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Units for Environment Statistics

and Their Classification

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A. Acknowledgement

1. This paper has drawn heavily on work undertaken by the authors on the International Recommendations for Water Statistics while they were employed in the United Nations Statistics Division.

B. Introduction

2. The purpose of this paper is to address the identification, definition and classification of statistical units as they relate to the collection, compilation, analysis and dissemination of environment statistics.

3. A statistical unit is the entity about which information is sought and for which statistics are ultimately compiled[1]. It is the unit at the base of statistical aggregates and to which tabulated data refer.

4. The determination of the units related to the environment along with the relevant units in the economy and the interactions between the two will help:

- Define in more detail the components of the environment and the economy about which data are compiled or from which data are collected;

- Describe the main classifications of statistical units relevant to environment statistics;

- Define the main characteristics of statistical units so that survey frames and the related statistical infrastructure needed for environment statistics can be constructed or existing infrastructure adapted;

5. A statistical unit may be an observational unit from which information is received and statistics are compiled or an analytical unit for which statisticians create by splitting or combining observation units with the help of estimations and imputations in order to supply more detailed and/or homogeneous data. A reporting unit is the entity from which specific data items (e.g. water abstracted, energy used, pollution emitted) are collected.

6. Section C addresses the statistical units of the environment and introduces the classification of environment assets. Section D presents the statistical units of the economy, which includes the description of enterprises, establishments and households. Section E addresses the classification of establishments to industries, and in doing so introduces the ISIC Rev. 4 and CPC Ver. 2 and the industries and products of particular importance for environment statistics. Section F presents the characteristics that are recommended to be recorded for the statistical units.

C. Statistical units of the environment

7. Defining the statistical units of the environment has proved difficult. In this paper we propose land area (or land parcel) as a fundamental statistical unit of the environment. To the land it is then possible to attach a variety of other units or descriptions of units, including an owner (an economic unit) as well as physical feature of the environment (such as a lake or forest). Figure 1. Shows an example of this.

Figure 1. Land area and the associated units of the environment and the economy.

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[1] See UNSD October 20007 "Statistical Units" paragraph 14: http://unstats.un.org/unsd/isdts/docs/StatisticalUnits.pdf
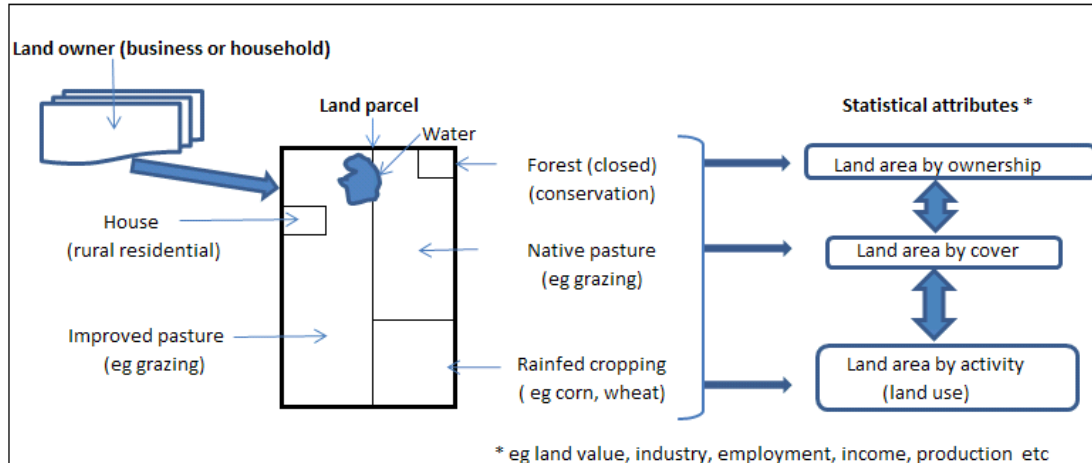
8. To a particular piece of land a variety of environmental units or land covers may be identified. These include, water resource (rivers, lakes, artificial reservoirs, etc), vegetation types, animals, soil and sub-soil resources. For the vegetation types these are probably approximated by land cover classifications.

9. For terrestrial and marine environments the African Climate Policy Centre uses ecosystems as environmental units. This reflects the Millennium Ecosystem Assessment, which also considered people and the economy as an integral part of the environment and earth's ecosystem[2]. The collection and compilation of information according to ecosystems facilitates the application of an ecosystems approach when analyzing climate related issues. For geological environments subsurface features such as aquifers, mineral deposits and oil and gas reservoirs, are used as environmental units. For atmospheric environments, atmospheric spheres are used, e.g. troposphere or stratosphere.

10. The atmosphere also exists above the land, but it is likely that for practical purposes the atmosphere is a statistical unit in its own right. It could be argued that the unit would be the space the atmosphere occupies, and not the elements (mainly nitrogen and oxygen) which compose the atmosphere, that is the unit. A similar argument can be made for the oceans (i.e. they are a three dimensional space.

11. However defined the units that make up environment are a mix of biological (e.g. plants and animals) and physical (rocks, minerals, water, etc.) and these interact in complex ways among themselves and with the units of the economy.

1. Problems of classification

12. It is important to note, that sometimes it is difficult to classify or find the exact boundary between the different units of the environment, for example where a lake ends and a river begins, where a river ends and an artificial reservoir begins, or a river ends and the sea begins. In practice units need to be classified on the best information available and this may require some subjective judgements. The case of wetlands is noted in the International Recommendations for Water Statistics.

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[2] Millennium Ecosystem Assessment 2005. Ecosystems and Human Well-being: A Framework for Assessment. (see page 26) [Online 18 June, 2010: http://www.millenniumassessment.org/documents/document.299.aspx.pdf]

D. Statistical units of the economy

13. It is essential to understand and define the statistical units of the economy as they interact with the environment. It should be noted that people and economic units can report information about environment units.

14. National statistical offices have much experience with identifying and classifying the statistical units of the economy. Much of the information below is drawn from the 2008 SNA[3] and the *International Recommendations for Industrial Statistics*[4].

1. Enterprises and establishments

15. An enterprise is an economic unit in its capacity as a producer of goods and services. An enterprise may operate one or more establishments, and may produce a variety of goods and services[5]. In the course of the production other goods and services will be consumed. The goods and services produced and consumed include water and sewerage services (see paragraphs below for more information on these goods and services and the CPC Ver. 2, which is used to classify them).

16. An establishment is an enterprise or part of an enterprise that is situated in a single location and in which only a single (non-ancillary) productive activity is carried out or in which the principal productive activity accounts for most of the value added[6]. Establishments are also known as local kind-of-activity units (local KAUs)[7]. Establishments are classified to industries using ISIC Rev. 4 on the basis of their principal productive activity (see Section D). Establishments also include government (i.e. a government office is an establishment).

17. As establishments have a single location, economic activities can be linked to specific locations and placed within river basins or administrative areas. It is important to distinguish establishments within enterprises when an enterprise has more than one establishment, especially when establishments are involved in different productive activities, or when they have the same productive activities but are located in different river basins or administrative areas. For example, if an enterprise is engaged in the making and selling of clothes consists of three establishments including a factory making clothes (ISIC 14 – Manufacturing of wearing apparel) and two shops, in different cities, selling clothes (both ISIC 47 – Retail trade), then it is important to separate the establishments within the enterprise. If they are not separated, then the water use (and other data of interest) might be incorrectly attributed to one ISIC (e.g. ISIC 47) rather than two (e.g. ISIC 14 and ISIC 47). In addition, if the establishments are located in different river basins or administrative areas, then the water use may be incorrectly allocated to one river basin or administrative area rather than two.

2. Households

18. A household is defined as a group of persons who share the same living accommodation, who pool some, or all, of their income and wealth and who consume certain types of goods and services collectively, mainly housing and food. In general, each member of a household should have some claim upon the collective resources of the household. At least some decisions affecting

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[3] 2008 SNA: http://unstats.un.org/unsd/sna1993/draftingPhase/WC-SNAvolume1.pdf

[4] UNSD February 2008 International Recommendations for Industrial Statistics: http://unstats.un.org/unsd/statcom/doc08/BG-IndustrialStats.pdf

[5] See 2008 SNA paragraph 5.1

[6] See 2008 SNA paragraph 5.3

[7] See 2008 SNA paragraph 5.14

consumption[8] or other economic activities (as households can be producers) must be taken for the household as a whole[9].

19.In demographic and social statistics the concept of a household is based on the arrangements made by persons, individually or in groups, for providing themselves with food and other essentials for living[10]. In general the definition of a households used in demographic and social statistics and economic statistics are very closely approximated[11].

20.The majority of the population live in households but there are also persons living in institutions that are not members of a household. This group constitutes the institutional households[12]. For example, persons living permanently in retirement homes and persons living in military bases.

E. Classification of economic units - establishments

21.To examine the interactions between the environment and economy in detail it is necessary to refer to more homogenous groups of establishments of production[13]. As such establishments are classified to an industry based on the process applied in the production of goods and services[14]. Establishments can also be classified by institutional sector based on the principal function, behaviour and objective of establishments.

22.The ideal situation is to identify and observe establishments engaged in only one productive activity. In practice, this is not always feasible, so establishments are classified on the basis of a principal activity using the *International Standard Industrial Classification of All Economic Activities Revision 4*[15].

1. Classification by industries: the International Standard Industrial Classification of All Economic Activities Revision 4 (ISIC Rev. 4)

23.An industry is a group of the establishments within the economy that are engaged in the same, or similar, kinds of production activity[16] (i.e. the type of activity undertaken to produce certain goods or services). As such the term industry includes agriculture, mining, manufacturing, service industries, etc.

24.The productive activity of economic units is termed principal, secondary or ancillary activity:

- The principal activity of an economic unit is the activity whose value added exceeds that of any other activity carried out within the same unit and whose output must be suitable for delivery outside the economic unit[17].

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[8] The term consumption here is used in the sense of national accounts. See paragraph **Error! Reference source not found.** for an explanation of how the term consumption is used in hydrology and environment statistics.

[9] See 2008 SNA paragraph 4.149

[10] See Principles and Recommendations for Population and Housing Census Revision 2., paragraph 1.448

[11] See 2008 SNA paragraph 4.150

[12] See Principals and Recommendations for Population and Housing Census Revision 2., paragraph 1.455

[13] See 2008 SNA paragraph 2.38

[14] See 2008 SNA paragraph 2.37

[15] See S008 SNA paragraph 2.39

[16] See 2008 SNA paragraph 5.5

[17] See 2008 SNA paragraph 5.8

▪ A secondary activity is an activity carried out within a single economic unit in addition to the principal activity and whose output must be suitable for delivery outside the economic unit[18].

▪ An ancillary activity is incidental to the main activity of the economic unit. It facilitates the efficient running of an enterprise but does not normally result in goods and services that can be marketed[19].

25. Economic units are classified to an industry using the *International Standard Industrial Classification of All Economic Activities Revision 4* (ISIC Rev. 4). When defining industries, ISIC Rev. 4 uses criteria such as input, output and use of the products produced and the character of the production process in defining and delineating ISIC classes. ISIC Rev. 4 is a hierarchical classification of all economic activities including: 21 Sections (a one letter alpha code, A-U, most aggregated level); 88 Divisions (2-digit code); 238 Groups (3 digit code) and 420 Classes (4-digit code and most detailed level).

26. Figure 2 shows the relationships of enterprises, establishments and industry classification. An enterprise may have only one establishment and can be classified to industry on the basis of its principal activity, as is the case for Enterprise 1 and Establishment 1 in Figure III.1. Establishment 1 is classified to Industry 1. In this case it could be one farm. An enterprise may have two or more establishments as is the case for Enterprises 2, 3, 4 and 5. In the case of Enterprise 2, the principal activities of both of its establishments are the same and hence are classified to Industry 1 (Agriculture, ISIC Rev. 4, Div. 01). It could be that the establishments are two farms, separated by distance, but owned and operated by one enterprise. Enterprise 3 has three establishments, which each have a different principal activity and so are classified to three different industries. Enterprise 4 also has two establishments, and in the example shown which is common in many countries, Enterprise 4 has establishments engaged in water supply (ISIC Rev. 4, Div. 36) and sewerage (ISIC Rev. 4, Div. 37) industries.

Figure 2 Relationship of enterprises, establishments and industry classification
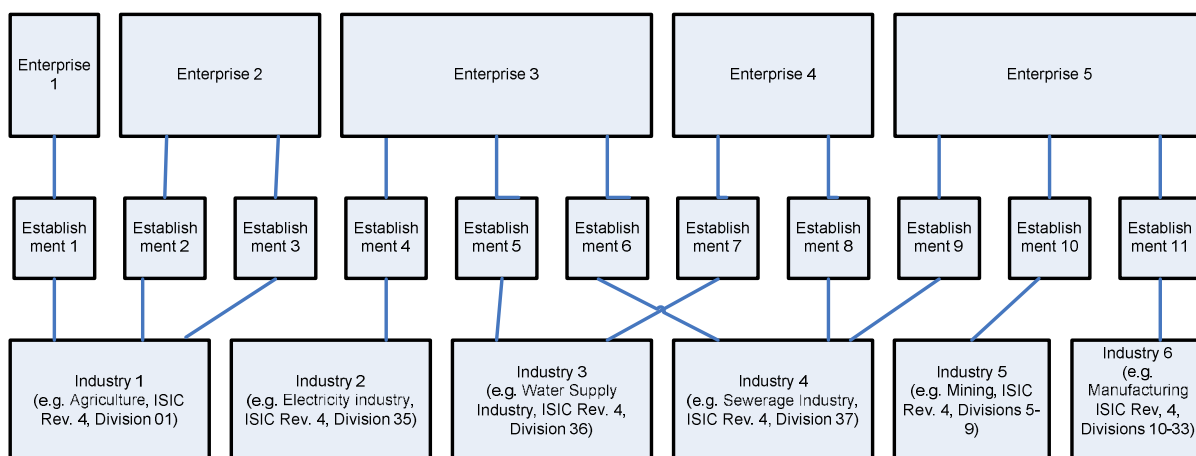
2. Products and the Central Product Classification Version 2 (CPC Ver. 2)

27. Products are the goods and services that are the result of production and are transacted. They are used for various purposes: as inputs in the production of other goods and services, for final

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[18] See 2008 SNA paragraph 5.9

[19] See 2008 SNA paragraph 5.10

consumption[20] or for investment. Products are classified using the Central Product Classification Version 2 (CPC Ver. 2)[21].

28. The CPC Ver. 2 constitutes a comprehensive classification of all goods and services produced by the economies of the world. It presents categories for all goods and services that can be the object of domestic or international transactions or that can enter into stocks. The CPC Ver. 2 is aligned with the *Harmonised Commodity Description and Coding System*[22] (or HS) and is also based on the physical characteristics of goods or on the nature of the services rendered. Each type of good or service distinguished in the CPC Ver. 2 is defined in such a way that it is normally produced by only one industry as defined in ISIC.

3. Industries important for environment statistics

29. Some industries are of special relevance to environment statistics because they use large quantities of natural resources, discharge large quantities of pollution to other economic units or the environment. These industries include:

- Agriculture (ISIC Rev. 4, Div. 01)

- Mining and quarrying (ISIC Rev. 4, Div. 05-09)

- Manufacturing (ISIC Rev. 4, Div. 10-33)

- Electricity, gas, steam and air conditioning supply (ISIC Rev. 4, Div. 35)

  - Hydro-electricity producers

  - Other types of electricity producers (e.g. coal, natural gas, nuclear, solar, wind, etc.)

- Water collection, treatment and supply (ISIC Rev. 4, Div. 36)

- Sewerage (ISIC Rev. 4, Div. 37)

(a) Agriculture

30. Agriculture (ISIC Rev. 4, Div. 01)[23] includes establishments engaged in the exploitation of plant and animal natural resources, comprising the activities of growing of crops, raising and breeding of animals, harvesting of timber and other plants, animals or animal products from a farm or their natural habitats. Crop and animal production is require the use of land, a large number of inputs including very large amounts of water in most countries. Agriculture can also be a significant source of waterborne emissions and in particular of nitrogen and phosphorus.

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[20] The term consumption here is used in the sense of national accounts. See paragraph **Error! Reference source not found.** for an explanation of how the term consumption is used in hydrology and environment statistics.

[21] Central Product Classification Version 2 (CPC): http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=25

[22] The *Harmonised Commodity Description and Coding* System (or HS) of tariff nomenclature is an internationally standardized system of names and numbers for classifying traded products developed and maintained by the World Customs Organization: http://www.wcoomd.org/home_online_services_hs_online.htm

[23] See ISIC Revision 4, Explanatory note for Division 01
http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=01

(b) Mining

31.Mining (ISIC Rev. 4, Div. 05-09)[24] includes establishments engaged in the extraction of minerals occurring naturally as solids (coal and ores), liquids (petroleum) or gases (natural gas) and also includes supplementary activities aimed at preparing the crude materials for marketing, for example, crushing, grinding, cleaning, drying, sorting, concentrating ores, liquefaction of natural gas and agglomeration of solid fuels.

32.Mining industries may cause significant disturbance to land, vegetation, water and may discharge pollution to the air or water. They also consume energy and other materials.

(c) Manufacturing

33.Manufacturing (ISIC Rev. 4, Div. 10-33)[25] includes establishments engaged in the physical or chemical transformation of materials, substances, or components into new products, although this cannot be used as the single universal criterion for defining manufacturing. Units engaged in manufacturing are often described as plants, factories or mills and characteristically use power-driven machines and materials-handling equipment. Units that transform materials or substances into new products by hand or in the worker's home and those engaged in selling to the general public of products made on the same premises from which they are sold, such as bakeries and custom tailors, are also included.

34.The manufacturing industries may use significant quantities of energy, water and other natural resources in production processes. Manufacturing industries also usually account for a significant proportion of the air and water pollution as well as solid wastes.

(d) Electricity, gas, steam and air conditioning supply

35.Electricity, gas, steam and air conditioning supply (ISIC Rev. 4, 35[26], the name of which is shortened to electricity industry hereafter) includes establishments engaged in the activity of providing electric power, natural gas, steam, hot water and the like through a permanent infrastructure (network) of lines, mains and pipes. Electricity generators use very large quantities of water for hydro-electricity generation and for cooling in thermal electricity generation stations.

(e) Water collection, treatment and supply industry and the sewerage industry

36.The water collection, treatment and supply industry (ISIC Rev. 4, Div. 36), the name of which is shortened to water supply industry in these recommendations, includes establishments engaged in water collection, treatment and distribution activities for household and industrial needs[27]. The water supply industry includes:

(f) Other industries

37.While the agriculture, electricity, water supply and sewerage industries are likely to be the most important for most countries, other industries may be of significance for some countries or for some users of environment statistics. These include:

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[24] See ISIC Revision 4, Explanatory note for Section B
http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=B

[25] See ISIC Revision 4, Explanatory note for Section C
http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=C

[26] See ISIC Revision 4, Explanatory note for Section D
http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=D

[27] See ISIC Revision 4, Explanatory note for Class 3600
http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=3600

- Forestry, fishing and aquaculture, (ISIC Rev. 4, Div. 02-03)
- Transport (ISIC Rev. 4, Div.)
- Accommodation (ISIC Rev. 4, Div. 55)
- Food and beverage services (ISIC Rev. 4, Div. 56)

38. Forestry and logging (ISIC Rev. 4, Div. 02)[28] includes establishments engaged in the production of round wood for the forest-based manufacturing industries (ISIC Rev. 4, Div. 16 and 17) as well as the extraction and gathering of wild growing non-wood forest products. Besides the production of timber, forestry activities result in products that undergo little processing, such as firewood, charcoal, woodchips and round wood used in an unprocessed form (e.g. pit-props, pulpwood, etc.). These activities can be carried out in natural or planted forests.

39. Fishing and aquaculture (ISIC Rev. 4, Div. 03)[29] includes capture fishery and aquaculture, covering the use of fish resources from marine, brackish or freshwater environments, with the goal of capturing or gathering fish, crustaceans, molluscs and other marine organisms and products.

40. The use of natural resources and the generation of waste and pollution by tourists is of particular interest in some countries where there are large numbers of tourists. Tourism is not defined as an industry in ISIC Rev. 4, but is a collection of activities undertaken by a range of establishments, classified to large number of industries. *The International Recommendations for Tourism Satellite Accounts*[30] provide guidance on the definition of the tourism and its relationship to industries. It is important to note that the consistent coding of economic units to industry (and sector) and a clear understanding of the principal, secondary and ancillary activities of the units enables the data from economic units to be arranged in variety of ways for a range of purposes, including national accounts, water accounts, and tourism satellite accounts. In the cases where tourism is of particular policy interest, the identification of units in the industries of accommodation (ISIC Rev. 4, Div. 55)[31] and food and beverage services (ISIC Rev. 4, Div. 56)[32] may be important.

4. Classification of unit by institutional sectors

41. Information on institutional sectors is included here because there is sometimes confusion in the classification of government owned establishments supplying water or sewerage services. Classification of establishments to industry is on the basis of activity, whereas classification to sector is based on ownership and the type of legal identity. Therefore government owned and operated establishments that supply water or sewerage services will have the institutional sector of government but will be classified by economic activity as the belonging to the water supply (ISIC Rev. 4, Div. 36) industry or sewerage (ISIC Rev. 4, Div. 37) industry respectively. In activity-based classifications the government owned units supplying water or sewerage services should **not** be classified to public administration and defence (ISIC Rev.4, Div. 84).

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[28] See ISIC Revision 4, Explanatory note for Division 02
http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=02

[29] See ISIC Revision 4, Explanatory note for Division 03
http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=03

[30] International Recommendations for Tourism Satellite Accounts:
http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/C7681ACFEC530658CA25742D001621DA/$File/52490_2006-07.pdf

[31] See ISIC Rev. 4, Div. 55: http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=55

[32] See ISIC Rev. 4, Div. 55: http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=56

F. Characteristics of statistical units

42.Statistical units may be characterised by a number of descriptive data items that help uniquely identify them and facilitate the process of producing environment statistics, in particular the survey design and sample weighting for estimation. The recommended characteristics of the statistical units of the inland water resources and the economy are presented below. These characteristics should be recorded in the different registers of the statistical units.

1. Characteristics of environmental units

43.Statistical units may be characterised by a number of descriptive data items that help uniquely identify them and facilitate the process of producing environment statistics. The characteristics of all potential environmental units is not proposed here, but the characteristics of inland water resources is presented as an example

Characteristics of inland water resources (bodies)

44.Inland water bodies can be characterised by six descriptive data items (see International Recommendations for Water Statistics), presented in Table 3 Additional characteristics may be added for particular water resources (for example, aquifers may be divided into confined and non-confined).

Table 3 Characteristics of inland water bodies relevant to environment statistics

Characteristics of inland water bodies
1. Name
2. Identification code
3. Location
4. Type of water body
5. Organisation(s) responsible for management
6. Physical characteristics

45.It is usual for lakes, rivers, wetlands, artificial reservoirs, glaciers and groundwater resources to be given a name, for example, Lake Baikal (Russia), The Amazon (Brazil), Lake Kariba (Zambia and Zimbabwe), Malaspina Glacier (USA) and The Great Artesian Basin (Australia), etc. In some cases the name also accurately describes the type of water resource, as is the case with Lake Baikal and the Malaspina Glacier in the examples given above. However this is not always true, as, for example, Lake Kariba is an artificial reservoir.

2. Characteristics of economic units

46.For the economic units, which usually equate to reporting units, Table 4 presents the 6 characteristics recommended for economic units to record in the *International Recommendations for Industrial Statistics* (IRIS).

Table 4 Characteristics of economic units

Characteristics of economic units
1. Identification code
2. Location^
3. Industry
4. Type of economic organisation
5. Type of legal organisation
6. Size

^For environment statistics this should include the river basin in which the unit is located in addition to geographic coordinates.