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**ENVIRONMENTAL INDICATORS FOR THE URBAN ENVIRONMENT:
A LITERATURE REVIEW**

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Environmental Indicators for the Urban Environment: A Literature Review

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ABSTRACT

A vast body of literature exists on the genesis and evolution of environmental indicators of all varieties. This document attempts to track the somewhat complicated progress of urban environmental indicators, where they are in usage and to what avail. It also emphasises the search to narrow down the range of 'ideal' indicators. The literature suggests that as experience and practice with indicators grows both in Ireland and world-wide the key set of urban environmental indicators can help policy makers and the public track sustainability issues more effectively. Indicators thus have a valuable role to play in the future of sustainable planning for urban areas.

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INTRODUCTION

A vast body of literature exists on the genesis and evolution of environmental indicators of all varieties. Their use and usefulness has been endorsed by the European Union, the Organisation for Economic Development, Eurostat and the World Health Organisation amongst others. This document attempts to comprehensively track the somewhat complicated progress of urban environmental indicators, where they are in usage and to what avail. Good examples are available from other countries that have invested in these areas of research, and lessons can be learned to apply to the Irish urban situation. There is an increasing need to monitor the trends in our rapidly growing society easily and simply. In the trial and error process to finding the most effective set of indicators, a review of the research to date can point us in the right direction and save time and errors.

This literature review was undertaken as part of an Irish EPA project to identify key indicators for the urban environment in Ireland. As such, the indicators looked at fell under distinct headings. These were:

1. Urban Demographics/Renewal
2. Transport
3. Environmental Quality Indicators
4. Noise
5. Built Environment
6. Ecological Footprint

There has been a certain amount of indicator application in Ireland, and this is discussed. The EPA has begun to increasingly focus on indicators, and local authorities can use them to chart progress over time and compare themselves to other urban areas. As experience and practice with indicators grows both in Ireland and worldwide the key set of urban environmental indicators can help policy makers and the public track sustainability issues more effectively.

URBAN ENVIRONMENTAL QUALITY

Urban areas are never static, they are constantly changing undergoing either expansion or contraction (Couch, 1990). With all their activities, buildings, infrastructure, services, institutions and populations, cities and towns form a complex mosaic of visible and invisible parts (OECD, 1997). Therefore, if urban policies are to be effective in urban areas, they should rely on understanding the dynamic and inter-related nature of a city's components. Comprehensive knowledge and information is needed to facilitate this. Dekker *et al.* (1992) state that certainty is directly related to rational behaviour because it makes decision making easier and it increases the chances of making the right decision. Currently however, this knowledge is incomplete and the capacity to address problems in urban areas is hampered by a lack of coherent and reliable data.

As an increasing proportion of the population live in urban areas (EPA, 1999), the importance of gathering information about these areas grows. Improving sustainability and quality of life for the citizens of an urban area include such factors as air quality, green space and access to public transport amongst many others.

Urbanisation and the function of Cities in the European Community

The European Commission's Green Book on the Urban Environment (1990) led to the establishment of the Expert Group on the Urban Environment in 1991. This paper was a watershed in giving a boost to policy consideration of the urban dimension and for bringing the potential of land-use planning to prominence

The study *Urbanisation and the function of Cities in the European Community* (1992) carried out by the European Institute for Urban Affairs, was important in highlighting some of the changes in the European urban system since the 1970's and the subsequent impacts of such changes on the Community as a whole (European Institute for Urban Affairs, 1992).

The Green Book on the Urban Environment (1990) initiated the European Sustainable Cities Project in 1993, the launch of the European Sustainable Cities & Towns Campaign in 1994, and the May 1997 Communication on the urban agenda.

The Dobris Assessment (1994) was the first pan-European state of the environment report by the European Environment Agency (EEA), and dedicated an entire chapter to the urban environment. Once again, the links between economic, social and environmental conditions are firmly established. The quality of the environment in over 50 European Cities was studied. Analysis of urban patterns, urban flows and urban environmental quality, led to the identification of five problem areas. These included air quality, noise, traffic, housing quality and the extent of and variable access to green areas and open space. The recommended action for cities arising out of this report is for the integration of policy and the adoption of an ecosystem approach to environmental management.

If urban policies are to be effective, they should rely on understanding the interrelated nature of the components of cities, especially in order to address urban conditions and long-term developments. Modern economic, social and urban policies have yielded many improvements, but not all cities and urban neighbourhoods benefit equally. Contemporary urban problems include environmental problems (e.g., air and noise pollution), socio-economic deprivation (e.g., crime, delinquency, homelessness and unemployment) and political problems (e.g., fraud and social unrest) (OECD, 1997). The persistence of urban problems suggests that our current understanding of cities is incomplete and ineffective.

Politicians, professionals and policy decision-makers have had much difficulty in identifying, describing, measuring and explaining constancy, change, ruptures and disparities in the condition and the development of cities. There is now a double challenge facing policies which affect, and contribute to, urban development and planning: to promote sustainable development, and at the same time to remedy the effects of mistaken policies of the past. A supportive framework is emerging at the EU level, which attempts to link effectively with national and local government policies and initiatives, and action is now needed to implement specific measures within this framework. Policies to address urban environmental issues show serious weaknesses, as follows (EEA, 1999):

- Urban growth is inextricably linked with economic growth, although it is not clear which fuels which.
- The spatial impact of telecommunications and computerised information networks is not yet known.

- Time lags associated with air pollutants exposure impacts compound to monitoring shortcomings and knowledge gaps, and make prioritisation and targeting difficult.
- The lack of Community agreed standard methods for assessing acoustic quality seriously limits the use of current EU legislation.
- The spatial impact of policies is difficult to measure, particularly due to the lack of adequate indicators for urban areas and of area typologies.

INDICATORS

The Role of Indicators

The OECD programme on environmental indicators has three major purposes (OECD, 1994):

- Keeping track of environmental progress;
- Ensuring that environmental concerns are taken into account when policies are formulated and implemented for various sectors, such as transport, energy and agriculture;
- Ensuring similar integration of environmental concerns into economic policies, mainly through environmental accounting.

The OECD identifies the three main functions of indicators as:

Simplification:	to reduce the number of components and measurements which are required to give an in-depth account of a condition or situation, as such, indicators and the amount they encompass, are limited in scope and content.
Quantification:	in order to provide a synthetic account of a specific condition or situation that can be analysed in further detail
Communication:	Indicators convey a message that ought to be easy to interpret. Therefore it is necessary to consider the aim and content of the message and who will interpret them (OECD, 1997).

The effectiveness is dependent on their ability to (MacGillivray and Zadek, 1994):

1. Communicate useful information: i.e. enabling situations to be understood and decisions made
2. Meaningfulness: i.e. accurately portraying what is happening
3. Resonance: i.e., allowing people to grasp the relevance to their own lives.

The following three principles should be remembered when using environmental indicators (OECD, 1994):

1. Indicators provide only one tool and need to be complemented by other information
2. Indicators must be reported and interpreted in the appropriate context
3. There is no single method of standardisation for the comparison of environmental variables across countries.

As such, the establishment of an indicator set is not an end in itself. If issues exist it is important to go beyond the data and understand the relationship and to perceive the uncertainties stemming from different degrees of vulnerability of receiving media and between areas and time.

The values of indicators are enhanced when they are used in combination with targets that have been set as part of national policies (Commission for Sustainable Development, 1995).

Indicators are not necessarily tools in themselves. In order to make them useful they must be: presented within their framework and linked to standard socio-economic statistics; the indicator system should provide enough detail to cover the political debates; it should give continuity to the societal actors, in order to provide them with a good basis for the planning (e.g., of investments or political instruments); and the indicator system should reflect the structure of the existing debates.

Representatives of economic sectors, environmental agencies and politicians may feel uneasy discussing their arguments with a wider audience, but in the long run all sides can profit from quantified commitments that are based on a public consensus, and thus cannot be easily overthrown by sudden switches of public opinion.

There is a trade-off between the need to simplify and condense information (making political mechanisms more transparent), and the desire to keep the indicators so simple that their users can still link them to the environment. The experience with other complex issues, such as the economy, shows that condensation and abstraction is necessary. Nobody wants to see the thousands of time series that are necessary to create GDP.

The Quality Issue

Defining a "good" indicator is a rapidly growing industry, fraught with difficulties. The OECD's work, for example, highlights three basic principles:

1. indicators are just one evaluation tool;
2. they should be reported and interpreted in an appropriate context;
3. there is no single method of standardisation for comparisons.

Whilst useful, such principles do not fully engage with the complex negotiation of interests that underpins the selection of indicators.

In practice, each person or organisation decides what sort of indicators they will work with, based on their own agenda. To some groups, indicators that will communicate meaningful and resonant information to their intended audiences, is of paramount importance. Conversely, those in search of technical excellence can overlook the needs of the audience.

While there are many questions and debates over indicator type and relevance, there remains a number of desirable characteristics that any indicator should possess (Hoon *et. al.*, 1997). Indicators should be:

1. developed within an agreed conceptual and operational framework;

2. sensitive such that a small change to the measures should result in a measured change in the indicator;
3. clearly and consistently defined so as to be unambiguous regarding interpretation and consistent results in different situations;
4. specific and measurable in that they have an explicit scale ranging from undesirable states to desirable states, that allows them to be used for assessment purposes;
5. policy oriented so as to provide practical information by being able to record either changes in the means recommended by policy or changes in the development impact attributable to policy;
6. Reflect input, output process and impacts;
7. Be readily collectable and thereby lower the technical and collection costs;

The Integration Issue

It is vital to clarify the assumptions and purposes behind the selection of a set of indicators, and to recognise their intended audience - as well as to identify the likely reactions (MacGillivray and Zadek, 1994).

We measure what we value, and we also come to value what we measure. In this context, indicators must be dynamic and process-oriented and reflect the following properties (*Ibid.*):

- require concepts and theories of change, which also lend themselves to developing indicators;
- nested relationships between individual, community, national, and global levels;
- interconnectedness between different elements, where change in one element is related to and impacts on the other elements. These processes of change reflect feed- back loops (positive and negative), sudden changes (punctuated equilibrium), and uncertainties in the whole process;
- be contextual in nature. This assumes that such indicators are not an understanding of reality waiting to be discovered by the detached scientist. Instead they are a constructed understanding—an informed perception—developed by those engaged in the activity under scrutiny.

Sensitively constructed and chosen, communicative indicators articulate the problems and educate the participants and the public by providing appropriate information. In doing so it is hoped that they will engender a sense of social responsibility for the problems they measure. This, it can be argued, will have two effects. First, it may encourage people to change their behaviour. Second, such information will change people's political responses, encouraging support for public policy to deal with the problems (*Ibid.*).

The orientation of an indicator can be established by considering the audience who interprets them. For example, indicators designed to assist policy makers in governments and multilateral organisations, in assessing policy and programme performance, may not be appropriate or effective in communicating to the public who are affected by such policy decisions.

For the purpose of understanding indicator relevance, Hoon *et al.* (1997), differentiate "Sustainable Living Indicators" into *exogenous* and *endogenous*. Exogenous indicators are national or global level indicators, that are derived from and based on established scientific facts and information while endogenous indicators are formulated at the community level and

evaluated against a standard or norm that is established endogenously by the local people themselves.

However, it is important to be aware that over manipulation of indicators to suit audience requirements can lead to over simplification of the data and result in miscommunication to the relevant audience. For this reason, it is important that the right balance is achieved (*Ibid.*).

Due to the fact that environmental assets are characterised by ubiquitous distribution and non-ownership, collection of information on these features, has not been an easy task.

As such, there exists is a serious "data gap" for countries without substantial statistical resources and for groups who cannot get access to data which does exist. Solutions such as the World Resources Institute's "rapid assessment methods" can be used to build up a picture of environmental performance in developing countries which have ostensibly limited environmental data, but UNICEF still lambastes governments for unacceptable "greying": the failure to keep statistics on vital issues up to date (MacGillivray and Zadek, 1994).

URBAN INDICATORS

Organisation for Economic Co-operation and Development

The 1991 Recommendations of the OECD Council on Environmental Indicators and Information, included a call for "Further development of a set of reliable, readable, measurable and policy relevant environmental indicators in order to contribute to better integrating environmental concerns in sectoral policies and urban policies." The three main purposes for indicator development by the OECD group on the State of the Environment are:

1. Indicators for the measurement of environmental performance
2. Indicators for integration of environmental concerns in sectoral policies
3. Indicators for integration of environmental concerns into economic policies, through environmental accounting.

The first part of this work programme was to develop a core set of indicators to be used in environmental performance reviews of OECD countries. (The OECD Environmental Performance Review Programme, was established in 1992, as is responsible for the assessing how member countries have progressed with national objectives and international commitments).

The Core Set of indicators are grouped under the following themes:

- | | |
|-------------------------------|--------------------|
| · Climatic Change | · Biodiversity |
| · Ozone depletion | · Waste |
| · Eutrophication | · Water Resources |
| · Acidification | · Forest Resources |
| · Toxic Contaminants | · Fish Resources |
| · Urban Environmental Quality | · Soil degradation |

The OECD has selected indicators for each of these themes. Each indicator is determined by the availability of data, determining if the indicator can be used in the short term, long term or medium term

It is hoped however, that the core set of indicators will go beyond its initial functions, and become a building block for the environmental aspect of sustainable development indicators and contribute to the broader objective of reporting on sustainable development.

The OECD programme on environmental indicators has three major purposes:

- Keeping track of environmental progress
- Ensuring that environmental concerns are taken into account when policies are formulated and implemented for various sectors, such as transport, energy and agriculture
- Ensuring similar integration of environmental concerns into economic policies, mainly through environmental accounting

The work on indicators is carried out in close co-operation with OECD Member countries. It has led to:

- Agreement by OECD countries to use the pressure-state-response (PSR) model as a common harmonised framework
- Identification and definition of several sets of indicators based on their policy relevance, analytical soundness and measurability
- Measurement and publication of these indicators for a number of countries.

The results of this work, and in particular its conceptual framework, have in turn influenced similar activities by countries and international organisations (e.g., the UNCSD, with its work on sustainable development indicators).

The OECD's environmental indicators are regularly used in environmental performance reviews; they are a valuable way to monitor the integration of economic and environmental decision making, to analyse environmental policies and to gauge the results. Beyond their immediate application in OECD environmental performance reviews, these indicators also contribute to the broader objective of reporting on sustainable development.

Eurostat Pressure Indices

The Pressure Index Project is one of the main actions foreseen in the Communication from the Commission to the Council and the European Parliament on "Directions for the EU on Environmental Indicators and Green National Accounting" (COM [94] 670).

The principal goal of this Project is to give a comprehensive description of the most important human activities that have a negative impact on the environment. Indicators are aggregated in such a way that environmental data can be communicated to non-scientific audience (European Commission, 1994).

These indicators cover most of the EU Member States, depending on data availability. The EEA has offered to fill some of the data gaps through their topic centres. Forty-six pressure indicators for ten policy fields (based on the themes of the European Union's Fifth Environmental Action Programme) have been selected. The ten policy fields are:

- | | |
|--|--------------------------------------|
| 1. Climatic Change | 2. Ozone Layer Depletion |
| 3. Loss of Biodiversity | 4. Dispersion of Toxins |
| 5. Resource Depletion | 6. Waste |
| 7. Air Pollution | 8. Marine and Coastal Zones |
| 9. Water Pollution and Water Resources | 10. Urban Problems, Noise and Odours |

Although the current set of 60 indicators selected for the first publication still looks convincing for many experts, one major shortcoming is that the selection process was not based on knowledge of real figures, but on perceptions. As such the Scientific Advisory Group will be asked to regularly check the scientific validity of the indicator set, and to replace a few obsolete indicators with new ones that reflect the latest state of the scientific and political debate (Jesinghaus, 1999).

Towards a Local Sustainability Profile: European Common Indicators

The Europe-wide sustainability monitoring initiative 'Towards a Local Sustainability Profile - European Common Indicators' has been developed through a bottom-up approach by a Working Group of the Expert Group on the Urban Environment² in close consultation with local authorities across Europe. The list of indicators published in this document as compulsory is:

- Citizen satisfaction with the local community
- Local contribution to global climate change
- Local mobility and passenger transportation
- Availability of local public green areas and local services
- Quality of local outdoor air

The additional indicators (voluntary) are as follows:

- Children's journey to and from school
- Sustainable management of the local authority and local businesses
- Noise pollution
- Sustainable land use
- Products promoting sustainability

² The Expert Group on the Urban Environment was set up by the European commission in 1991 to consider how future town and land use planning strategies can incorporate environmental objectives and to advise how the Commission can develop the urban environment dimension within Community environment policy. In 1993 the Expert Group launched the Sustainable Cities Project together with the European Commission. The Expert Group was relaunched in 1999, following the adoption of the Communication Sustainable Urban Development in the European Union: A Framework for Action (COM(98)605), to provide specific advice and assistance on the development of European-level policy and instruments in fields of activity relation to the Communication.

The development of environmental indicators is a ubiquitous activity. However, the nature of activities varies in relation to their scale, orientation and relevance to different audiences.

The ultimate aim of many of these initiatives is to link environmental, economic and social indicators in a sustainable development framework. As of now, developments remain embryonic. Such poor progress may be the result of the poor conceptual understanding of sustainability, or reflect constraints posed by the lack of available supporting data and the resources required to provide them.

Pressure-State-Response

The pressure-state-response framework was originally developed by the Organization for Economic Cooperation and Development (OECD) and has been widely adopted in a modified form by OECD countries and a wide range of other organisations.

There are relationships between human activities (pressures) and the conditions of the environment. However, these relationships can be complex and the condition of the environment typically depends upon a wide range of natural as well as human factors. Information coming under the state category would answer the question 'what is the state of the environment, and what are the trends?' Pressure data answers the question 'why?' and response information answers the question 'what are we doing about it?'

Urban Environmental Indicators in Other Countries

Canada

Canada has taken a huge interest in the area of indicator research and has been responsible for the development of some very influential initiatives ranging in scale from the local to international levels of application. The orientation of these initiatives has also ranged from sustainability, to environmental performance to sector-specific indicator sets (Commission for Sustainable Development (Canada), 1995).

The main body leading the effort to devise these sets of environmental indicators is Environment Canada, a science-based government department whose goal it is to ensure progress towards sustainable development.

State of the Environment Reporting in Canada has led to the development of indicator sets by numerous government authorities. Some of these include:

- The British Columbia's First State of the Environment Report in 1993
- The Quebec Government, has produced two State of the Environment reports and is now involved in the development of sectoral indicators
- The Yukon Government in co-operation with Environment Canada is producing a territorial State of the Environment report.

At urban level, indicators are being identified as part of the State of the Environment reporting process and being produced countrywide.

Canada also participates enthusiastically in International Projects. Some examples include the Canadian Standards Association (which participation in the development of international standards for environmental performance evaluation) and the indicator development programme of the OECD, the North American trilateral Committee on Environmental Information, and the World Tourism Organisation.

United States

The United States EPA defines an environmental indicator as "a parameter (i.e., a measure or observed property), or some value derived from parameters (e.g., via an index or model) which provides managerially significant information about patterns or trends (changes) in the state of the environment, in human activities that affect or are affected by the environment, or about relationships among such variables. As defined here, indicators include geographic (spatially referenced) information, and such information used in environmental management at any scale, i.e., not just for high-level policy-makers".

The State Environmental Goals and Indicators project (SEGIP) (US EPA, 1999) is a co-operative agreement between the US EPA and the Florida Centre for Public Management, to assist state environmental agencies in improving their environmental management capabilities. The objectives of the programme aim to:

- Increase the number of environmental agencies that are effectively utilising environmental goals and indicators
- Enhance the quality of the state agency environmental goals and indicator systems
- Improve integration of environmental goals and indicators with other environmental management tools and methodologies

Australia

According to the Department of the Environment, Sport and Territories (1994) in Australia, the set of key indicators is defined as 'the minimum set that, if properly monitored, provides rigorous data describing the major trends in, and impacts on,...human settlements'.

The selected criteria should satisfy as many of the following as possible:

- Serve as a robust indicator of environmental change
- Reflect a fundamental or highly valued aspect of the environment
- Be either national in scope or applicable to regional environmental issues of national significance
- Provide an early warning of potential problems
- Be capable of being monitored to provide statistically verifiable and reproducible data that show trends over times, and preferable, apply to a broad range of environmental regions
- Be scientifically credible
- Be easy to understand
- Be monitored regularly with relative ease
- Be cost-effective
- Have relevance to policy and management needs
- Contribute to monitoring of progress towards implementing commitments in nationally significant environmental policies
- Where possible and appropriate, facilitate community involvement
- Contribute to the fulfilment of reporting obligations under international agreements

- Where possible and appropriate, use existing commercial and managerial indicators
- Where possible and appropriate, be consistent with other countries indicators

Environmental Objectives have been developed for each environmental issue. These objectives aim to guide ongoing State of the Environment activities including policy development and establishment of definitive environmental indicators.

Environmental Indicators in Ireland

The Principle of Sustainability is a declared cornerstone of environmental policy in Ireland (National Development Plan 1994-1999). However the EPA's State of the Environment Report identifies that, in order for Ireland to meet the challenges of sustainability, the existing range of environmental management tools will need to be broadened (EPA, 1996).

Following in the footsteps of international environmental management initiatives, Ireland has focused its attention on the development of environmental indicators as a means of assessing progress towards sustainability.

This section looks at our national response to the sustainability transition, and assesses our success to date in developing indicators as environmental management tools.

Ireland's Response to the Sustainability Transition

Ireland has ratified the following Conventions:

1. UN Framework Convention on Climatic Change;
2. Basel Convention on Control of Trans-boundary Movements of Hazardous Waste and their disposal;
3. UN Convention on Biological Diversity at UNCED in 1992;

Green 2000 Report -1993

In 1991, the Green 2000 Advisory Group was established by the Government to carry out a fundamental review of the key issues affecting the natural environment (Green 2000 Advisory Group, 1993). The group reported steady deterioration in certain areas. General recommendations made by the group included:

- arresting any further deterioration;
- integration of environmental protection considerations into all policy areas and at all levels of implementation by Government;
- maximising Ireland's potential in having the highest quality environment in the European community.

Assessing Sustainability in Ireland - 1995

This Report was geared towards advancing the debate in Ireland, on how sustainability might be assessed. The discussion centred on the establishment of baseline objectives, from which performance could be judged. Recommendations from this report suggested that:

- the EPA should take on the responsibility of overseeing the articulation and overall development of the sustainability framework;
- the DoE should take on the task of overseeing the linking of the sustainability indicator process to the policy system and policy choices for development and the sustainability strategy;
- the sectoral Departments should take on the task of identifying and monitoring the environmental indicators for their sectors;
- the agencies with responsibilities for endowments (wildlife, parks, monument's, forestry, energy. Agriculture, marine, should monitor the performance and trends in regard to their endowments, in accordance with agreed protocols;
- the CSO and ERSI should guide performance on the development of green satellite accounts;
- The research community in has been central to the development of existing information systems. These should take on the task of designing systems for filling in the gaps in the existing system, and for developing means of linking the information systems to the decision-making process and the public.

State of the Environment in Ireland, 1996

With the adoption the Environmental Protection Agency Act, 1992, the newly established Environmental Protection Agency, took over as the principal body responsible for co-ordination of environmental business within the country.

Under Section 70 of the Act, the Agency is obliged to prepare and publish a report on the State of the Environment at intervals not exceeding five years. The structure of this report must be in accordance with the Organisation for Economic Co-operation and Development's (OECD) recommendations. As such, the report outlines:

- the driving forces of social and economic activities;
- the resulting pressures which impact on the environment;
- the current environmental condition and trends; and finally
- the responses in terms of programme, control and actions for protecting the environment.

Environmental Indicators are also identified as being important tools for monitoring progress towards sustainability. The report acknowledges the importance of integrating the country's' monitoring systems into international networks, but also encourages the development of national sector-specific indicators for specific purposes. Three priority areas relating to eutrophication, the urban environment and waste are identified as requiring urgent attention (EPA, 1996).

National Sustainable Development Strategy 1997

This strategy provides a framework for the achievement of sustainability at the local level and sets the context for the preparation of a Local Agenda 21. It calls on planning authorities to incorporate the principles of sustainable development into their development plans and to ensure that planning policies support its achievement.

In this document, the Government states that it will build on the work already undertaken to develop sustainability indicators for the purpose of monitoring and implementation of the strategy.

A work programme to guide the development of Sustainability Indicators is defined. Under this framework the Government states that it will take into account the recommendations of the ERSI, EPA, National Sustainability Indicators Forum (1995), and the Department of the Environment.

The phased approach to the adoption of the work programme outlines the following objectives:

1. The EPA is to prepare a set of National Environmental Quality Indicators by 1998. This work will focus initially on the priority areas of eutrophication, waste and the urban environment (as recommended by the EPA in their State of the Environment Report, 1996)
2. Work will proceed in those areas necessary to approach the measurement of sustainability indicators and the preparation of satellite environmental accounts, for EU and other International contributions:
3. Co-ordination of environmental data, by the EPA and the CSO, to tackle the data gaps affecting the quality of environmental indicators.

Towards Regional Sustainability - Agenda 21 scoping report for the Dublin and Mid-East Region 1997

This scoping document was the first regional response to the National Sustainability Strategy. The roles of the Regional Authorities in the sustainability challenge include:

- Integrating sustainable development aims into the local authority's policies and activities
- Raising awareness and education
- Measuring and monitoring progress towards sustainability

Under the first objective of the National Sustainable Development Strategy, Regional Authorities are also asked to assist in the development of regional sustainability indicators relevant to conditions in their regions (DoE&LG, 1997).

CAAS Environmental Services, have since been invited to carry out a consultancy in respect of the drawing up of a draft report for the Dublin and Mid-East Sustainability Indicators Working Group (Carroll, 1999).

Measuring Progress towards Sustainable Development - 1999

This discussion document, prepared by the EPA, aims to seek the views on the measurement of progress towards sustainable development in Ireland. The document describes a model that

provides a potential framework for integration of a number of management tools in order to provide for sustainable management.

The document presents some of the ideas on how sustainability targets might be set within the overall context of the framework set out in the National Sustainable Development Strategy, and how progress towards these targets might be measured using environmental indicators, environmental quality objectives (EQO's) and environmental quality standards (EQS's). A model demonstrating the inter-relationship between these tools is also proposed. Working examples of the model are presented for eutrophication, waste management and the urban environment (EPA, 1999).

Bannon and van der Kamp (1996), note that as Ireland becomes increasingly urbanised, the issue of sustainability will become more of an urban concern. The state of the Environment report 1996, also addresses the urgency with which indicators pertaining to the urban environment need to be addressed.

Achieving a sustainable development path requires that the characteristics of this path be identified, understood, and taken fully into account in policy and implementation.

However, due to the ubiquitous nature of environmental assets, their evaluation in monetary terms has proven difficult. As such data has had to be expressed in physical units. This has resulted in the culmination of a huge amount of information, difficult for even an expert to assimilate. The formulation of environmental indicators, however, can elevate some of the stress of data handling, by allowing for large amounts of technical data to be expressed in a more digestible form.

As such environmental indicators are increasingly seen as one of the tools necessary for helping to chart and track the course towards a sustainable future (OECD, 1994).

INDICATOR THEMES

The indicators chosen and subsequently examined in this project came under six headings as follows:

1. Urban Demographics/Renewal
2. Transport
3. Environmental Quality Indicators
4. Noise
5. Built Environment
6. Ecological Footprint

1. URBAN DEMOGRAPHICS

In the period 1985 to 1996, the number of households in the EU grew faster than the population, as household size decreased (EEA, 1999). This, together with increasing per capita consumption (predicted to continue to grow by 0.5% between 1990 and 2010) tends to increase pressures on natural resources. Improvements in efficiency of the use of natural resources are not sufficient to fully compensate for the increased consumption. A UK study investigating the balance of negative and positive factors on the use of energy in households

found that energy use per household decreased by 7% in the period 1974 to 1994, however the number of households grew 23% in that period, so that on balance, the overall energy consumption by households increased by 15% (Boardman *et al.* 1997).

Despite the effectiveness and usefulness of indicators as a means of providing information, they are ineffective and meaningless unless they can be related to specified objectives, targets or goals of the authority using them (OECD, 1994). They need to be utilised in the formulation of effective urban policies. A policy in this sense may be seen as an instrument to bridge the gap between actual and desired states.

Urban Renewal

The term urban renewal is American in origin and refers to the revitalisation of the older parts of towns and cities. It is of growing importance for two reasons. Firstly, as the populations of towns and cities grow, urban areas grow larger and their centres grow older so inevitably more and more renewal of the urban fabric has to take place. Secondly, there is growing concern about the constant expansion of towns and cities into their agricultural hinterlands whilst large quantities of urban land and buildings are abandoned and left derelict. The renewal movement thus seeks to promote the reuse and redevelopment of the existing urban fabric before further land is taken irrevocably into urban use (Couch, 1990).

Urban regeneration involves a wider economic process that attempts to increase what has decreased such as investment, employment, consumer expenditure, population etc. On the other hand renewal involves reuse and reinvestment in the physical structure of existing urban areas. Urban regeneration could thus be defined as the process of reversing economic, social and physical decay in our towns and cities where it has reached the stage when market forces alone will not suffice (UK's Royal Institution of Chartered Surveyors, 1996).

As our urban centres are growing, it is important for a local authority to be aware of the location of this growth. A clear distinction can be made between growth within our urban centres and growth on the periphery of these centres. For the success of urban renewal policies, it is important that growth is observed within the urban boundaries as opposed to growth in the environs. When the second Urban Renewal Scheme was initiated in 1994, the then Minister for the Environment, Michael Smith, stated that it is people, not buildings, that make up a town or city. One of the most heartening aspects of the urban renewal programme is that it is encouraging people to move back into inner urban locations, re-establishing living and vibrant areas and communities. The new scheme, with strong incentives for residential development, will copperfasten the trend towards living in the centre of towns and cities. (Smith, 1994).

This statement summarises the principal objective of the urban renewal schemes which sought to repopulate town centres at a time when suburban growth competed with these areas for population growth. Recent private sector apartment construction within the inner urban area has encouraged a new inner town/city population to locate within and consequently regenerate our urban cores (Bannon, 1998). In order to attract people and hence businesses back into the city/town centres, the type of development attracted to the designated areas consisted mostly of residential and commercial type developments.

A decrease in the density of an urban population is not necessarily a positive occurrence. Although it indicates less crowding and more liveable space per inhabitant in the urban area as a whole, it also indicates urban sprawl.

Since 1986, over £1.7 billion of private sector investment in Ireland has been generated in designated areas under the Urban Renewal Schemes (KPMG, 1996). KPMG (1996) were commissioned by the Department of the Environment to carry out a detailed study of the impact, effectiveness and cost of the Urban Renewal Schemes, particularly in relation to:

- Assessing the costs and benefits of the schemes in economic and fiscal terms including the tax incentives, the level of investment generated and the impact on local authority revenues
- Addressing the role and effects of the different categories of development in terms of the social fabric of urban areas
- Assessing the architectural and urban design quality of developments including the relationship with the existing built environment
- Making recommendations on future strategies.

The Urban Renewal Schemes were first introduced in 1986 in response to the increasing problem of dereliction and dilapidation in large tracts of Ireland's major cities. The incentives introduced were primarily tax-based, targeting both investors in and occupiers of properties in designated areas. Since 1986, the Urban Renewal Schemes have been extended to include the majority of Ireland's major towns.

The report found that the development encouraged in Ireland's towns and cities under the Urban Renewal Schemes has addressed widespread dereliction and rejuvenated areas that were in decline or had fallen into disuse. Many prominent parts of these urban centres have been renewed and there is evidence to suggest that this enhancement has contributed to growth in economic activity in town centres. In addition, new residential developments in designated areas rely on existing infrastructure such as water supply and roads thereby reducing the need to develop greenfield sites in the outskirts of already sprawling towns and cities with downstream benefits in terms of traffic management, air pollution and maximising utilisation of existing services and infrastructure.

2. TRANSPORT

With the use of transport urban indicators still at an embryonic stage in Ireland, it has been necessary to look overseas to find cities where such work has already been carried out. By using international case studies an important insight into the range and effectiveness of various policies can be obtained. This section is the outcome of communication with many different countries, and the assessment of numerous indicator programmes. The section focuses primarily on the work of the City of Melbourne and the Transportation Association of Canada. In addition a brief overview is given of the Lancashire Green Audit and the work by Sustainable Seattle.

The City of Melbourne

The importance of a sustainable environment is evident in Melbourne and is accorded high priority in the corporate plans and strategies of municipal Councils. A recent Australian Bureau of Statistics pilot survey found that environmental protection expenditure averaged 18% of total expenditure by Council (Australia Institute of Urban Studies, 1999). The City of Melbourne is home to over 42,000 people and to the headquarters of numerous provincial, national and international companies. It is also at the centre of a radial metropolitan transport system that includes an excellent public transport network. During the daytime it has a business, working and visiting population of over 400,000, with a large proportion of its

workforce and the users of its cultural and entertainment facilities coming from Melbourne's suburbs and regional cities.

As part of its aim to increase awareness of environmental and sustainability issues, the City Council publishes an environmental indicators bulletin, the first of which was published in August 1998. It is their intention to publish a regular series of environmental indicators and in time to extend the range of themes covered so that Councils and their local communities can get an increasing flow of valuable information on the state of the environment (Australian Institute of Urban Studies, 1999). The report also tries to demonstrate that monitoring environmental performance at the local level need not be difficult or expensive. The indicators used in the report were selected not only because they cover key aspects of the environment but also because they were relatively easy to collect.

Indicators relevant to transport:

1. Journey to Work
2. Noise
3. Air Quality

The example of Melbourne is a good example of the integration of sustainable transport indicators at the urban level into the planning process. It attempts to put values on the goals of the development plan to move towards more environmentally friendly public transport.

Canada

In 1993 the Transportation Association of Canada (TAC), through its Urban Transportation Council, first published a *New Vision for Urban Transportation*. This was a 30-year generic vision for Canadian urban areas that could be tailored to fit local conditions. The vision has been cited by the OECD as an example of "best thinking on environmentally sustainable transportation in Canada" (Transportation Association of Canada, 1998).

In order to monitor progress in achieving this New Vision for Urban Transportation the TAC Urban Transportation Council began a long term program to establish and maintain a consistent and reliable data base of urban transportation and urban development indicators for Canadian municipalities (Transportation Association of Canada, 1996). These indicators would show if an urban area were progressing towards sustainability, and highlight the policies that are achieving the best results. The intention was to form some sort of factual basis behind the overall goals. Information would be updated on a five year cycle (linked to national census years) to enable time series analysis.

Indicators chosen under the heading Urban Structure include information on land area, residential population and total population, all of which form important base statistics for developing and comparing transportation indicators across cities.

The Urban Transportation Indicators Programme is a good example of where progress is monitored towards achieving predefined goals set out in the New Vision for Urban Transportation. It measures how far each of the cities progresses towards sustainability. By comparison between the eight cities assumptions can be made as to which options proved most successful. By planning in this manner the local officials are well aware of the problems facing them in each of their cities, and of the best available solutions.

Lancashire's Green Audit

The origins of Lancashire's Green Audit go back to 1989 when the Lancashire Environmental Forum was initiated. A 'State of the Environment Report', was published in 1991. This gave rise, in 1993, to the Lancashire Environmental Action Programme (LEAP), which has a fifteen-year time-scale. It contains a range of broad goals and 200 proposals for action to be undertaken by Forum organisations and the community.

In total thirty-nine indicators were selected by the Lancashire Environmental Forum to monitor the County's environmental, social and economic conditions. The indicators are organised under eleven themes, representing goals that collectively form a vision for sustainable development.

Under theme four: *basic needs for everyone met more locally*, two out of eight indicators relate to transport.

- Basic services within walking distance.
- Distance travelled to work.

Theme seven which looks at *access to facilities, goods services and people whilst protecting the environment*, contains two indicators:

- Mode of travel
- Transport investment.

Of note with regard to the Lancashire approach is that in the six-month piloting period Lancashire County Council carried out a comprehensive exercise to ascertain community views about sustainability indicators, sustainability and quality of life in general. Focus group discussions were held with different sections of the population and interviews conducted with key stakeholders of the Lancashire Environment forum. The results of this exercise were published in *Public Perceptions and Sustainability in Lancashire* (MacNaghten *et al.*, 1995). This measure helped ensure that sustainability was kept at a local level, which is where most progress can often be made.

Sustainable Seattle Indicators Project

This project is worth some attention in that it takes the issues of community participation a step further. Sustainable Seattle is a volunteer network and civic forum founded in 1991, with the aim of improving cultural, economic, environmental and social vitality. The aim of the first project of Sustainable Seattle was the development of a set of indicators using an integrated approach combining a public participation process with research.

Forty indicators were chosen, including indicators on vehicle miles travelled and fuel consumption. The project intended to raise public awareness, identify achievable goals, make long term trends visible, help individuals and the community to establish priorities, serve as a foundation for action, explain what sustainability means and institutionalise the concept over the long term. By working at a local level people are closely linked to emerging trends and impacts on the environment.

The use of transport indicators in helping to better plan for our future is becoming an increasingly more common phenomenon in towns and cities throughout the world. In the case of Melbourne, indicators were drawn up to develop a picture of where the city stood in terms of sustainability. On the basis of this information the new City Plan adopted objectives to reduce reliance on the private car and improve public transport. In Canada, the process was

begun differently. Here a vision was drawn up of how the city should progress into the future, and to help monitor this progress an indicators programme was developed. The two approaches are however not dissimilar in that, in time the use of indicators and planning will act as checks and balances against one another. The future may indeed lie in the integration of indicators into the development plan.

In the latter two examples the indicators are focusing far more on the local level, with widespread community participation in both cases. By bringing the indicators to the ordinary person on the street sustainability can become a realistic goal.

The ideal situation would be to operate an indicators programme that draws from all these examples. For example in Canada the organisation of the programme at a national level adds greater consistency among cities, while in Lancashire and Seattle the work is brought to the individual citizens. Both of these approaches are important and ideally should be combined. In this way both decision-makers and the general public are in a position to work towards sustainability.

European Environment Agency

The EEA's (2000) Environmental Issues Series number 12, *Are we moving in the right direction: Indicators on transport and environment integration in the EU*, states that the success of current and future integrated policies can only be judged by identifying key indicators that can be tracked and compared with concrete policy objectives. It is the first indicator-based TERM (Transport and Environment Reporting Mechanism) report and was designed to help EU and Member States to monitor progress with their transport integration strategies, to identify changes in the key leverage points for policy intervention (such as investments, economic instruments, spatial planning and infrastructure supply), and to make results accountable to society. An 'ideal' list of 31 indicators was selected following consultation with various Commission services, national experts, other international organisations and researchers. The TERM action plan aims to

- Improve indicator scope and definition;
- Improve basic transport statistics and environmental and land cover data and information;
- Improve methods for country comparisons and provide geographic differentiations;
- Develop methods for country comparisons and provide geographic differentiation;
- Develop methods to evaluate the effectiveness of certain policy measures;
- Track development in transport and environment targets;
- Extend TERM to EU Accession Countries
- Enhance structures for networking and linking with research
- Develop a broad dissemination strategy

3. ENVIRONMENTAL QUALITY INDICATORS

In the past, rising incomes, and consequent growth in consumption, have tended to increase energy and water usage and waste generation. To break this linkage between economic development and environmental pressures will require significant changes in attitudes and lifestyles. Urban waste has increased in volume and changed in composition over the past two decades in Europe (EEA, 1999); while volumes are still expected to increase, current management practices do not meet the requirements of the EU waste hierarchy, nor is waste generation generally subject to corrective economic instruments such as taxation. Energy consumption by both transport and households has risen steadily in the past two decades and further increases can be anticipated unless energy pricing measures provide a sufficient deterrent. Urban air pollution is the source of a range of problems both within cities as well as

outside as emissions from cities lead to an increase in the regional background concentration levels of many pollutants. These problems include damage to flora and fauna, decomposition of materials, buildings, historical monuments, weather and climatic changes, as well as health risks mostly associated with inhalation of gases.

Although air quality in Europe and particularly in the large European urban areas has improved in recent decades, nearly 40 million people residing in the 115 larger European cities still experience exceedance of the WHO air-quality guidelines for at least one pollutant every year (European Commission, 1998).

Indicators of physical environmental quality have been developed and applied using a number of analytical frameworks. Although the OECD has stated that there is no definitive set of environmental indicators, it is recognised that there is a need to co-ordinate the initiatives of OECD Member countries, to prepare guidelines for the use of environmental indicators, and then to formulate and apply a core set of selected and aggregated indicators (OECD, 1997).

Urbanisation exerts environmental pressures, both on the nature areas in cities (forests, large parks and wetlands) and beyond the boundaries of cities.

The past decade has seen considerable improvements in the ambient concentrations of sulphur dioxide (SO₂), lead and particulates. The main sources of SO₂ and particulates in the past being industry and energy production from coal and heavy fuels combustion, emission reduction mostly relied on the emergence of new clean energy sources and more efficient combustion technologies. Lead levels in the EU were controlled by reducing lead content in fuel as a result of the ECC Directive for unleaded petrol (EC Directive 85/210/EEC).

However, the levels of nitrogen oxides (NO_x), Volatile Organic Compounds (VOCs), CO and O₃ remain high in most European cities (EEA, 1998).

Controlling air pollution from road traffic is identified as the single biggest and most complex issue (EEA, 1999). A variety of methods include improving public transport, diverting traffic from city centres by building ring roads, reducing car use by means of parking policies or encouraging bicycle use, have been used with varying degrees of success. National and EU-level regulations aiming at automobile emissions reduction, such as the introduction of catalytic converters (EC Directive 91/441/EEC), or unleaded petrol (EC Directive 85/210/EEC) resulted in lower vehicle emission factors.

The European Commission's Auto Oil Programme was aimed at improving air quality by means of evaluating cost-effective measures to reduce emissions from road transport. The process involved the car manufacturing industry and the oil industry and resulted in a number of Commission proposals in 1996 and final agreement in 1998 between the Council and the European Parliament on measures for passenger cars, light commercial vehicles and quality of petrol and diesel fuels. The measures are laid down in Directives 98/69/EC and 98/70/EC:

- A two-step tightening of vehicle emission limit values for passenger cars and light commercial vehicles with the first step in the year 2000 and the second step in 2005
- New environmental specifications for petrol and diesel fuels to take effect from the year 2000; very low-sulphur fuels to be mandatory from 2005
- Provision made for earlier phase-in of very low-sulphur fuels
- Leaded fuels to be phased out by 2000 (with the possibility of derogation up to 2005)
- Proposals to be brought forward by the Commission for further complementing measures to take effect from 2005.

The first Dutch National Environmental Policy Plan was published in 1989. The authors of this Plan agreed that a set of instruments was necessary to enable the assessment of the implementation process of all the measures included. The themes of Dutch environmental policy (Adriaanse, 1994) are as follows:

- Change of climate (both the greenhouse effect and the depletion of the ozone layer)
- Acidification of the environment
- Eutrophication of the environment
- Dispersion of toxic substances
- Disposal of solid waste
- Disturbance of local environments
- Dehydration of soils
- Squandering of resources.

A comparative study of environmental quality in four European cities has been funded by the European Commission Strategic Action Programme for International Co-operation (SAPIC). This study, completed in 1992, included the cities of Erlangen (Germany), Stoke-on-Trent (England), Thessaloniki (Greece) and Rennes (France). A report about this study presents a summary of the results. The main objective of the study was to improve information available at the city level for effective environmental policy management. A comparative approach was used to identify similarities and differences in the availability of data and information, how it was collected, what limitations existed (especially how monitoring could be improved), and how clearly presented information could be widely disseminated to the general public.

To date, comparisons of information and data in these four cities are concerned with ambient air quality, levels of emissions into the atmosphere, radioactivity, noise levels, land uses, the distribution and quality of natural landscapes and parks, contamination of the ground, old waste disposal and industrial sites, ground water, quality of surface waters, quality of drinking water, effluents and used water, sewerage sludge and waste water, and management of wastes. These themes were considered in order to identify environmental problems which the representatives of each city considered to warrant high or low priority for future strategic action and co-operation.

In Italy, an attempt was made to divide environmental quality indicators into three categories (OECD, 1999):

1. Indicators for which definite processes of improvement have been under way for some time. This is the case of sulphur dioxide emissions and the corresponding air concentrations.
2. Indicators for which processes of improvement have begun to be noted only recently. Many indicators examined belong to this category.
3. Indicators in stationary or worsening condition. These are indicators relating to aspects which, although of recognised significance in terms of their impact on the environment and the quality of life, register no improvements. This is the case with carbon dioxide emissions and waste production amongst others.

Availability of data for environmental quality indicators is a problem in Ireland. There are 12 branches of the Association of Irish Energy Agencies, which give an energy profile for particular areas.

Monitoring is non-existent for most of the pollutants concerned in most urban areas in Ireland with the exception of Dublin, and in some cases, Cork. Smoke and Sulphur Dioxide are monitored in Dublin, Cork, Galway, Limerick, Waterford, Dundalk and Ennis of the urban centres examined in this report. Nitrogen oxides and Carbon Monoxide are monitored only for Dublin and Cork and lead and VOCs only for Dublin so far.

There has been increasing interest in the measurement of PM₁₀ (particulate matter measuring less than 10 micrometres in diameter) mass concentrations following several studies in US cities which show a statistically significant positive association between daily concentrations of airborne particulate matter and non-accidental mortality. There has also been an increased interest in volatile organic compounds (VOC's) in view of their important role in the formation of photochemical oxidants such as ozone, hydrogen peroxide and peroxyacetyl nitrate (PAN). They also serve as gaseous precursors for the formation of airborne particulates. In addition, a number of these organic compounds encountered in urban air and formed in both petrol and diesel exhausts are carcinogenic (e.g., benzene). The EPA (1997) commissioned a baseline study on the concentrations of VOC's and PM₁₀s in Dublin and found that inner city sites close to heavy traffic routes exceed present US EPA PM₁₀ standards and that air quality in Dublin with respect to VOC's is influenced by vehicular sources and concentrations are representative of a moderately polluted urban environment.

4. NOISE

Noise remains a serious environmental problem; it is estimated that about 32% of the EU population (about 120 million people) is exposed to road noise levels over 55Ldn dB(A) (EEA, 1999).

In order to facilitate the preparation of urban policies in respect of noise, it is necessary to have a detailed understanding of the urban noise climate. At present, there is no central database for measured noise levels in Ireland or even a coherent national policy in respect of noise measurement and assessment. The study carried out as part of the Urban Environmental Quality Indicators project for the EPA represents the first stage in creating a better understanding of the urban noise climate in Ireland.

Certain parameters are used when mapping and describing noise levels and the following is a selection of the most common ones.

- **Decibel (dB):** a unit of noise level based on a logarithmic scale. Used to describe a variety of quantities, with “*sound pressure level*” being the quantity of interest in the EPA study.
- **dB(A):** an A-weighted decibel value - a means of expressing sound pressure level in a manner that takes into account the non-linearity of human hearing.
- **L_{Aeq}:** the equivalent continuous sound level. It measures the A-weighted sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period. Effectively a type of “average”.
- **L_{AN}:** a statistical parameter, where N ranges from 1 to 100. It measures the A-weighted sound level exceeded for N% of a measurement period. The most commonly encountered

statistical parameters are L_{A10} (used to describe traffic noise) and L_{A90} (used to describe background noise).

- **L_{Amax} , L_{Amin} :** the maximum and minimum A-weighted sound levels recorded during a measurement period respectively.

Irish Guidance

There is no single piece of comprehensive legislation available on noise in Ireland to date. The main guidance available on noise measurement and policy in Ireland consists of sections of various pieces of legislation and standards documents, both national and international. The following two are those most commonly used:

- **Environmental Protection Agency Act, 1992 (No. 7 of 1992):** Sections 106, 107 and 108 deal with noise. Section 106 deals with the Minister's powers to regulate noise, Section 107 deals with the powers of the EPA and local authorities and Section 108 covers the action to be taken in the event of noise nuisance. Indicators are not discussed.
- **Guidance Note for Noise in Relation to Scheduled Activities:** this is published by the EPA and intended to assist with Integrated Pollution Control Licensing. It offers guideline values at noise-sensitive locations of 45dB(A) and 55dB(A) in terms of L_{Aeq} . In practice, these guidelines are becoming widely used in relation to all manners of activities due to the absence of relevant legislation.

Other publications in limited use in relation to noise levels are:

- **Roads Act, 1993 (No. 14 of 1993)**
- **Road Traffic (Construction, Equipment and Use of Vehicles) Regulations, 1963 (S.I. No. 190 of 1963)**
- **European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations, 1988 (S.I. No. 320 of 1988)**
- **European Communities (Lawnmowers) (Permissible Noise Levels) Regulations, 1989 (S.I. No. 102 of 1989)**
- **Control of Dogs Act 1986 (No. 32 of 1986),** also 1992 amendment and associated regulations

Other guidance in wide use in Ireland on noise is several British Standard documents:

- **BS4142: 1997: Method for rating industrial noise affecting mixed residential and industrial areas** - describes methods for determining specific noise levels from sources in terms of L_{Aeq} and background noise levels in terms of L_{A90} . It also describes a method for determining the likelihood of a particular noise giving rise to complaints. Whilst the scope of the guidance is limited, the methodology is suitable for application in a wide variety of instances.
- **BS5228: 1997: Noise and vibration control on construction and open sites** - offers guidance in relation to setting noise and vibration criteria. It bases its guidance on L_{Aeq} .

- **BS8233: 1987: Code of practice for sound insulation and noise reduction for buildings** - offers guidance in relation to intrusive noise within buildings in terms of L_{Aeq} . It also mentions guidelines for external areas in terms of L_{A10} .
- **Calculation of Road Traffic Noise** – covers the measurement and prediction of noise from traffic. It utilises the L_{A10} parameter expressed over an 18-hour period.

Other Guidance in Use within the EU

The following documentation is used in other EU Member States.

- **Planning Policy Guidance 24: Planning and Noise** – outlines planning considerations in relation to noise, introduces the concept of noise exposure categories for residential development and advises on the use of planning conditions to minimise the impact of noise. Uses L_{Aeq} .
- **ISO1996: 1982: Acoustics – Description and measurement of environmental noise** – general guidance in relation to noise measurement. Expresses a preference for using L_{Aeq} as a noise descriptor and also suggests use of L_{A95} .
- **World Health Organisation Environmental Health Criteria 12: Noise** – a detailed discussion of a wide variety of noise related topics. Uses L_{Aeq} when talking about annoyance in the community.
- **Code of Practice on Environmental Noise Control at Concerts** – uses L_{Aeq} in relation to noise limits.

Future Noise Policy

The European Commission's Green Paper on Noise (COM(96)540) was the first step in the development of a noise policy with the aim that no person should be exposed to noise levels endangering their health and quality of life. One of the main aims of the paper was to help give noise abatement a higher priority in policy making. The framework for future action as set out in the green paper may be summarised as follows:

- a proposal for providing for the harmonisation of methods of assessment of noise exposure and the mutual exchange of information;
- an action plan in relation to the reduction of road traffic noise through consideration of tyre noise, fiscal instruments, road worthiness tests and low noise road surfaces;
- ongoing consideration of rail noise;
- use of a combination of instruments to combat air transport noise;
- plans to simplify existing legislation.

A detailed response to the green paper was compiled following consultation with the member states and interested bodies. In summary, it was decided to implement the framework outlined above through a Directive, complemented by additional actions at EU level on noise from sources and products.

Six Working Groups (WG) were established in order to assist with the development of the new EU noise policy. These are discussed in turn below:

WG1 – Indicators: this WG will recommend physical indicators to be used in the European Union to describe noise from all outdoor sources for assessment, mapping and planning and control purposes and will propose methods of implementation.

WG2 – Dose/Effect: this WG will establish a set of relationships between noise exposure (dose, in terms of an agreed indicator) and the effects of the noise.

WG3 – Computation and Measurement: this WG will address the harmonisation of computational and associated methods for noise assessment, mapping, planning and noise abatement.

WG4 – Noise Maps: this WG will develop guidelines for effective noise mapping, provide assistance to member states in noise mapping and collaborate in the initiation of European noise mapping.

WG5 – Abatement: this WG will make guidelines to be used by local authorities for designing noise abatement plans and the execution of those plans.

WG6 – Railway: this WG will deal with noise emissions from railway vehicles.

The activities of these working groups are obviously of particular interest to this study. The calendar for policy action is as follows:

1999:	proposal of the commissions for a Framework Directive
End 2001:	harmonised methods and EU targets established by WG
2002:	Framework Directive in force
2006:	harmonised methods in force
Beyond 2006:	EU targets in force if appropriate

5. BUILT ENVIRONMENT

Existing building stock represents a major resource at several levels. First, in its present state, it represents a massive investment of energy. Changes to it also represent energy expenditure. Buildings are major consumers of energy. And not least, as pointed out in the Green Paper on the Urban Environment, the built environment plays a significant role in the health and well being of its human occupants. As the requirements for urban management continue to advance, there will be a steady increase in the demand for indicators of urban quality.

Ireland has no established measures of built environment quality that have more than local application, apart from the designation of areas of archaeological interest. There is a measure of building quality relating to architectural and historic value, which is made under the National Monuments Acts and the Planning Acts. In addition to this rating of individual buildings, some planning authorities have established conservation areas, as worthy of special protection measures on the grounds of the architectural and historic value of the buildings, and this could be regarded as a measure of the quality of the built environment. However, such

designations do not have statutory basis under the Planning Acts at present, and there is no consistency in their application.

There is as yet no systematically compiled record of the resource represented by the stock of buildings in the country. However, there have been systematic but partial inventories of the built environment, beginning with the work of An Foras Forbartha. Several planning authorities still use the Foras information as the baseline on buildings of architectural and historic interest. There have been others. The Dublin Environmental Inventory conducted a partial audit of buildings within the canal cordon of Dublin city, and the current Historic Heart of Dublin project is recording two areas within this cordon. CAAS have also carried inventory work on behalf of local authorities. For several years, the Office of Public Works conducted systematic surveys of a small number of towns on a pilot basis and with a restricted budget. This work was transferred to and augmented by Duchas. It has been placed on a statutory footing under the title of the National Inventory of the Architectural Heritage (NIAH).

Legislation dealing with the built environment falls into two principal categories: the National Monuments Acts and the Planning Acts. Other related legislation includes the Sanitary Services Act (1964), the Building Control Act (1990), the Heritage Act (1995) and the Derelict Sites Act (1990). While the Building Control Act and the Heritage Act are, in different ways, concerned with environmental quality and are subject to review on that basis, there has been only selective review of the impact of other legislation on environmental quality.

National Monuments Acts 1930-1994

The first National Monuments Act was enacted in 1930. Since then, there have been several revisions, but they are treated as one Act, and as a whole provide the legislative basis for State activity with regard to monuments (through the National Monuments and Historic Properties Service, NMHPS). Under the 1987 Amendment: Minister for Arts, Heritage, Gaeltacht and the Islands may enter in the Register of Monuments, monuments associated with the commercial, cultural, economic, industrial, military, religious or social history of the place in which the monument is situated, or any monument predating 1700. Where a building has been so registered, the owner must give two months notice to Minister of work to the monument. NMHPS may request Minister for a preservation order. The Act confers fairly effective protection to buildings to which it applies.

Planning Acts 1963-1993

The Planning Acts comprise the Local Government (Planning and Development) Act of 1963 and the amendments subsequently enacted, and the regulations drawn up to give effect to the provisions of these enactments. These Acts provide a broad framework of planning law including development control, in which protection of architectural heritage is an allowable objective: that is, a Planning Authority may frame objectives through its Development Plan for the preservation of amenities, and these may include 'buildings of artistic, architectural or historic interest' and 'fixtures or features of artistic, architectural or historic interest forming part of the interiors of structures'.

There are Prescribed Bodies under the Acts, who must be consulted in certain cases relating to heritage. These are the Department of Arts, Heritage, Gaeltacht and the Islands, the Heritage Council, An Taisce and the Arts Council. Under Section 10 of the Heritage Act 1995, the

Minister for Arts, Heritage, Gaeltacht and the Islands, on the advice of the Heritage Council, can designate a building in the ownership of a public authority as a 'heritage building' - the effect is to oblige owners to seek Council advice in the event of any change to the building.

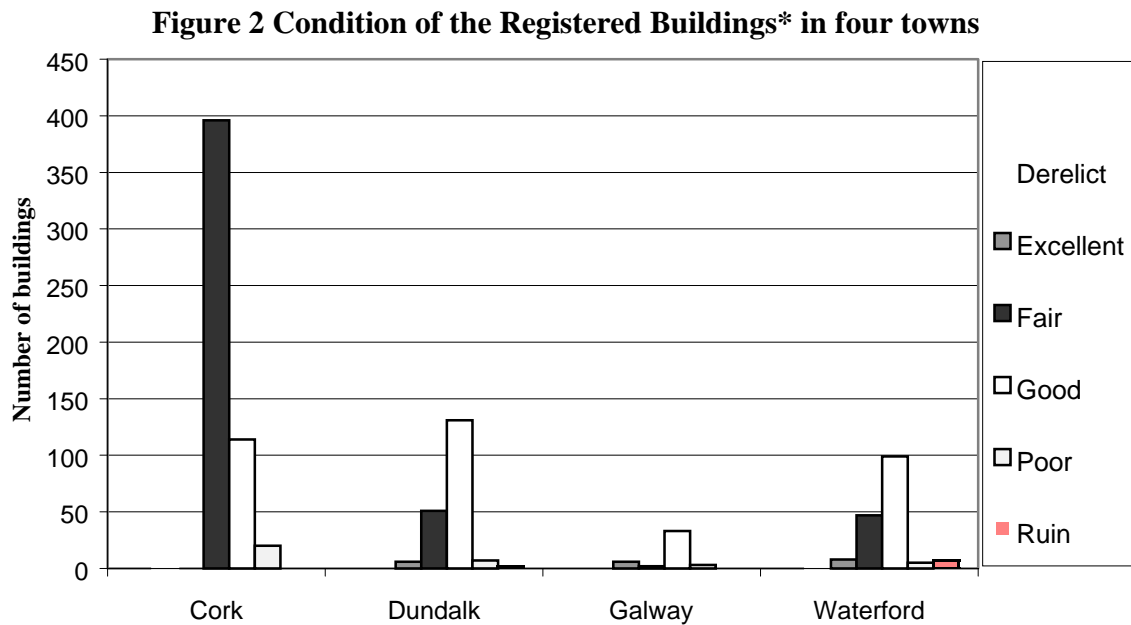
Significant forth-coming changes to the regulatory environment have been announced by the Government through jointly-issued statements by the Minister for the Environment and the Minister for Arts, Heritage, Gaeltacht and the Islands. These derive from a report, 'Strengthening the Protection of the Architectural Heritage', published in 1996. They comprise amendments to the Planning Acts, the introduction of new legislation under the working title of the 'Heritage Bill', together with a series of supporting measures affecting guidance issues.

The following amendments to the Planning Acts have been indicated:

- Planning Authorities will be obliged to list buildings for preservation
- Preservation to include entire structure including interiors
- Protection to extend to entire curtilage
- Development Plans may be amended within the statutory period
- Appointment of 'conservation officers'
- Designation of 'conservation areas'

The main provisions of the Heritage Act, 1999 have been described as follows (Duchas, 1998):

- The National Inventory of the Architectural Heritage will be established on a statutory footing. The target for completion of the NIAH is twelve years, giving a completion date of 2011. The compilation of data under the NIAH will provide the first comprehensive benchmark of the building stock, as from the date of the survey.
- The Minister will recommend buildings to Local Authorities for inclusion on lists for protection in their Development Plans under the Planning Acts. The Authorities will be obliged to have 'due regard' to such recommendations.
- The Bill will facilitate the provision of advice and guidance by the Heritage Service.



Source: Pender *et al.*, 2000

6. ECOLOGICAL FOOTPRINT

The ecological footprint of a designated population is the area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces, wherever on Earth the land and water is located (Rees, 1996; Wackernagel and Rees, 1996).

Ecological accounting, the basis for carrying capacity assessments, can be traced back to as early as 1872, when Reverend Thomas Malthus famously published the *Essay on the Principles of Population as It Affects the Future Improvement of Society*, discussing agriculture's seemingly limited ability to feed an ever larger human population. Since then, many scholars have developed conceptual approaches and accounting procedures to analyse the relationship between people and nature.

In the 1970s, William Rees developed the 'regional capsule' (subsequently the Ecological Footprint) concept as a teaching tool to stimulate multi-disciplinary planning students to think about human carrying capacity. In 1980, William Catton added a new dimension to the human carrying capacity debate by describing the implications of exceeding the long-term carrying capacity and the subsequent population crash.

The idea of Ecological Footprint Analysis (Wackernagel and Rees, 1996) is closely tied into theories of sustainability. To live sustainably, the essential products and processes of nature must not be used more quickly than they can be renewed, and wastes must not be discharged more quickly than they can be absorbed. It is essentially that of an accounting tool enabling an estimation of the resource consumption and waste assimilation requirements of a defined human population or economy in terms of a corresponding productive land area. In terms of a city, it estimates the total area of terrestrial ecosystem types needed continuously to support all the social and economic activities out of the people of the city as they go about their daily activities. Wackernagel and Rees (1996) estimate the Ecological Footprint of an average Canadian; the amount of land required from nature to support a typical individual's present consumption, to be almost 4.3 hectares.

Table 1. Land & Land Use Categories for Ecological Footprinting

Eight Main Land and Land Use Categories		
Energy Land	1	Land appropriated by fossil energy use
Consumed Land	2	Built Environment
Currently used Land	3	Gardens
	4	Crop Land
	5	Pasture
	6	Managed Systems
Land of Limited Availability	7	Untouched forests
	8	Non-Productive Areas

Environment in Focus: A discussion document on key national environmental indicators (EPA, 1999) finds the ecological footprint of Ireland to be 2.38 hectares per person, or a total of 86,325 km² (equating to 1.23 times the size of the state). The findings are relatively small, and this is explained as being due to features such as low population density and a high percentage of productive agricultural land. Moreover, this preliminary footprint measurement included only four categories of domestic consumption (fossil fuels, built-up land, food and forestry) and may have been overly conservative.

The Ecological Footprint of any population can be used to measure its current consumption and projected requirements against available ecological supply and point out any shortfalls. It can be seen as an indicator to help us plan for sustainability. It not only addresses such global concerns as ecological deterioration and material inequity; it also links these concerns to individual and institutional decision-making. Further refinement is necessary to develop the tool's full potential for planning practitioners' everyday decisions. The shortcomings of the model are discussed in full in *Environmental Indicators for the Urban Environment* (Pender *et al.*, 2000).

SUMMARY AND CONCLUSIONS

Future Indicator Directions

Indicators have been steadily developing and becoming more sophisticated over recent years. The challenges facing their future development can be seen to include (Canada's 1995 report to the United Nations Commission on Sustainable Development):

- the need to link indicators that track changes in the natural environment to economic and social (including human health) changes, in terms of both causes and effects;
- the need to ensure that indicators are scientifically credible and relevant and understandable to non-specialists;
- the need for nationally comparable data and harmonised methods of collecting data, monitoring, and reporting on sustainability of ecosystems. Efforts should focus on the development and selection of indicators that can fit into a hierarchy of national, regional, and ecological frameworks;
- the recognition that current data gaps make it difficult to compare regions or data from year to year. As such a need exists, to address trend data and measurement techniques which are often inadequate, not standardised, and inconsistent;

- the need to improve the contextual presentation and marketing of indicators, both to encourage and to assist decision makers to use them. Environment Canada is investigating creative ways to target packages of indicators for decision-makers;
- the uncertainty and contradictory evidence encourage disputes over environmental issues. Widely accepted indicators at local, regional, and national levels can provide a common basis for reaching better decisions. The delivery of timely and understandable indicators to decision makers will help them make decisions based on sound scientific data and will foster a better informed public.

Although environmental indicators have been advocated as being "powerful environmental management tools", many shortfalls can arise from their mis-application. As such, it is important that the criteria for selecting them should be clearly stated at the outset. Achieving a sustainable development path requires that the characteristics of this path be identified, understood, and taken fully into account in policy and implementation.

However, due to the ubiquitous nature of environmental assets, their evaluation in monetary terms has proven difficult. As such data has had to be expressed in physical units. This has resulted in the culmination of a huge amount of information, difficult for even an expert to assimilate. The formulation of environmental indicators, however, can alleviate some of the stress of data handling, by allowing for large amounts of technical data to be expressed in a more digestible form.

As such environmental indicators are increasingly seen as one of the tools necessary for helping to chart and track the course towards a sustainable future (OECD, 1994). Sustainability and sustainable development have become catchwords. A sustainable town or city might be described as one which succeeds in balancing economic, environmental and socio-cultural progress through processes of active citizen participation (Mega and Penderson, 1998). All cities are now confronted with the challenge of considering economic, social and environmental issues simultaneously. However, if sustainability is a coherent policy goal, it must be possible to measure whether we are moving towards it. Information is needed in order to both assess this progress and to reduce uncertainties that are inherent in the process of decision-making.

Indicators would thus appear to have been rediscovered in recent years as a means to measure our progress towards achieving sustainability in our urban centres. According to the European Foundation for the Improvement of Living and Working Conditions (*Ibid.*), they have high potential for those cities wishing not simply to adapt but to initiate the desired transformation towards a sustainable urban centre.

Despite the effectiveness and usefulness of indicators as a means of providing information, they are ineffective and meaningless unless they can be related to specified objectives, targets or goals of the authority using them. They need to be utilised in the formulation of effective urban policies. A policy in this sense may be seen as an instrument to bridge the gap between actual and desired states. The indicators recommended by the Aalborg Charter can be taken as an example of linking measurements to a policy framework. Indicators to measure urban patterns include the urban population figures that differentiate between the number of inhabitants in the city and the number of inhabitants in the conurbation. Measurements of urban land cover would include the area within the legal boundaries; the area of the actual

built environment and the total amount of green space provision available. Derelict sites could be measured as a percentage of the total area and likewise the urban renewal areas could be related to the total land area of the city or town. These figures alone, whilst revealing, are static and meaningless unless they are inserted into some form of a framework.

The literature suggests that indicators have a valuable role to play in the future of sustainable planning for urban areas. More experience in various countries and situations will narrow down the range of 'ideal' indicators, and those which tell succinctly and clearly a story across time, or as a comparison between areas. They can alert the public and the policy makers to change in important aspects of their environment and/or the need to change.

The formulation of urban policies requires that the urban environment be well understood. Currently, however, this knowledge is incomplete and the capacity to address environmental problems in urban areas is hampered by a lack of coherent and reliable data. Obtaining objective and reliable information on the pressures and state of the urban environment also requires the identification and development of environmental indicators to help identify environmental management strategies, to monitor progress and assess the effectiveness of programmes and measures designed to improve the overall state of the environment in the urban areas. Environmental indicators are physical, chemical, biological or socio-economic measures that best represent the key elements of a complex ecosystem or environmental issue. An indicator ideally needs to be embedded in a well-developed framework and have meaning beyond the measure it represents.

REFERENCES

- Adriaanse, A. 1994. Environmental Policy Performance Indicators, A Study in the Netherlands. SDU Uitgeverij, Koninginnegracht.
- Australian Institute of Urban Studies. 1999. Environmental Indicators for Metropolitan Melbourne. Bulletin 2. Melbourne City Council. <http://home.vicnet.net.au/~aius>.
- Bannon, M. and van der Kamp, H., 1996. Issues in Sustainability, Occasional Paper No. 5. Department of Regional and Urban Planning, UCD.
- Bannon, M J, National Urban Policies - Ireland, Department of Regional and Urban Planning Research Paper Series, 1998, pg15.
- Boardman, B. et al. 1997. Cold House, Warm Houses and Household Energy Use: a Challenge for the Twenty-First Century; The road to Kyoto - WWF Climate Change Conference, June 1997
- William Carroll, May 1999. Re. Development of Regional Environmental Indicators. Dublin Regional Authority, Personal Communication.
- Catton, W.R. 1980 Overshoot: The Ecological Basis of Revolutionary Change Urbana; Univerisity of Illinois Press.
- Cherry, G. 1972. Urban Change and Planning_GT Foulis and Co. Ltd, London.
- Couch C. 1990. Urban Renewal: Theory and Practice_MacMillan, London.
- CEC, 1996. Implementation of the European Community Programme 'Towards Sustainability'. Office for Official Publications of the European Community, Luxembourg
- Commission for Sustainable Development. 1995. Report of Canada to the United Nations Commission on Sustainable Development: Part II, Section II Indicators for Sustainable Development. <http://www.ec.gc.ca/agenda21/part2-2.html>
- Commissions for Sustainable Development. 1995. Report of the secretary-general to the CSD on Chapter 40 of Agenda 21, 'Information for Decision-Making' (E/CN.17/1995/18).
- Convery, F.J., and Feehan, J., 1995. Assessing Sustainability in Ireland. Proceedings of a Conference held at University College Dublin April 18th and 19th, 1995. The Environmental Institute, University College Dublin.
- Dekker, A., Gouverde, H., Markowski, T. and Ptaszynska-Woloczko, M. 1992. Conflict in Urban Development_Ashgate, England.
- Department of the Environment & Local Government. 1997. National Sustainable Development Strategy. Government Publications.
- EPA, 1996. State of the Environment in Ireland. Environmental Protection Agency, Ireland.

EPA, 1997. A Baseline study on the concentrations of Volatile Organic Compounds and PM10 in Dublin City. Environmental Protection Agency, Ireland.

EPA, 1999. Measuring Progress Towards Sustainable Development. Environmental Protection Agency, Ireland.

European Commission, 1994. Communication from the Commission to the Council and the European Parliament on Directions for the EU on Environmental Indicators. European Commission. Office for Official Publications of the European Communities, Luxembourg.

European Commission, 1996. Future Noise Policy - Green Paper European Commission COM(96)540 Final, Brussels, Belgium

European Commission, 1998. Territorial breakdowns and terminology to be used in Urban Statistics in Eurostat. European Commission. Office for Official Publications of the European Communities, Luxembourg.

European Community, 1994. Europe's Environment. The Dobris Assessment: An Overview. Office for Official Publications of the European Communities, Luxembourg

EEA, 1998. Europe's Environment: The Second Assessment. European Environment Agency. Copenhagen, Denmark.

EEA, 2000. Are we moving in the right direction. Indicators on transport and environment integration in the EU. Copenhagen, Denmark.

European Institute of Urban Affairs, 1992. Urbanisation and the function of Cities in the European Union Regional Development Studies No. 4, CEC Directorate General for Regional Policies.

Eurostat. <http://europa.eu.int/comm/eurostat/>

Green 2000 Advisory Group, 1993. Green 2000 Report. Government Publications
Green Paper

Friends of the Earth (Netherlands). 1992. Actieplan Nederland Duurzaam (Action Plan Netherlands). <http://www.milieudefensie.nl/info.htm#Steun>

Galbraith, J.K. 1964. Economic Development. Oxford University Press.

Hoon, P., Singh, N. & Wanmali, S. 1997. Sustainable Livelihoods: Concepts, Principles and Approaches to Indicator Development. A draft Discussion Paper. Poverty and Sustainable Livelihoods Social Development and Poverty Eradication Division, Bureau for Development Policy, United Nations Development Programme.

Jesinghaus, J. 1999. A European System of Environmental Pressure Indices: The Indicators. European Commission DG 34 (Eurostat), Environment Statistics Unit, Luxembourg

KPMG, 1996. Study on the Urban Renewal Schemes. Department of the Environment.

MacGillivray, A. and Zadek, S. 1994. Accounting for Change: the role of sustainable development indicators from the ESRC. Global Environmental Change Programme. New Economics Foundation.

Malthus, T. R. 1872. - Essay on the principle of population. J. Murray, London.

MacNaghten, P., Grove-White, R., Jacobs, M., Wynne, B. E. and Peattie, K. 1995. Public perceptions and sustainability in Lancashire: indicators, institutions, participation. *Local Gov. Stud.*, 21(4), 1995, 678.

Mega, V. & Pedersen, J. 1998 Urban Sustainability Indicators. European Foundation For The Improvement Of Living and Working Conditions.

National Development Plan: 1994 - 1999. Government Publications

OECD, 1994. Environmental Indicators: OECD Core Set. OECD, Paris

OECD, 1997. Better Understanding Our Cities: The Role Of Urban Indicators. OECD, Paris.

OECD, 1999. 'Towards Sustainable Development - Indicators to Measure Progress' OECD Conference hosted by the Italian Authorities. Rome, 15-17 December 1999.

Pacione, M. 1990. Urban Problems: An Applied Urban Analysis. Routledge, London

Pender, A., Dunne, L., and Convery, F.J., 2000. Environmental Indicators for the Urban Environment. Environmental Institute, UCD, Dublin.

Rees, W.E. 1978. An Ecological Framework for Regional and Resource Planning. The University of British Columbia, Vancouver: UBC School of Community and Regional Planning.

Rees, W.E. 1996. Revisiting carrying capacity; area-based indicators of sustainability. *Popul. Environ.* 17, 195-215.

Russell, P. 1999. Re: The Urban Audit. Department of Regional and Urban Planning U.C.D. Personal Communication May 1999.

Smith, M. 1994. Minister for the Environment, DoE Introduction to the 1994 UR Schemes, DoE Publication, 1994.

Transportation Association of Canada. 1998. A New Vision for Urban Transportation. Transportation Association of Canada, Urban Transportation Indicators in Eight Canadian Urban Areas, TAC Ottawa, 1996.

UK's Royal Institution of Chartered Surveyors in EU Publication, Expert Group on the Urban Environment, Brussels, March, 1996

UN Centre for Human Settlements, 1998. Urban Indicators Programme.
<http://www.urbanobservatory.org>

United States EPA. 1999. State of the Environment Goals and Indicators project (SEGIP)
<http://www.epa.gov/OWOW/indic/I.html>

Canada's Environmental Indicator Series is published on the internet and can be found at
http://199.212.18.79/~ind/English/TOC/toc_e.HTM

Wackernagel, M. and Rees, W. 1996. Our Ecological Footprint: Reducing Human Impact on the Earth. New Society Publishers, Gabriola Island, BC.

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