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Environmental Impact Assessment Review
22 (2002) 415–439

Environmental Impact Assessment Review

www.elsevier.com/locate/eiar

Cumulative effects assessment: A review of UK environmental impact statements

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Received 1 January 2002; received in revised form 1 March 2002; accepted 1 March 2002

Abstract

The consideration of cumulative effects in environmental impact assessment (EIA) has been required in the UK, though somewhat ambiguously, since the EC Directive (85/337/EEC) was implemented in 1988. This paper describes the results of a review of cumulative effects considerations in 50 UK environmental impact statements (EISs) prepared for a variety of project types produced between 1989 and 2000. The results of the review suggest that cumulative effects are far from thoroughly addressed. Only 24 EISs (48%) mentioned the term 'cumulative effects/impacts' and only 9 EISs (18%) provided a discussion, which were mostly qualitative. The problems in addressing these issues are explored, and the main findings include the various interpretations of the concept of cumulative effects and the varied treatment of cumulative effects issues. Where cumulative effects are considered in the scoping stage, this led to a further discussion or analysis of these effects. The research concludes that for a better consideration of cumulative effects, an effective driving force would be the local planning authority (and other competent authorities) requiring developers during the scoping process to address cumulative effects and so help meet the most recent strengthened legal requirements of the EC EIA Amendment Directive 97/11/EC and UK Regulations. More tailored guidance for developers and authorities alike is needed for this to happen.

Keywords: Cumulative effects assessment (CEA); Habitats directive; Ramsar sites; Site of Special Scientific Interest (SSSI); EIA; SEA

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0195-9255/02/$ – see front matter
PII: S0195-9255(02)00010-0

1. Introduction

This paper examines the extent that cumulative effects are considered in environmental impact statements (EISs) in the UK. The results of a review of a sample of 50 EISs are described, and deficiencies in the consideration of cumulative effects are identified. Some of the issues explored are: whether the lack of an accepted definition of cumulative effects has been a limiting factor in undertaking cumulative effects assessment (CEA); whether scoping has an important role in ensuring that these effects are considered in the environmental impact assessment (EIA); and whether certain projects, which are part of planned developments, such as urban regeneration projects, are more likely to consider these effects. In the final section, the paper presents suggestions for improving the quality of CEAs in environmental assessments (EAs).

The assessment of cumulative effects in UK EISs has been perceived generally as poor (Glasson et al., 1995; Pritchard, 1993; Fuller and Sadler, 1999). Previous reviews of EISs, which have been concerned with their overall quality (Jones et al., 1991; Therivel et al., 1992) or their ecological assessment, have noted that cumulative effects were not assessed (Treweek et al., 1993; Royal Society for the Protection of Birds (RSPB), 1995; Byron et al., 2000).

In the European Union, the assessment of cumulative impacts or effects of certain public and private projects has been required since the EC Directive (85/337/EEC) on EIA was issued (Commission of the European Communities (CEC), 1985). Cumulative effects are referred to in Annex III of the Directive in which the description of the likely significant effects of the proposed project on the environment should include cumulative effects. The Directive was originally implemented in the UK under the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988, which refer to cumulative effects in Schedule 3 as optional information to be included in the environmental statement.

More recently, the Amendment Directive 97/11/EC, which became effective in 1999 amending Directive 85/337/EEC, makes a further reference to cumulative impacts. This Directive states that in the criteria for selecting projects to be assessed, the characteristics of projects must be considered having regard to the 'cumulation with other projects' and the environmental sensitivity of areas likely to be affected (Annex III, Commission of the European Communities (CEC), 1997).

This Directive is implemented in the UK inter alia through the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999, SI 1999 No. 293, with the provisions also referring to the 'cumulation with other projects' in the Selection Criteria for Screening Schedule 2 Development. These Regulations, however, unlike the EC Directives and previous 1988 UK EIA Regulations, list cumulative effects alongside direct and indirect effects in the main text of Schedule 4 (Part I), where such information is now conditional, rather than ambiguous (as in Directive 85/337/EEC) or optional (as in the 1988 Regulations). This Schedule (Part I) states that,

"a description of the likely significant effects of the development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the development ..." be included in environmental statements. This information is conditional inasmuch as the information in Schedule 4 Part I, "... is reasonably required to assess the environmental effects of the development and which the applicant can, having regard in particular to current knowledge and methods of assessment, reasonably be required to compile ..." (Regulation 2 (1)). This is potentially much stronger than the wording in the 1988 Regulations where information on cumulative effects was entirely optional on the developer. The listing of cumulative effects along with direct and other effects implies that a similar level of importance should be attached to cumulative effects as to other effects in the list, which may have implications as to how cumulative effects are treated in future EIAs. The conditionality highlighted above can, most probably, best be determined at the scoping stage by the competent authority, where the legislation may now provide more support in requiring such assessment.

Another legislation that refers to cumulative or combined impacts is the Habitats Directive (92/43/EEC). This Directive requires that an 'appropriate assessment' should be conducted when "a plan or project is likely to have a significant effect on the site (special area of conservation) either individually or in combination with other plans or projects" (Article 6, Commission of the European Communities (CEC), 1992). The Directive is implemented in the UK as the Conservation (Natural Habitats & C.) Regulations (SI 1994 No. 2716). The Regulations propose that 'appropriate assessment' be carried out by a competent authority before authorising "a plan or project which is likely to have a significant effect on a European site in Great Britain (either alone or in combination with other plans or projects)" (Department of Environment (DOE), 1994, p. 26). A 'European site' in this context refers to a special area of conservation (SAC), a site of community importance or a designated special protection area (SPA) for birds.

However, there are a number of issues concerning the consideration of cumulative effects in EIAs. First, there is no definition of cumulative effects or impacts and no specific requirements in the legislation as to how cumulative effects could be addressed. Second, the guidance to the procedures (DOE, 1989; Department of Environment, Transport and the Regions (DETR), 1999) do not mention methods or frameworks for the assessment of cumulative effects. The lack of guidance and frameworks for the assessment of cumulative effects in the UK are some of the constraints for EIA practitioners, who have had to rely on international standards (Fuller and Sadler, 1999). Guidance for the assessment of cumulative effects include those from the USA and Canada (US Council on Environmental Quality, 1994, 1997; Lane and Wallace, 1988; Cumulative Effects Assessment Working Group and AXYS Environmental Consulting, 1999). However, the above guidance,

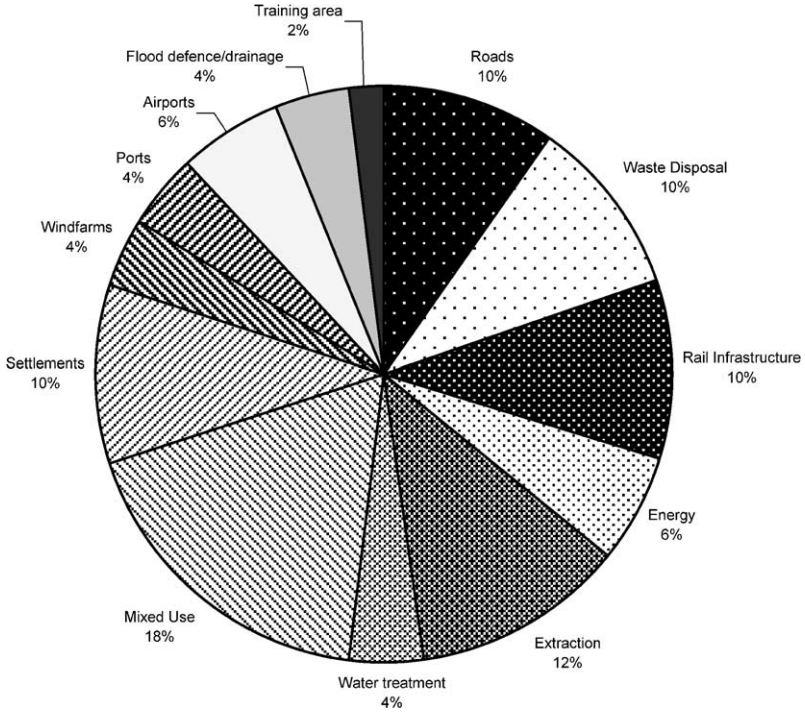

Fig. 1. EIS sample project types.

although helpful, were designed to fit these countries' EIA procedures, which vary from the EIA implementing procedures in the UK. The EC Guidance on CEA (Hyder, 1999), which was issued more recently, unfortunately fails to make a framework for CEA more explicit (Fuller and Sadler, 1999). Another issue is the importance attached to cumulative effects in the decision-making process, which may have implications for whether these cumulative effects are even considered in the first place. For example, Dodd (1996) noted that there is a general perception that cumulative effects cannot be used for refusing planning permission.

2. Method for the review of EISs

A sample of 50 EISs in the EIS collections held by the Department of Environment, Transport and the Regions (DETR),[1] Department of Environmental

[1] Since June 2001, the Department of Transport, Local Government and the Regions (DTLR).

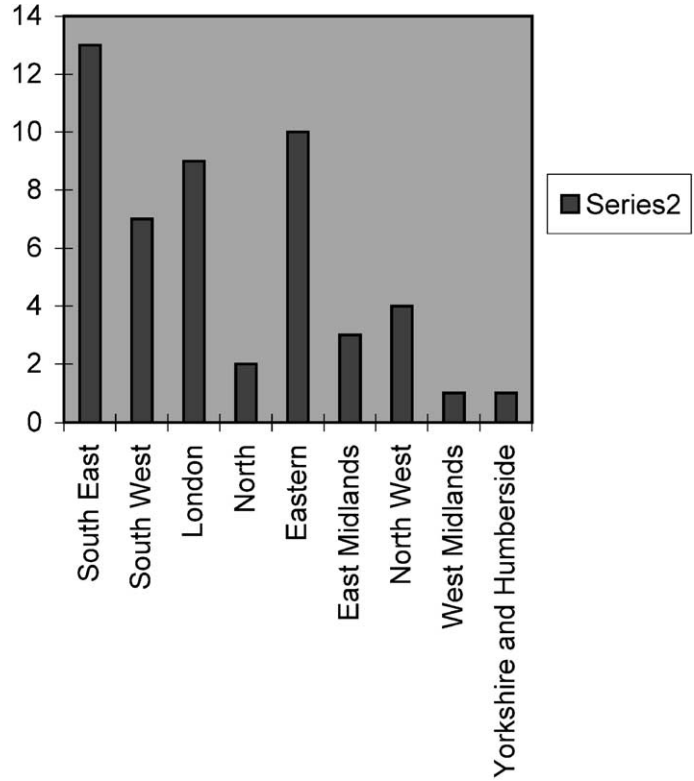

Fig. 2. EIS sample by regions.

Science and Technology at Imperial College, as well as those provided by personal contacts, were reviewed. The sample consisted of various types of projects and geographical locations. Fig. 1 illustrates the composition of EISs reviewed, grouped into broad categories of development. Fig. 2 shows a breakdown of the EISs by regional location, and a list of the EISs reviewed is shown in Appendix A.

Although the EISs were randomly chosen from the EIS sources mentioned above, a stratified sampling procedure was followed. Within the sample, three subsamples were included: urban regeneration projects (8 EISs), a number of projects in a subregion, the Thames Gateway area[2] (13 EISs) and eight pairs of projects located adjacent to each other or within a defined area. Urban

[2] The Thames Gateway is a major region of planned development and regeneration and lies to the east of London, including inner and outer London boroughs, such as Greenwich, Lewisham, Newham, Tower Hamlets and parts of the counties of Essex to the north of the River Thames and Kent to the south of the river.

regeneration projects were seen as potentially having significant effects (e.g. traffic and air pollution) requiring serious consideration of cumulative effects particularly because these projects are often being promoted as part of planned programmes of associated developments within a regeneration framework. The Thames Gateway was chosen as being an area targeted for rapid and programmed development over the next 20 years, and the particular focus for current research activity by the authors. Among the remainder, as balanced a sample as possible across other sectors was selected. The EISs were prepared from 1989 to 2000, with 24 (48%) EISs prepared in 2000 and 4 (8%) EISs prepared in 1999. The sample of EISs reviewed was limited to the EISs that were available in the libraries mentioned above. Any conclusions from the study are therefore indicative and not definitive. The majority of the sample (56%) were recent EISs (prepared in 1999–2000) to give an indication of current practice. Apart from the main EIS report, other relevant documents were examined, which included the nontechnical summary, supplementary reports, planning statements and scoping reports. The reason for examining documents other than just the EIS was to get a better picture of the EIA process as a whole, rather than just what was reported in the EIS. The aim of the review, therefore, was to investigate the

Table 1
Review categories and examples of review criteria

Review categories	Review criteria
Consideration and documentation	EIS/documentation mentions cumulative effects
Concepts of cumulative effects	EIS/documentation defines cumulative effects
	EIS/documentation refers to cumulative effects indirectly: combined effects, in-combination effects, interaction of effects
Scoping	EIS/documentation identifies cumulative effects issues
	EIS/documentation establishes spatial boundary for the analysis
	EIS/documentation establishes temporal boundary for the analysis
	EIS/documentation identifies VECs
	EIS/documentation identifies other activities/developments affecting VECs
Baseline conditions	EIS/documentation characterises resources identified in scoping
	EIS/documentation characterise stresses affecting these resources
	EIS/documentation defines baseline conditions of affected environment
Identification, prediction and evaluation of effects	EIS/documentation identifies potential cumulative effects and cause–effect relationships
	EIS/documentation considers cumulative effects: for all affected resources or selected resources
Methods	EIS/documentation mentions guidance and methodologies used
	EIS/documentation describes qualitative analysis
	EIS/documentation describes quantitative analysis
Evaluation of significance	EIS/documentation describes criteria for evaluation of impact significance
	EIS/documentation refers to existing thresholds and indicators
Mitigation	EIS/documentation proposes mitigation measures and indicates their effectiveness
	EIS/documentation considers residual impacts after mitigation
Monitoring and effects management	EIS/documentation includes proposals for monitoring and management of cumulative effects

extent that cumulative effects are considered in EIAs, rather than simply the quality of the EISs themselves.

The detailed review criteria were based on CEA evaluation frameworks (US CEQ steps in CEA, 1997) and Burris and Canter's (1997) criteria questions. In applying these criteria, a modified procedure was developed that was appropriate to the UK context, after consulting the guidance on EAs (DOE, 1989, 1995; Department of Environment, Transport and the Regions (DETR), 1999). Hopefully, the criteria could be used in future reviews of cumulative effects considerations of EIAs and EISs in the UK.

The review process focused on the concepts of cumulative effects, the approach to CEA, methods used to identify and predict cumulative effects, any proposals for mitigation and monitoring measures. The review also investigated whether the EIA process allowed for the consideration of cumulative effects by examining the different stages of the process and their documentation. Furthermore, since one of the reasons suggested in the literature as to why cumulative effects are not addressed in UK EIAs is due to the lack of guidance, the review investigated if any guidance was referred to and whether the EC Guidance published in 1999 had been used in recent EIAs. The review criteria schedule is summarised in Table 1.

3. Results from the review of EISs

3.1. Concepts of cumulative effects and documentation

The results from the review are summarised in Table 2. Only 24 (48%) EISs mentioned the term 'cumulative impacts/effects.' A further four (8%) EISs

Table 2
Analysis of the sample of environmental impact statements

Sample of environmental impact statements	50 EISs		EISs
Mentioned 'cumulative effects'	24	No mention of cumulative effects	26
Provided a definition of cumulative effects	8		
Referred indirectly to cumulative effects by using the following terms: combined effects; in-combination effects or interaction of effects	4		
Identified potential cumulative effects	15	Concluded that there were no cumulative effects without any assessment	1
Considered cumulative effects	13	Concluded that cumulative effects were insignificant without assessment	4
Addressed cumulative effects by providing some analysis	9		
Discussed cumulative effects for all affected resources	5	Discussed cumulative effects for some affected resources	4
Identified other developments	1	Identified other developments	3
Identified only similar developments or actions	2	Identified only similar developments	1
Identified one other action	2	Identified no other actions	0

referred indirectly to cumulative effects through the use of the following phrases: in-combination effects, combined effects or effects interactions.

The term 'cumulative effects' was mentioned in the nontechnical summary, table of contents or introduction in 18 (36%) EISs, while 5 (10%) EISs mentioned the term in the EIS, 1 EIS referred to cumulative effects in a letter to the competent authority and 1 EIS mentioned the term in the planning statement. Of the EISs that mentioned 'cumulative effects,' 11 (22%) EISs were prepared in the year 2000 (out of 24 prepared in the same year), which seem to suggest an increasing awareness of these effects in more recent EISs.

Eight (16%) EISs provided a definition of cumulative effects. Some of the definitions of cumulative effects were:

- "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions" as defined in National Environmental Policy Act (1969) (Isle of Grain EIS and Woodville EIS);
- "an analysis of the consequences of more than one direct and/or indirect impact acting together" (Barrow, 1997) in (Westhay Heath EIS);
- "if there is more than one factor from a site impacting upon the local population and/or the local environment this would be a cumulative impact, for example, noise and dust" (Kingsnorth Landfill Site EIS);
- "cumulative impacts relate to the sum total of the effects of either individual operations or entire schemes on a single person, the community or the local environment over a period of time" (Woodhead EIS);
- "cumulative effects arise from accumulation of a number of effects, either:
  - of a different nature at a particular location . . .;
  - at different locations but affecting the same resource . . .;
  - of the same nature at different locations . . .; or
  - over a period of time" (Channel Tunnel Rail Link (CTRL) EIS).

The definition provided by the CTRL EIS was the most comprehensive. One EIS (Rochdale) commented on the lack of guidance on assessing cumulative effects but consulted the Institute of Environmental Assessment and interpreted cumulative effects in terms of:

- "effects of development over time (i.e. 'residual' effects);
- effects of development in terms of space elsewhere (i.e. 'off-site' effects);
- effects of development in relation to other effects (i.e. 'synergistic' effects)."

One EIS (Otterburn) observed that there is no accepted definition of cumulative effects, but three types of cumulative effects to be considered were suggested in the scoping process:

- the 'additive' effect of proposals that individually are of minor/moderate significance, but in total have an effect of major significance;

- incremental effects, the effect of what is proposed, taking into account existing activities and developments and their interactions with the environment;
- where the level of effect reflects the timing of impacts over a certain period.

Other EISs that mentioned cumulative effects put forward the following concepts of cumulative effects: as changes in environmental quality, the sum of direct and indirect impacts, residual impacts after mitigation and the combined effects of individual impacts from developments on receptors. As can be seen from the above definitions, there are various interpretations of the concept of cumulative effects. The situation is further complicated by the requirement under the Habitats Directive, which introduces the concept of in-combination effects.

The results of the review revealed the following concepts regarding cumulative effects:

1. cumulative effects as residual effects (Thameside Gas Pipeline and Beldevere Combined Heat and Power Plant EISs);
2. cumulative effects as a combined effect by two projects (the CTRL and M2 EISs, Testwood Lakes EIS and the Heathrow Express (considering Heathrow Terminal 5 ES));
3. interactions of impacts of the project (Stonecastle Farm Quarry EIS and Westhay Heath EIS);
4. impacts from the proposed project and from other past, present and future projects/actions (Ebbsfleet Development, Trinity III Terminal Extension and the Ipswich New Quays EISs);
5. impacts of developments within a scheme (Swale Gateway EIS and Otterburn EIS).

The concept of cumulative effect adopted in an EIA subsequently influenced the range of impacts investigated in the process. In the first example, where cumulative effects are considered as residual impacts, the discussions were limited to the identification of what are the direct and indirect impacts that may remain after mitigation. The more constrained the concept of cumulative effects, such as those in Concepts 2, 3 and 5 (combined effects of two projects, interactions of impacts in a project or impacts of developments within a scheme), then the range of impacts investigated was limited to those elements. On the other hand, a broader concept of cumulative effects, such as in Concept 4, led to the consideration of impacts from a number of projects in the wider area.

The reporting and documentation of cumulative effects were generally poor, except for a few cases. Most of the EISs that mentioned cumulative effects in the introduction did not address cumulative effects further in the EIS. One EIS concluded that there were no cumulative impacts, yet without any analysis. There were six (12%) EISs that discussed cumulative effects in Section 1. The discussion consisted of definitions, types of cumulative effects and other

projects that should be considered. Cumulative effects were discussed more thoroughly in nine (18%) EISs that devoted a section in the main part of the EIS. In addition, the combined effects of the two projects CTRL and M2 motorway were discussed in a separate annex.

3.2. Scoping

The review examined the process of the EIA, such as the scoping stage. There were 30 (60%) EISs that mentioned conducting scoping: 23 (46%) EISs mentioned scoping and 7 (14%) EISs referred to consultations. Among those that conducted scoping, 8 (16%) EISs mention preparing scoping reports and 14 (28%) EISs mention considering cumulative effects in scoping. From these 14 EISs, nine (64%) EISs were prepared in the year 2000 and seven (50%) EISs were located in or adjacent to designated conservation sites (such as Sites of Special Scientific Interest (SSSIs), SPAs and Ramsar sites). In such cases, the scope of cumulative effects investigated was focused on those valued environmental resources.

The geographical scope for the investigation of cumulative effects was defined at different levels. These ranged from interaction of impacts within the development site (Otterburn, Swale Gateway EISs) to the cumulative impacts over an area covered by an SPA such as the Orwell and Stour Estuaries (Trinity III Terminal Extension and Proposed New Quays at Ipswich EISs) and the combined impacts along a corridor where the two schemes run parallel (CTRL and M2 widening EISs). The geographical scope for the analysis of the visual effects in Wharrels Wind Farm EIS ranged from fixed points (20–21 km) away and 'cross-country,' across the countryside for those travelling through the landscape.

The temporal frame for the analysis of cumulative effects has not been mentioned in most of the EISs. However, the temporal range for assessment of cumulative effects in the Trinity III Terminal Extension EIS was 5 years, and so all plans or projects underway or proposed within that time frame were included in the assessment. In the CTRL and M2 widening combined assessment, the temporal boundary was 20 years, which included both the construction and operational phases of both schemes.

In considering past, present and future activities and projects that may interact with the effects associated with the project, the coverage was uneven. There were 28 EISs that considered some aspects: 4 (8%) EISs discussed past and present projects only and 14 (28%) EISs mentioned present and future projects, while others only mentioned other present or past projects. There were seven (14%) EISs that did not mention other projects at all. Only 15 (30%) EISs described other past, present and future projects. Relevant future projects identified consisted of developments where planning permission had been granted, developments where planning permission has been applied for and proposed projects such as those identified in the Local Plan. Sources of information regarding

permitted developments were the local authority and for proposed developments, either the Local Plan or Local Studies, such as the Transport Study. Two EISs that provided a more thorough consideration of other projects were the Trinity III Terminal Extension EIS and the Proposed New Quay at Ipswich EIS. The former included all plans or projects underway or proposed within the estuary in the assessment. In the Proposed New Quay EIS, projects considered included developments within and adjacent to the SPA. Developments outside the SPA, but close to it, and its relevance were also taken into account, and whether the activities may result in potential disturbance to birds due to construction noise and movement.

3.3. Baseline conditions

The review examined the baseline conditions described. The aim was to assess the extensiveness of the baseline survey. To consider cumulative effects, the affected environment should be defined broadly to include any potentially significant effects occurring away from the immediate project area. Most EISs in the review limited themselves to the immediate area surrounding the project. The characterisation of the affected resources (e.g. air, water, landscape character) was undertaken adequately in most of the EISs.

Difficulties in characterisation of stresses were more evident. Stress factors pertaining to each resource were not adequately considered in general. Determining the threshold beyond which cumulative effects significantly degrade a resource or ecosystem is usually problematic, but for certain resources (air and water quality) where established thresholds were available, these were used. Some thresholds, such as significance of visual effects, are not easily determined, and those EISs that considered these effects (Wharrels Hill Wind Farm EIS and Rochdale EIS) relied to a great extent on professional judgement.

An example of an EIA, where the focus of the assessment is one valued resource, is the Trinity III Terminal Extension EIS. The important (valued) environmental characteristics or VECs were defined as the Stour and Orwell Estuaries SPA and the Trinity Marshes proposed SPA and its designated features, such as the population of waders and wildfowl and the habitat and resources that are required to support them. The key VECs considered in the assessment were the system hydrodynamics and the extent of the intertidal area. In addition, the combined effect of noise and light disruption to feeding and roosting birds in the vicinity of the development was also considered.

3.4. Identification, prediction and evaluation of effects

The review next investigated the identification, prediction and evaluation of cumulative effects in the EISs. As shown in Table 2, there were 15 (30%) EISs

Table 3
Project EIAs that addressed cumulative effects

Projects	VECs	Issues/impacts	Approaches	Mitigation measures	Determination of significance	Comments
Swale Gateway Development, 1994. Integrated assessment of four potential property development sites	Landscape character, visual amenity	Impacts upon landscape and views; traffic and disturbance of archaeological remains; water quality; proximity to SSSI	Professional judgement	Landscaping–peripheral screening	Landscape and visual effects not significant	Qualitative assessment of changes in landscape character and views; considered the combined effects of the four projects within the development
CTRL and M2 junctions (1–4) widening, 1994 • High-speed railway • Road widening	Landscape character; ancient woodland; agricultural land; surface and groundwater quality	Landscape and visual impacts; loss of ancient woodland; disruption to farming; traffic impacts during construction	Professional judgement	Landscaping–screening; fencing; traffic management plans; topsoil collection and reuse	Significant effects: loss of ancient woodlands; visual; heritage; landscape	Qualitative assessment of all affected resources; quantified assessment of noise from operations; considered the combined effects of the two projects
Ebbsfleet Development, 1995 • Mixed use developments including commercial, residential, leisure and	Landscape character; visual amenity; Ebbsfleet marshes, SNCI; water resources quality;	Change in landscape character; visual impacts; loss of reedbeds; habitat fragmentation; loss of grassland and vegetation; impacts on surface and groundwater; disturbance to	Professional judgement and use of findings from previous studies	Provision of additional wetland habitats; routing of surface run off; construction code of conduct to minimise cumulative impacts	Significant cumulative impact on Ebbsfleet Marshes SNCI	Qualitative assessment of all affected resources; considered other projects: CTRL, IPS, STDR and Ebbsfleet Development

commercial facilities	areas of archaeological interest	archaeological features; increase in traffic			
Wharrels Hill Wind Farm and Visitor Centre, 2000	Landscape character; visual amenity; tranquility	Increase in incidence of perception of wind turbines; impacts at fixed points and travelling (cross country effect)	Professional judgement; analysis of zones of visual influence; reference to public attitudes on wind farms	• visual effects not unacceptable	Qualitative assessment of visual impacts; considered similar developments—three other wind farms
Otterburn Training Area, 1995 • Road strengthening and widening; • New facilities for gun spurs . . .; • New accommodation blocks	Landscape character; visual amenity; recreation; heritage sites	Increase in scale of built development and activities; impact on views	Professional judgement	Minor/moderate effect on landscape character; moderate effect on views	Qualitative assessment of impacts on all affected resources; assessed alongside direct and indirect impacts; considered the effects of different actions within a programme
Trinity Terminal III (Phase 2) Extension, 2000 • Quay extension	Intertidal areas; waders and wild fowl and habitats; Stour and Orwell SPAs; water quality in estuary	Loss of intertidal areas; loss of feeding and roosting habitats; decrease in tidal range; combined impacts from lighting and combined impacts from noise on Trimley marshes p SPA	Hydrological modelling; use of findings from previous studies; professional judgement and consultation	Benefit of 13.7 ha within estuary system; enhancement of 23 ha; loss of 4.6 ha within SPA	Qualitative and quantitative assessment on hydrology and estuarine environment; considered effects of past, present and future projects within or adjacent to the estuaries; 'appropriate assessment' study

(continued on next page)

Table 3 (*continued*)

Projects	VECs	Issues/impacts	Approaches	Mitigation measures	Determination of significance	Comments
Proposed New Quays in Cliff Quay, Ipswich, 2000 • New quay	Intertidal habitats—Stour and Orwell Estuaries SPA, Ramsar and SSSI	Loss of intertidal areas; increase in rate of intertidal erosion	Hydrological modelling; expert judgement and; use of findings from previous studies	Relocation of dredged material within estuary system	Effects insignificant	Qualitative and quantitative assessment on hydrology and intertidal area; considered effects of past, present and future projects within or adjacent to the estuary; 'appropriate assessment' study
Flood Defences Improvement, 2000 • Southend on Sea Improvement of sea defences	SPA/Ramsar sites	Habitat loss; disturbance to birds	Professional judgement		Combined effects not significant over the effects of sea defences	Qualitative assessment; considered other future projects in study area; 'appropriate assessment' study

that identified cumulative or combined effects, and only 9 (18%) EISs provided an analysis, some of which considered cumulative effects on all affected resources (CTRL and M2 widening EISs, Swale Gateway, Ebbsfleet and Otterburn). Three EISs (Trinity III Terminal Extension, Proposed New Quays, Ipswich and Flood Defences Improvement, Southend on Sea) considered cumulative effects on a designated site SPA. The Wharrels Hill Wind Farm focused on landscape character and visual amenity. Those EIAs that considered all affected resources presented a more balanced assessment while those that focused on a particular resource provided a more detailed assessment of cumulative effects on that resource. For instance, the Trinity III Terminal EIS focused on the following hydrodynamic effects: a change in the tidal range; increased accretion in the harbour; and the loss of intertidal areas. Cumulative impact modelling was undertaken for relevant projects in the Stour and Orwell Estuaries where it was considered that the impacts of each of the schemes would be large. For schemes with smaller predicted hydrodynamic impacts, the estimate provided by summing the separate impacts of the schemes were considered adequate for the EIA.

Important cause-and-effect relationships were identified in the Proposed New Quays at Ipswich EIS, where the loss of the intertidal area could cause displacement of birds. Likewise, cause–effect analysis was used in considering potential successive impacts on receptors (e.g. fauna and flora, soil, water quality) and to examine more closely indirect causes and effects of the primary impacts in the Stonecastle Farm Quarry EIS.

However, out of the 15 EISs that identified potential cumulative effects, four (8%) EISs concluded without analysis that these effects were not significant. Uncertainty in impact assessment was mentioned in nine (18%) EISs, while risk was mentioned in seven (14%) EISs. Transboundary/global issues were mentioned in only one EIS, which was a proposal for a wind turbine. This EIS (Somerton Wind Farm) referred to the positive effect on air quality that the proposal would bring.

3.5. CEA methods

The methods used to identify cumulative effects included: professional judgement, matrices and consultations. In the Westhay Heath EIS, a scoping matrix was used to identify potential cumulative effects arising from the projects' activities and as a guide to the key areas that required further analysis.

Cumulative effects were described qualitatively in 13 (26%) EISs although noise impacts were quantified in the combined assessment of two EISs (CTRL and M2 widening). In the Trinity III Port Extension and the Proposed New Quays, losses of intertidal areas were also quantified.

Modelling (hydrodynamic) was used to predict and quantify impacts in two EISs (Trinity III Port Extension and Proposed New Quays at Ipswich). The Wharrels Wind Farm EIS used Zones of Visual Analysis plans to assess

cumulative visual impacts. In addition, public consultations were conducted during an exhibition attended by 250 people. Comments were sought on the findings of the EA, including visibility maps and photomontages showing the appearance of the wind farm from a number of vantage points. These comments were taken into account in the wind farm design and visitor facility proposal.

As far as guidance is concerned, a few EISs mentioned the lack of guidance on CEA. One EIS mentioned using guidance from the US CEQ, and another mentioned seeking guidance from the Institute of Environmental Assessment. Only one EIS referred to the EC Guidance. Table 3 shows the EIAs that provided some analysis of cumulative effects.

3.6. Evaluation of significance

The criteria used for determining significance of impacts in general were described in 42 (84%) EISs. In most cases, the criteria described in the DOE's Guidance on the Preparation of Environmental Statements (DOE, 1995) were followed in evaluating significance of effects. The nine EISs that provided an analysis of cumulative effects also evaluated the significance of these effects. The means of evaluating significance were based on the following criteria: impact magnitude, spatial extent, duration and frequency. For example, the sum of the combined effects of projects on individual species was used in determining the significance of combined effects in the Flood Defences Improvement EIS. In the CTRL and M2 Combined Assessment, the significance of an accumulation of noise effects from construction and off-site rail and road movements on a residential area was assessed based on an aggregation of noise impact calculations. Another example illustrates how the significance of visual effects was established. The magnitude of impact was correlated with the sensitivity of the receptors (residents, walkers, workers who were graded high, medium or low depending on proximity and activity) (Wharrels Wind Farm EIS).

3.7. Mitigation, monitoring and management of effects

The mitigation measures proposed in most of the EISs were for the direct impacts of the project. Mitigation measures for cumulative effects were proposed in only four EISs. For example, the CTRL and M2 widening combined assessment proposed the following mitigation measures to reduce cumulative impacts: For the combined community effects on local vehicle travellers, mitigation of impacts consisted of implementing appropriate controls on movements of construction traffic from both schemes, and for combined ecological effects, compensation for loss of habitats were provided by proposals for opportunities for habitat development. In the Trinity III Terminal Extension EIS, one of the mitigation measures proposed was the creation of

habitat at Trimley Marsh to compensate for the reduction in intertidal exposure associated with the channel deepening and the terminal extension. However, as indicated in the EIS, it is difficult to predict the cumulative loss of intertidal area within the estuaries because the outcome of the sediment replacement, habitat creation and beneficial use schemes considered are still to be determined and the implementation of the future schemes is not certain. In addition, as pointed out in the EIS, the analysis of the effectiveness of mitigation measures does not include the mitigation measures of other project proposals in the estuary (the Proposed New Quays at Ipswich and Bathside Bay Reclamation).

The effectiveness of the mitigation measures were indicated in 20 (40%) EISs, but these referred to impacts in general and not specific to cumula tive effects. Residual impacts after mitigation were mentioned in 47 (94%) EISs.

Monitoring proposals were mentioned for some impacts, such as impacts on air, noise or water resources but not for cumulative effects in particular. Only 27 (54%) EISs mentioned monitoring and 12 (24%) EISs indicated that the results of the monitoring programme will be incorporated into the project operations. Management plans to mitigate impacts were proposed in 34 (68%) EISs, but these were for impacts in general and not the long-term management of cumulative effects.

Table 4
Pairs of project EIAs

Projects	Cumulative effects considerations
1. Thameside Energy Park CHP Plant and Energy Distribution System and Natural Gas Pipeline to Energy Park	Pipeline EIS mentioned cumulative effects but no assessment
2. Kingsnorth Integrated Waste Management Facility and Kingsnorth Integrated Waste Management Facility Residue Disposal Site	Both EISs mentioned cumulative effects but no assessment
3. Kings Cross Railways Bills 1 and 2	Both EISs mentioned cumulative effects but no assessment
4. CTRL and M2 (junctions 1–4) widening	A combined effects assessment annex for both projects
5. Ebbsfleet Development and South Thameside Development Route (STDR)	Ebbsfleet Development EIS provided analysis but STDR EIS did not mention cumulative effects
6. Stockmoor Village and Willstock New Village	No mention of cumulative effects
7. Trinity III Terminal (Phase 2) Expansion and Proposed New Quays at Cliff Quay, Ipswich	Both conducted cumulative effects assessments
8. Heathrow Terminal 5 and Heathrow Express Underground (HEU)	Although HEU EIS referred to the Heathrow Terminal 5 EIS, there was no analysis of cumulative effects

3.8. Results of subsamples

In the subsample of eight EISs of urban regeneration projects, only two EISs considered cumulative effects. This may suggest that cumulative effects are not considered adequately in this sector and follows findings from previous studies that the quality of urban development EISs are less satisfactory than other types of projects (Lee and Dancy, 1993), but the sample is too small to allow any concrete conclusions.

In the subsample of 14 EISs in the Thames Gateway, six (42%) EISs considered cumulative effects, but two of these were the CTRL and the M2 widening, which produced a combined assessment. Although the percentage of EISs that considered cumulative effects in this region is higher than the percentage for the whole sample, the sample is not large enough to allow any generalisation.

In the subsample of eight pairs of EISs, there were only two pairs of EISs that both conducted an assessment of cumulative effects: CTRL and M2 widening and the Trinity III Terminal Extension and Proposed New Quay at Ipswich. In another pair of EISs, one EIS (Ebbsfleet Development) identified potential cumulative effects though another project identified in that EIS (the South Thameside Development Route (STDR)) did not mention cumulative effects in its EIS. In other pairs of EISs, cumulative effects with reference to the other projects were mentioned (Thameside Energy Park and Gas line; Kingsnorth IWMF and Landfill; Kings Cross Bills 1 and 2). Where an existing plan or framework, such as transport plans, are already in place, other projects are then mentioned in the impact study. However, although the Willstock and Stockmore EISs considered each other in terms of studies of transport and hydrology in the area, cumulative effects were not specifically mentioned in the EISs. Table 4 shows cumulative effects considerations in the paired EIAs.

4. Discussion

The results of this review reveal that EISs in the UK continue to fail to address cumulative effects issues adequately. Only 24 of 50 EIAs (48%) mentioned cumulative effects, and most of these EIAs failed to address cumulative effects thoroughly. Ten EISs that mentioned cumulative effects in the introduction did not consider or refer to cumulative effects subsequently. Out of the 15 EISs that identified cumulative effects, only nine EISs provided some analysis. The systematic consideration and assessment of cumulative effects was found only in three EISs, the combined assessment (CTRL and M2 widening), which considered the combined effects of the two projects, and the Otterburn EIS and Swale Gateway EIS, which considered the cumulative effects of the developments within their schemes.

Some findings from this survey are supported by those from previous reviews of EAs in the US. A review of 89 EAs by McCold and Holman (1995) revealed that 35 EAs (39%) mentioned cumulative impacts, and in a review of 30 EAs by Burris and Canter (1997), 14 EAs (47%) used the term cumulative impacts. Similarly, findings from reviews of Canadian CEA reports (Baxter et al., 1999; Mendoza Duran et al., 2000) reveal that the standard of CEAs undertaken is unsatisfactory.

Of particular concern in this survey is the varied interpretation of what is meant by cumulative effects. One reason for this may be because neither the EC Directive nor the UK Regulations provide a definition of cumulative effects. In this sample alone, out of 24 EISs that mentioned cumulative effects, there were eight different definitions provided. In addition, other EISs referred indirectly to cumulative effects as combined effects, in-combination effects and interaction effects. From the survey, the definition of cumulative effects adopted in the EIA determined the scope of the assessment. A narrower definition, such as that of interaction of impacts within the project resulted in the analysis of the cumulative impacts of the project alone, while a wider definition, which included other projects (past, present and future), led to a broader geographical and temporal scope.

The relationship between the EIA requirement for the assessment of cumulative effects and requirement for the assessment of in-combination effects under the Habitats Directive needs to be clarified. Some EISs (e.g. Trinity 111 Terminal Port Extension and the Proposed New Quays at Ipswich EISs) have suggested that the CEA in the EIA could provide the information necessary for the 'appropriate assessment' by the competent authority as required under the Habitats Directive. The findings from this study reveal that most of the EISs that considered cumulative effects were adjacent to or near statutory designated sites, such as European Sites. Out of the eight EISs that provided an analysis of cumulative effects, three EISs were prepared as part of the appropriate assessment for the Habitats Directive (Trinity III Terminal Extension, Proposed New Quays at Ipswich and the Flood Defences Improvement at Southend on Sea). The review revealed that the assessments of cumulative effects in the first two EISs were more detailed than the analysis undertaken by the other EISs in the sample. This may be because of the added protection afforded statutory designations, more specific guidance relating to the Habitats Directive and/or more concern about these affected resources (birds) by environmental organisations. A deficiency that was observed in the survey was the inadequate attention to defining the temporal and spatial boundaries for the study and to identifying other existing and proposed projects in the area. The geographical boundary for most EISs was the immediate area surrounding the project, rather than a broader regional context that might be more appropriate for some of the larger-scale developments. This limited spatial boundary precludes the determination of other existing and planned projects and impacts, which when considered with the impacts of the project, could be cumulative. Information

provided by most EISs on other developments was limited, so that their potential additional stress on the affected resource could not be determined. Apart from three EISs (Ebbsfleet Development, Trinity III Terminal Extension and Proposed New Quays, Ipswich) there was a failure to take adequate account of other past, present and future developments. This is particularly true regarding future developments. This failure to take account of likely future developments may be due to the lack of specific requirements and guidance on what developments to include. Existing developments were taken into account mostly in the traffic assessments of EISs, which followed the procedure in the guidance (Design Manual for Roads and Bridges, vol. 11, Department of Transport et al., 1993). As far as temporal considerations are concerned, these were limited in most cases to the construction and start of operation of the project. One difficulty in assessing cumulative effects, as pointed out in the Trinity III Terminal Extension EIS, is that while a regional CEA might be a more appropriate level for assessing cumulative effects (such as for an estuary where many developments are being proposed), this type of assessment may be beyond the scope of a project EIA.

Where an existing plan or framework is available, these have been used to set the context for the EIAs. For example, cumulative impact studies in the Stour and Orwell Estuary have been used in addressing cumulative effects in two EISs (Trinity III Terminal Extension and proposed New Quays, Ipswich). However, some EISs do not always make use of such frameworks to assess the relative contribution of the proposed project. For example, Kent County Council has developed an air quality model that includes estimates of all major sources of pollution and is regularly updated. The model was used by two EISs for two project proposals in this area (Kingsnorth IWMF and Ridham Dock) in identifying other potential sources of pollution in the region, it but did not continue the analysis to address cumulative effects. In another example, the Bridgwater Transport Study provided the context for the assessment of transport impacts of two proposed housing developments (Willstock and Stockmoor). The hydrological study for the area was also used in both the Willstock and Stockmoor villages EISs, but the cumulative effects of both projects were not addressed. It seems that the difference between these EIAs and that of the Trinity III Terminal Extension and Proposed New Quays EISs (which conducted CEAs) is the strong emphasis placed on the assessment of combined effects or CEA during scoping and consultations in these EIAs, as revealed in the EISs. Comments from statutory consultees (such as the Ministry of Agriculture, Fisheries and Food, Suffolk County Council, Royal Society for the Protection of Birds, English Nature) in the Trinity III Terminal Extension EIS stress the need for cumulative effects to be assessed. As stated in the Proposed New Quay EISs, the aim of the CEA was to supply information to allow the competent authority to determine whether the proposed development is likely to have a significant effect on the Stour and Orwell Estuaries SPA as required by the Habitats Directive.

The findings of the study reveal that cumulative effects were mentioned more frequently in recent EISs, but the EISs that actually discussed or analysed those effects were not related to when the EISs were prepared. Furthermore, the consideration of cumulative effects was not related either to the type of development or geographic location, except when it was adjacent to a protected site. It seems, from this study at least, that CEA is facilitated by two factors: (1) when the projects are part of a development or programme by a single proponent (such as the Otterburn and the Swale Gateway EISs) or (2) when similar projects in the area under consideration are being assessed (Trinity III Terminal Extension and the Proposed New Quays at Ipswich EISs).

5. Conclusions

This survey shows an uneven and inconsistent treatment of cumulative effects in the EISs reviewed and highlights the limitations of project EIAs in addressing cumulative effects. Some of the constraints to CEA recognised in some of the EISs themselves were the uncertainty in regulatory requirements, lack of guidance and access to information on other relevant developments. It is worth noting, however, that in EIAs where the scoping stage considered cumulative effects, these effects were subsequently identified and discussed. This suggests that scoping can play a significant role in ensuring that cumulative effects are considered in EIAs. But more importantly, for cumulative effects considerations in EIAs to improve, these effects should be given equal weight with other factors in the decision-making process.

The Amendment Directive 97/11/EC now provides a clearer opportunity (though not mandatory) for scoping within the EIA process, whereby developers are encouraged to consult with the competent authority and obtain a scoping decision.[3] The most effective driving force for better consideration of cumulative effects is therefore likely to be the local planning authority (and other competent authorities) encouraging developers through better scoping to meet the most recent requirements of the legislation to address cumulative effects. Past arguments that developers were not required to provide information on cumulative effects will no longer be a legitimate excuse now the Amendment Directive 97/11/EC and the UK Regulations have strengthened cumulative effects more on a par with other impacts (Schedule 4 of the 1999 Regulations). This, in turn, requires a greater awareness of CEA by local planning authority planners and a better understanding of cumulative effects and methodologies for how such effects can be addressed. More tailored guidance for developers and authorities alike is needed for this to happen.

[3] Regulation 10, Town and Country Planning (Environmental Impact Assessment) Regulations 1999 (England and Wales).

Appendix A. EISs reviewed in the survey

ES no.	Title of EIS	Date submitted	Project type
1	South Lowestoft Relief Road	1999	Road
2	Birmington-Staveley By-pass	1995	Road
3	A 142 Fordham By-pass	2000	Road
4	Immingham Combined Heat and Power Plant	Nov 2000	Power station
5	Thameside Energy Park CHP Plant and Energy Distribution System	Feb 2000	Power station
6	Natural Gas Pipeline to Thames Energy Park	Dec 1999	Gas pipeline
7	Ridham Dock Integrated Waste Management Facility	May 1999	Waste to energy facility
8	Belvedere Refuse to Energy Project	April 1991	Waste to energy facility
9	Kingsnorth Integrated Waste Management Facility	Oct 1996	Waste to energy facility
10	Kingsnorth Integrated Waste Management Facility Residue Disposal Site	Oct 1996	Landfill site
11	Norton marsh: Proposed Extension to Arpley Landfill	Oct 2000	Landfill site
12	Flood Defences Improvement—Southend on Sea	2000	Flood defence
13	Isle of Grain Propose Drainage	Dec 2000	Land drainage
14	Westhay Heath Peat Extraction	July 2000	Peat extraction
15	Potton Pool Quarry	July 2000	Sand and gravel quarry
16	Woodhead Open Cast Coal Extension	June 2000	Open cast mine
17	Stonecastle Farm Quarry	May 2000	Quarry extension
18	Medway Cement Works	1997	Cement plant and quarry
19	Havering Riverside	1997	Commercial/ industrial
20	Multiplex cinema, Health and Fitness Centre and Food Outlet—Barnstaple, Devon	Aug 2000	Mixed use development
21	Park Royal Southern Gateway	Feb 2000	Mixed use development
22	East Manchester District Centre	Aug 2000	Mixed use development
23	Chavasse Park—Liverpool	Feb 2000	Mixed use development
24	Rochdale—Greater Manchester	Aug 2000	Mixed use development

25	Broomsgrove—Hastings	Aug 2000	Mixed use development
26	Redevelopment of Taylor Woodrow site	Aug 2000	Mixed use development
27	Earlsgate—Swindon	Sept 2000	Residential settlement
28	Woodville Woodlands—Leicester	Dec 2000	Residential settlement
29	The Swale Gateway Development	Feb 1994	Industrial/ commercial and residential schemes
30	Stockmoor Village	Nov 2000	Residential
31	Willstock New Village	May 2000	Residential
32	Kings Cross Railways Bill Nos. 1 and 2	May 1991	Railway terminal improvements
33	Jubilee Line Extension	March 1990	Underground railway
34	CTRL	1994	Rail link
35	M2-Junctions 1–4 widening	Nov 1994	Motorway widening
36	Ebbsfleet Development	Dec 1995	Railway station and mixed use development
37	South Thameside Development Route	Oct 1995	Road
38	London City Airport	Dec 1989	Runway extension
39	Terminal 5—Heathrow Airport	1993	New terminal
40	Heathrow Express Extension	Sept 1994	Underground railway
41	Manchester Airport 2nd Runway	1993	New runway
42	Gravesend Wastewater Treatment Works	Dec 1996	Wastewater treatment plant improvements
43	Motney Hill Wastewater Treatment Works	Sept 1994	Wastewater treatment plant improvements
44	Wharrels Hill Wind Farm	Dec 2000	Wind farm
45	Somerton Wind Turbine	1998	Wind farm
46	Testwood Lakes	July 1991	Reservoir and mineral extraction
47	Otterburn Training Area	April 1995	Army field training centre
48	Trinity III Terminal (Phase 2) Extension	Oct 2000	Port extension: new quay
49	Propose New Quays at Former Power Station Site—Cliff Quay, Ipswich	Sept 2000	New quays
50	South Ipswich Brownfield Regeneration and Improved Access to Port	Dec 2000	Mixed use and linked road

References

Barrow C. Environmental and Social Impact Assessment: An Introduction. London: Arnold Publishers, 1997.

Baxter W, Ross W, Spaling H. To what standard? A critical evaluation of cumulative effects assessments in Canada. Environ Assess 1999;7(2):30–2.

Burris R, Canter L. Cumulative impacts are not properly addressed in environmental assessments. Environmental Impact Assessment Review 1997;17(1):5–18.

Byron H, Treweek J, Sheate W, Thompson S. Road developments in the UK: an analysis of ecological assessment in environmental impact statements produced between 1993 and 1997. J Environ Plann Manage 2000;43(1):71–97.

Commission of the European Communities (CEC). Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment. Official Journal: L175, 5 July 1985.

Commission of the European Communities (CEC). Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. Official Journal: L206, 21 May 1992.

Commission of the European Communities (CEC). Council Directive 97/11/EC amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment. Official Journal: L073, 14 March 1997.

Cumulative Effects Assessment Working Group & AXYS Environmental Consulting. Cumulative effects assessment practitioners guide. Ottawa: Canadian Environmental Assessment Agency, 1999.

Department of Environment (DOE). Environmental assessment: a guide to the procedures. London: HMSO, 1989.

Department of Environment (DOE). Conservation (Natural Habitats & C.) regulations, SI 2716. London: HMSO, 1994.

Department of Environment (DOE). Guidance for the preparation of environmental statements. London: HMSO, 1995.

Department of Environment, Transport the Regions (DETR). The town and country planning (environmental impact assessment) (England and Wales) regulations 1999, SI 1999 No. 293. London: HMSO, 1999.

Department of Transport, Scottish Office Industry Department, The Welsh Office Y Swyddfa Gymreig, The Department of the Environment for Northern Ireland. Design manual for roads and bridges: vol. 11. Environmental assessment. London: HMSO, 1993.

Dodd A. Environmental appraisal: what happens next? A paper presented at the IEA and EARA Joint Annual Conference: 24 September 1996, London.

Fuller K, Sadler B. EC guidance on cumulative effects assessment. EA 1999;7(2):33–5.

Glasson J, Therivel R, Chadwick A. Introduction to environmental impact assessment. London: UCL Press, 1995.

Hyder Consulting guidelines for the assessment of indirect and cumulative impacts as well as impact interactions. Brussels: EC DGX1 Environment, Nuclear Safety and Civil Protection, 1999.

Jones C, Lee N, Wood C. UK Environmental Statements 1988–1990: An Analysis. Occasional Paper No. 29. EIA Centre, Department of Planning and Landscape, University of Manchester, 1991.

Lane P, Wallace R. Reference guide, feasibility study and overview of institutions interested in cumulative effects assessment: vol. 1. Reference guide to cumulative effects assessment in Canada. Hull, Quebec: Canadian Environmental Research Council, 1988.

Lee N, Dancy R. The quality of environmental impact statements in Ireland and the United Kingdom: a comparative analysis. Proj. Appraisal 1993;8(1):31–6.

McCold L, Holman J. Cumulative impacts in environmental assessments: how well are they considered? Environ Prof 1995;17(1):2–8.

Mendoza Duran A, Spaling H, Ross W. Management of Cumulative Effects in Protected Areas. Paper presented at the Cumulative Environmental Effects Management Conference, 1–3 November 2000, Calgary, Alberta.

National Environmental Policy Act, 1969. 42 USC 4321–4347, Published 1 January 1970.
Pritchard D. Towards sustainability in the planning process: the role of EIA. ECOS 1993;14(3/4):10–5.
Royal Society for the Protection of Birds (RSPB). Wildlife impact: the treatment of nature conservation in environmental assessment. Sandy: RSPB, 1995.
Therivel R, Wilson E, Thompson S, Heaney D, Pritchard D. Strategic environmental assessment. London: Earthscan, 1992.
Treweek J, Thompson S, Veitch N, Japp C. Ecological assessments of proposed road developments: a review of environmental statements. J Environ Plann Manage 1993;36(3):295–307.
US Council on Environmental Quality. Cumulative effects analysis: handbook for NEPA practitioners. Washington, DC: US CEQ, 1994.
US Council on Environmental Quality. Considering cumulative effects under the National Environmental Policy Act. Washington, DC: US CEQ, 1997.