



DEVELOPING MONITORING PROTOCOLS FOR SPATIAL POLICY INDICATORS

Draft Contents List

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Inventory of valued resources

Cork Harbour: Eight principle issues of interest in the environs of Cork Harbour were identified as part of Phase 1. These include: agriculture; employment; water quality; tourism and recreational use; land use and development; fishing; atmospheric emissions and conservation. In addition the perceived valued resources of Cork Harbour may be categorised as:

- Agricultural Land
- Birdlife
- Estuarine Wetlands
- Fin fish
- Industrial facilities
- Port facilities
- Recreational Space
- Shell fishery
- Tourist facilities

For the purpose of Phase 2 we have concentrated on four of the main resources of Cork Harbour:

- Aquaculture
- Birdlife
- Industrial facilities
- Tourist facilities

(Details in section 3.3.5)

The Shannon Estuary: The eight principle issues of interest in the environs of the Shannon Estuary, identified as part of Phase 1, include: agriculture; employment; water quality; tourism and recreational use land use and development; fishing; atmospheric emissions and conservation. In addition, the perceived valued resources of the estuary include:

- Agricultural Land
- Birdlife
- Estuarine wetlands
- Fin fishery Port facilities
- Industrial facilities
- Marine mammals (bottlenose dolphins)
- Recreational Space
- Shell fishery

The main resources identified to be examined in more detail (section 3.3.5) are:

- Aquaculture
- Bird and Dolphin watching
- Industrial facilities
- Tourism resources

3.3 Policies

3.3.1 Identification

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3.3.5 Cork Harbour and Shannon Estuary - resources and relevant policies

Tourism

Irish Government policy is to increase tourism and achieve a wider distribution of tourists (National Development Plan 2000-2006). County Development Plans aim to promote tourism in both Cork Harbour and the Shannon Estuary; however, there are no specific policies directly targeting the potential of the two estuaries. Table 3.1 details legislation dealing with conservation and natural resources which have a direct impact on tourism.

Table 3.1 *Policies and Legislation of relevance to tourism*

Level	Legislation/Policy	
<i>International</i>	Bathing Waters Directive (76/160/EEC)	
	Birds Directive (79/409/EEC)	
	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) EU Regulation (3626/82 EEC)	
	Common Fisheries Policy 1983 (EU)	
	Convention on the Conservation of Migratory Species of Wild Animals or Bonn Convention (1983) & Council Decision 82/461/EEC on the Bonn Convention	
	Convention on the Conservation of European Wildlife and Natural Habitats or Bern Convention (1979) & Council Decision 82/72/EEC concerning the conclusion of Bern Convention	
	Demonstration Programme on Coastal Zone Management	
	EC Habitats and Species Directive (92/43/EEC) & the Conservation (Natural Habitats) Regulations 1994	
	OSPAR	
	Urban Wastewater Treatment Directive (97/27/EEC)	
	Water Framework Directive 2000	
	<i>National</i>	Heritage Act 1995
		Wildlife Act 1976
		Wildlife Amendment Bill 1999
European Communities (Natural Habitats) Regulations 1997		
Harbours Act 1946, 1996.		
National Development Plan 2000-2006		
A Marine Research, Technology, Development and Innovation Strategy for Ireland		
<i>Local</i>	County Development Plans	
	Cork Kerry Tourism Regional Tourist Plan 1999-2006	
	Special Interest Marine Tourism in the West Clare Peninsula –Marine Institute, Shannon Development and Clare County Council, December 1999.	
	Southern and Eastern Region Development Strategy 2000-2006	
	Integrated Development of the Shannon Estuary: A Strategic Study	

Fishing/Aquaculture

Many of the national policies relating to fishing aim to balance the objectives of the EU Common Fisheries Policy (CFP). National Technical Conservation Measures (TCMs) enable the fishing regulations defined by the CFP. The present TCMs are set down in Regulation 850/98; there have

been six amendments since 1998. National plans also provide for fisheries research and development (National Development Plan 2000-2006; A Marine Research, Technology, Development and Innovation Strategy for Ireland). The County Development Plans recognise the potential of angling as an important recreational and tourism activity for the rural economy.

Table 3.2 *Policies and Legislation of relevance to fishing/aquaculture*

Level	Policy
<i>International</i>	Common Fisheries Policy
	Shellfish Waters Directive (79/923/EEC), Surface Waters (shellfish) Classification Regulations 1997, and Surface Waters (shellfish) Directive 1997.
	Shellfish Hygiene Directive (91/492/EEC) & Food Safety (Live Bivalve Molluscs and Other Shellfish) Regulations 1992.
	EC Directives 91/492 and 91/493 Shellfish Waters Toxin Monitoring.
	EC Directive 91/67 Restrictions on Movement of Shellfish
<i>National</i>	Fisheries Acts, 1959-1999
	Harbours Acts, 1946 and 1996
	Fishery Harbour Centres Acts, 1968-1998
	Foreshore Acts, 1933-1998
	Marine Institute Act, 1991
	Continental Shelf Act, 1968
	Maritime Jurisdiction Act, 1959
	Whale Fisheries Act, 1937
	Oil Pollution of the Sea (Civil Liability and Compensation) Acts, 1988 to 1998
	Dumping at Sea Act, 1996
	Sea Pollution Act, 1991
	Sea Pollution Amendment Act, 1999
	Whale Fisheries Act, 1937
	A Marine Research, Technology, Development and Innovation Strategy for Ireland
	National Development Plan, 2000-2006
	Quality of Shellfish Waters Regulations, 1994.
	Irish Aquaculture –The Future; Strategy for meeting the global seafood challenge
<i>Local</i>	County Development Plans
	Cork Kerry Tourism Regional Tourism Plan 1999-2006
	Integrated Development of the Shannon Estuary – A Strategic Study

Birdlife/ Cetaceans

Ireland's nature conservation policies in recent years have focused on the identification, designation and conservation of protected areas. These arose from the government's statutory obligations to establish Natural Heritage Areas (NHA's) with legislative backing to afford protection to sites designated under EU regulations on wild birds and habitat protection. Birdlife in Cork Harbour is protected under EU legislation (RAMSAR), while the dolphins in the Shannon Estuary are protected at national and EU level. All cetaceans in Irish waters are protected under the 1976

Wildlife Act and in 1991 the Irish government declared the Irish Economic Exclusion Zone a whale and dolphin sanctuary. In addition, cetaceans are protected by European legislation and are listed Annex IV of the EU Habitats Directive. Bottlenose dolphins are also listed as Annex II of the Habitats Directive (species requiring the designation of Special Areas of Conservation, SACs).

Table 3.3 *Policies and Legislation of relevance to birdlife/cetaceans*

Level	Policy
<i>International</i>	Birds Directive (79/409/EEC)
	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) EU regulation (3626/82 EEC)
	Common Fisheries Policy 1983 (EU)
	Convention on the Conservation of Migratory Species of wild Animals or Bonn Convention (1983) & Council Decision 82/461/EEC on the Bonn Convention
	Convention on the Conservation of European Wildlife and Natural Habitats or Bern Convention (1979) & Council Decision 82/72/EEC concerning the conclusion of Bern Convention
	Demonstration Programme on Coastal Zone Management
	RAMSAR Convention
	EC Habitats and Species Directive (92/43/EEC) & the Conservation (Natural Habitats) Regulations 1994
	UN Convention on Biological Diversity at Rio Summit
<i>National</i>	Wildlife Act, 1976 and Wildlife Amendment Bill, 1999
	National Development Plan, 2000-2006
	A Marine research, technology, Development and Innovation Strategy for Ireland
	First report on the implementation of Convention on Biological Diversity for Ireland 1998-Duchas
	Heritage Act, 1995
	National Monuments Act, 1930
	Irish Whale and Dolphin Sanctuary Declaration 1991
<i>Local</i>	County Development Plans
	Integrated development of the Shannon –A Strategic Study
	Local Agenda 21

Industry

Much of the legislation relating to industry and development reflects the need to achieve higher environmental standards, particularly at a time when the economic status of the country is increasing the need for expansion of industry and infrastructural development. Agencies such as the Environmental Protection Agency (EPA) and An Bord Pleanála (Planning Appeals Board) have objectives to ensure that sustainable development is achieved. Industrial emissions and water quality are routinely monitored to comply with EU and national legislation. At a local level the local authorities are responsible for producing ‘ Air Quality Management Plans’.

Table 3.4 *Policies and Legislation of relevance to industry*

Level	Policy
<i>International</i>	Dangerous Substance Directive (76/464/EEC) & Paris Convention 1974
	Environmental Impact Assessment (EIA) 85/337 as amended 97/11/EC
	Integrated Pollution Control (96/61/EEC) & Pollution Prevention Control Act (1999)
	MARPOL 73/78 and Merchant Shipping Acts and Regulations
	Nitrates Directive (91/676/EEC)
	United Nations Convention on the Law of the Sea (UNCLOS)1982
	Urban Waste Water Treatment Directive (97/27/EEC)
	Water Framework Directive 2000
	OSPAR Convention
<i>National</i>	Local Government Acts 1963-1993, 1994
	European Communities (Environmental Impact Assessment) Regulations,1989 and Amendment Regulations 1994
	Environment Protection Agency Act, 1992
	Waste Management Act, 1996
	National Development Plan 2000-2006
	Harbours Acts, 1936 and 1996
	Air Pollution Act, 1987
	Radiological Protection Act, 1991
	Sea Pollution Act, 1991
	Sea Pollution Amendment Act, 1999
<i>Local</i>	County Development Plans
	Cork Main Drainage Scheme, EIS, 1992
	Integrated Development of the Shannon Estuary, A Strategic Study
	City Docks Integrated Area Plan–Cork Corporation Urban Renewal Scheme
	Port of Cork–Strategic Development Study –Stage 1 report, December 1999.
	Review of operations and structures of the seaports in the Shannon estuary.

All of the legislation and policies at national and local level listed above are discussed in detail in the Phase 1 Appendix.

3.4 Indicators

3.4.1 Review of Environmental Indicators Development

An *indicator* has been defined by the OECD as "a parameter, or a value derived from parameters, which points to/provides information about/describes the state of a phenomenon/environment/area

with a significance extending beyond that directly associated with a parameter value" (OECD/GD(93)179). In more general terms, indicators may be described as quantified information which can help explain in simple terms how certain trends (e.g. economic, social, environmental) are changing over time. The main function of indicators is communication, providing or promoting information exchange regarding the issue they address. As such, they should be scientifically valid, analytically sound, measurable and verifiable. A well-selected set of indicators will provide a shortened, yet generally correct, picture of a system.

For example, several important economic measures have been used for many years to ascertain how the economy of a country is performing - such measures can include GDP, employment level, rate of inflation, etc. These aggregated statistics provide only a general picture, failing to explain why certain trends may be occurring, and possibly overlooking the situation in a specific area of industry, society, or geographical area. Overall, however, they can aid in economic policy decision-making by providing both policy-makers and the public with reasonable indicators of changes in the economy. It was from this type of economic analysis that the idea of an indicator was apparently derived, and then applied to other areas (www.environment.detr.gov.uk).

While indicators can help focus attention on key issues and highlight some significant trends, it must be remembered that they are, by their nature, simplifications. They can only relate to areas that can be readily quantified and aggregated in a meaningful manner. For example, areas such as natural beauty, or quality of land management, are difficult to quantify and measure objectively. It is therefore important to recognise that quantified indicators, while being a very useful tool, have their limitations.

3.4.2 European Community

On a European level, there are currently a wide variety of environmental indicators in use. These indicators are vital tools for identifying and delivering concise, scientifically credible information reflecting trends in the state of the environment, as well as monitoring the progress made in realising environmental policy targets. While communication of quantified information in a readily understandable and accessible manner is the main function of indicators, three major purposes for environmental indicators have been defined by the EEA (European Environmental Agency) in relation to policy-making (Smeets & Weterings, 1999):

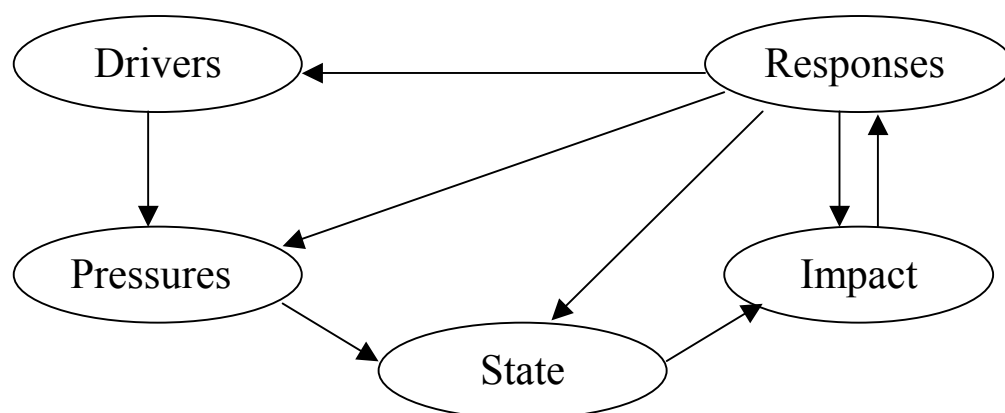
1. "to supply information on environmental problems, in order to enable policy-makers to value their seriousness;
2. to support policy development and priority setting, by identifying key factors that cause pressure on the environment;
3. to monitor the effects of policy responses."

In addition to these points, environmental indicators may also be used to great effect in increasing public awareness on environmental issues (Smeets & Weterings, 1999).

The DPSIR framework

The *Driving Force-Pressure-State-Impact-Response* (DPSIR) framework has been developed by the EEA for organising information about the state of the environment. Most indicator reports currently compile sets of physical, biological or chemical indicators, reflecting a systems analysis view of the relations between the environmental system and the human system. According to this view (see Fig 3.4.2), social and economic developments (Drivers) exert Pressure on the environment, resulting in the State of the environment changing. This then leads to Impacts on factors such as human health, ecosystems and materials, which may result in a societal Response that feeds back on Driving forces, or on the state or impacts directly, through adaptation or curative action (Smeets & Weterings, 1999).

Fig. 3.4.2: The DPSIR Framework for Reporting on Environmental Issues



Indicators for *driving forces* describe the social, demographic and economic developments in society and the corresponding changes in life styles, overall levels of consumption and production patterns. *Pressure* indicators describe developments in release of substances (emissions), physical and biological agents, the use of resources and the use of land. *State* indicators give a description of the environment (physical, biological and chemical) in a certain area. *Impact* indicators describe changes in the quality and quantity of natural resources due to pressure on the environment. Finally, society may respond to these changes through environmental, general economic and sectoral policies, which can be described by *response* indicators. (Kristenses, 1997 as in EPA 1999).

The EEA then classifies indicators into four simple groups (Smeets & Weterings, 1999):

- A. *Descriptive indicators* (What is happening to the environment and to humans?) - describing the actual situation with regard to the main environmental issues;
- B. *Performance indicators* (Does it matter?) - measuring the 'distance(s)' between the current environmental situation and the established environmental quality objective or target;
- C. *Efficiency indicators* (Are we improving?) - directly relating environmental pressures to human activities;
- D. *Total welfare indicators* (Overall, are we better off?) - some measure of total sustainability, a kind of 'Green GDP'. (Smeets & Weterings, 1999).

3.4.3 UK

3.4.4 Ireland [Review of status of indicators in Ireland - 2]

Over the last decade there have been many calls for the production of environmental indicators in Ireland with associated efforts to develop them. This results from increasing concerns about the sustainability of the world's depleting stock assets at the hands of human activity. In Ireland, a Government of Renewal Policy in 1994 stated that the government parties were committed to

"... working towards a new set of indicators of sustainable economic development which will take account of environmental and social factors. These indicators will be used alongside the existing measures of economic activity such as GDP."

The main objective of this commitment was to go beyond existing measures of economic activity produced within the national accounting framework, to ultimately develop a more complete picture

of economic and social progress in Ireland. With this in mind, the ESRI (the Economic & Social Research Institute) put forward a publication on "Formulating Environmental and Social Indicators for Sustainable Development" (Scott *et al.*, 1996). This publication identified three main types of indicators, the development of which Ireland might adopt:

a) *Environmental indicators for individual themes:*

Indicators for individual themes have seen much work internationally, forming a foundation for the future development of more sophisticated indicators. These indicators can be expressed in physical terms, and can be constructed at various levels of refinement (e.g. national, regional or local). The pressure-state-response breakdown is the most commonly used by practitioners. This framework has the advantage of answering three simple questions: (i) What is the state of the environment and its evolution? This is answered by *state* indicators. (ii) Why is it changing? This is answered by *pressure* indicators. (iii) What are we doing about it? This is answered by *response* indicators. Such indicators described include the OECD's Core Set of Environmental Indicators, many of which could be assembled for Ireland (See Table 3.4.4).

b) *Environmentally adjusted (or Green) national income:*

Measurement of green national income is income that is adjusted to take environmental considerations into account. However, Ireland produced its first National Accounts (based on *traditional* national income) just over 50 years ago, and the idea of an environmentally adjusted national income is still in its infancy. National income is a poor measure of welfare, and as currently measured, only incorporates depreciation of produced assets. It neglects to take into account the depreciation of non-produced natural assets which are non-marketed, and even those which are marketed (such as forest and mineral depletion).

One of the main obstacles in calculating a green national account is that there is no easy way to adjust the current national accounts, as many questions are still present as to how monetary valuation of depletion and degradation of natural assets is to be valued.

c) *National Sustainability Indicators:*

A sustainability indicator is a measure of the change in assets, and is thus related to green national income in that the data requirements are similar. If there is a positive change in assets over a period of years, then society is on a sustainable path. However, as with the green national income, measurement difficulties arise, as monetary valuation cannot easily include aspects of environmental sustainability that have no price (Scott *et al.*, 1996).

Table 3.4.4: Example of a Core Set of Indicators for the Aquatic Environment. (Clenaghan et al., 1999).

(Indicators in bold denote those for which data is currently available)

ISSUES	SECTORS	DRIVING FORCE	PRESSURE	STATE	IMPACT	RESPONSE	EFFICIENCY	PERFORMANCE		
Eutrophication /organic pollution	Agriculture	<ul style="list-style-type: none"> • Trend in consumption of N and P fertilisers • Livestock intensity (Lu/ha) 	<ul style="list-style-type: none"> • N+P emissions to water from all agricultural sources • Total N+P applied to land from fertiliser + livestock per ha utilised agricultural area • N+P budget surplus • Soil P status 	<i>Rivers:</i> <ul style="list-style-type: none"> • BOD • Orthophosphate • Macroinvertebrate Q rating <i>Lakes:</i> <ul style="list-style-type: none"> • Lake trophic status classification • Total phosphate 	<ul style="list-style-type: none"> • Annual number of fish kills (related to sector) • Economic /ecological cost to fisheries • Increased water treatment costs 	<ul style="list-style-type: none"> • % of farms in REPS scheme • % of farms with NMP 	<ul style="list-style-type: none"> • Phosphate and nitrogen usage/ha of utilised agriculture • Crop yields / P application • Livestock numbers / P application 	<ul style="list-style-type: none"> • % of river sampling stations with Q ≥4 • % of river sampling stations with median MRP ≤30 µg P/l • % of lakes oligotrophic or mesotrophic • % of lakes with average total P ≤20 µg P/l 		
	Industry	<ul style="list-style-type: none"> • Industrial Growth 	<ul style="list-style-type: none"> • N+P emissions from industry 						<ul style="list-style-type: none"> • Extent of nutrient removal (tertiary treatment) by industry • % of industries with IPC licences 	<ul style="list-style-type: none"> • Industrial phosphate emissions / GNP
	Household	<ul style="list-style-type: none"> • Population increase 	<ul style="list-style-type: none"> • N+P, BOD emissions from STW and other point sources 						<ul style="list-style-type: none"> • % of urban waste water treated in compliance with EU Directive 	<ul style="list-style-type: none"> • P emissions / capita from municipal STW and other point sources
Soil erosion	Agriculture	<ul style="list-style-type: none"> • Sheep numbers • Area of bare soils due to herbage removal 	<ul style="list-style-type: none"> • Estimate of associated top soil losses 	<ul style="list-style-type: none"> • Suspended solids concentration • Sediment cover on substrate • Turbidity 	<ul style="list-style-type: none"> • Ecological /economic damage to fisheries • Increased water supply costs 	<ul style="list-style-type: none"> • Reduction of sheep nos. in sensitive areas 	<ul style="list-style-type: none"> • Sheep nos. / ha • Soil loss / ha of sheep grazing land • Soil loss / ha of arable land 	<ul style="list-style-type: none"> • % of streams with annual mean suspended solids ≤ 25 mg/l • Trend in area of lakes/streams deleteriously affected by sedimentation 		
	Energy	<ul style="list-style-type: none"> • Peat removal rate from bogs 	<ul style="list-style-type: none"> • Estimate of associated top soil losses 						<ul style="list-style-type: none"> • % of peat extraction areas with adequate slit trap provision 	<ul style="list-style-type: none"> • Peat energy production / estimated soil loss
	Forestry	<ul style="list-style-type: none"> • Planted and clearfelled area 	<ul style="list-style-type: none"> • Estimate of associated top soil losses 						<ul style="list-style-type: none"> • Extent of compliance with forestry and fishery guidelines 	<ul style="list-style-type: none"> • Area planted or clearfelled/ estimated soil loss
Acidification	Industry	<ul style="list-style-type: none"> • Industrial growth 	<ul style="list-style-type: none"> • Industrial production of SO₂ and NO_x 	Trend in stream/lake <ul style="list-style-type: none"> • pH • Alkalinity • Aluminium • Acid-sensitive species 	<ul style="list-style-type: none"> • % of streams and lakes with impoverished fauna • Ecological/economic damage to fisheries 	<ul style="list-style-type: none"> • % of industries with IPC licences 	<ul style="list-style-type: none"> • NO_x and SO₂ / capita • Emissions / unit of product 	<ul style="list-style-type: none"> • Trend in area exceedence of critical loads of acidifying substances • % of lakes and rivers with minimum pH 5.5-9.0 • EU target compliance for emissions 		
	Transport	<ul style="list-style-type: none"> • Vehicle nos. 	<ul style="list-style-type: none"> • NO_x emissions 						<ul style="list-style-type: none"> • % vehicles with catalytic converters 	<ul style="list-style-type: none"> • Vehicle emissions of NO_x / capita
	Energy	<ul style="list-style-type: none"> • Energy production 	<ul style="list-style-type: none"> • Production of SO₂ and NO_x 						<ul style="list-style-type: none"> • % of power stations with IPC licences 	<ul style="list-style-type: none"> • NO_x and SO₂ / capita • Emissions/ GDP • Emissions/ energy generated
	Forestry	<ul style="list-style-type: none"> • % of land in acid sensitive areas afforested 							<ul style="list-style-type: none"> • % reduction in afforestation of areas sensitive to acidification 	

The work on environmental indicators is proceeding currently on all fronts, and no single type of indicator should be developed above all others for Ireland. The Environmental Protection Agency has listed some refinements to the measures used by the OECD, in order to reflect Ireland's particular condition. From the above information it is clear that the quality of indicators selected will be greatly dependent on the quality of data available, and it is obvious that in a number of areas the availability of this data is limited. In order to fill these gaps, it is important to ensure good liaison between the agencies involved. The ESRI publication identifies the following as the main bodies collecting and disseminating data on environmental issues at that time (1996):

- Environmental Protection Agency (EPA);
- Department of the Environment (DoE);
- Department of Energy (within Transport, Energy and Communications) and the Irish Energy Centre;
- Central Statistics Office (CSO).

The CSO has overall responsibility for co-ordinating official statistics compiled by public authorities, economic and social statistics and national accounting data in particular, while the EPA has primary responsibility for the co-ordination of environmental data. It is therefore necessary to ensure co-operation between these two bodies, and this may also lead to cost savings in occasions of overlap in data collection collation and dissemination activities. It is stated in "Sustainable Development - A Strategy for Ireland" (1997) that:

"...(the) EPA and CSO will have a primary role in the collection and co-ordination of environmental data and official statistics to develop suitable indicators... work towards the definition of indicators will be refined as information systems and methodologies are developed, and as consensus grows internationally about the choice of themes for international comparisons."

The Environmental Protection Agency

Under the Environmental Protection Agency Act 1992, the EPA is charged with (among other duties) a statutory obligation to establish and maintain a database related to environmental quality. It is in fact in an optimum position for the task, given its role as the licensing and monitoring agency. The area of information to be covered includes the quality of inland waters, estuarial and coastal waters, and groundwaters (as well as ambient air quality, soil quality, noise levels, inventories of emissions to the environment, and any other matters as may be deemed appropriate). In 1998 the EPA compiled a list of environmental indicators for Ireland, with an emphasis on issues

such as eutrophication, waste and the urban environment. This was followed in 1999 by two complementary discussion documents, which are discussed in more detail below:

1. Measuring Progress Towards Sustainable Development - with special reference to the aquatic environment, waste management and the urban environment. A discussion document.
(Clenaghan *et al.*, 1999)

This document proposes the use of environmental indicators and environmental quality objectives at a detailed level in measuring progress towards the sustainable management of Ireland's natural resources. It discusses some ideas on how progress towards the achievement of sustainability targets set out in the National Sustainable Development Strategy might be measured through the development of indicators. Three themes were chosen to provide examples of how issues may be addressed within the proposed model; surface water quality (particularly eutrophication), solid waste management, and the urban environment. The following is a brief outline of indicators that might be useful in monitoring eutrophication and organic pollution in the aquatic environment, as described in the 1999 document:

Working Example: The Aquatic Environment - Indicators of Eutrophication/Organic Pollution

Among the main *driving forces* of water pollution in Ireland are agriculture (problems related with animal wastes, and inappropriate application of phosphate fertilisers), point source discharges from waste water treatment works, land-spreading of industrial waste, and sewage sludge.

- *Pressure indicators* should allow for the development of a nutrient budget for each sector, thus allowing an estimate of the contribution each sector makes to the eutrophication problem.
- *State indicators* essentially measure the quality of the media in question. In this case, both biological and physico-chemical indicators may be used to determine the extent of eutrophication/organic pollution in the water body.
- *Impact indicators* will provide a picture of the impact of the eutrophication/organic pollution in the water body. Such impacts may include increased growth in plant and algal species, possibly resulting in major changes in floral and faunal composition due to competition, loss of light, and deoxygenation. Some changes may be monitored by the proposed state indicators, and additional impact indicators, such as number and type of reported pollution incidents, and number of fish kills, could also be used.
- *Response indicators* should indicate how different sectors are attempting to reduce nutrient output and other forms of organic pollution. Increased regulation through various national and international legislation (e.g. Integrated Pollution Control and Waste licensing, and the

adoption of the Urban Waste Water Treatment Directive) help enable close monitoring of the *response* of various sectors, particularly industrial and household sectors, to eutrophication and organic pollution.

2. **Environment in Focus - A Discussion Document on Key National Environmental Indicators (1999)**

This document attempts to reflect the dynamic interaction between human and environmental systems by identifying key national environmental indicators. It is structured around the DPSIR framework, as developed by the European Environmental Agency from an OECD framework for the organisation of environmental indicators (see section 3.4.2)

There were four main environmental themes focused on for this document, namely, climate change, eutrophication, the urban environment and waste. From these four themes the EPA proposed a short list of indicators detailed below. The EPA recommends that these indicators should be updated and reported on regularly to provide an overview of key environmental trends:

EPA recommended indicators

Energy Consumption & Economic Growth	River Quality
Greenhouse Gas Emissions	Fish Kills
Emissions of Sulphur Dioxide (SO ₂)	Afforestation
Emissions of Nitrogen Oxides (NO _x)	Phosphorus Levels in Soil
Urban Air Quality	Number of Threatened Species
Waste Arisings	Number and Area of Protected Sites

From the 1999 discussion document, the following is a brief description of the indicators identified by the EPA under the DPSIR framework that are of relevance to estuarine areas and the LOSPAN project:

Driving force indicators

- *Population:* An increase in population levels leads to increased demands and pressures on the environment. Consumption is the main driving force resulting in the use of natural resources in economic activities and for the generation of waste and pollution affecting the environment.

- *Energy Demand and Economic Growth:* As the economy grows so too does energy consumption, leading to increased emissions of carbon dioxide, depletion of non-renewable fossil fuel, and increased emissions of pollutants.
- *Industrial Production:* Industrial production has doubled between 1991 and 1998, leading to greater demands and pressures on the environment. This results in higher consumption of raw materials and energy, increased emissions to air and water and increased generation of waste.
- *Fertiliser Sales:* Since 1980, sales of nitrogen fertiliser have continued to increase, while there has been some reduction in the use of phosphorus and potassium in the last few years. Intensive use of fertilisers has contributed to eutrophication in surface waters and can adversely affect groundwater quality.
- *Livestock Numbers:* Increasing numbers of livestock leads to increased pressures on the environment in terms of greenhouse gas emissions, agricultural wastes, acidification, eutrophication and overgrazing. The main influence on livestock numbers in Ireland is agricultural policy in Europe.
- *Tourism:* In recent years tourism has played an increasingly significant role in the economic and cultural development of Ireland. In order to protect Ireland's green image and sustain this valued source of revenue for the country, it is necessary to conserve the very environment that attracts a high numbers of tourists.

Pressure Indicators

- *New Housing Completions:* Irish house building levels have doubled since 1993 and are at the highest rate in Europe relative to population. This has given rise to increased demand for developable land and pressures on water and sewerage facilities and the social infrastructure including roads, public transport and amenities.
- *Emissions of Sulphur Dioxide (SO₂):* Due to a switch to low sulphur fuels in the energy and industrial sectors emissions of SO₂ have decreased since 1980. In 1994 Ireland signed an international protocol (the Oslo Protocol) with a commitment that SO₂ emissions in the year 2000 would be 30% lower than 1980 figures.
- *Emissions of Nitrogen Oxides (NO_x):* Under an international protocol (Sofia Protocol), Ireland was required to stabilise NO_x emissions at 105,400 tonnes from 1994 onwards. This, however, has not been achieved. A revised protocol will require further reductions after 2000.

- *Emissions of Greenhouse Gases:* The impacts of the enhanced greenhouse effect in Ireland are expected to include enhanced agricultural production, drying out of peatlands, severe winter storms and flooding, lower summer flows in rivers and a rise in sea levels.
- *Use/fate of Selected Chemicals:* Facilities using certain toxic chemicals are required to produce an annual report called a Pollution Emissions Register (PER) where particular chemicals are tracked through the process. It is important to protect the environment from the negative impacts of these chemicals by tracking them through the lifetime of their usage.
- *River Loads to Estuaries:* In order to manage the marine environment in a sustainable fashion, it is necessary to reduce the many polluting inputs from land-based activities, such as sewage effluent, industrial waste, radioactive substances and litter.
- *Exploitation of Selected Fish Stocks:* More efficient fishing and increased landings have developed due to improved technology and increasing demand. This is placing a further strain on fish stocks around Ireland that are already severely depleted.
- *Household and Commercial Waste Arisings:* There is an equivalent of 0.52 tonnes of waste generated by each person in the State every year, imposing a great burden on waste management services and the environment.
- *Household and Commercial Waste Management:* Current national targets include a diversion of 50% of household waste away from landfill and the development of waste recovery facilities employing environmentally beneficial technologies.
- *Hazardous Waste Generation:* An estimated 327,862 tonnes of hazardous waste was generated in Ireland in 1996, with approximately 98,000 tonnes of this unreported, consisting mainly of agricultural, municipal and various product wastes as well as waste from non-IPC (Integrated Pollution Control) licensed industrial activities.

State Indicators

- *River Water Quality:* There has been a decrease in the length of river classified as unpolluted over the last 10 years, primarily due to eutrophication. River quality is classified as unpolluted, slightly polluted, moderately polluted, and seriously polluted, measured as percentage of the 13,200 km baseline.
- *Nitrate Levels in the Larger Rivers:* While current levels of nitrate enrichment in Irish surface waters are generally low, they are increasing in some tributaries in the high tillage areas, particularly in the east and south-east.
- *Phosphorus Levels in Soils:* Phosphorus content in many soils are now at levels where losses will occur during periods of high rainfall and reach local streams and other surface waters. To help prevent serious impacts on water quality, the National

Sustainable Development Strategy aims for a reduction of 10% per annum in artificial phosphorus fertiliser usage over the next 5 years.

- *Fish Stocks:* Over-fishing has led to a dramatic reduction in spawning stock levels in the past. This important resource must be carefully managed in order to achieve a sustainable level of exploitation.
- *Changes in Bird Populations:* Over the last few decades, some bird species have suffered a dramatic decline in numbers. This is due to a multitude of factors, including habitat loss, reduction in food supplies, predation, and poisoning from pesticides. As various bird species are dependent on the quality of their habitats and surrounding environment, they provide an important indicator as to the quality of that environment.

Impact Indicators

- *Fish Kills:* Following a decrease in the number of fish kills in the early 1990's, a renewed increase was recorded for the 1995-1997 period, with agricultural effluent remaining as the most frequent cause of the fish kills. Fish kills are a matter of grave concern not only from the purely ecological aspect, but also from the economic and amenity perspective.
- *Drinking Water Quality:* The report on drinking water quality in Ireland for the year 1997 shows that over 91% of public supplies and 64% of group schemes are at an acceptable standard. Group water supply schemes have shown signs of improved water quality in recent years.
- *Bathing Water Quality:* The most recent EU report rates the quality of Ireland's bathing water as excellent in both coastal and freshwater areas. There has however been a decline in recent years, possibly due to a number of factors including adverse weather conditions, run-off from agricultural land and effluent discharges.
- *Effects of Chemicals on Biota (e.g. TBT):* Tributyltin (TBT) is highly toxic to many marine plants and animals and has proved to be a general problem in Irish waters. Since restrictions on its use were imposed in 1987, periodic surveys have taken place using two common marine snails as biological indicators. The most contaminated areas are port regions, especially in estuaries and embayments, where ships and pleasure craft are present and may have TBT paints applied in docks.
- *Numbers of Threatened Fauna:* Information on threatened species in Ireland is contained in "Red Data" books. There has been much population fragmentation and range reductions of Irish terrestrial fauna due to habitat loss, particularly over the last generation.

- *Ecological Footprint of Ireland:* Society's ecological footprint represents "the corresponding area of productive land and aquatic ecosystems required to produce the resources used and to assimilate the wastes produced by a defined population at a specified material living standard." Ireland's ecological footprint is conservatively estimated at 2.38 hectares per person, a total of 86,325 km². This equates to 1.23 times the size of the state (70,394 km²). Ecological footprinting provides a means of demonstrating the importance of sustainable lifestyle and consumption patterns.

Response Indicators

- *Numbers of Integrated Pollution Control (IPC) and Waste Licences Issued:* The first IPC licence was issued in 1994, and by the end of April 1999 345 had been issued. Regulation and enforcement of IPC licences provide a dynamic operating procedure within which progressive environmental improvements can be achieved.
- *Urban Waste Water Treatment:* In 1999, it was calculated that 76% of urban waste water entered freshwaters and estuaries while the remainder entered coastal waters. Of this, just four locations (Ringsend and Howth outfalls in Dublin, Cork, and Dundalk) accounted for approximately 50% of waste water arisings and they accounted for the bulk of urban waste water not receiving secondary treatment.
- *Controls on Litter:* Litter has been a significant problem in Irish towns and cities for many years, but also has an impact on freshwater, estuarine and coastal areas. Legislation has been directed at reducing potentially growing litter problems.
- *Participation in Rural Environmental Protection Scheme (REPS):* The participation in the REPS scheme is currently greatest in percentage terms for farms in the west and north west of Ireland. It is designed to reward farmers for carrying out their farming activities in an environmentally sympathetic manner, and to encourage the environmental improvement of existing farm holdings.
- *Number and Area of Protected Sites:* There has been an unprecedented number of protected sites designated under the EU Habitats and Birds Directives in Ireland over the last 3-4 years. Ireland's protected areas programme aims to conserve and protect about 10% of the country. These are areas considered to be of prime importance for biodiversity.
- *Environmental Strategies and Management Plans:* The National Sustainable Development Strategy seeks to re-orientate all areas of Government policy and economic and societal activity that impact on the environment, in order to maintain the strong growth that Ireland enjoys in an environmentally sustainable manner. At local

and regional levels a number of management plans are being, or have been, developed - particularly in relation to waste and the protection of water quality.

- *Environmental Awareness and Attitudes:* Public support is needed in order to implement legislation effectively and to minimise damage to the environment. Therefore the concerns and environmental awareness of the public are crucial to the well-being of the environment
- (EPA - Environment in Focus, 1999).

3.4.5 France

3.4.6 Selection Criteria

4 DEVELOPMENT OF MONITORING PROTOCOLS

4.1 Introduction

4.1.1 Existing Information

4.1.2 Baseline Data

4.1.3 Comparison with other Fragile Areas

4.2 Exe and Teign Estuaries

4.2.1 Existing Information

4.2.2 Baseline Data

4.2.3 Comparison with other Fragile Areas

4.2.4 Future Development

4.3 Morlaix Bay

4.4 Cork Harbour and Shannon Estuary

4.4.1 Cork Harbour and Shannon Estuary - Valued Resources

Cork Harbour

Birdlife

Cork Harbour is a highly complex estuarine system, hosting a large number of wintering birds. It is especially important for waders such as Black-Tailed Godwit (*Limosa limosa*) and Redshank (*Tringa tetanus*) and has one of the largest flocks of Shelduck (*Radorna tadorna*) in the country. Great Crested Grebes (*Podiceps cristatus*) occur in nationally important numbers in Cork Harbour. The North East corner of Cork Harbour has RAMSAR site status, a wetland of International Importance for its wintering populations of waterbirds. This area forms an integral part of the greater Cork Harbour which regularly holds over 20,000 waterfowl. The site is important to wintering populations of Black-tailed Godwit, Curlew (*Numenius arquata*) and Redshank and in spring to the migrating Whimbrel (*Numenius phaeopus*). Many feeding waders utilise the mudflats that occur westwards to Aghada, while species such as Scaup (*Aythya marila*), Goldeneye (*Bucephala clangula*) and Great Crested Grebe use the sea offshore. Because Rostellan Lough is impounded, its bird community is distinct, with diving ducks and grebes most conspicuous. Frequent visiting species are Snipe (*Gallinago gallinago*), Little Grebe (*Tachybaftus ruficollis*), Pochard (*Aythya ferina*) and Tufted Duck (*A. fuligula*), some of which breed at the site as does Mallard (*Anas platyrhynchos*). The Rostellan Lough, Aghada Shore and Poul nabibe Inlet are designated as Natural Heritage Areas (NHA) and are of local significance for their waterfowl. The Douglas Estuary and the western part of Lough Mahon are significant areas of saltmarsh, reedbed and intertidal mudflat holding nationally important numbers of waders.

The whole of Cork Harbour has also been designated as a Special Protection Area for Wild Birds (SPA) under the European Communities (Conservation of Wild birds) regulations, 1994 enhancing the status of NHAs. Sections of the Harbour such as the NHAs should not be considered in isolation as bird populations are very mobile throughout the area. The preparation of management plans for these areas is carried out by local government (planning and development) in association with the National Parks and Wildlife Service (The South East Coast of Ireland, An environmental appraisal - 1995)

Fishing/Aquaculture

Cobh town situated in the outer part of Cork Harbour is a productive fishing port with gross annual landings worth £2.5 million in 1998, landings are mainly pelagic with some demersal landings

occurring also. Drift netting operations occur in the Harbour and are located in areas traditionally known for their salmon movement. Sea angling, as well as being a purely recreation pursuit is most appropriately considered as a tourism based product or activity. It is well positioned to grow as significant element of Irish tourism, particularly in the South West. Cork Harbour was once famous for its angling, especially Blonde Ray and Turbot. Today, however, angling in this extensive all weather location is in decline due to over fishing, disturbance due to industrial scale dredging, industrial development impacts in the area and possibly other, as yet undetermined factors.

Aquaculture is important within Cork Harbour and Atlantic Shellfish, one of Irelands largest producers of native and Pacific oysters, is located within the inner harbour. This is one of the few companies in Ireland to successfully farm the native flat oyster, *Ostrea edulis*. Ongoing selective breeding has appeared to minimise the effects of the destructive disease *Bonamia*, which since its introduction in the late 1980s to this region, has caused high mortalities in the native oyster. A unique system has been set up in the inner harbour to breed the native oyster in isolated water ponds. No exchange of water takes place between ponds. Water is pumped from the estuary to the ponds, hence it is imperative that the water quality of the inner harbour is satisfactory. Monitoring for harmful dinoflagellates takes place by an on site scientist; water quality is examined by the Marine Institute.

A recent report produced by a consultancy agency CIRCA on Irish aquaculture has predicted the following increases in peripheral coastal income and jobs investment by 2004: An increase in total income by £14.87m; to create over 1,000 new part-time and full-time jobs in coastal peripheral areas; to develop and further test manage farming techniques for applicability to wild species e.g. scallops and lobsters; to develop value added products, particularly for *C. gigas* oysters; to increase new species e.g. char, urchins and eels to 344 tonnes (Irish aquaculture - the future, 2000).

Tourist facilities

There is an established tourist base in Cork Harbour which is in the process of being developed by a number of recent or planned investments. Bord Fáilte has designated the area around Cork City as one of its five major tourism areas in the State. The main tourist attractions in the Harbour include Cobh Heritage Centre (The Queenstown project), Fota Wildlife Park, The Royal Cork Yacht Club situated in Crosshaven and the Sailing/Watersports Centre in Cobh. Crosshaven and Fota areas are primarily centres for tourism/leisure and plans were drafted in the 1996 County Development Plan for continued sustainable development of tourism in these areas.

Fota Wildlife Park: This 70 acre site is situated on Foaty Island in the upper reaches of Cork Harbour. Over 25% of the estate is covered by woodland, the remainder open grassland and lakes. The site is managed extensively without the use of chemicals and a unique visitor attraction on the island is the wildlife park. Visitor numbers have increased in recent years and apart from the recreational aspect the park also provides an educational ecology programme for schoolchildren at both primary and secondary school level.

The Royal Cork Yacht Club: This is the oldest Yacht Club in the world, founded in 1720. It is situated in Crosshaven just inside the mouth of Cork Harbour and boasts a large enthusiastic sailing membership and a fleet ranging from the smallest sailing dinghies to fine open ocean ranging and cruising yachts. Among the local, national and international fixtures hosted by the club is Irelands premier yachting event - Ford Week – a biennial gala of international sailing competition and festivities. Over 70% of the 700 entries come from outside Ireland and with an average of 12 people per boat this brings substantial business to the hospitality industry in Crosshaven.

The Southern counties of Ireland benefit by approximately £8 million per annum from the Port of Cork's cruise liner traffic. The dramatic increase in cruise visitors since 1990 has been accomplished through aggressive international marketing and successful expansion of the port cruise handling facilities to meet the growing international demand for this type of vacation (independent report undertaken by Dept. of Economics, UCC, 1997).

The settlements and industrial areas of Cork Harbour have good amenities, with attractive and undeveloped areas. If the amenity areas of the harbour become duly eroded, this will adversely affect the development areas. The principle areas of concern with regard to tourism development are water quality and the impact of new developments such as quarrying.

The Cork County Development Plan of 1996 put forward suggestions for developing tourism in Cork Harbour, including:

- Encouraging an increase in the degree of interaction between the operators of the tourist attractions in the area as they seem to operate as free-standing attractions. Interaction would provide better linkage between attractions and improve conditions for developing secondary attractions on an economically viable basis.
- Developing a tourist waterbus service that would provide a pleasant way of reaching attractions and in turn would promote linkage of attractions.
- Developing a tourist/transport information network and upgrading the Cobh rail line.

Industrial facilities

Developments in Cork have reflected the importance of Cork Harbour to the local economy over past centuries. The Port of Cork is Ireland's primary industrial deepwater port. The industries based in the harbour include chemical, pharmaceutical, power generation, steel manufacturing and oil refining. IDA Ireland is the government agency responsible for attracting overseas industry to Ireland. At Ringaskiddy, in the lower harbour, IDA Ireland owns a land bank of over 1000 acres with infrastructural facilities to match the exacting needs of industry. There are five major chemical/pharmaceutical companies located at Ringaskiddy – ADM, Pfizer, Smithkline Beecham, Novartis and Warner Lambert. The co-operation of the local authorities Cork Co. Council, Port of Cork Company, IDA, providers of services and the local community has led to Ringaskiddy's success as a significant site for industrial development. Plants located upriver at Little Island range from pharmaceutical to industrial gas plants. A wide range of companies can be found at Tivoli industrial estate which is situated further upstream close to Cork city. By the middle of the present decade employment in industry in Cork harbour is likely to exceed 5,000 people and the ports frequent shipping services are an important factor in attracting new industries (Port of Cork Yearbook 2000-2001).

The refinery at Whitegate is Ireland's only oil refinery and supplies 40% of the country's needs. In 1997, the refinery had a throughput of 2.9 million tones (equivalent to £257 million/year) one third of which is exported. An isomerisation plant was constructed at the oil refinery at Whitegate to comply with requirements of the Auto-Oil 2000 plan, and EU Programme establishing emission reduction targets. Irish Ispat Ltd., situated on Haulbowline Island in the lower harbour, remains the only steelmaking and rolling plant in Ireland. In recent years it has been developed into one of Europe's most modern steel industries. Significant movement of seaborne traffic occurs at regular intervals at the Haulbowline plant, as 90% of its rolled steel output is exported.

IFI, the Ammonia/Urea Complex is located at Marino Point in Cork harbour and is one of Ireland's largest operating chemical plants. It is a world scale project and incorporates the highest levels of chemical technology. IFI's exports worldwide from the plant at Marino Point have contributed in excess of £500 million towards Ireland's balance of payments since the plant was established at Marino Point (Port of Cork Yearbook 1999).

The Port of Cork company handles commercial trade at City Quays, Tivoli and Ringaskiddy. This represents a significant portion of the trade passing through Cork Harbour. The remainder of the trade operates from private quays, of which the major share flows through Whitegate. It is

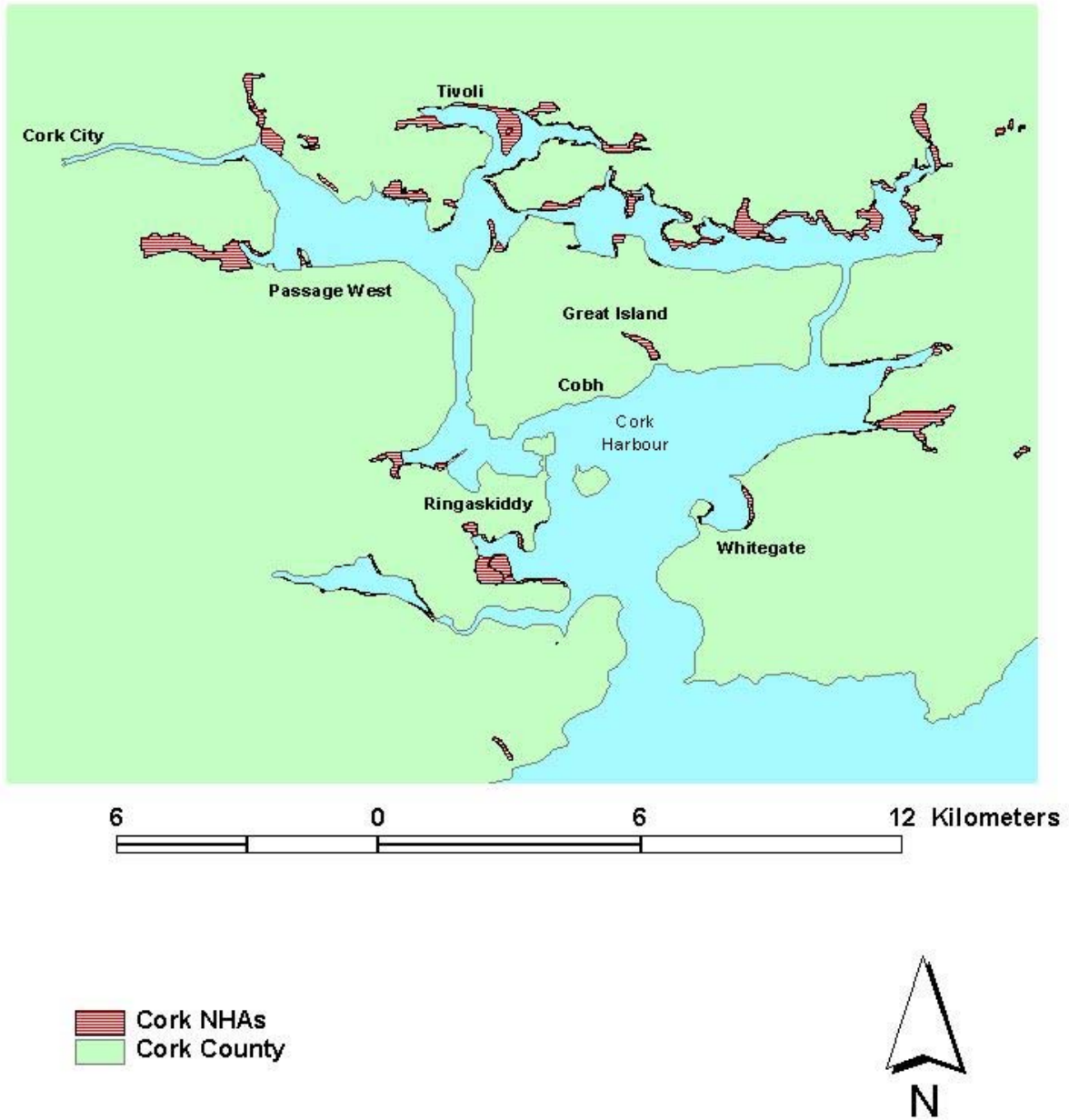
forecasted that in the medium term the commercial port operations at City Quays will decline and cease. This will be driven by the commercial redevelopment of landside estates. In addition it is perceived that the planning authorities are unsympathetic to port developments in the centre of Cork. The Deepwater Terminal at Ringaskiddy was extended to a total of 485m long in 2000. There has been a recent upgrade of the Ferry terminal at Ringaskiddy and the capacity considered sufficient for the foreseeable trade. However aggressive marketing is likely to be needed to maintain market share in this trade, with other Irish ports nearer the UK likely to dominate the Irish Sea corridor. The future for the terminal is seen as trade with mainland Europe and a freight only service to mainland Europe is seen as a possibility. In the medium term the Port of Cork will need new facilities to accommodate trade growth and to reduce the environmental demands and restrictions on existing facilities. (Port of Cork Yearbook, 1999). A recent press release highlighted a record year in trade for the Port of Cork in 2000, with cargo throughput up by 1.2 million tonnes and a 10.2% increase in imports.

To coincide with the dawning of the new millenium the port constructed two visually attractive amenities at Tivoli Industrial and Dock Estate and at Ringaskiddy. These were provided for the enjoyment of the residents in the area and in the recognition of the inconvenience sometimes caused by port development.

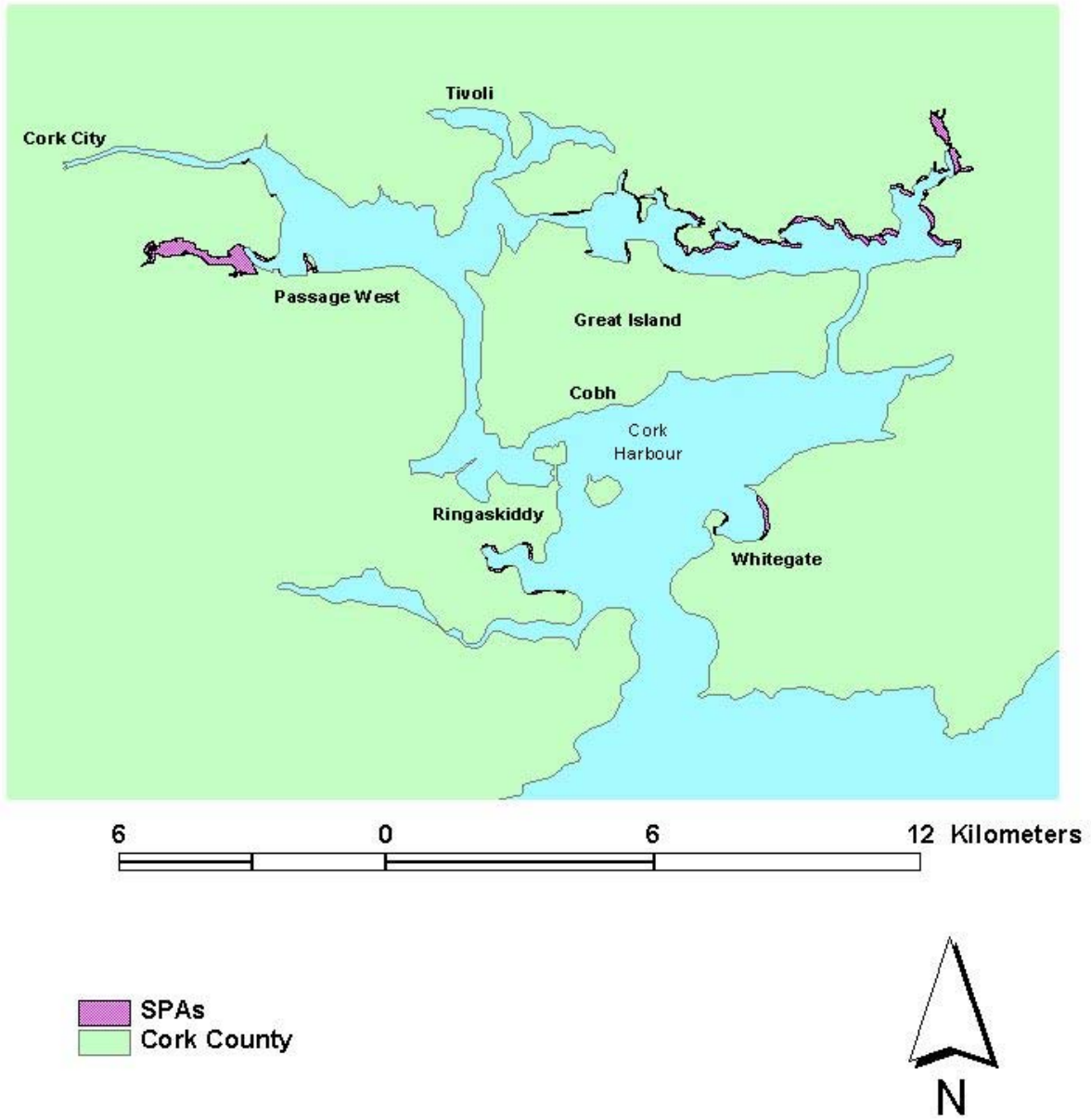


Aerial view of Cork Harbour

NHAs - Cork Harbour
Source: LOSPAN GIS



SPAs in Cork Harbour:
Source LOSPAN GIS



The Shannon Estuary

Tourist facilities

During 1999 the Shannon region's total tourism revenue growth was twice the national average and overseas revenue growth was four times the national average. Looking at trends over the past five years the Shannon region's overseas tourism revenue growth was the strongest of any region in Ireland, growing by over 70%, compared to the national average of 43%. Factors contributing to this include the strength of tourism investment in the region, reflected in the new products that were created, in addition to more effective marketing. Tourism product development is pro-actively pursued by Shannon Development; this semi-state body supports initiatives such as project identification, a tourism advisory service for prospective developers and grant aid for certain categories of tourism projects. Through its network of tourist offices, Shannon Development provided tourist services to over 500,000 visitors to the region in 1998. Tourism resources include golf, heritage features and a range of visitor attractions which are almost exclusively located along the coast-line and tend to be largely marine based. Tourism development is grant-aided from a number of sources including the Operational Programme for Tourism (Shannon Development), LEADER and the County Enterprise Board. Since 1994 over £5 million has been approved for grant-aid in the area. There is a focus on alternative marine related activities and a proposal for a thalassotherapy centre as well as an ornithological centre at Poulfnasherry

Marine tourist development has been significant at the Kilrush marina (120 berths) and eco-tourism (dolphin watching) at the West Clare Peninsula. The Kilrush marina represents the biggest single investment in the area in recent years. Marina facilities have been further complemented by the addition of an associated holiday hostel and watersports activity center. The marina has been a catalyst for other developments in sea angling, sailing training and dolphin watching. Shannon Development has proposed to upgrade a number of smaller quays such as Kilbaha, Carrigaholt, Labasheeda and Kildysert to provide a necklace of satellite harbours and moorings for visiting and local vessels in the study area (Special Interest Marine Tourism in the West Clare Peninsula, 1999).

The power generating station at Moneypoint has infrastructure capable for docking large-scale commercial vessels. Larger vessels could be accommodated here if dredging, as proposed by Shannon Estuary Ports, was carried out at the mouth of the Shannon Estuary. Shannon Development and the Ports Authority are planning to promote the Moneypoint Port and other areas as a turn-around port for cruise liners, utilizing Shannon Airport to pick up and drop off passengers. (Integrated Development of the Shannon Estuary - A Strategic Study, 1989).

Birdwatching and Dolphin watching

According to criteria adopted by the 1974 International Conference on the Conservation of Wetlands and Waterfowl, the Shannon Estuary is a wetland of international importance for birds. Its significance is also recognized in the International Waterfowl Research Bureau list of Wetlands of International Importance for Waterfowl in Western Europe and North-West Africa. The Shannon-Fergus Estuary holds Ireland's largest concentration of wintering wildfowl and waders. Areas of national importance include the Shannon Airport shore and the saltmarsh at Rineanna Point, Aughinish Island and Foynes Island. Special Protected Areas (SPAs) have been designated in the Poulnasherry Bay, Clonderlaw Bay and the Fergus Estuary, primarily to protect the habitat of wintering bird populations. The majority of sites suitable for bird-watching are inaccessible as they are surrounded by private land. As referred to previously there are proposals for the development of an ornithological centre at Poulnasherry.

The geographical location of Ireland at the edge of the continental shelf contributes to it being one of the best locations in Europe for observing whales, dolphins and porpoises. Twenty three species of cetacea have been recorded in waters off Ireland. The bottlenose dolphin population, which inhabits the Shannon, is one of only six resident European populations. This dolphin population has been the centre of a growing tourism industry. Commercial trips to see the dolphins began in 1993 from Carrigaholt, Co. Clare and expanded to Kilrush in 1994. The bottlenose dolphin is listed in Annex II of the Habitats Directive (species requiring the designation of Special Areas of Conservation). Proposals to manage the Shannon Estuary as an SAC are being drawn up by Dúchas (the Heritage Service). Dúchas has drafted legislation (Refuge for Fauna (Shannon Estuary) Designation Order, 1997) restricting boat numbers and activities in the vicinity of the dolphins. In a study of dolphin watching tour boats in the Shannon in 1997 and 1998, baseline information on dolphin watching activities in this area were obtained. This information may be used to determine further research and monitoring needs (Berrow *et al*, 1999). There was evidence from the study that the carrying capacity of present operators at some locations may soon be reached with the possibility of increasing the number of vessels or the use of vessels with greater capacity. Larger vessels means fewer trips are required to accommodate the growing number of visitors and limited number of trips will minimize disturbance to the dolphins. However financial considerations such as the cost of running larger vessels and also the quality of the product on offer are also an important consideration in the development of dolphin watching. The IWC (International Whaling Commission) set down some principle guidelines for whale-watching (1997) and these should be adhered to. It has been suggested that a programme to monitor interactions of tour boats and

dolphins should be implemented at the beginning of any whale-watching/dolphin watching development (Berrow *et al*, 1999). Integrating scientific observations and dolphin watching using the tour boats as ‘platforms of opportunity’ would be beneficial.

A survey of the dolphins in the estuary carried out by researchers at University College Cork, in association with the Marine Institute (Ingram *et al*, 2000), over the past four years, provides a basis from which sound conservation management strategies can be developed in order to properly conserve this species and its habitat, to develop a sustainable dolphin watching industry and to develop/monitor other coastal zone industries such as oil and gas exploration and shipping development within the Shannon.

Aquaculture

The marine food sector in Ireland is valued in excess of £300 million and the aquaculture area accounts for one third the value of Irelands fish output. This has huge potential for growth in production and value added processing. The Minister for the Marine and Natural Resources recently announced a plan for a tenfold increase in annual oyster production on the Shannon Estuary to some 4,000 tonnes over the next ten years. The report, commissioned by Shannon Development and an Bord Iascaigh Mhara with assistance from the Ministers Department and the Marine Institute, and completed by Galway Aqua Consultants Ltd and the Aquaculture Development Centre, NUI, Cork, puts forward innovative proposals for the use of wasteheated water from power stations for aquaculture facilities and the introduction of the farming of species such as eels, turbot and bait worms. It is also proposed that the Marine Institute should conduct research and development studies to facilitate early pilot production of abalone and sea urchins. The report recommends that a coastal management approach should be adopted for the development of the aquaculture industry and the minister announced that he "...fully supports the establishment of a forum to develop an Integrated Coastal Zone Management Group for the estuary which is home to wide ranging and diverse activities including industry, agriculture, fishing and tourism as well as aquaculture. This approach will ensure that the targets outlined in the report are achieved and the legitimate concerns of other users are addressed."

There are oyster farms located at the following sites within the Shannon Estuary Askeaton, Ballylongford, Poulmasherry, Kilrush and Carrigaholt, all of which produce the pacific oyster (*Crassostrea gigas*).

Industrial facilities

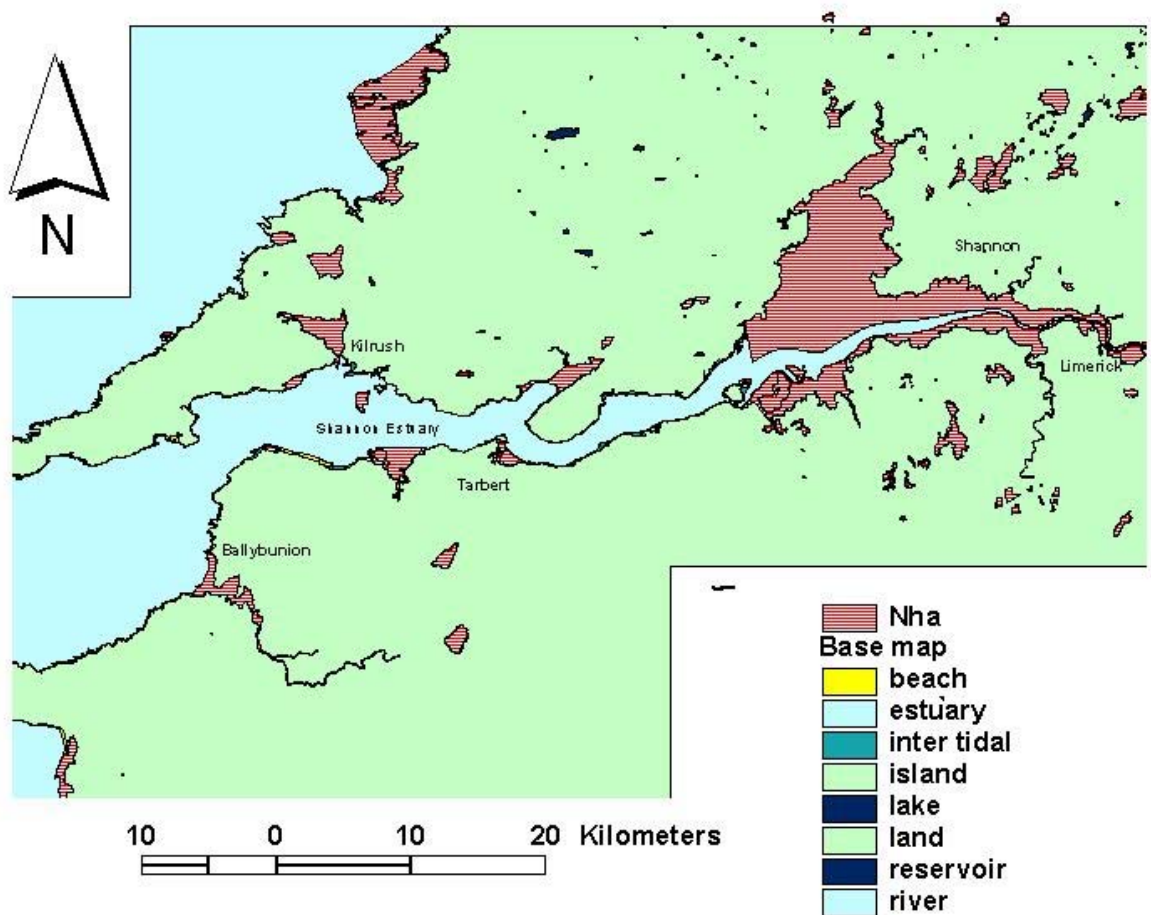
The Shannon Free Airport Development Company (Shannon Development) was set up by the Irish government in 1959, the role of which was to maintain and increase passenger and freight traffic, to create additional employment through the establishment of industrial enterprises and to enhance tourism potential through the creation of new tourist attractions. The company rapidly developed industrial and tourism infrastructures in the region. This early need to innovate was to set the tone for subsequent operations of the company and established Shannon Developments reputation as a leader in the development of regional development initiatives. The Shannon Estuary's success factors include unique investment incentives, world class infrastructure, international airport location, very low corporate taxation, fast approval and establishment of projects. Irelands high-growth, low-inflation economy have made it the top location in Europe for international investment and many companies have chosen to locate and repeatedly expand key manufacturing, international service and software development facilities in Ireland. Shannon Free Zone, Irelands largest cluster of North American investments, has a successful track record as a location for international companies wishing to serve the European market.

Considerable investment has been made at industrial sites at Askeaton, Co. Limerick (100+ hectares) and a large potential industrial site (200+ hectares) exists at Ballylongford, Co. Kerry. Port related industry such as Aughinish Alumina (alumina production), ESB at Moneypoint/Tarbert (electricity generation) and others have created over 2000 jobs in the locality.

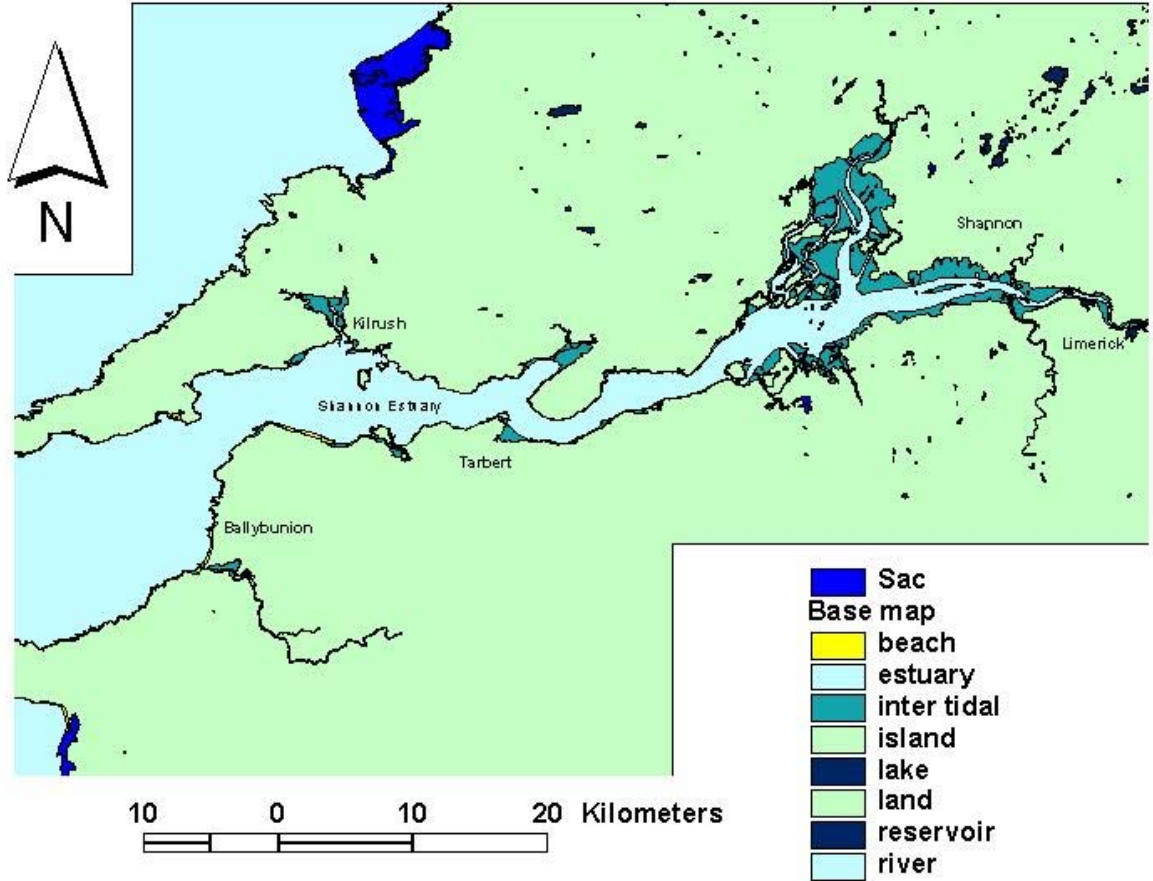
Current strategies aim to promote developments in the Shannon Estuary across a range of economic sectors such as maritime industry, shipping, tourism, aquaculture and other activities. The estuary's future is recognized as being 'multi-functional' and 'multi-sectoral'. However this diversity contains the seeds of significant conflict between users. A process of ongoing coastal zone management will be significant in reducing conflict and enhancing complementary relationships between activities.

NHAs Shannon Estuary

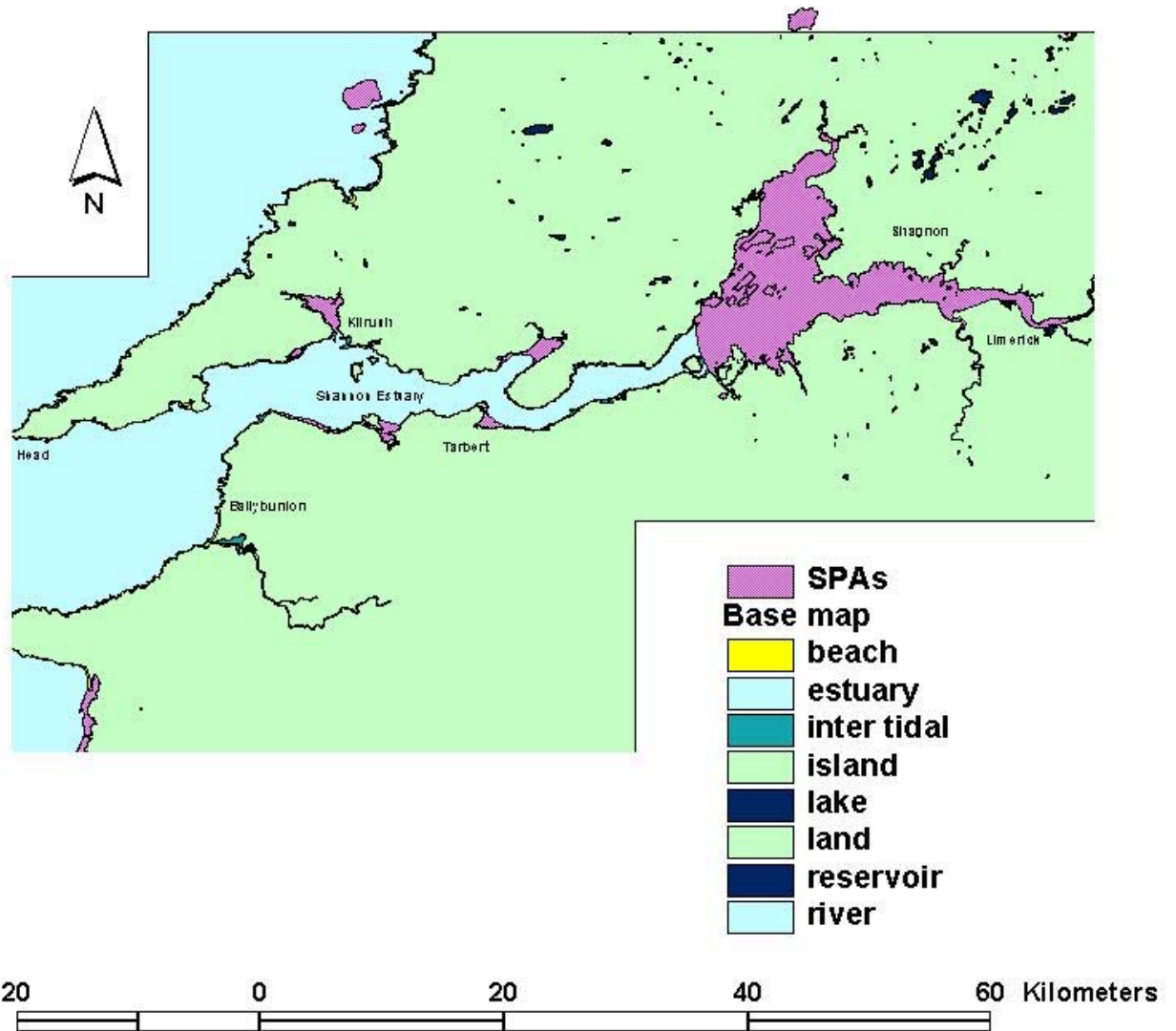
Source: LOSPAN GIS



SACs Shannon Estuary
Source: LOSPAN GIS



SPAs in the Shannon Estuary:
Source LOSPAN GIS



4.4.1 Current status of Indicators in relation to resources of Cork Harbour and Shannon Estuary

The current level of data present to help enable the identification of potential indicators, and the development of monitoring protocols, is mostly due to statutory policies, both national and international. This is especially true in the areas such as water quality. For example, the EPA holds the main responsibility for monitoring the water quality of rivers, lakes and estuaries in Ireland, while the Local Government (Water Pollution) Acts, 1977-90 give primary, but not exclusive, responsibility for control of water pollution to local authorities.

Section 75 of the Environmental Protection Agency Act, 1992, relates to the specification of environmental quality objectives (EQOs) by the Agency. The section requires that the Agency specify and publish quality objectives which the agency considers reasonable for the purpose of environmental protection. EQOs describe the intended use of a particular medium and the quality required for it to be maintained. For example, water uses include bathing, fishing, recreational use and abstraction for drinking water. EQOs are met by the application of EQSs (Environmental Quality Standards) which are media-specific standards (Measuring Progress Towards Sustainable Development - EPA, 1999).

The EPA is currently working to identify sustainable targets for surface water. It is through the use of indicators that the quantity of success in achieving EQOs, EQSs, and sustainable targets can be measured. Table 4.4.1 gives a brief overview of the national environmental indicators identified by the EPA which are of most importance for monitoring the valued resources of Cork Harbour and Shannon Estuary.

Table 4.4.1 Current status of indicators in relation to the resources

Spatial Activity	Driving Force Indicators	Pressure Indicators	State Indicators	Impact Indicators	Response Indicators	Valued resource affected
<i>Industry</i>	Industrial Production, Fertiliser Sales	New building completions (demand for development land and pressures on water and sewerage facilities as well as social infrastructure; Emissions of Nitrogen Oxides and Greenhouse Gases; Use/Fate of Selected Chemicals; River Load to estuaries; Hazardous Waste Generation	River Water Quality (BOD, Nitrate levels, Orthophosphate) Changes in Bird Population (Habitat loss)	Fish Kills, No. of Threatened fauna; Drinking water quality and increased water treatment costs; Effects of chemicals on biota	% of industry with IPC licenses; extent of nutrient removal by industry; % of urban wastewater treated in compliance with EU Directive.	Birdlife, Fisheries, Aquaculture Water Quality, Tourism
<i>Tourism</i>	Population increase. Economic growth and demands on leisure activities.	New developments in scenic areas –holiday homes, golf courses etc. Increasing pressures on local infrastructure.	Water quality changes; Localised reduction of fish stocks due to overfishing; Changes in Bird populations due to disturbance and habitat loss.	Noise nuisance, bathing water quality; Blue Flag beaches	Number and Area of Protected Sites; Environmental Strategies and Management Plans; Environmental Awareness and Attitudes	Water quality; Birdlife; Fisheries.
<i>Agriculture</i>	Trend in Nitrogen sales; Livestock intensity.	N and P emissions to air and water; N and P budget surplus; Soil P status	Lake water quality, Nitrate levels in rivers; Phosphorus levels in soils.	Economic /ecological costs to fisheries; Increased water treatment costs;	% of farms in REPS schemes; % of farms with NMP	Water Quality; Fisheries;
<i>Land Use and Housing Development</i>	Population increase	Increasing demand for development land and pressures on facilities; Household waste arisings	Changes in water quality; Smoke concentrations in built up areas; Loss of habitat and effect on flora and fauna.	.Noise nuisance; Water quality; Traffic safety; Trends in journey times in cities	% of urban wastewater treated; Sales of unleaded petrol; Recycling rates	Water Quality; Birdlife.
<i>Fishing</i>	Population increase		Reduction in fish stocks	Overfishing, wasteful by-catches and negative impacts on seabirds and marine mammals.	Conservation strategies – CFP stringent fishing quotas; targeting new species; changes in awareness and attitudes.	Fisheries; Cetaceans; Birdlife.

5 SPATIAL POLICY INDICATORS - SPECIFIC EXAMPLES

5.1 Introduction

5.2 Specific examples of indicators in estuarine environments - 4

Cork Harbour and the Shannon Estuary

Water quality

Water quality is considered a valuable indicator in the present study as the spatial activities identified in both Cork Harbour and the Shannon Estuary will have direct and/or indirect effects on water quality which in turn will affect the valued resources identified in the estuaries (e.g. tourism, birdlife, fisheries etc).

The governmental bodies responsible for the monitoring of water quality in Ireland are the Environmental Protection Agency (EPA), the Marine Institute and local government (Corporation and County Council).

Environmental Protection Agency (EPA)

In Ireland, the EPA is responsible for monitoring the water quality of rivers, lakes and estuaries. Both winter and summer surveys are carried out by the EPA to assess maximum nutrient levels and maximum growth levels of algae in estuarine systems. Measurements of oxidase, nitrogen, ammonia, chlorophyll content as well as standard pH, salinity and temperature are recorded. Water quality is assessed to identify 'sensitive' and 'less sensitive' areas in the context of the EU Urban Waste Water Treatment Directive. Estimation of riverine inputs of pollutants to the Harbour also takes place and this involves the estimation (from measurements and extrapolation) of the loads of selected substances carried into the estuary, primarily nutrients and metals. This information is needed for the comprehensive study of riverine inputs, which states who have ratified the Oslo and Paris Conventions for the Protection of the Marine Environment of the north-east Atlantic (OSPAR) are obliged to undertake. This began in Ireland in 1990 and is on-going. The EPA's State of the Environment Report for Ireland in 1996 stated that only limited serious pollution and little change in condition had occurred since the previous review period (1987-1990). Findings of the EPA's surveys are reported in recent publications on water quality in Ireland and available on request.

County Councils

County councils have had a role in monitoring estuarine water quality in the past and surveys were carried out at three to four year intervals. The last survey of Cork Harbour was carried out in 1997 jointly with the EPA and nutrient levels at five points in Cork Harbour were measured. There are no plans at present for future surveys of the Harbour, it appears that the responsibility for any future surveys lies with the EPA. Many counties have included coastal zone management in their county development plans and recognise the importance of improvements in water treatment and effluent discharges etc. Although local authorities are not directly involved with the monitoring process, they play an important role in the management of Ireland's coastal waters.

The Marine Institute

The determination of water quality, trace metal levels and chlorinated hydrocarbon concentrations in fish and shellfish from Irish waters is carried out to fulfil the monitoring requirements of legislation such as the 1979 European Union Council Directive 79/923/EC, the European Commission Decision 1993 and the requirements of the Joint Monitoring Programme of the Oslo and Paris Commissions (OSPAR). This analysis is undertaken by the Marine Institute and provides valuable information for the National Monitoring Programme. Water and shellfish samples are collected from major-shellfish growing areas and analysed for physiochemical and chemical parameters. Temperature, salinity, pH and dissolved oxygen measurements are taken as well as water samples for suspended solids determination. This is carried out by the Fisheries Research Centre (FRC) and the current programme of monitoring in Irish waters began in 1993 twice yearly. The frequency of monitoring has been reduced to once a year where conditions have been shown to be in accordance with the Directive. Shellfish are examined for metal and hydrocarbon analyses. A report of the 1995 survey of Cork Harbour showed that water and shellfish quality was good and conformed to the requirements of the Directive. Organochlorines and organics measured in Cork Harbour continued to be very low. Results of the surveys can be found in FRC reports on the marine monitoring programme which are produced annually. An ongoing trend monitoring programme is carried out by the FRC for the purpose of food safety, this has been running for the past four years and involves the monitoring of water and shellfish quality.

The Fisheries Research Centre also carries out a biotoxin monitoring programme and is the EU designated National Reference Laboratory on Marine Biotoxins in Ireland (Council Decision 93/383 EEC). The programme, which began in 1984, is operated under EC Directives 91/492 and 91/493 and involves testing the shellfish for toxins and analysing water samples for toxin producing phytoplankton. The complex toxin profile of Irish shellfish waters necessitates year round vigilance

on the part of the industry and monitoring agency and the Marine Institute recommends that weekly testing should be integrated into the producers routine quality control procedures. The results of the monitoring programme have shown that DSP (Diarrhetic Shellfish Poisoning) is detected regularly in many of the shellfish areas in the country. PSP (Paralytic Shellfish Poisoning) toxicity has also been detected, though not as frequently as DSP. The monitoring programme ensures that these harmful toxins (along with new toxins discovered in recent years eg. *Spiramino acid*) do not reach the market and hence cause no threat to human safety. The research into the sources and distribution may provide a solution to the problem that has caused huge economic losses to the shellfish industry in Ireland annually.

It is noted in the State of the Environment report of 1996 that pollution was evident in the Lee Estuary in Cork Harbour. The measured deoxygenation was regarded as not sufficient to impede the passage of migratory fish; however, it was stated that variations in oxygen levels need further assessment. Heavy metal levels in water, sediments, fish and shellfish are monitored. The State of the Environment report of 1996, stated that elevated concentrations of three metals, copper, zinc and mercury were found in Cork Harbour; the levels were noted as either stable or decreasing over time. The degree of organochlorine contamination was deemed exceptionally low in the European context. Water quality in both channels of the River Lee in the upper Harbour has improved over the past twenty years due to the installation of interceptor sewers that channel sewage downstream of the bridges. There has also been a reduction in BOD load discharged into the estuary from industrial sources. However, there is still significant room for improvement in water quality particularly in the upper harbour. It is stated in the EPA report on Water Quality in Ireland 1995-1997 that BOD, ammonia and phosphate concentrations were frequently elevated in the upper harbour, which may be associated with local wastewater discharges. Values of these parameters were all generally low in the outer harbour, with the exception of occasional high values in the Ringaskiddy/Cobh area. While water quality has generally remained good in the outer harbour, the export of enriched water from the inner harbour was occasionally sufficient to stimulate enhanced phytoplankton growth in this area.

The Cork Main Drainage Scheme is currently underway and this will facilitate compliance with the EU Wastewater Directive under which discharges of untreated sewage from major coastal towns are to be eliminated by the year 2000. The completion of the Cork Main Drainage Scheme, including the operation of the treatment plant, will have a major influence in improving water quality. The EU Urban Wastewater Directive will require treatment of Midleton's sewage effluent, this along with improvements that have already taken place to Midleton's drainage system should ensure a higher

water quality. Colloidal suspension in washings from sand and gravel extraction is potentially harmful to fish life. The incidence of a number of deposits along the northern shoreline of the channel could give rise to water quality problems unless stringent controls are maintained (County Development Plan 1996). A joint initiative is ongoing between Cork Corporation, Cork County Council and private industry to survey water quality in Cork Harbour. This will improve water quality management in the future and also prepare the way for a Water Quality Management Plan, which was referred to in the Cork City Development Plan 1998.

The main threat to water quality of the River Shannon is eutrophication or over-enrichment by nutrients, particularly phosphorus. Investigations of some of the lakes of the River Shannon carried out in the early 1990s indicated a marked decline in the water quality and the decline was attributed to excessive inputs of phosphorus. Sources of phosphorus were identified as agricultural activities and municipal waste discharges. A catchment monitoring and management plan was commissioned to oversee an improvement in water quality of the River Shannon catchment by the reduction of phosphorus inputs from all sources. Results of investigations suggest that the symptoms of eutrophication, high chlorophyll concentration and reduced water transparency have been ameliorated significantly in recent years. However the decline in phosphorus concentrations in the lakes indicate that the reductions to date in the input of this nutrient are not sufficient to make this element growth limiting. Instead there is strong evidence that zebra mussels (a non-native species of bivalve, first recorded in Ireland in 1997) are controlling the size of populations of planktonic algae and cyanobacteria in the water. It was evident that the concentrations of phosphate were sufficient to support higher growths of algae and cyanobacteria and in the event of a decline in the zebra mussel population it is likely that chlorophyll concentrations will increase again. There is therefore need to reduce phosphorus emissions further (River Shannon Lake Water Quality Monitoring, 1998 & 1999, EPA).

EPA surveys carried out over the period 1995 to 1997 in the estuary showed that BOD concentrations were generally low throughout the estuary, oxidised nitrogen concentrations were relatively low in relation to salinity, ammonia concentrations were low except in the vicinity of Limerick where moderate levels were recorded. The entire estuary was generally phosphorus limited throughout the year. Overall there was no apparent change in water quality of the Shannon estuary since 1991-1994 (Water Quality in Ireland, 1995-1997, EPA).

The recent Water Framework Directive (2000) established a framework for community action in the field of water policy and will involve the integration of the various bodies responsible for water

management in Ireland. As a follow-up to the recently adopted Water Framework Directive which entered into force on 22 December 2000, the European Commission has proposed a list of 32 priority substances to be phased out, including eleven substances identified as hazardous. Once this list has been finally adopted by the Council and the European Parliament, the Commission will propose Community-wide water quality standards and emission controls for these chemicals. For substances on the list classified as priority hazardous substances, the controls will mean that all releases to the aquatic environment will cease within a 20 year period. Some of these substances are well known pollutants such as mercury, cadmium and tributyltin.

Air Quality

Air quality monitoring in Ireland remains focused on the measurement of sulphur dioxide and particulates (smoke) with simultaneous measurements of daily values of the two pollutants at almost 60 monitoring sites throughout the country, mainly in urban areas. The standards currently in force in Ireland follow from EC Directive 80/779/EEC (CEC, 1980) on air quality limit values for SO₂ and suspended particulates which specifies limit values for annual, winter and daily reference periods. The levels of both smoke and SO₂ in 1998/1999 were very low and fully compliant with the Irish air quality standards (Air Quality Monitoring annual report 1998, EPA). The Air Quality Framework Directive 1996 (96/62/EC) provides a framework under which the European Commission is bringing into force a range of daughter directives to tackle a wide range of priority air pollutants throughout Member States.

Emissions from point sources typically arise in the context of industrial processes; ambient air quality monitoring is just one way of monitoring/assessing the impacts. Complementary stack emission monitoring is commonly carried out to ensure compliance with licensing requirements. Dispersion modelling allows the likely impacts of these emissions to be determined numerically, facilitating comparisons with limit and guideline values for ambient concentrations. As the accuracy of such predictions is uncertain, emissions monitoring and dispersion modelling cannot always provide reliable estimates of pollution effects. The measurement of atmospheric pollution concentrated at dispersion points in the vicinity of a point source remains the most reliable method of determining air quality. A complete assessment of air quality through monitoring alone requires a well distributed and maintained network of monitoring stations, employing reliable and accurate measurement equipment. However these are expensive and it is important that monitoring campaigns are carefully planned to ensure that as much useful information as possible is gathered with the available resources.

The European Air Quality Framework Directive requires that areas around significant point sources be defined as air quality zones and that the air quality is assessed at least every five years. This requires the completion of short monitoring campaigns in the vicinity of the point source (Optimal Monitoring of Air Quality in the Vicinity of Point Sources – report for EPA, Feb., 2000).

Air quality data are obtained largely from Local Authority monitoring programmes and also from the Environmental Protection Agencies monitoring activities. In order to comply with Integrated Pollution Control (IPC) license requirements, industrial companies must carry out their own emissions monitoring and incorporate the data in their license application. Data from the many industries in Cork harbour is held at the EPA regional office in Inniscarra, Co. Cork. It is evident that the majority of the industries situated in the harbour comply with the IPC license requirements. The EPA contacted the pharmaceutical company Warner Lambert, which is situated in Ringaskiddy in Cork harbour, in January 2001, commending them on having a compliant audit and noted the efforts made to comply with the requirements of the IPC license. This is not always the case however and much controversy surrounding air pollution from Irish Ispat (steel industry) in Cork Harbour has occurred over the past number of years. Numerous records exist of complaints from the naval base at Haulbowline and from local people in the area surrounding Ispat. These complaints refer to emissions causing significant environmental pollution. A letter sent to Ispat in January 2001 from the EPA required Ispat to cease all activities giving rise to these emissions and if this did not occur then the agency will apply to the High Court for injunctive relief against the facility. Irish Ispat responded to the EPA's 'Air monitoring report' of Jan. 23, 2001 and acknowledged that guideline limit values were exceeded on a number of occasions and that the probable cause of this was due to the castor fans. Irish Ispat proceeded to point out that an abatement system has been decided upon and instalment planned for April 2001 and that ambient levels of various pollutants will be reduced significantly.

In an EPA report on Ambient Air Monitoring at Haulbowline Naval Base June-August 2000, a mobile laboratory was used. Levels of lead, benzene, SO₂, oxides of nitrogen and carbon monoxide were measured and none of these exceeded directive limits during the monitoring period. However concentrations of PM₁₀ particles exceeded the annual limit value for the protection of human health. On three episodes where very high levels of PM₁₀ particles were recorded, it was noted that easterly winds were blowing from the Irish Ispat steel plant to the Naval Base (information provided by the EPA, Cork).

Air quality monitoring in Cork is also carried out by the Cork Corporation. Parameters such as suspended particulates, sulphur dioxide, nitrogen dioxide, nitric oxide, carbon monoxide, ozone,

lead and aromatics are considered. These are mainly generated or affected by fuel consumption in traffic and space heating including domestic. The data generated from the Cork Corporations monitoring scheme is forwarded at the end of the year to the EPA and it is intended that eventually they will have access to this data through a modern link. In a report on air pollution in Cork city produced by the Cork Corporation in 1999, suspended particulates had been reduced from 90% to 30% of the EU limits due to the ban on the sale of coal. Sulphur Dioxide levels were always low in Cork, reaching about 25% of the EU limit. Nitrogen Dioxide levels were 50% of the EU limit. Ozone levels reached a maximum of 90% of the EU threshold value. Carbon monoxide levels were found to be about 50% of UK and WHO standards. Lead monitoring has restarted in Cork and levels have fallen from 10% to 2.5% of the EU standard over the past 10 years due to an increase in sales of unleaded petrol (Air pollution in Cork city, Cork Corporation, 1999 report).

The EPA completed a draft National Air Quality Monitoring Programme in 1999 and invited comment from the department of the Environment, Local Authorities and other interested parties. The programme details the extent of air quality monitoring to be carried out in the State over the coming 10 years to meet national needs and to implement Directive 96/62/EC. A substantial increase in the level of air quality monitoring is proposed by the EPA with an emphasis on continuous monitoring for priority pollutants such as nitrogen oxides and particulate matter in urban areas. Extended or new monitoring networks of fixed measurement stations are being established in 2001 and these will be supplemented by mobile monitoring facilities

Biological indicators

Tributyltin (TBT) has been used extensively since the 1970s as a biocide in antifouling paint on ships and small boats and also in the 1980s on cage netting in salmon farms. Since 1987 its use was prohibited on vessels less than 25m in length and on all structures including nets as it is highly toxic to many marine organisms. It acts as an endocrine disruptor in certain gastropods; female dogwhelks develop a progressively masculine physiology that is dependent on the amount of TBT in the tissues. Reproductive impairment of marine fauna resulting from TBT contamination has resulted in population decline in some areas. Since 1987 periodic surveys have taken place using dogwhelks as biological indicators and it enables the mapping of TBT dispersion from source and changes in contamination. There has been a general reduction in TBT contamination in areas of aquaculture and small craft but an increase in other areas, especially estuaries and embayments where ships are present and may have TBT applied in docks. There is a significant amount of boat traffic in the Shannon Estuary every year, approximately 8m tonnes of port traffic, particularly in

coal, oil, iron ore and animal foodstuffs. The Shannon Estuary is a significant contributor to international port traffic in Ireland and hence the issue of TBT is of relevance. Increased controls are necessary to reduce TBT levels in the environment and the ban on the use of TBT-based paints extended to include vessels up to 50 metres in length. Source: Marine Institute (Environment in Focus, EPA 1999).

Bioassays can provide information on the toxicity of contaminated sediments of estuaries by measuring the level of effect on test organisms through pre-selected endpoints. Some species of bivalve molluscs (eg. *Scrobicularia plana* and *Macoma balthica*) have been identified as suitable indicators of sediment contaminants, especially metals. Studies carried out on the potential use of *Tapes semidecussatus* for bioassays have shown that it is suitable for use in commercial whole sediment toxicity tests, especially in Ireland (Byrne & O'Halloran, 1999).

Tourism as a spatial policy indicator and its relevance to the Shannon Estuary

Tourism and the trend in number of visitors is considered to be a driving force indicator. Tourism has become a significant part of the cultural and economic development in Ireland over the past number of years and supports thousands of jobs many of which are in rural communities. In 1998, the number of overseas tourists was over 1.5 times the resident population. This increase in tourist numbers is creating increased pressure on the physical infrastructure and increased traffic congestion in major tourist areas. Alongside this there lies the problem of increasing pressure put on the natural environment in sensitive areas. This recognition has led to a pilot Initiative on Tourism and the Environment by the Department of Tourism, Sport and Recreation which is now underway and aims at demonstrating how particular problems affecting tourism and the environment might be dealt with (Environment in Focus, EPA 1999). The trends in visitor numbers to the Shannon region between 1993 and 1997 show that the tourism revenue increased in this region by 13.6% over this period and visitor numbers increased by 3%. There is potential for the development of ecotourism in the estuary through dolphin watching. However, stringent controls must be set in place to protect the dolphins from negative impact of tourism (as discussed in section 4.4).

5.3 Teign Estuary

[Development/Landscape theme]

5.4 Exe Estuary

[Agriculture theme]

5.5 Morlaix Bay

[Water Quality/Shellfish theme]

5.6 Summary

6 PROTOCOLS FOR MONITORING INDICATORS

6.1 Introduction

6.2 Cork Harbour

6.3 Shannon Estuary

6.4 Teign Estuary

6.5 Exe Estuary

6.6 Morlaix Bay

6.7 Summary

7 MANAGEMENT STRUCTURES

8 DEVELOPMENT OF PHASE 3

REFERENCES

Air Pollution in Cork City, 1999 report, Cork Corporation.

Air Quality Monitoring, annual report 1998, Environmental Protection Agency.

Berrow S.D., 1999. Tour boats and dolphins: A note on quantifying the activities of whalewatching boats in the Shannon estuary, Ireland. *J. Cet. Res. Manage.* 1(2):1-5

Byrne P.A., O'Halloran J., 1999. Aspects of assaying sediment toxicity in Irish Estuarine ecosystems. *Marine Pollution Bulletin*, Vol. 39, 97-105.

Clenaghan C., Crowe M., Carty G., 1999. Measuring Progress Towards Sustainable Development with Special Reference to the Aquatic Environment, Waste Management and the Urban Environment. Environmental Protection Agency, Wexford.

CEROI (Cities Environment Reports on the Internet). DPSIR Framework - tutorial page. (www.ceroi.net/reports/arendal/dpsir.htm)

Department of Economics, UCC, 1997. Independent report.

Department of the Environment and Local Government, 1997. Sustainable Development - A Strategy for Ireland. Department of the Environment and Local Government, Dublin.

Department of the Environment, Transport and the Regions, 1997. Indicators of Sustainable Development for the United Kingdom. (www.environment.detr.gov.uk/epsim/indics/isd.htm)

Dunne L., Convery F., 2000. Key Indicators of Urban Environmental Performance in Ireland. (<http://members.home.net/earth2000/Dunne.html>)

Environment In Focus - A Discussion Document on Key National Environmental Indicators.1999. Environmental Protection Agency, Wexford.

Field Studies Council Research Centre & Natural Environment Consultants Ltd. The South East Coast of Ireland, An environmental appraisal (1995).

Ingram, S., Rogan, E., Holmes, B & O' Flanagan, C., 2000. A survey of bottlenose dolphins in the Shannon Estuary. The Marine Institute, Marine Resource Series, March 2000.

Irish Aquaculture – The Future. Strategies for meeting the global seafood challenge, CIRCA, June 2000.

Kristensen P., 1997. Feasibility study on the production of a yearly EEA Indicator Report - a report to the European Environment Agency. National Environmental Research Institute, Denmark.

National Development Plan 2000 - 2006; A Marine Research, Technology, Development and Innovation Strategy for Ireland.

Organisation for Economic Co-operation and Development, 1993. OECD Core Set of Indicators for Environmental Performance Reviews - A synthesis report by the Group on the State of the Environment. OECD/GD(93)179, Environmental Monographs No. 83.

Optimal Monitoring of Air Quality in the Vicinity of Point Sources – report for the Environmental Protection Agency. Feb., 2000.

Port of Cork Yearbook 2000/2001.

Port of Cork Yearbook 1999/2000.

River Shannon & Lake Water Quality Monitoring, 1998 & 1999, Environmental Protection Agency.

Scott S., Nolan B., Fahey T., 1996. Formulating Environmental and Social Indicators for Sustainable Development. Policy Research Series, Paper No. 27, March 1996. The Economic & Social Research Institute, Dublin.

Shannon Development, 1989. Integrated Development of the Shannon Estuary, A Strategic Study. Shannon Free Airport Development Company.

Smeets E., Weterings R., 1999. Environmental indicators: Typology and overview. Technical report No. 25. European Environmental Agency, Copenhagen.

Special Interest Marine Tourism in the West Clare Peninsula. Marine Institute, Shannon Development and Clare Co. Council, 1999.

Water Quality in Ireland, 1995-1997, Environmental Protection Agency.

Water Quality Management Planning in Ireland. 1999. Environmental Protection Agency, Wexford.