marine adventitious marine juvenile and marine seasonal species in addition to a variety of estuarine resident species would also be indicative of good water quality.

References

Elliott, ME & Taylor, CJL, 1989. The structure and functioning of an estuarine/marine fish community in the Forth Estuary, Scotland. In: RS Klekowski, E Styczynska & L Falkowski (eds): 21st European Marine Biology Symposium, Gdansk, 1986, 227-240. Polish Academy of Sciences.

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Pomfret, JR, Elliott, M, O'Reilly, MG & Phillips, S, 1991. Spatial and temporal patterns in the fish communities in two UK North Sea estuaries, 227-284. In: *Estuaries and Coasts: Spatial and Temporal Intercomparisons*. ECSA 19 Symposium. Eds Elliott, M & Ducrottoy, JP. Olsen & Olsen, 1991.

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TABLE 3A

“National Background”, “Substantially Elevated” and “Grossly Elevated” Contaminant Levels in the Common Mussel, *Mytilus edulis*, Analysed in Accordance with ICES Guidelines

Substance	“National Background”	“Substantially Elevated”	“Grossly Elevated”	Unit
Mercury	0.15	1.5	3	mg/kg dry
Cadmium	1	10	20	mg/kg dry
Chromium	2	15	40	mg/kg dry
Copper	6	20	45	mg/kg dry
Lead	4	25	50	mg/kg dry
Nickel	1.50	15	30	mg/kg dry
Zinc	0.90	400	600	mg/kg dry
DDT*	0.20	100	200	µg/kg wet
HCB	1	10	20	µg/kg wet
HCH	1	10	20	µg/kg wet
Dieldrin	2	20	50	µg/kg wet
PCBs ^o	0.10	50	100	µg/kg wet

* DDT expressed as the sum of the three p, p-isomers;

– HCH expressed as the α -isomer;

^o PCBs expressed as 2.5 times the sum of the seven ‘IUPAC’ congeners, numbers 28, 52, 101, 118, 138, 153 and 180, to give an Arochlor equivalent.

TABLE 3B *Fucus vesiculosus*/*F. spiralis* mg/kg dry weight

Substance	“National Background”	“Substantially Elevated”	“Grossly Elevated”
Mercury	0.02	0.2	0.4
Cadmium	1	8	16
Arsenic	10	100	240
Chromium	1	6	12
Copper	3.5	35	70
Lead	1	10	20
Nickel	4	40	80
Zinc	35	350	700

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ESTUARY CLASSIFICATION SYSTEM - APPROVED FOR USE 1995

Class	Description	Aesthetic Condition	Fish Migration	Benthic Community and/or Bioassay	Resident Fish	Persistent Substances (Biota) (Note 14)	Water Chemistry (Note 15)	
							Dissolved Oxygen (DO)	EC Red List and Dangerous Substances
A	Excellent	Unpolluted (Note 3)	Water quality allows free passage (Note 7)	Normal (Notes 9, 12 & 13)	Resident fish community normal (Table 2)	<2X National background (Table 3)	Minimum DO >6mg/l (Note 16)	100% compliance of samples (Note 17)
B	Good	May show signs of contamination (Note 4)	Water quality allows free passage (Note 7)	Normal (Notes 9, 12 & 13)	Resident fish community normal (Table 2)	> or = 2X National background but < substantially elevated (Table 3)	Minimum DO < or = 6 mg/l but > 4 mg/l (Note 16)	Annual compliance of samples (Note 17)
C	Unsatisfactory	Occasional observations or substantiated complaints of pollution (Notes 1 & 5)	Water quality restricts passage (notes 7 & 8)	Modified (Notes 9, 10, 12 & 13)	Resident fish community modified (Table 2)	> or = substantially elevated but < grossly elevated (Table 3)	Minimum DO < or = 4mg/l but >2mg/l	One or more List II substances fail to comply. List I and Red List all comply (Note 17)
D	Seriously polluted	Frequent observations or substantiated complaints of pollution (Notes 2 & 6)	Water quality allows NO passage (Note 7)	Impoverished or severely modified (Notes 9, 10, 11 & 12)	Resident fish community impoverished (Table 2)	> or = Grossly elevated level (Table 3)	DO < 2mg/l	One or more List I or Red List substances fail to comply (Note 16)