System of Environmental Economic Accounting

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SEEA TECHNICAL NOTE: WATER ACCOUNTING

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This note is a part of a series of Technical Notes prepared to support the development of data based on the System of Environmental Economic Accounts (SEEA) Central Framework, the first international standard in environmental economic accounting. Since SEEA is not a single account but a series of modules, the accounts in each of the various modules can be developed separately in accordance with the priorities and the resource availability in each country.

The series of Technical Notes is comprised of a) a note addressing general issues that cut across domains focusing on institutional arrangements and institutional processes that encourage efficient implementation of the standard and associated data compilation exercises (see *Institutional Arrangements and Statistical Production Processes for the Implementation of the SEEA-Central Framework*) and b) a number of notes on specific modules. It is recommended that those wishing to develop data related to any of these specific modules should read the cross cutting note in conjunction with the note on the specific modules to be developed.

The notes on modules summarize the data requirements and other operational considerations in 20-25 pages designed to provide sufficient guidance to initiate the development of the accounts. The notes also provide reference information for additional publications that will support the full development of the accounts and provide information on extensions and linkages that can be exploited once the accounts and tables are in place.

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1. Introduction

1. Water is essential for life. It is a key element in growing food, generating energy, producing many products, and ensuring the integrity of ecosystems and the goods and services they provide. Increasing demand for freshwater from agriculture, urban and industrial use, and population growth results in pressure on water resources, with many countries (or regions within countries) reaching conditions of water scarcity and facing limits to economic development. Moreover, water quality may deteriorate over time further limiting the availability of freshwater resources.

2. Water accounting comprises a number of different accounts that capture information on physical and monetary flows of water, and the availability of water resources to reflect the integral role that water plays in human life, economic activity and environmental integrity.

3. This technical note provides an overview of water accounting according to the System of Environmental Economic Accounting 2012 Central Framework (SEEA CF), which was adopted by the United Nations Statistical Commission in 2012 as the international statistical standard for environmental-economic accounts. The water accounts are also supported by the System of Environmental-Economic Accounting for Water (SEEA-Water) and the International Recommendations for Water Statistics (IRWS). The accounting approach of SEEA-Water is based on the same conceptual framework as the SEEA CF.

4. At the heart of SEEA water accounting is an accounting approach that records, as completely as possible, the stocks and flows of water within and between the economy and the environment. It supports analyses of the role of water within the economy and of the relationship between the environment and water-related economic activities. The concepts and definitions that comprise the water accounts are designed to be applicable across all countries, irrespective of their state of economic development and variations in water sources and uses.

5. The water accounts support an integrated approach to water management and it is important for analytical purposes to compile the accounts regularly. Countries will also need to assess temporal and spatial considerations when developing water accounts.

6. The general purpose of SEEA Technical Notes is to summarize the key features of accounting for a given topic to support countries in the implementation of the SEEA, and describe what might be a minimum set of information to guide initial efforts in compilation. This technical note will describe the main features of the SEEA accounts for water and present a set of core accounts which comprise an adapted version of the SEEA Central Framework accounts to focus and guide initial compilation.

7. The core accounts represent a minimum set of information which countries should aim to compile and report, explicitly identifying the most important data items. While the core accounts represent a minimum set, countries may often wish to extend the level of detail in areas deemed particularly policy relevant. The Technical Notes provide highlights of such possible extensions in the explanatory text. The level of detail and industry disaggregation of the core accounts is relatively uniform across the set of module-specific technical notes. For the modules where industry disaggregation is relevant, five broad industry classes are identified. In addition, specific industries

relevant to each module are also included separately, such as the water collection, treatments and supply industry and the sewerage industry in the case of water.

8. In addition to the core accounts, this technical note presents a combined presentation (see section III). This combined presentation provides countries with a template to present and disseminate an aggregated set of key monetary and physical information relevant to water from a range of sources (including the SEEA and SNA). The information included in the combined presentations are data items which are of key relevance to policy makers and which, often in combination, are used to calculate particularly important indicators (including the SDG indicators). The level of industry disaggregation mentioned above is maintained, allowing countries to present key information at a sector specific level.

9. The development of core accounts was requested by the UN Statistical Commission at its 44th session in February 2013. The core accounts for water, along with other core accounts such as those for energy, land, and others, constitutes the starting point in the development of common reporting tables in close coordination with international agencies.

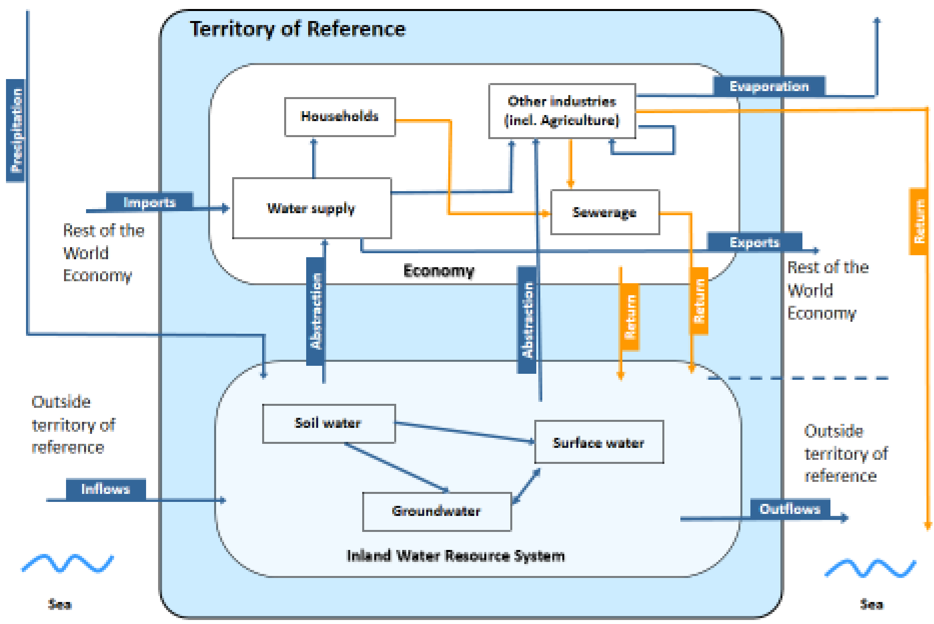
10. Section II briefly describes the SEEA accounting system for water and presents the core accounts for water. Section III presents the combined presentation for water, and provides an overview of the types of indicators which can be derived. Section IV discusses the data sets required to produce the core accounts including the main concepts, data sources and compilation methods. Section V describes how the core accounts and related datasets may be extended to address broader issues, and how they can be linked to other data sets. Section VI provides references and links to supporting material.

2. SEEA-CF accounts for water

11. Together the various accounts for water in the SEEA CF build a system of information to study the inland water resources system and its relationship with the economy, where the economy is delineated by the boundaries set in the System of National Accounts. This system is captured in simplified form in Figure 1[1]. There are three main accounts for water that capture various aspects of this system. These are listed briefly below:

[1] For a more in-depth discussion please refer to the SEEA-Water Chapter II

Figure 1: Main flows within the inland water resources system and the economy



12. The **Physical Supply and Use Tables** (PSUT) measure, in physical (volume) terms: 1) the flows of water entering the economy, which are either abstracted from the environment or imported; 2) the flows of water and wastewater between different economic units within the economy, and; 3) the return flows of water from the economy to the environment (directly or via sewerage treatment plants)[2].

13. The **Monetary Supply and Use Tables** measure the monetary flows associated with water related products. The Monetary Supply Table captures total output of water related products to derive the total supply of natural water and sewerage services[3]. The Monetary Use Table captures expenditure by different economic units on natural water and sewerage services[4].

14. The **Asset Account** describes the inland water resources system in terms of stocks and flows, providing information on the stocks of water resources at the beginning of the accounting period, the corresponding changes in those stocks due to economic activity (e.g. abstractions and returns) and natural processes (e.g. outflows to other territories), and the closing stocks of water at the end of the accounting period. This can be thought of as a hydrological water balance. Asset accounts for water are generally only considered in physical terms, as valuation of water consistent with the SNA valuation principles is still under discussion.

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[2] Associated with the flows of water described here, Emissions Accounts can be compiled to measure the quantity of pollution added to water by the economy (see SEEA Water chapter IV and SEEA CF chapter III).
[3] Other water related products can also be included.
[4] As total output is usually measured at basic prices while total expenditure is measured at purchasers' prices, adjustments are made to basic prices to account for taxes, subsidies and trade and transport margins.

15. The core accounts described in this technical note are the minimum set of the PSUT, monetary supply use tables and asset accounts which are described above. They constitute the main building blocks for the combined presentation for water, which brings together the most relevant information derived from the core accounts along with other key information from other sources (e.g. economic and labor statistics). The following sections (II.1 to II.3) lay out each core account in more detail.

2.1 Physical Supply and Use Tables for Water

16. Core Account 1 is a basic PSUT for water which contains information on the supply and use of water and provides an overview of water flows. It is likely that these flows will be concentrated in relatively few cells in the tables and these should form the focus of initial compilation. Physical supply and use tables for water can be compiled at various levels of detail, depending on the required policy and analytical focus and data availability.

17. The breakdown of economic activities as identified in the columns of Core Account 1 distinguishes major groups associated with water supply and use. Columns 1, 2 and 3 identify the Agriculture (ISIC A), Mining and Quarrying (ISIC B), and Manufacturing (ISIC C) industries respectively, as these are key sectors in water use and wastewater generation. The fourth column identifies ISIC D separately (i.e. ISIC 35 Electricity, gas, steam and air conditioning supply) as it is a major user of water for generating hydroelectric power and for cooling purposes. The next two columns identify ISIC divisions 36 and 37 respectively, as these are the key industries for the distribution of water and wastewater treatment respectively.

18. The rows of Core Account 1 for water are divided into five sections, which capture different aspects of water flows. Each section is discussed in turn, including definitions of terms and detailed explanation.[5]

1: Sources of Abstracted Water (from the environment)

19. Section 1 organizes information on water abstracted from the environment. The Physical *Supply* Table records this abstracted water in the 'flows from the environment' column. The Physical *Use* Table then allots the water abstracted from the environment to the corresponding industry responsible for its abstraction. The rows in section 1 are broken down to reflect abstraction from different water sources and can be further (dis)aggregated to highlight particular sources based on national policy concerns. The International Recommendations for Water Statistics provide the necessary data items for this disaggregation[6].

[5] Dark grey cells are null by definition. There are exceptions (for example, if a country imports wastewater for treatment), though these are rare.
[6] See IRWS data item 'E: Physical Data Items for Flows from the Environment to the Economy' and corresponding sub-categories (pg. 136-137).

Core Account 1: Physical Supply and Use Table for water

PHYSICAL SUPPLY TABLE	Industries (by ISIC) Agriculture, Forestry & Fishery (ISIC A)	Mining and Quarrying (ISIC B)	Manufacturing (ISIC C)	Electricity, gas, steam & air conditioning supply (ISIC D)	Water collection, treatment & supply (ISIC 36)	Sewerage (ISIC 37)	Other Industries	Total Industry	Households		Flows from the Rest of the World (Imports)	Flows from the Environment	TOTAL SUPPLY
1. Sources of Abstracted Water:													
Inland Water Resources												967	967
of which: Surface water												441	441
of which: Groundwater												476	476
Other Water Sources												202	202
TOTAL SUPPLY ABSTRACTED WATER												**1 169**	**1 169**
2. Water:													
Distribution of abstracted water	0	0	0	0	378	0	0	**378**			0		**756**
Own use of abstracted water	108	34	80	404	14	100	2	**744**					**744**
3. Wastewater and re-used water:													
Wastewater to treatment	18	35	82	6	1	0	49	**192**	236				427
Own treatment of wastewater	0	0	0	0	0	0	0	**0**	0				0
Re-used water produced (for distribution)	0	3	7	0	0	43	0	**53**	0				53
TOTAL WASTEWATER AND RE-USED WATER	18	38	89	6	1	43	49	244	236				**480**
4. Return flows of water:													
To inland water resources	65	7	16	300	47	228	1	**664**	5				669
To other sources	0	2	4	100	0	256	0	**362**	0				362
TOTAL RETURN FLOWS	65	9	21	400	47	484	1	**1 026**	5				**1 031**
of which: Losses in distribution	0	0	0	0	47	0	0	**47**	0				47
5. Evaporation of abstracted water, transpiration and water incorporated into products:													
TOTAL WATER EVAPORATED, TRANSPIRED AND INCORPORATED INTO PRODUCTS	76	13	30	3	2	1	4	**128**	10				**138**
6. TOTAL SUPPLY	268	94	220	812	443	627	56	**2 520**	250		0	1 169	**3939**

PHYSICAL USE TABLE	Industries (by ISIC) Agriculture, Forestry & Fishery (ISIC A)	Mining and Quarrying (ISIC B)	Manufacturing (ISIC C)	Electricity, gas, steam & air conditioning supply (ISIC D)	Water collection, treatment & supply (ISIC 36)	Sewerage (ISIC	Other Industries	Total Industry	Households	Accumulation	Flows to the Rest of the World (Exports)	Flows to the Environment	TOTAL USE
1. Sources of Abstracted Water:													
Inland Water Resources	108	34	80	304	437	0	2	**967**					967
of which: Surface water	55	24	56	301	5	0	0	**440**					440
of which: Groundwater	3	10	24	3	433	0	2	**476**					476
Other Water Sources	0	0	0	100	2	100	0	**202**					202
TOTAL USE ABSTRACTED WATER	108	34	80	404	440	100	2	**1 168**					**1 169**
2. Water (use):													
Use of distributed water	39	14	32	4	0	0	51	**139**	240		0		**378**
Own use of abstracted water	108	34	80	404	3	100	2	**733**	11				**744**
3. Wastewater and reused water:													
Wastewater received from other units					0	427		**427**			0		427
Own treatment of wastewater	0	0	0	0	0	0	0	**0**	0				0
Re-used water (distributed reuse)	12	12	28	0	0	0	0	**53**	0				53
TOTAL WASTEWATER AND REUSED WATER	12	12	28	0	0	427	0	480	0		0		480
4. Return flows of water:													
To inland water resources												669	669
To other sources												362	362
TOTAL RETURN FLOWS												1 031	**1 031**
5. Evaporation of abstracted water, transpiration and water incorporated into products:													
TOTAL WATER EVAPORATED, TRANSPIRED AND INCORPORATED INTO PRODUCTS										10		128	**138**
6. TOTAL USE	268	94	220	812	443	627	56	**2 520**	250	10	0	1 159	**3 939**

20. ***Abstraction** is defined as the amount of water that is removed from any source, either permanently or temporarily, in a given period of time.*

21. Water may be abstracted from surface water (including artificial reservoirs, rivers, lakes, wetlands and snow/ice), groundwater, soil water and other water sources (including precipitation and abstraction from the sea).

22. The capture of precipitation through, for example, the capture of water from the roofs of houses in water tanks, is recorded as abstraction through precipitation. Precipitation which falls and directly enters the inland water system (including the soil) is not recorded in the PSUT, but in the asset account for water resources (as this constitutes a flow within the environment).

23. Following the general treatment of household own-account activity in the national accounts, the abstraction of water by households for own use should be recorded as part of the activity of the water collection, treatment and supply industry (ISIC 36) and used by households. In countries where this is a major source of drinking water for households, presenting this information separately is encouraged.

24. Water used for hydroelectric power generation is considered abstraction and is recorded as a use of water by the abstractor (ISIC 35). Water abstracted but not used in production, such as water flows in mine dewatering, is also recorded as abstraction, because it represents a competing use of water. These flows of water are then recorded as natural resource residuals in 'return flows' (section 4 of Core Account 1). It is recommended to record these types of flows separately, because countries may wish to exclude these volumes of abstracted water when calculating indicators to highlight water stress resulting from abstraction by the economy.

25. Consistent with the treatment in the asset accounts for water resources, water in artificial reservoirs is not considered to have been produced, i.e. artificial reservoirs are considered to be in the environment. Consequently, abstraction from artificial reservoirs is recorded as abstraction from the environment. Flows of precipitation into artificial reservoirs and flows of evaporation from the reservoirs are not recorded in the PSUT for water (as they constitute flows within the environment), but rather in the asset accounts.

26. Depending on national circumstances, countries may wish to separately identify abstraction of soil water. Abstraction of soil water refers to the uptake of water by plants and is equal to the amount of water transpired by plants plus the amount of water that is embodied in the harvested product. Most abstraction of soil water is used in agricultural production[7] and in cultivated timber resources, but in theory the boundary extends to all soil water abstracted for use in production to include, for example, soil water abstracted in the operation of golf courses.

2: Water (distribution and use of abstracted water)

27. Section 2 describes the distribution and use of water within the economy which is either abstracted from natural resources or imported (as recorded in section 1).

28. The supply table records the supply of abstracted water by the industries undertaking the abstraction, differentiating between water abstracted for distribution and water abstracted for own use. The supply table also records imports of water from the rest of the world[8], which is usually negligible. The total of water abstracted for own use, water abstracted for distribution, and imported water represents the **total water available for use** in the economy.

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[7] As can be seen in the physical use side of Table 1, total abstraction for inland water resources for ISIC A is significantly larger than the sum of abstraction from surface water and ground water, as abstraction of soil water is also included (although not separately identified).

[8] Imports and exports of water refer to flows within the economy (i.e. imported water has been delivered to resident economic units by non-resident economic units and oppositely for exports). This differs from inflows and outflows of water, which refer to flows within the environment (i.e. flows of water in to and out of the territory's inland water system).

29. Most of the water for distribution is recorded under ISIC 36 (water collection, treatment and supply). However, there may be other industries that abstract and distribute water as a secondary activity. Basic data on secondary activities are generally less available, and so initial estimates should focus only on cases where significant volumes of secondary activity water abstraction for distribution are believed to exist. ISIC 35 is usually the industry that distributes the most amount of water as a secondary activity. It is also important to have the physical flows of secondary activities aligned with the relevant flows in the monetary accounts.

30. The use table records how this water is used, either as intermediate use by industries, final use by households, or exports to economic units in the rest of the world. Use of distributed water is the amount of water that is delivered to an industry, household or the rest of the world by another economic unit. This water is usually delivered through systems of pipes, but other means of transportation are also possible (such as artificial open channels and trucks).

3: Wastewater and re-used water

31. Section 3 presents information on flows of wastewater between economic units. The supply table records the generation of wastewater by industries and households, and can be disaggregated in terms of its intended destination. The use table in turn records receipt of this wastewater, where the vast majority of wastewater received goes to ISIC 37 (Sewerage).

32. ***Wastewater***[9] *is discarded water which is no longer required by the owner or user.* Wastewater can be discharged directly into the environment either before or after treatment (a return flow which is recorded in section 4), supplied to a sewerage facility (recorded in the supply table as wastewater to treatment) or supplied to another economic unit for further use (recorded in the supply table as reused water for distribution). Flows of wastewater may also include exchange of wastewater between sewerage facilities in different economies. These flows are recorded as imports and exports of wastewater.

33. ***Reused water*** *is wastewater supplied to another user for further use with or without prior treatment*[10]. This excludes recycling of water within the same economic unit. Information on these flows, although potentially useful for analysis of water-use efficiency, is not generally available. Reused water is considered a product when payment is made by the receiving unit[11].

34. Once wastewater is discharged into the environment (e.g., into a river), its re-abstraction downstream is considered a new abstraction from the environment rather than a re-use of water in the accounting tables, and is therefore recorded in Section 1.

[9] Note that in different water contexts outside of the SEEA CF, wastewater is often defined differently - in some cases, it may only include water requiring treatment. In the SEEA, the definition encompasses a broader set of return flows.
[10] It is also commonly referred to as reclaimed wastewater, although re-used water is the standard definition used in the SEEA CF and the IRWS.
[11] For the purposes of the SEEA CF, reused water is recorded in section 3 when payment is made and it is considered a product. Countries may wish to separate re-used water for which payment is made and for which there is no payment, and record it in two different rows of the PSUT for the purposes of aligning with the monetary supply and use tables.

4: Return Flows of Water to the Environment

35. Section 4 captures information on flows of water from the economy to the environment (i.e. ***return flows***). The physical supply table highlights the volume of return flows by contributing industries and households. Corresponding figures for total return flows of water are recorded in the "environment" column of the physical use table, as they represent the amount of water received by the inland water system.

36. The majority of return flows will be recorded from ISIC 37 (Sewerage). The rows in section 4 can be further disaggregated according to the destination of the return flows - the International Recommendations for Water Statistics provides the list and definition of the necessary data items[12]. As an extension, countries may also wish to disaggregate these return flows according to the level of treatment to which the water has been exposed (i.e. primary, secondary and tertiary treatment as defined in the SEEA[13]).

37. Some return flows of water to the environment are losses of water. Losses of water encompass flows of water that do not reach their intended destination. The primary type of losses of water is losses incurred during distribution. Losses during distribution occur between a point of abstraction and a point of use, or between points of use and reuse of water. These losses may be caused by a number of factors including evaporation and leakages.

38. ***Urban run-off***, a significant flow of water, is that portion of precipitation on built-up areas that does not evaporate or percolate into the ground, but flows via overland flow, underflow or channels, or is piped into a defined surface-water channel or a constructed infiltration facility. Urban run-off that is collected by a sewerage system is recorded as the abstraction of water from the environment (and, by convention, attributed to the sewerage industry (ISIC Division 37) in the supply table. It may then be treated before returning to the environment, treated and/or distributed as reused water, or returned directly to the environment. Urban run-off that is not collected by a sewerage or similar facility but flows directly to the inland water system is not recorded in the PSUT as it is a flow within the environment[14].

5: Evaporation of abstracted water, transpiration and water incorporated into products

39. To fully account for the balance of flows of water entering the economy through abstraction and returning to the environment as return flows of water, it is necessary to record three additional physical flows; evaporation of abstracted water, transpiration, and water incorporated into products. These combined flows are captured in section 5, and are often referred to synonymously as 'water consumption' or 'final water use'[15]. While ideally these flows would be recorded separately, direct measurement of these flows is very difficult in practice, especially as it relates to the distinction

[12] See Data Item H: Returns of water to the environment by economic units (pg. 138-139)
[13] See IRWS alternative breakdown of Data Item H (pg. 139)
[14] Rather, it is recorded in the asset account.
[15] The SEEA-Water uses the term 'water consumption' while the SEEA Central Framework uses 'final water use'

between transpiration and water incorporated into products (particularly plants). As such, a combined flow may be recorded[16].

40. Flows of evaporation are recorded when water is distributed between economic units after abstraction, for instance, during distribution via open channels or while in water storage tanks and similar structures. The transpiration of water occurs when soil water is absorbed by cultivated plants as they grow and is subsequently released to the atmosphere.

41. Amounts of water incorporated into products (e.g., water used in the manufacture of beverages) are shown as supplied by the relevant industry, commonly a manufacturing industry or agriculture.

2.2 Monetary Supply and Use Tables for Water

42. Core Account 2 is a basic form of a Monetary Supply and Use Table for Water. SEEA monetary supply and use tables for water fully articulate in monetary terms the flows of water products in an economy between different economic units. Monetary supply and use tables have their origins in economic accounting and the PSUT, and utilize the organizational principles and characteristics of these tables.

43. While the physical supply and use tables provide information on; 1) flows from the environment, 2) flows within the economy, and 3) return flows to the environment, the monetary supply and use table for water records only those flows related to water products (i.e. flows within the economy). Two water related products are specifically identified in the Core Account 2[17]:

44. ***Natural Water (CPC 1800)*** is associated primarily with the output of ISIC 36 (water collection, treatment and supply). In the monetary supply and use tables, natural water corresponds to the exchanges of water between economic units (mainly between ISIC Division 36 and other economic units, such as other industries, households and the rest of the world). It should be noted that this division is very broad, covering very different types of water exchanged in the economy, including reused water and water use in agriculture.

45. ***Sewerage, sewage treatment and septic tank cleaning services (CPC 941)*** includes sewerage and sewage treatment services (CPC 9411) and septic tank emptying and cleaning services (CPC 9412). These services are primarily associated with the output of ISIC division 37 (Sewerage).

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[16] The combined flow of evaporation of abstracted water, transpiration and water incorporated into products may be estimated as the balance of total supply and total use.

[17] Depending on data availability, countries may also wish to include other products related to water. These include: operation of irrigation systems for agricultural purposes, which is part of CPC 86110; water-related administrative services, which are part of CPC 91123; and site remediation and clean-up services (for surface water and groundwater) (CPC 94412 and part of CPC 94413).

Core Account 2: Monetary Supply and Use Table for Water

	Industries (by ISIC)								Rest of the World	Taxes less subsidies on products, trade & transport margins	**Actual Final Consumption**		**TOTAL**
	Agriculture Forestry & Fishery (ISIC A)	Mining and Quarrying (ISIC B)	Manufacturing (ISIC C)	Electricity, gas, steam & air conditioning supply (ISIC D)	Water collection, treatment & supply (ISIC 36)	Sewerage (ISIC 37)	Other Industries	**Total Industry**			Households	Government	
Supply of water products (currency):													
Total Supply of Products	170 737	80 143	187 000	195 769	6 570	5 036	6 478 288	7 123 543					
of which: Natural Water (CPC 1800)	0	4	9	1	6 570	14	7	6 605	1	- 2			6 604
of which: Sewerage Services (CPC 941)	0	0	0	0	0	5 022	0	5 022	2	14			5 038
Intermediate consumption and final use (currency):													
Natural Water (CPC 1800)	406	193	450	88	1 004	100	1 229	3 470	4		3 074	60	6 608
Sewerage Services (CPC 941)	3	69	160	1	13	1	1 406	1 653	3		3 316	66	5 038
Other products	145 597	38 454	89 727	180 683	2 360	1 718	5 842 990	6 301 529			605 817	50 096	**6 957 442**

46. The data in the supply table is usually measured at basic prices (excluding taxes and trade and transport margins and including subsidies), while the data in the use table is usually measured at purchasers' prices (including taxes and trade and transport margins and excluding subsidies). Compilers therefore need to include taxes, trade and transport margins and exclude subsidies to the output at basic prices in the supply table to get to purchasers' prices.

47. It should also be noted that in many countries the services of water collection, treatment and supply are publicly funded, and so countries may be inclined to record such output under the 'government' column in the supply table. However, it is advised that these activities are recorded under ISIC 36[18].

2.3 Physical Asset Account for Water

48. Unlike other environmental assets, such as timber resources or mineral resources that are subject to slow natural changes, water is in continuous movement through the processes of precipitation, evaporation, run-off, infiltration and flows to the sea. The natural cycle of water (i.e. the hydrological cycle), involves connections between the land surface and subsurface, the oceans, and the atmosphere. These flows are recorded in Core Account 3, which is a simplified physical asset account. Asset accounts for water resources focus on the inflows and outflows of water to and from the land surface and subsurface, and on the destination of these flows.

49. Physical asset accounts for water resources should be compiled by type of water resource and should account for both the stock of water at the beginning and end of the accounting period and changes in the stock of water over the accounting period. Changes in the stock of water should consider additions to the stock, reductions in the stock and other changes in the stock.

50. The temporal reference of economic data generally differs from that of hydrological data[19]. It is important that the hydrological and economic data used in the accounts refer to the same temporal

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[18] This is consistent with the ISIC approach, whereby no distinction is drawn according to the kind of ownership, the type of legal organization or the mode of operation because such criteria do not relate to the characteristics of the activity itself. Units engaged in the same kind of economic activity are classified in the same category of ISIC irrespective of such considerations.

[19] Hydrological data typically refers to the 'hydrological year', consisting of a 12-month period in which over-all changes in storage are minimal and carry-over is reduced to a minimum.

reference, and so the reference period for hydrological data will need to be adjusted to align with that of the economic accounts.

51. Countries may wish to focus initial efforts on specific types of water resources which are of national importance or vulnerable to depletion. Countries are also advised to focus primarily on compiling information on changes in stocks rather than calculating total stocks, as the former may be sufficient to assess sustainability of water use[20].

Core Account 3: Physical Asset Account for Water[21]

	Type of Water Resources: Surface Water: Artificial Reservoirs	Surface Water: Lakes	Surface Water: Rivers and Streams	Surface Water: Glaciers, ice & snow	Groundwater	Soil Water	TOTAL
1. Opening stock of water resources	**1 500**	**2 700**	**5 000**	**0**	**100 000**	**500**	**109 700**
2. Additions to stock:							
Returns	300	0	53	0	315	0	**668**
of which: for hydro power and cooling	*100*	*0*	*0*	0	*0*	*0*	***100***
Precipitation	124	246	50	0		23 015	**23 435**
Inflows from other territories	0	0	17 650	0	0		**17 650**
Inflows from other inland water resources	1 054	339	2 487	0	437	0	**4 317**
Discoveries of water in aquifers	0	0	0	0		0	**0**
TOTAL ADDITIONS TO STOCK	**1 478**	**585**	**20 240**	**0**	**752**	**23 015**	**46 070**
3. Reductions in Stock:							
Abstraction	280	20	141	0	476	50	**967**
of which: for hydro power and cooling	*100*	*0*	*0*	0	*0*	*0*	***100***
Evaporation & actual evapotranspiration	80	215	54	0		21 125	**21 474**
Outflows to other territories			9 430	0	0		**9 430**
Outflows to the sea			10 000	0	0		**10 000**
Outflows to other inland water resources	1 000	100	1 343	0	87	1 787	**4 317**
TOTAL REDUCTIONS IN STOCK	**1 360**	**335**	**20 968**	**0**	**563**	**22 962**	**46 188**
4. Closing stock of water resources	**1 618**	**2 950**	**4 272**	**0**	**100 189**	**553**	**109 582**

52. When compiling asset accounts for water, countries will also need to consider spatial and temporal information needs. Water is a bulky commodity and the costs of transporting and storing it are often high. This site-specific nature of water means that it may be more accurate and useful for some countries to compile accounts at the level of a river basin, and aggregate these accounts at the national level. Furthermore, annual accounts may hide potential seasonal variability which is an important issue for some countries, affecting the reliability, cost, and quality of water supply. Ideally quarterly accounts would help to analyse these intra-annual variations, but the trade-off with

[20] Information on the stock of water is often less available than information on flows. For this reason, countries should consider how they can work toward developing sources for this information. Consideration of this challenge at an early stage may allow opportunities to be identified as various programs are developed limiting the overall costs of obtaining this information.
[21] Dark grey cells are null by definition, though there are exceptions. For example, if an artificial reservoir is at the border of a territory, water may leave the country by this reservoir. In addition, water may flow directly from a lake to the sea if the lake is separated from the sea by a dike.

correspondingly high data demands will need to be assessed carefully[22]. Each section of Core Account 3 including a definition of terms is provided below:

1: Opening and closing stock of water[23]

53. ***Water Resources*** *consist of fresh and brackish water in inland water bodies, including groundwater and soil water*. The stock of surface water is related to the quantity of water in a territory of reference measured at a specific point in time (usually the beginning or end of the accounting period). Surface water includes water in artificial reservoirs[24], lakes, rivers and streams [25], snow and ice and glaciers.

54. Stocks of groundwater and soil water are measured consistent with the definitions above. The measurement of soil water may extend to cover all soil but may also be limited (e.g., to soil water in agricultural and forestry areas), depending on the analytical purposes of the water account. The measurement scope of soil water should be clearly articulated in any asset account for water resources.

2: Additions to the stock of water resources

55. ***Returns*** represent the total volume of water that is returned to the environment by economic units into surface water, soil and groundwater during the accounting period.

56. ***Precipitation*** consists of the volume of atmospheric precipitation (rain, snow, hail, etc.) on the territory of reference during the accounting period before evapotranspiration takes place.

57. ***Inflows*** represent the amount of water that flows into water resources during the accounting period. The inflows are disaggregated according to their origin: (i) inflows from other territories/countries; and (ii) inflows from other water resources within the territory, including inflows through abstractions from the sea/oceans.

58. ***Discoveries of water in new aquifers*** refer to the quantity of water in newly discovered aquifers (as distinct from the overall capacity of the aquifer). Increases in the volume of water in a known aquifer should be recorded as inflow of water resources to ground water.

3: Reductions in the stock of water resources

59. ***Abstraction*** is the amount of water removed from any source, either permanently or temporarily, in a given period of time.

60. ***Evaporation and actual evapotranspiration*** constitute the amount of evaporation and actual evapotranspiration that occurs in the territory of reference during the accounting period, excluding

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22 For a more complete discussion refer to SEEA-Water Chapter II (section E)
23 See International Recommendations for Water Statistics (United Nations, 2012a), Chapter 4 for a more detailed discussion.
24 The water in artificial reservoirs is not considered to have been produced; therefore, artificial reservoirs are considered to be in the environment and are recorded in the asset accounts along with other inland water resources.
25 The stock level of a river is measured as the volume of the active riverbed determined on the basis of the geographical profile of the riverbed and the water level. This quantity is usually very small compared with the total stock of water resources and the annual flows of rivers.

amounts already recorded as abstracted from soil water. Evaporation refers to the amount of water evaporated from water bodies such as lakes and artificial reservoirs, where the latter may be particularly important for some countries to consider.

61. ***Outflows*** represent the amount of water that flows out of inland water resources during the accounting period. Outflows are disaggregated according to the destination of the flow; i.e., (i) other water resources within the territory, (ii) other territories/countries and (iii) the sea/ocean.

3. Combined presentation and Indicators for Water

62. The aim of the combined presentation for water is to provide a comprehensive overview of all key water data in one table. The combined presentation for water combines information on flows of water in both monetary and physical terms, information on stocks of water, and information from the national accounts and labor statistics in order to present an overview of the physical and economic characteristics of water flows between the environment and the economy in a country.

Combined Presentation for Water

		Industries (by ISIC)								Rest of the World	Actual Final Consumption		TOTAL
		Agriculture, Forestry & Fishery (ISIC A)	Mining and Quarrying (ISIC B)	Manufacturing (ISCED C)	Electricity, gas, steam & air conditioning supply (ISIC D)	Water collection, treatment & supply (ISIC 36)	Sewerage (ISIC 37)	Other Industries	**Total Industry**		Households	Government	
MONETARY FLOWS	**1. Intermediate Consumption and Final Use (currency):**												
	Natural Water (CPC 1800)	406	193	450	88	1 004	100	1 229	3 470	4	3 074	60	**6 608**
	Sewerage Services (CPC 941)	3	69	160	1	13	1	1 406	1 653	3	3 316	66	**5 038**
	Other Products	145 597	38 454	89 727	180 683	2 360	1 718	5842 990	6301 529	0	605 817	50 096	**6957 442**
	2. Gross Value Added (currency)	24 731	42 327	98 763	14 997	3 193	3 217	632 663	819 891				**819 891**
	3. Employment	371	663	1 548	61	41	43	8 204	10 931	0	0	0	**10 931**
PHYSICAL FLOWS	**4. Supply of water (million m3):**												
	Distribution of abstracted water	0	0	0	0	378	0	0	378	0			**378**
	Wastewater to treatment	18	35	82	6	1	0	49	192	0	236	0	**427**
	Total return flows of water	65	9	21	400	47	484	1	1 026		5	0	**1 031**
	5. Use of Water (million m3):												
	Total abstraction of water	108	34	80	404	440	100	2	1 169				**1 169**
	of which: Own use of abstracted water	108	34	80	404	3	100	2	733		11		**744**
	Use of distributed water*	51	26	60	4	0	0	51	191	0	240		**431**
	TOTAL USE OF WATER*	159	60	140	408	3	100	53	924		251		**1 175**
	6. Water Consumption (million m3)	76	13	30	3	2	1	4	128		10		**138**
	7. Total Actual Renewable Water Resources (TARWR) (million m3)												**43367**
FIXED ASSETS FOR WATER	**8. Gross fixed capital formation (currency):**												
	For water supply	582	3	13	819	2 872	0	0	4 289				**4 289**
	For water sanitation	0	0	0	0	0	2 874	0	2 874				**2 874**
	9. Closing stocks of fixed assets for water supply (currency)	6 112	13	71	9 871	25 347	0	17	41 431				**41 431**
	10. Closing stocks of fixed assets for water sanitation (currency)	0	0	0	0	0	37 457	0	37 457		10		**37 467**

**Includes re-used water (distributed re-use) and excludes wastewater received (for treatment)*

63. The first two sections of the combined presentation (items 1, 2 and 3) stem from the monetary use table for water (i.e. core account 2) and national accounts data respectively[26]. Item 1 focuses on two water-related products: natural water and sewerage services. Depending on data availability and analytical importance, a country may want to split out other products related to water (see footnote

[26] Item 3, employment should use estimates consistent with national account concepts.

12). Item 1 also includes estimates of total supply of products (i.e., including the output of non-water products), which in addition to information on gross value added for each industry (item 2), provides an indication of the relative significance of the output of water-related products as a proportion of total industry output.

64. The third section on physical flows (items 4, 5 and 6) stems from Core Account 1, reflecting volumes of water supplied between economic units, as well as use of water and water consumption. The bulk of the supply of water to other economic units (item 4) appears in the columns corresponding to the Water collection, treatment and supply industry (ISIC 36). Total use of water reflects the water intake of an economic unit. It should be noted that if flows relating to hydropower are significant within the total physical flows of water, they could be shown explicitly as an "of which" column for ISIC 351 within ISIC 35. Finally, the term 'water consumption' refers to total water evaporated, transpired or incorporated into products. It should be noted that "water consumption" is synonymous with the term 'final water use' which is used in the SEEA Central Framework[27].

65. The combined presentation of physical and monetary information as illustrated for items 1-6 allows for the derivation of consistent indicators to evaluate the impact of changes in the economy (e.g. changes in economic structure) on water resources and their use. Using combined accounts in economic models permits the analysis of possible trade-offs between alternative water policies and economic strategies[28]. For example, countries may wish to link the abstraction and use of water in physical terms with estimates of output and value added by industry to calculate sectoral water use efficiency within the economy.

66. The fourth section of the combined presentation table (item 7) captures information on water assets which is useful for assessing the sustainability of water use. Total Actual Renewable Water Resources (TARWR) can be derived from the water asset account (i.e. core account 3). TARWR is the theoretical maximum annual volume of water resources available in a country. The maximum theoretical amount of water actually available to the country is calculated from data on the following: (*a*) sources of water within a country itself; (*b*) water flowing into a country; and (*c*) water flowing out of a country[29]:

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27 During use, some water may be retained in the products generated by the industry, or some of it may have evapo-transpired during use. It should be noted that in most industrial activities water is lost mainly as a result of evaporation as opposed to the situation in agriculture, where water is consumed as a result of evaporation and transpiration by plants and crops. The term "consumption" refers to water which after use is not returned to the environment (inland and sea water). It is different from "water use", which denotes the water that is received by an industry or households from another industry or is directly abstracted. The term "water consumption" is used in the hydrological sense and is the term used in the SEEA water, while the term 'final water use' is used in the SEEA CF to define the same issue. This may create confusion among national accountants who tend to consider the terms "consumption" and "use" as synonymous

28 The potential links to economic models are described further in SEEA Applications and Extensions.

29 For a more detailed explanation of the calculation of TARWR and the associated data items, refer to the International Recommendations for Water Statistics, Annex III, page 167

TARWR = Precipitation to run off + Natural transfer from soil water to groundwater + Inflows from other territories – Outflows to other territories – (Overlap + Treaty obligations)[30]

67. The fifth section of the combined presentation (items 8, 9 and 10) incorporates information on fixed assets for water supply, including estimates of gross fixed capital formation (investment) for water supply and treatment operations. Investments in ISIC 36 and 37 are essential but investments in other industries where there are significant secondary activities should also be recorded. Data on fixed assets can be obtained from the National accounts.

68. The information presented in the combined presentation for water can be used to derive a number of key indicators for the water sector. The accounting approach and presentation also allows for the disaggregation of these indicators by sector to allow for more detailed analysis. While a number of indicators can be calculated, a brief discussion of those indicators relevant to the Sustainable Development Goal on Water is provided below:

Indicator on Safely Treated Wastewater (target 6.3): wastewater sent to treatment by economic units is captured under item 4 *(wastewater to treatment)*. Countries may wish to add rows to further disaggregate by type of treatment (primary, secondary or tertiary). The ratio of wastewater sent to treatment to total return flows (both under item 4) can be calculated from the combined presentation. This can be calculated for each ISIC category in the table and households, as well as for the economy as a whole.

Indicator on Water Stress (target 6.4): measured as the ratio of total water abstraction (under item 5) to total actual renewable water resources (TARWR – item 7). This indicator provides information on the sustainability of water use in the country.

Indicator on Water-Use Efficiency (target 6.4): measured as the ratio of value added (item 2) to total water use (under item 5). The combined presentation provides the data to construct this indicator both for the country as a whole and for each. The changes in efficiency can provide valuable information on how industries are reacting to policies affecting water usage.

69. Other indicators are also supported by the core accounts and combined presentation, such as the data related to gross capital formation. The overall gross capital formation for water supply and water sanitation divided by economy wide gross capital formation gives an indication of the relative importance of investment in water supply and water sanitation assets.

4. Compilation of water accounts

70. The Generic Statistics Business Process Model (GSBPM) can be used to support the compilation of SEEA accounts as outlined in the first note in this series "Statistical Production Processes for Implementation of the SEEA Central Framework". Figure 2 briefly outlines the steps in this process below.

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[30] Overlap is defined as natural transfers of groundwater to surface water minus natural transfers of surface water to ground water.

Figure 2: Steps in the Generic Statistics Business Process Model (GSBMP)

OVERARCHING MANAGEMENT FUNCTIONS	1. **Specify Needs:** Engage users to identify their detailed statistical needs, propose high level solution options and prepare the business case
	2. **Design**: Design and develop activities and any associated practical research work needed to define the statistical outputs, concepts, methodologies, collection instruments and operational processes. Specify all relevant metadata as well as quality assurance procedures
	3. **Build:** Build and test the production solution
	4. **Collect:** Collect and gather all necessary information (data and metadata), using different collection modes and load them for further processing
	5. **Process:** Clean data and prepare them for analysis
	6. **Analyze:** Produce statistical outputs, examine them in detail and prepare them for dissemination. Prepare statistical content and ensure outputs are 'fit for purpose' prior to dissemination. Ensure statistical analysts understand the statistics produced
	7. **Disseminate:** Release the statistical product and support users to access and use the output
	8. **Evaluate:** Conduct an evaluation of the process and agree an action plan

71. When building accounts (SEEA or SNA for example) it is often the case that that existing data sources need to be used as much as possible. The Specify Needs, Design and Build phases will often need to be undertaken simultaneously and iteratively, as one evaluates the capacity of existing data sets to meet needs relative to the potential costs of initiating new data development.

72. This section outlines some basic steps that are relevant in the compilation of water accounts. The initial compilation of water accounts will require several steps that may not need to be undertaken for each data cycle but should be revisited periodically in conjunction with regular budget and planning cycles.

73. The Guidelines for the Compilation of Water Accounts and Statistics, as well as the International Recommendations for Water Statistics (IRWS) and the SEEA Water provide more complete guidance on the organization of basic data and the preparation of accounts.

4.1 Specify Needs

74. When starting compilation of water accounts first make the business case, defining the analytical and policy uses of the information being compiled. Obtain high-level institutional and political buy-in through stakeholder discussions to ensure a solid basis for institutionalisation of the accounts' compilation in the longer term, also ensuring that appropriate institutional frameworks and adequate resources are in place.

75. Consult with policy makers, stakeholders and potential data providers on the issues of most importance for the country. Set out the specific accounts and the dimensions of each account that would best respond to the information needs of the country based on these discussions.

76. It is common practice to begin compilation of the water accounts on a pilot basis, which can help to obtain the political buy-in for a more regular compilation by providing an initial illustration of the information compiled and its associated uses. In the short term, compile pilot accounts using existing data. Learn from each phase of the pilot compilation and assess technical issues associated with implementation before beginning institutionalisation of the accounts. Undertake an evaluation,

both of priority data gaps which require new data development and of needs to harmonize existing data collection processes.

77. In the longer term, harmonize to the extent possible data collection processes within different institutions responsible for the collection of water related statistics. Data collection should be harmonized to ensure that consistent SEEA-based definitions and classifications are used to collect water data which can then be integrated into the accounts. This will make the compilation process of the accounts much easier and smoother in the long run.

4.2 Design and Build

1: Establish institutional arrangements

78. Build strong institutional arrangements from the outset to establish a common goal and combined strategy for compilation of water accounts, and to facilitate the exchange of knowledge, expertise and data.[31] As a first step, understand the roles and responsibilities of relevant agencies as well as the data sources they hold (including availability and quality).

79. Develop a mechanism to work together in a collaborative fashion. Establishing a high-level committee of strategic partners will cement political buy-in and can support more cooperative working arrangements and data sharing at the technical level. Technical working groups can then be established under the high-level committee. Establishing and maintaining good working relations with the agencies that are the source for basic data can pay dividends later on in the production process when estimation challenges benefit from expertise in all concerned agencies.

80. For the case of water, key strategic partners often include the national statistics office, water ministries, the ministry of planning and/or finance and the agriculture and/or environment ministry. The roles of these different agencies regarding water policy and management will depend on the country. Some countries have a national ministry of water resources (which may also include irrigation). These ministries play a key role in defining the country's water policies and should be included as key strategic partners from the outset.

81. Other countries may have a more decentralised water management system, with provincial, state or regional water authorities. It is therefore essential to understand the legal framework which determines the roles and responsibilities of different agencies in order to identify the key strategic partners, which will include both users and producers of data.

82. The data required to compile the core accounts will be collected by different members of the National Statistics System which will go beyond the key strategic partners identified. In the case of water, other important institutions which collect and use water data include Government agencies responsible for meteorology and hydrology, agriculture, environment, energy, central planning, finance, geology and geological surveys, and land use and land planning. Furthermore, water suppliers and sewerage service providers (including both governmental and non-governmental

[31] The Guidelines for the Compilation of Water Accounts and Statistics, and the Implementation Guide for the SEEA Central Framework provide more a more detailed discussion on developing institutional arrangements for the compilation of accounts.

agencies), water research organizations and non-governmental organizations such as water industry associations and/or farmer associations will hold key sources of data.

83. Approach and include these agencies in technical working group arrangements during the design and build phase, to establish agreement on the goals, mandates and roles and responsibilities associated compilation of the water accounts.

2: Define statistical requirements - design outputs

84. The core accounts and their definitions described in this technical note present a simplified and aggregated version of the main SEEA accounts for water, and can therefore be used as an initial template to guide compilation. The core accounts identify the most important data items, and provide relatively aggregated industrial classifications (while still separating out the most important industries for water, namely ISIC 36 and 37).

85. Based on national circumstances and starting from the core accounts, decide the appropriate level of disaggregation. This includes industry disaggregation, as well as disaggregation of data items on flows and stocks of water. This technical note provides some indication of the potential to disaggregate, where specific considerations for each account include;

- *PSUT:* Consider including water abstraction by source, recording wastewater treatment by treatment category, separating out flows of water by purpose (e.g. hydropower, cooling water, mine dewatering etc.), and recording the destination of return flows (e.g. returns to fresh water, returns to the sea etc.)

- *Monetary Supply and Use Table:* Consider including other water-related products

- *Physical Asset Account:* Consider focussing on changes in stocks instead of total stock, focussing on specific water resources, and compiling accounts by river basins.

86. Based on stakeholder discussions in the Specify Needs phase, the outcome of the Design phase will provide a basis to examine the adequacy of the existing data and assess data sources for new data items.

87. Find an appropriate balance between the detail sought by policy makers and analysts, and the capacity of the statistical infrastructure to deliver sufficiently robust estimates, especially in the early stages of development. Recognise the demands for detailed estimates so that the development of data sources and systems can anticipate eventual improvements in these dimensions. It is important to manage expectations by clearly stating that the objectives of the accounts are to develop a macro picture of the relationship between the economy and the water system.

3: Define statistical requirements - identify key data items and prioritise

88. When first setting up water accounts, take care not to be overly ambitious. Focus on major suppliers and users of water first, and then improve the estimates as experience in compiling the account is acquired.

89. For water abstraction, focus in the initial stages on surface and groundwater abstracted by water utilities (ISIC 36) and water abstracted by agriculture, after which abstraction for own use by electric

power stations and mining, quarrying and manufacturing industries should be considered if these flows are significant. Estimates of water supplied to households and industries by water utilities (ISIC 36) should also be collected as a priority.

90. In many countries losses in water supply systems and losses in irrigation conveyance systems represent a large proportion of water abstracted by water utilities and agriculture. Losses can therefore be a very important data item to assess the efficiency of distribution.

91. Total wastewater generated and returned to the environment can be estimated as the difference between water abstracted and water consumed. In a first stage estimate the direct returns to the environment from agriculture, sewerage, and possibly ISIC 351[32], where returns of water from hydroelectricity and cooling water will be substantial. Wastewater sent to sewerage (ISIC 37) by households should also be collected as a priority. Other flows of wastewater to sewerage from industries (such as manufacturing) should then be collected with focus on the largest industries first. If large, measuring urban runoff should also be a priority.

92. In the first stage measure water consumption based on estimated coefficients for households and industries connected to the water supply network. Water consumption by agriculture will also be a large data item, which may be sourced from the ministry of agriculture. In a second stage a more detailed industry by industry calculation can be performed.

93. For the physical asset accounts, changes in stocks of renewable water are usually more relevant than the stocks themselves, so these should be developed as a priority[33]. When calculating additions to stock, large data items will typically include returns (as discussed above, also including losses), precipitation[34] and inflows from other countries (if large for the country). When calculating reductions in stock, abstraction of surface water and groundwater (as discussed above) should be a priority. Where relevant, estimates of the amount of water discharged directly to the sea and outflows to other countries can be included. At the first stage, only transboundary inflows and outflows through surface water may be measured.

94. For evapotranspiration, a rough estimate of total evapotranspiration may be enough in a first stage. In a second stage the evaporation for each surface water body may need to be reported separately from evapotranspiration in land areas (particularly when evaporation from artificial reservoirs is a policy concern).

95. For the monetary accounts, collect total sales of water and sewerage utilities as a priority. In a second stage estimates of the amount spent by households and industries in the self-provision of water and sewerage can be included. Ensure these monetary flows are linked with the physical flow accounts.

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[32] When water abstraction by ISIC 351 is large, direct returns will also be very large and should be estimated.

[33] If countries do wish to calculate stocks, in the first stage only the volume of water in a few artificial reservoirs and lakes may be reported, and then a more complete inventory of reservoirs and lakes followed by estimates of volumes in aquifers and snow may be performed. In a third stage, the volume of soil water and water in wetlands may be estimated. Note that the stock of water in rivers and streams is usually not considered a relevant priority for water accounts.

[34] Which in the first stage may be based on normal or long-term average precipitation in volume for the country

4: Identify important data sources

96. Chapter 3 of the *Compilation Guidelines for Water Accounts and Statistics* provides a description of the raw data and processes needed to incorporate physical and monetary data on water into the accounts. A brief discussion of data sources is provided below. The strategy to collect data will largely depend on the type of water management system that is in place in the country.

97. ***Abstraction, distribution and treatment by ISIC 36 and 37:*** Often the supply and treatment of water will be managed by a limited number of enterprises. As a result, surveys (or complete enumeration) of these enterprises on their activities (including abstraction, distribution and treatment) may be important data sources for the abstraction and supply of water by ISIC 36 (for drinking water supply) and returns of water. It may also be the case that the operation of water supply and treatment industries generates various administrative data sets, for example, on readings from water meters. With appropriate privacy considerations, such administrative data sets may be very useful.

98. ***Losses:*** Given that losses during distribution can be significant (upwards of 50%), data on such flows will be essential if balanced accounts are to be produced. Water utilities often measure the amount of water 'produced' (i.e. injected into the supply network) and the amount of water billed. This 'unaccounted for water' or 'non-revenue water' can be used as a proxy for these losses.

99. ***Abstraction by other industries:*** Broadly speaking, if there is no irrigation (i.e. rain fed agriculture) then the abstraction of water by agriculture is considered to be *soil water abstraction*, and can be estimated as crop evapotranspiration (i.e. equal to water consumption by crops). Ministries of agriculture may provide estimates on the amount of water required/used by crops, based on inventories of crop lands by types of crops. If irrigation is also used then this portion of water is considered *abstraction of surface water and/or groundwater*. Data sources may include inventories of irrigation associations or agriculture water suppliers, data on the volume of water rights held by the users or irrigators, or data on volumes declared for the payment of water fees or royalties.

100. Often the abstraction of water by ISIC 351 (Electric power generation, transmission and distribution) is concentrated among a number of large plants, such that national inventories of electricity generators combined with information on the amount of electricity generated and the technology used at these plants can be used to estimate water abstraction.

101. For other industries, much of the water used will likely be supplied by water utilities (ISIC 36) which may provide information on water billed to different users. If other specific industries abstract significant amounts of water directly[35], such as the beverage industry, then data may be available on water rights held and/or declarations for the payment of fees and royalties.

102. Water flows can vary significantly both spatially and temporally. As a result, even when basic data sets are available, more detailed data collection may be required. In particular, there may be a need to specifically target large water users for additional data collection, either through surveys or other sources. The location and time of abstraction, especially for large water users, should be taken

[35]Volumes are likely to be small and should not be a priority for data collection.

into account. Variability in use can also be wide even within narrowly defined industries, which needs to be taken into account when developing these data sources.

103. ***Water stocks and changes in stocks:*** Hydrological / meteorological data are likely to provide the main information for measuring stocks and changes in stocks of water resources. Through direct measurement or the use of scientific models, data from these sources will provide measurement of, among other things, surface and groundwater stocks, river flows, precipitation, evapotranspiration, and natural transfers between water bodies. The *Compilation Guidelines for Water Accounts and Statistics* provide a more in-depth discussion on how hydrological data on water flows and stocks can be processed and integrated into the accounts[36].

104. ***Monetary Flows:*** Data from the national accounts and related economic surveys will provide the basis for generating monetary supply and use tables and combined presentations, and for comparing physical flows of water (as recorded in the PSUT for water) with corresponding measures of economic activity. In addition, the national accounts can provide information on transactions associated with the abstraction, distribution and treatment of water including payments for water rights, water prices, costs of production and levels of investment and capital stock.

105. Often data on ISIC 36 (Water Collection, treatment and supply) and ISIC 37 (Sewerage) from the national accounts is very difficult to disaggregate, often because these services operate within the same establishment, or the data has been combined due to a common management company or to address confidentiality issues. Efforts should be made to disaggregate this information.

106. At this point if sufficient basic data are not available to produce one or more of the accounts, it may be necessary to initiate a project to generate the missing data. This may well mean that account development splits into two paths; one for the accounts that can be initiated with existing data and one where development will have to wait for the availability of basic data.

5: Build the mapping and correspondence

107. After identifying potential data sources, assess their suitability for estimating the desired variables identified in the accounts. It is important to thoroughly assess the metadata for the available data sets. First, assess whether or not the definitions conform to/and or support those set out in the design phase. Determine the severity of any shortcomings and whether they can be overcome with estimates based on alternate sources.

108. Key at this stage is to clearly ascertain the classification, conceptual and coverage differences across the various data sets to be used as basic inputs. Assess if there are readily available concordances between the classification systems and if there are reliable sources that can be used to estimate adjustments for conceptual and coverage differences.

109. As with all accounting work there are a range of challenges centred on aligning the available water data with the conceptual definitions and scope required for coherent accounts. For water accounting some particular challenges include:

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[36] Refer to pages 86-103

- Aligning data spatially where physical stock and flow information may be available at a river basin or catchment level while economic data are only available at a national or administrative region level.

- Accounting for losses of water during abstraction and distribution and the flows of water lost through theft.

- The recording of household activity, particularly in countries where abstraction of water for own use is prevalent.

- The need for an appropriate sampling frame which draws a representative picture of water supply and use from the business register. If samples are drawn on the basis of turnover, employment, or value added there is a risk that the information in terms of water and supply and use is not representative, resulting in large imbalances in the core accounts.

110. Since these accounts deal with physical flows and stock, consideration should be made to fully understand the challenges in converting estimation methods from other domains where the focus has been economic values. There are some differences in coverage from the SNA and these will have to be implemented. One example is the different treatment of sales of water between enterprises. Also, the residuals associated with these physical flows are not generally measured in the economic accounts and thus additional information and processes will need to be developed.

6: Address data gaps

111. In some cases where partial data exist, but there are some important data gaps, it may be a good idea to construct a preliminary account filling in the missing data with estimates based on related flow coefficients or modelling. The accounting structure may help to produce estimates based on the inherent checks and balances. While such an exercise may not produce a viable account, it may well reveal more about the extent and importance of data gaps, thus providing a better foundation for the development of these missing basic data.

112. When addressing data gaps, compilers can use estimates based on related flows or modelling, or consider looking for ball park estimates using other countries' data. For large data gaps which are a priority for development, new questionnaires and samples may be necessary.

113. In the case where basic data must be developed, initiate a separate project to develop the necessary data. This project should follow the GSBPM steps and generic principles as set out in the first note in this Technical Note series. Depending on the organization of responsibilities within the National Statistical System this step may involve additional agencies or sectors of the NSO.

4.3 Collect and Process

114. In this stage, data are imported and processed and the concordances developed in the 'design and build' phase[37] are applied. The heterogeneity of the data for water flows means that validation of

[37] This is assuming that clean microdata sets are already available.

data sources at the micro level may be needed to assure the quality of the datasets being used. Care should be taken in assessing data that may have a high degree of variability.

115. Given that data may be acquired from a number of institutions or agencies, it is important to establish data transfer protocols as a priority. Invariably agencies require changes/upgrades to software systems which impact data integration if protocols are not in place. It is also important to collect metadata with each period or at least verify that it has not changed so as to be aware of any changes to classification, definitions, etc.

116. Prepare preliminary estimates, including the estimation of data for any data gaps. Given the use of proxies to estimate some data and the varying quality and coverage of these, it is likely that different methods will need to be considered for each industry/sector of the economy.

117. As data is taken from different sources, validation or range checks should be introduced to ensure the numbers make sense when put together in the accounts. Where large disparities exist, expert judgement will be needed to understand the cause of these differences, potentially revisiting metadata and making adjustments to the data where needed. Staff in the source agency should be closely consulted throughout this process.

4.4 Analyse

118. At this stage, tables and graphic representations should be produced, including undertaking an analysis of time series and analytical indicators where possible and recognising the likely need for multiple iterations of this and the previous step. Time should be taken to assess the validity of the data and indicators, for which the user community should be consulted. The documentation of metadata and data quality should also be prepared at this stage.

119. As mentioned, it is recommended that in cases where significant basic data come from other agencies that staff of those agencies be asked to participate in the analysis of the estimates. These experts often have in depth knowledge that can allow the identification and resolution of inconsistencies.

4.5 Disseminate

120. The dissemination of data should always be accompanied by sufficient documentation and metadata to allow users to fully understand the information being disseminated (e.g. including indicators, methodological notes and statements of data quality). This is particularly important for the initial dissemination of a new program of data where one might want to identify the initial data as ‘experimental’ or ‘preliminary’ and make it clear that user input is being sought in order to improve future releases. An important part of the release of the data and accounts is publication of the metadata. Moreover, it is important to consider how the statistical tables can be accompanied by story lines and visualisations to draw out the main findings.

121. Upon release, the possible differences in the SEEA water accounting figures and other water statistics previously disseminated should be properly clarified, and conceptual terms should be properly defined and explained. For example, the inclusion of water abstraction by ISIC 351 should be highlighted to users as other water withdrawal statistics may not include these. In reference to this issue, the purpose of the water accounts to present competing use of inland water resources should be elaborated.

4.6 Evaluate

122. At this stage, the appropriate archiving of data along with the related methodological and meta-data documentation has to take place. This archiving includes the final review of the estimates, the data sources, the methods and IT systems, as well as documenting user feedback.

123. These last two steps are very important for all statistical programs, but when initiating a new program of data seeking user feedback is crucial. This in turn depends on the existence of good documentation on the methods and systems so as to properly inform users and assess their feedback.

5. Extensions

124. Extensions in water accounting include the spatial disaggregation of both monetary and physical information in the accounts, as well as the linking of water accounts with other SEEA accounts such as agriculture accounts and experimental ecosystem accounts.

125. The accounts described in the SEEA CF largely relate to specific materials and resources, and the various stocks and flows recorded for a country as a whole. However, all materials, substances and resources are found in particular locations and, from a policy perspective, knowledge of the location of various stocks and flows may be of particular relevance. Indeed, national averages usually hide important local variations and spatially disaggregating data can help to better identify environmental spatial patterns which can be particularly important for water.

126. The quality of spatial coding must be assessed carefully as additional datasets are linked and integrated with the water accounts. The original purpose and sources may not provide precise locational information in all cases. For example, data for many economic data programs are gathered by enterprise, usually through the head office of the enterprise. Head offices are often not located where the majority of material flows occur, particularly in large scale manufacturing operations which often use large volumes of water. It may be necessary to pursue more precise locations for some economic activities to fully exploit such data integration.

127. Water is an important consideration in Experimental Ecosystem Accounting, both as a reflection of ecosystem condition and because water flow is an important ecosystem provisioning service. Spatial coding will be important in linking to ecosystem accounts, where water assets and provisioning services will need to be linked to ecosystems which are measured using a spatially based approach[38].

128. Links to other SEEA accounts should also be considered. In the case of water, an obvious linkage is to the agriculture accounts. In building the water accounts, one should be sure to develop the databases and accounts such that these linkages can be made easily, integrating the data from multiple accounts to further inform policy makers. Increasingly there is interest in linking many of these data sets with social indicators. The access of household of various classes to water and other resources may be of interest. Also, the extent to which household need to abstract their own water supplies should be considered.

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[38] For a more detailed discussion, refer to the 'SEEA EEA Technical Guidance 4 on Water and Ecosystem Accounting'

6. References and Links

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