



Water accounts

**Physical and monetary data connected to abstraction,
use and discharge of water in the Swedish NAMEA**

**by Gunnar Brånvall, Marianne Eriksson, Ulf Johansson, Peter Svensson,
Statistics Sweden, Environment Statistics**

December 1999

CONTENTS

1. INTRODUCTION	4
1.1 Objectives of the project	4
1.2 Flows of water in Sweden	4
2. FRAMEWORK FOR THE TABLES ON ABSTRACTION, USE AND DISCHARGE TO WATER	8
3. RESULTS	10
3.1 Water abstraction/supply	10
3.2 Water use	12
3.3 Wastewater treatment and discharge	19
3.4 Monetary data	22
3.5 Environmental - economic profiles for some manufacturing industries	27
4 DATA SOURCES	29
4.1 Physical data	29
4.2 Monetary data	32
5. CONCLUSION AND FUTURE WORK	39
ANNEX	40
REFERENCES ▶	41

PREFACE

Statistics Sweden has developed physical environmental accounts since 1993. Accounts for the use of energy and emissions to air are now regularly compiled. This report presents the first step to develop accounts for water. In a NAMEA framework accounts are presented for water abstraction, use and discharge of water. Available physical and monetary data referring to 1995 are recalculated and adjusted to the environmental accounts.

The report is prepared on commission from Eurostat, who supports and co-ordinates development of environmental accounts in the EU member states. The European Commission (DG XI) has contributed financially to the project. Gunnar Brånvall, Marianne Eriksson, Ulf Johansson and Peter Svensson have all contributed in preparing this report.

1. INTRODUCTION

1.1 Objectives of the project

All societies are for survival dependent of clean water in sufficient quantities. In Sweden there will probably always be enough water but shortage can arise temporarily and be rather severe in some areas. But we have to keep a close eye on water quality and improve it. It goes without saying that there has to be effective treatment of wastewater from all major urban areas and yet much remains to be done.¹ It is important that we improve the quality of the Swedish water and to prevent further pollution to the water. Since water is such a vital part of the environment and used in huge quantities in the economy and economic activities have a substantial impact on water quality it is essential to include both the use of water and emission to water in the environmental accounts.

Statistics Sweden is at present developing an economy-wide material flow account, but water is at present not included. This study of the flows of water in the society can also be seen as a supplement to the material flows account.

This project, which is the first step to set up accounts for water, will focus on those water flows in the technosphere which may be referred to as water abstraction, use of water and emission to water. Both water which is market produced and sold as a commodity and self supply of water (non-market produced) will be included. In the account physical data and monetary data connected to the use of water and treatment of wastewater will be presented. Only already available data, in both physical and monetary units, will be used but will be recalculated if necessary to adjust to the accounts. Most of the data refer to a single year, 1995. A set of supply/use table in a NAMEA-type of frame work will be presented with an evaluation of the available data and recommendations for improvement and further development of the accounts. Data on water resources is not included in this first step of water accounts but may at a later stage be included.

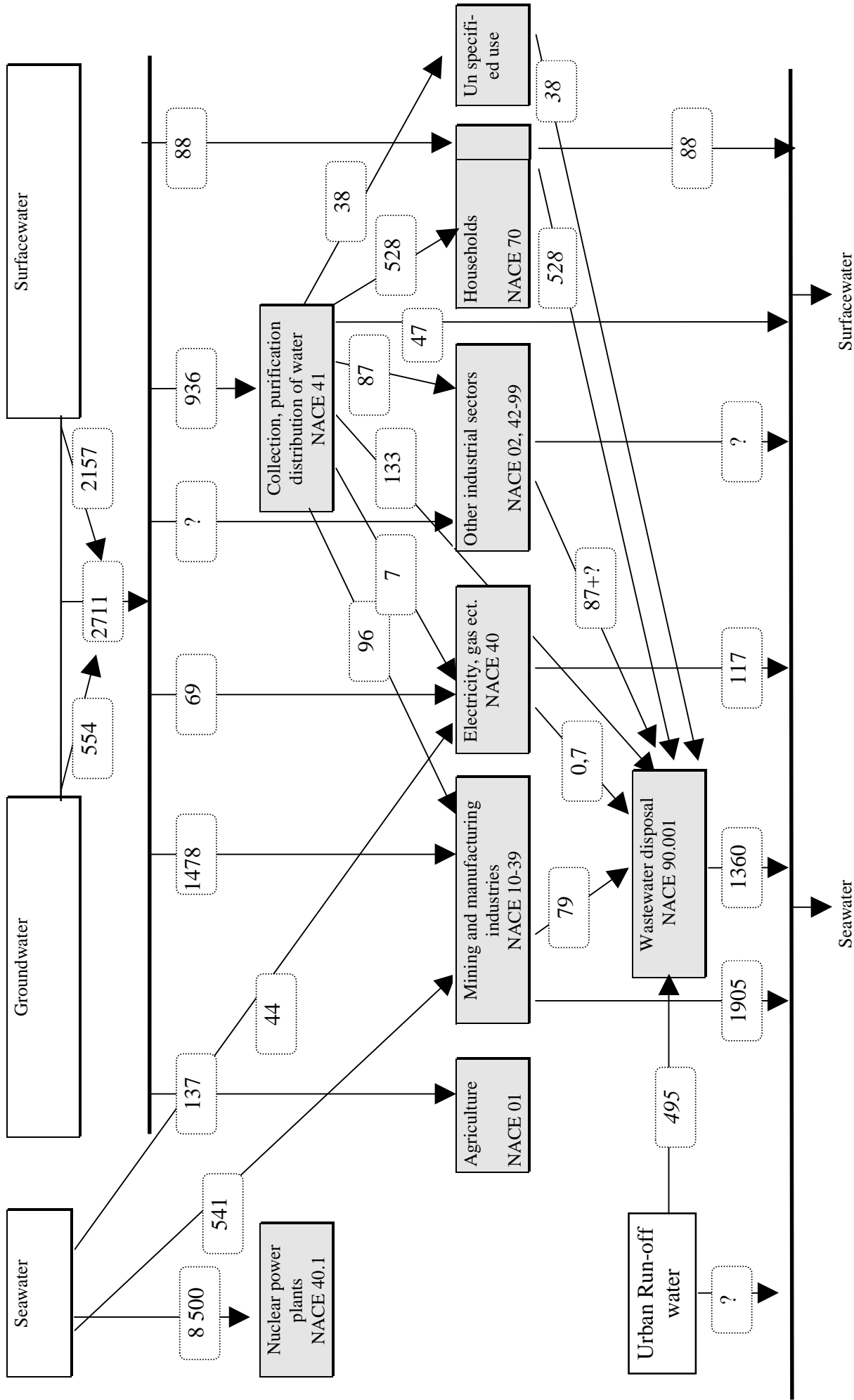
The report first contains an overview of the flows of water in Sweden. In section 2 there is a description of the used framework, section 3 shows the results and in section 4 there is information on the used data together with discussions on data quality and calculations methods. The last section sums up the experience gained in this pilot study together with recommendation for further work.

1.2 Flows of water in Sweden

In Sweden there are 95 700 lakes with an area of 42 000 km², which is 9,3 per cent of the total land area. The total freshwater resources that can be utilised in activities based on running water have been estimated to 178 000 Mm³, which is equal to the yearly run-off to the sea. The total abstraction amounts to 3 300 Mm³ per year.

¹ National Atlas of Sweden, Climate, Lakes and Rivers. Page 171

Figure 1. Swedish water flows related to technosphere (1995), Mm³



In Figure 1, the most important flows of water related to the technosphere are shown. The water resources in ground water, surface water and sea water are shown on the top of the figure in their role as reservoirs for water abstraction. We have taken the liberty to duplicate them at the bottom of the figure in their role as recipients of (more or less) polluted water. In between a few boxes are shown, representing the main human activities relating to water. These are classified according to NACE codes. Flows between the boxes are measured in Mm^3 and refer to the year 1995.

Two of the activities are directly based on qualitative treatment of water: NACE 41 abstracts raw water, produces and distributes tap water which is sold to customers. NACE 90.001 represents the Municipal Waste Water Treatment Plants, (MWWTP:s), which produce the service of wastewater removal and treatment.

Raw water for tap water production is taken both from ground water and surface water. Public waterworks serve about 7 860 000 persons or about 90 per cent of the population. It is mostly in rural areas where the households have private water abstraction. The public waterworks supply 5 per cent of water used in the manufacturing industry and supply also for public use. As a total there are 2 100 public waterworks, of which 375 answer for 86 per cent of the water abstraction.

There are 2 100 MWWTP:s, 7 779 000 persons or about 90 per cent of the population are connected. Almost 500 plants, which serve more than 2 000 persons, treat about 90 per cent of the total wastewater. Standard sewage water is of course produced in every economic activity and it is usually taken care of by the MWWTP:s. In addition to this, some process water is delivered from industries to MWWTP:s.

The abundance of water in Sweden may also be noticed by the large industrial abstraction of water, especially surface water - $1\,500\ \text{Mm}^3$. These activities are concentrated to a few water intensive process industries, notably the pulp and paper industry. Some large mining, steel and chemical plants are also quite water intensive. The purpose of the use of water is mainly for cooling or in the production process. All industries with intensive use of water are subject to rigorous environmental control, which imposes treatment programs for the process water. Data on their discharges to water can be found annually in environmental reports. However, it should be mentioned that around half of the total industrial abstraction is used, in stainless pipes, for the purpose of cooling. It is considered to be discharged almost without pollution. These large industrial water flows do not correspond to "water products", but are rather to be considered as "auxiliary activities", for example in the production of pulp. This makes it more difficult to study their economic implications.

The largest of all flows shown in the figure is $8\,500\ \text{Mm}^3$ of sea water used for cooling in Swedish nuclear plants. This water is returned to the sea (almost) without pollution, but causes a local warming of the recipient. Water used by Swedish nuclear plants is excluded from the account since the resource of seawater is almost unlimited and the environmental impact is very small.

As seen from the Figure 1 the total abstraction for tap water production is around 940 Mm³. There of 133 Mm³ is estimated to be losses or measuring errors by water abstraction or by use of water. The losses are presumed to come into the wastewater system by urban run off. The total amount of wastewater reaching the MWWTP:s is larger, around 1 300 Mm³. In order explain the difference, we have introduced a box for drainage and run-off water, some of which by tradition finds its way into the wastewater systems of Swedish MWWTP:s. (The present Swedish policy is to aim at a separate drainage network for this type of water.)

The framework for the supply and use tables are based on flows of water illustrated in Figure 1. The different NACE groups are aggregated but in the tables presented in the following parts of the report the manufacturing industries have been disaggregated into 17 industries. For some sectors such as agriculture, households there is supplementary information in tables linked to the accounts.

For all of the physical flows of water there are corresponding monetary transactions or more often internal expenditures involved. Water abstracted by the public waterworks is a commodity to be sold on a market and is referred to in the tables as market produced water, all other abstraction is for own final use. The MWWTP:s provide wastewater treatment services but there are also internal expenditures for the treatment of wastewater.

In section 3.1-3.3 physical data concerning abstraction and discharge to water are shown. In section 3.4 expenditures for abstraction and treatment of wastewater are shown. Section 3.5 shows some examples of indicators with both physical and monetary data.

2. FRAMEWORK FOR THE TABLES ON ABSTRACTION, USE AND DISCHARGE TO WATER

The logical structure of the tables is illustrated in Figure 2, which is a simplified version of Figure 1. There are four tables with physical data in the water accounts and one with monetary data. Table 1 and 2 deal with abstraction and use of water. Table 3-4 deal with production of wastewater and discharge to water. Table 5 (a and b) deal with costs for producing freshwater and wastewater treatment. For any cutting, crossing flows may be sorted either by their starting box ("supply") or by the receiving box ("use"). The first four tables are defined by flows crossing the broken lines marked Table 1-4. Table 1 and 3 follow 'in-arrows' (supply from nature or production of wastewater). Table 2 and 4 follow 'out-arrows' (use of water and discharge to water). Table 5 (a and b) associate a monetary measure to flows.

For any box, one may compute the difference between total out-flow and total in-flow. This difference represents water which disappears within the box and is sometimes regarded as "consumption". For most industries - NACE 01 is an exception - it may be estimated to zero on our scale of accuracy and this applies also to the MWWTP:s. This concept of net "consumption" (or "production" in the case of a negative value) provides less trivial results when applied to the contents of various polluting substances in the water. Thus Supplementary table 4.1 estimates the removal of some pollutants from wastewater accomplished by Swedish MWWTP:s (The destiny of removed material - in the sludge - is out of scope for this report).

In the Swedish National Accounts (SNA) the households expenditure for water and treatment of wastewater as well as expenditures for waste are accounted as expenditure in NACE 70 'Real estate sector'. These expenditures are regarded as expenditures connected to housing and not as private consumption. In the water accounts we have in accordance with SNA chosen to report data for households in NACE 70.

Table 1 shows the abstraction or supply of water by different NACE groups. The abstraction is divided in groundwater, surface water and seawater. The table shows the total abstraction divided by public waterworks and private abstraction. Abstraction by the public waterworks (NACE 41) is referred to as market produced since it is produced to be a commodity to be sold on a market. For all other NACE groups water is abstracted only for own-use i.e. non-market produced. Only market produced water has an explicit price and the cost for production and expenditures for the buying sector are found in the input-output tables on SNA. Information on the internal cost for the self supply of water are not available except for irrigation in the agricultural sector.

Table 2 shows the total use of water and use by purpose by different NACE groups. The total use of water is divided into the use of market produced water and non-market produced. Which means that this table shows the users of water from the public waterworks.

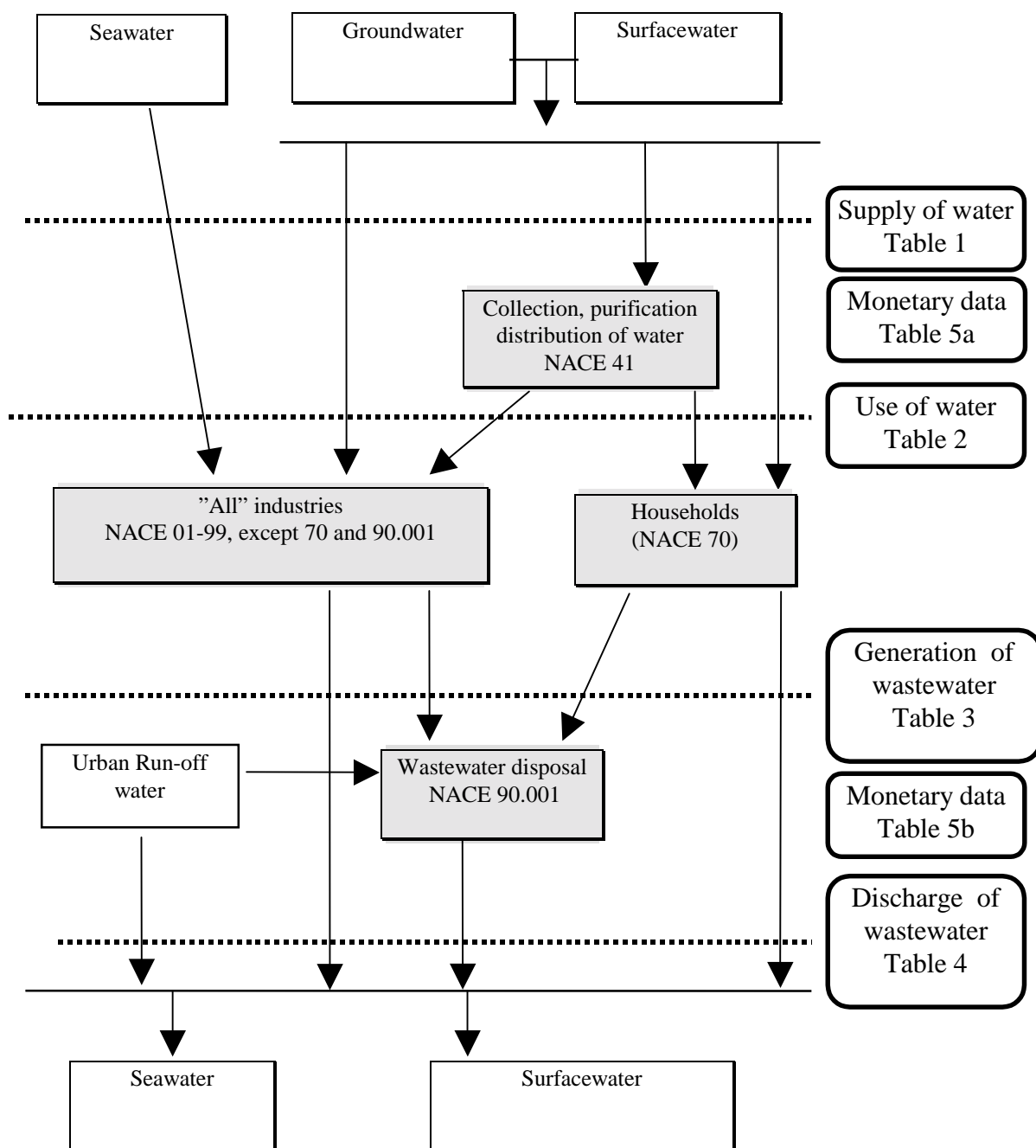
Table 3 shows the total production of wastewater with information on the quantity of water sent to MWWTP:s and the quantity discharged direct from the industries.

Table 4 shows the quantity of water discharged to nature together with some information on quantities of polluting substances.

Table 5a shows the estimated monetary data connected with the supply and use of water.

Table 5b shows the estimated monetary data connected with treatment of waste water.

Figure 2. Supply and use of water and wastewater



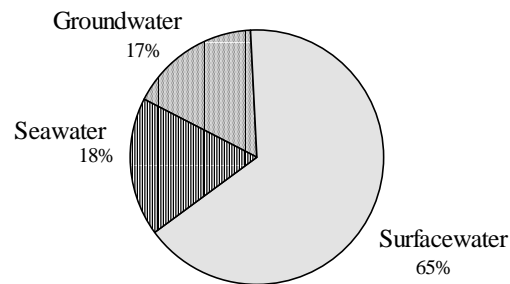
3. RESULTS

3.1 Water abstraction/supply

Table 1 Abstraction / supply of water (1995), 1000 m³

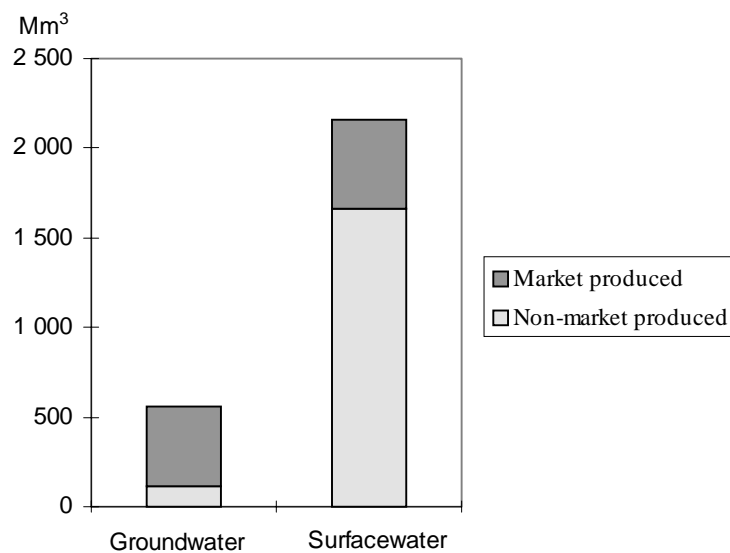
Industry	NACE	Market produced			Non-market produced			Total
		Ground water	Surface water	Total	Ground water	Surface water	Sea water	
Agriculture	01				66 418	70 873		137 291
Forestry	02							
Mining and Quarring	10-14				15 229	24 845	2 521	42 595
Manufacturing industries								
of which								
Food products and beverages, tobacco	15-17				10 600	7 709	29 802	48 111
Textiles and textile products, leather	17-19				913	8 307		9 220
Wood and wood products	20				946	15 924	1 661	18 531
Pulp, paper and paper products	21				16	975 059		975 075
Publishing, printing	22				3	42	19	64
Coke, refined petroleum and nuclear	23				8	117		125
Chemicals and chemical products	24				2 968	180 639	309 274	492 881
Rubber and plastic products	25				450	11 286	5 045	16 781
Non-metallic mineral products	26				3 947	6 305	1 923	12 175
Basic metals	27				2 843	160 193	188 826	351 862
Fabricated metal products, except	28				721	11 366	38	12 125
Machinery and equipment	29				270	19 545		19 815
Office machinery and computers	30				42	24	2	68
Electrical machinery and apparatus	31-32				1 303	1 990	1 753	5 046
Instruments, watches and clocks	33				77	44	61	182
Motor vehicles, transport equipment	34-35				238	9 885	7	10 130
Other manufacturing	36-37				111	238	11	360
Not possible to disaggregate by manufacturing sector					1 474	4 192	1	5 667
Electricity, gas, steam and hot water	40				897	68 480	44 174	113 551
Collection, purification and distribution	41	444 948	491 353	936 301				
Construction	45							
Wholesale and retail trade	50-52							
Hotels and restaurants	55							
Transport, storage and communication	60-64							
Financial intermediation	62							
Real estate	70				88 449			88 449
Renting and business activities	71-74							
Other, excl. 90.001	80-99							
Sewage disposal	90.001							
Public administration	75							
Total		444 948	491 353	936 301	197 923	1 577 063	585 118	2 360 104

The total abstraction of water in Sweden was 3 296 Mm³ in 1995, which is a little more than 1 000 litre per person and day. 65 per cent of the total water abstraction is surface water. Seawater amounts to 18 per cent of the total abstraction. The total abstraction of seawater is made as own abstraction by the manufacturing industries and used as cooling water. Seawater used by the nuclear powerplants is not included in the accounts. The use of seawater in nuclear power plant is estimated to 8 500 Mm³.

Figure 3 Abstraction of water by type of water (1995)

The main part of freshwater abstraction, 65 per cent, is made as self supply for own final use and the remaining 35 per cent are abstracted by public waterworks for distribution to different customers.

The public waterworks take about half the quantity of water from groundwater and half from surface water. Water for own final use are mainly taken from surface water.

Figure 4 Abstraction of surface and groundwater

3.2 Water use

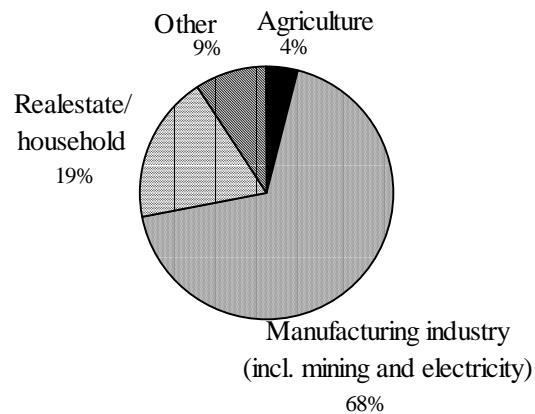
Table 2 Use of water (1995), 1000 m³

Industry	NACE	Market produced	Non-market produced	Total	Use by purpose			
					Cooling water in production of electricity	Other cooling water	Production processes	Other use
Total intermediate consumption of industries								
Agriculture	01		137 291	137 291				137 291
Forestry	02							
Mining and Quarrying	10-14	1 312	42 594	43 906		271	41 659	1 977
Food products and beverages	15-16	25 917	48 112	74 029		43 522	27 516	2 991
Textiles and textile products	17-19	2 459	9 220	11 679	53	3 773	7 303	551
Wood and wood products	20	1 249	18 531	19 780		669	18 256	855
Pulp, paper and paper products	21	3 327	975 075	978 402	24 615	279 730	665 309	8 748
Publishing, printing	22	2 466	64	2 530		190	715	1 625
Coke, refined petroleum and products	23	271	125	396		260	87	48
Chemicals and chemical products	24	18 891	492 881	511 772	996	482 419	21 305	7 051
Rubber and plastic products	25	995	16 782	17 777		15 267	1 844	666
Non-metallic mineral products	26	2 716	12 175	14 891		7 796	5 492	1 602
Basic metals	27	8 592	351 862	360 454	20 916	257 659	78 422	3 457
Fabricated metal products, except machinery and equipment	28	4 164	12 126	16 290	40	11 251	2 782	2 216
Machinery and equipment	29	5 473	19 815	25 288		19 013	2 947	3 328
Office machinery and computers	30	406	67	473		223	69	181
Electrical machinery and apparatus	31-32	3 385	5 045	8 430		3 473	3 593	1 364
Instruments, watches and clocks	33	1 025	181	1 206		443	195	568
Motor vehicles, transport equipment	34-35	6 446	10 130	16 576		9 452	4 162	2 962
Other manufacturing	36-37	695	360	1 055		137	480	438
Not possible to disaggregate by sector		6 469	5 667	12 136				12 136
Electricity, gas, steam and hot water supply	40	6 681	113 551	120 232	105 880	4 866	6 057	3 429
Collection, purification and distribution of water	41	180 596		180 596				180 596 ¹⁾
Construction	45							
Wholesale and retail trade	50-52							
Hotels and restaurants	55							
Transport, storage and communication	60-64	86 522		86 522				86 522
Financial intermediation	62							
Renting and business activities	71-74							
Other, excl. 90.001	80-99							
Sewage disposal	90.001							
Public administration	75							
Real estate	70	527 975	88 449	616 424				616 424
Unspecified use		38 269		38 269				38 269
Total use		936 301	2 360 103	3 296 404	152 500	1 140 414	888 193	1 115 295

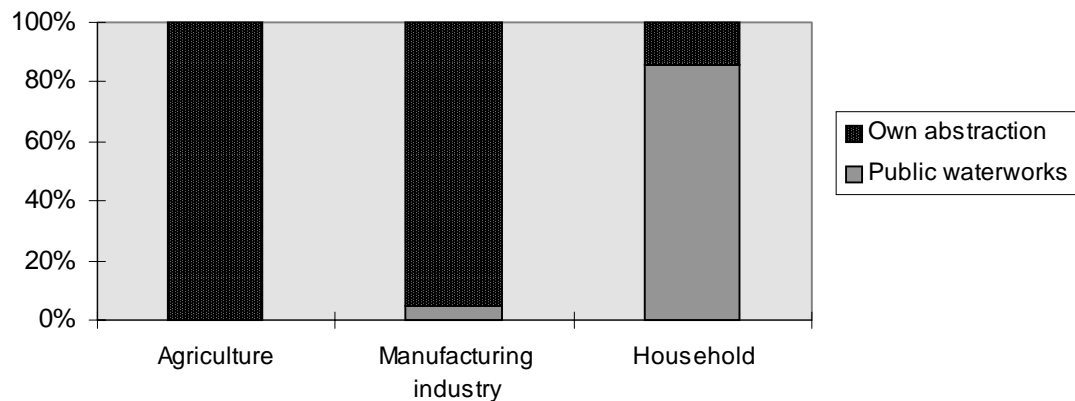
1) This figure represents the difference between abstracted and sold quantity.

The total use of water by industry is shown in Table 2, with a separate account of the use of water from market produced water and non-market produced. When linking economic transaction in SNA with the use of water it is possible to get information on expenditure for water purchased as a commodity but expenditures for own abstraction can not be distinguished without special investigations.

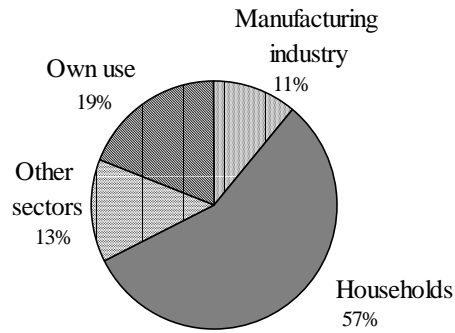
Of the total use of water 68 per cent was used by the manufacturing industry, including mining and electricity, 19 per cent by the households and only 4 per cent by agriculture. Information on use in other industrial sectors are not available by industry, but as a total it amounted to 9 per cent of the total use.

Figure 5 Use of water by industry (1995)

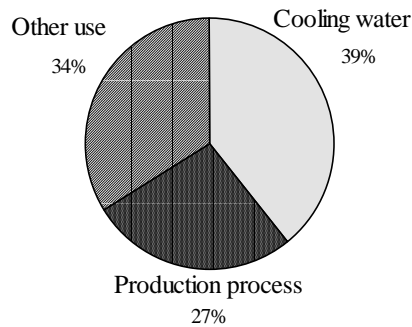
For the manufacturing industry water from own abstraction cover 95 per cent of the total use of water and the public waterworks supply 5 per cent . For the households 86 per cent of the water are supplied by public waterworks and 16 per cent are from private withdrawal. The use of water in agriculture for irrigation and livestock are entirely from self supply. Data on self supply for other users is not available.

Figure 6 Percentage of water by self supply and by public waterworks

The public waterworks serves both households and the industrial sectors. More than half of the water is used by households and 11 per cent by the manufacturing industry. Of the abstracted water 19 per cent is recorded for own use in the waterworks. "Own use" here refers to water used in the operation of the waterworks e.g. cleaning but also losses. Losses can be leakage in the distribution network or measuring errors. Losses are estimated to 14 per cent of the total water abstraction.

Figure 7 Use of water from public waterworks (1995)

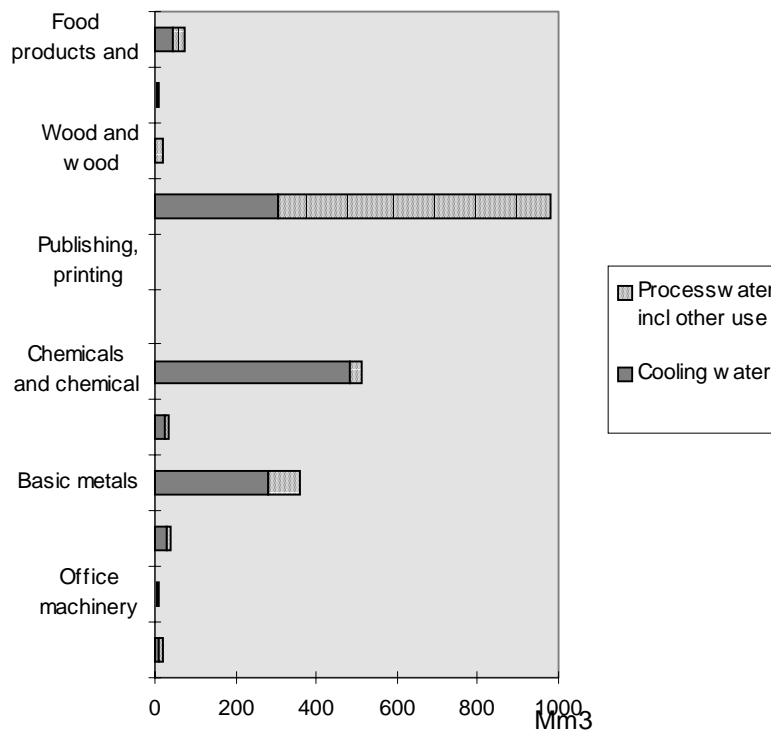
Water is used for different purposes, 39 per cent of the water is for cooling and 27 per cent is used in processes in the manufacturing industry. In Table 2 some purposes are shown for the manufacturing industry, for the other sectors the purposes are shown in supplementary tables.

Figure 8 Total use of water by purpose (1995)

Manufacturing industry

The manufacturing industry uses water for cooling, in the production process or other use i.e. sanitation. Of the total use in the manufacturing industry 56 per cent was cooling water, 42 per cent was water used in the production process and 2 per cent for other purposes. Cooling water is used in huge quantities but has only little impact on the environment. Process water and sanitary water are more or less polluted and need treatment before discharge to nature.

Figure 9 Use of water by purpose in the manufacturing industries (1995), Mm³

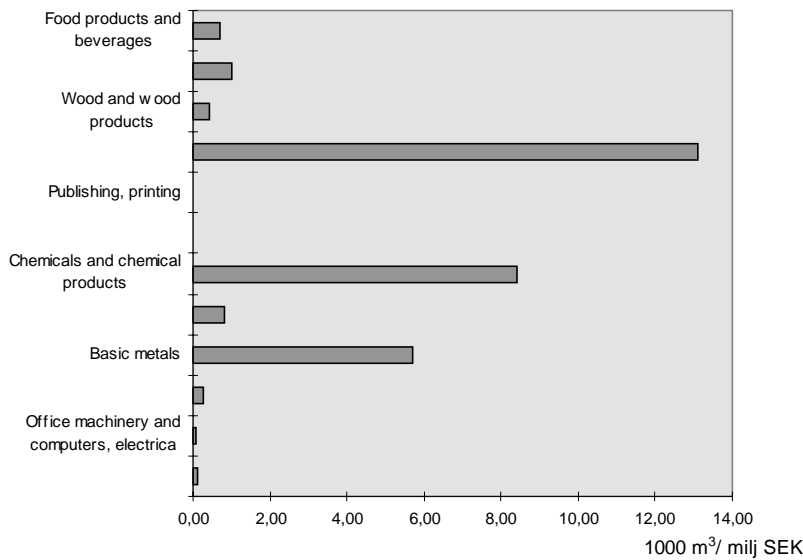


In the Swedish manufacturing industry there are three industries that use 90 per cent of the water, that is Pulp, paper and paper products (NACE 21), Chemicals and chemical products (NACE 24) and Basic metal (NACE 27). Pulp, paper and paper product industry uses 75 per cent of the total use of process water.

Another way to look at the importance of water in the production is to set the use of water in relation to production value. The same three industries as in the previous diagram where water is very important e.g. the Pulp, paper and paper product industry uses 13 100 m³ per million SEK of production value.

Disregarding the three water intensive industries, the average use of the remaining industries is below 1 000 m³ per million SEK production value.

Figure 10 Use of water in relation to production value in the manufacturing industries (1995), in litres per SEK

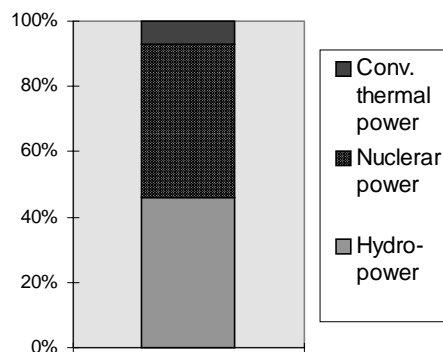


Energy production

The use of water in the Electricity, gas steam and hotwater supply (NACE 40) amounts to 120 Mm³. In addition to this the nuclear power plants used 8 500 Mm³. Water used by the nuclear power plants is not included in the water accounts since the supply of sea-water is almost unlimited and the emission has a very small impact on the environment. In Sweden 47 per cent of the electrical production was produced by the nuclear power plants.

Another important use of water in the Swedish economy is the use of water in Hydropower stations. Hydropower stations produced 46 per cent of the electrical production in Sweden. Water in hydropower stations is not included in the water accounts since there is no abstraction of water but only use of potential energy from the water. Hydropower stations with water reservoirs and water regulations of the rivers will of course have other impact on the environment such as loss of biodiversity, loss of habitat and loss of pristine nature areas.

Figure 11 Production of electricity (1995)



Agriculture

Water in agriculture is used for irrigation and livestock. The estimated use for irrigation relates to the amounts needed in a dry season. In an ordinary season the use for irrigation is about 40 per cent compared with a dry season.

Areas with possibilities for irrigation is 4 per cent of the total arable area.

Supplementary table 2.1 Use of water in agriculture (1985)

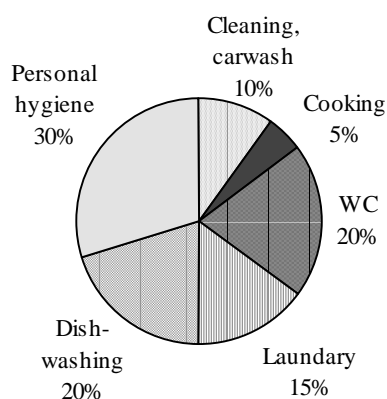
	Mm ³	per cent
Irrigation	94	69
Livestock	43	31
Total	137	100

Households

Expenditures for water used by the households are in SNA counted as intermediate consumption in the real estate sector (NACE 70) i.e. it is part of the expenditure for housing and not looked upon as private consumption. In the environmental accounts for water the physical data for use of water by households are in the same way as in SNA linked to the real estate sector. The use of water by households amounts to 616 Mm³, which makes the average use of water in Sweden to 189 litre per person and day.

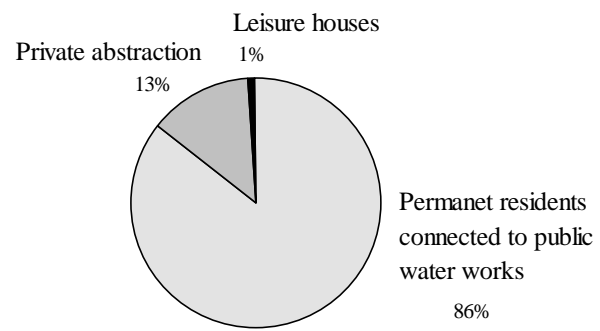
Some estimates are available on the use of water for different purposes which shows that 30 per cent is used for personal hygiene and 20 per cent for dish-washing.

Figure 12 Use of water in households by purpose



Source: www.smn.environ.se

In Sweden about 85 per cent of the population are connected to the public waterworks. For the households not connected to the public waterworks we have assumed the use of water to be the same as for persons connected to public waterworks. For leisure houses not connected to the public waterworks we have assumed the total use to be 1 per cent of the total use in households.

Figure 13 Total abstraction of water of the household sector (1995), 1 000 m³

3.3 Wastewater treatment and discharge

It was shown in the use Table 2 that large amounts of water are used in a few water intensive industries, notably the pulp and paper industry.

Part of this water is delivered to the MWWTP:s but a larger part is treated and discharged by the industry itself. This can be studied Table 3 which also contains information on whether the water is discharged to inland waters or to the sea. Note, however, that these flows differ very much in pollution content. Cooling water as well as process water are included

Table 3 Generation and discharge of wastewater (1995), 1 000 m³

Industry	NACE	Discharge to public sewage system	Total private discharge	Thereof to inland waters	to sea	Total
Agriculture	01					
Forestry	02					
Mining and Quarring	10-14	1 157	45 306	42 767	2 539	46 463
Manufacturing of						
Food products and beverages, tobacco products	15-16	25 154	43 178	11 107	32 071	68 332
Textiles and textile products, leather products	17-19	3 080	8 337	8 337	0	11 417
Wood and wood products	20	1 327	16 068	13 989	2 079	17 395
Pulp, paper and paper products	21	7 682	873 006	361 112	511 894	880 688
Publishing, printing	22	2 282	62	41	21	2 344
Coke, refined petroleum and nuclear fuel	23	357	10	6	4	367
Chemicals and chemical products	24	5 352	488 792	159 999	328 793	494 144
Rubber and plastic products	25	1 193	16 391	5 201	11 190	17 584
Non-metallic mineral products	26	2 617	8 197	6 812	1 385	10 814
Basic metals	27	3 972	355 181	159 521	195 660	359 153
Fabricated metal products, except machinery and equipment	28	4 379	11 749	9 928	1 821	16 128
Machinery and equipment	29	5 615	19 666	19 640	26	25 281
Office machinery and computers	30	381	61	59	2	442
Electrical machinery and apparatus, radio, television and communication	31-32	4 136	4 225	2 108	2 117	8 361
Instruments, watches and clocks	33	1 023	165	59	106	1 188
Motor vehicles, transport equipment	34-35	7 644	8 687	8 484	203	16 331
Other manufacturing	36-37	623	266	220	46	889
Not possible to disaggregate by sector		727	5 517	5 514	3	6 244
Electricity, gas ,steam and hot water supply	40	725	116 888	67 360	49 528	117 613
Collection, purification and distribution of water	41	132 972	47 624			180 596
Construction	45					
Wholesale and retail trade	50-52					
Hotels and restaurants	55					
Transport, storage and communication	60-64	86 522				86 522
Financial intermediation	62					
Renting and business activities	71-74					
Other, excl. 90.001	80-99					
Sewage disposal	90.001					
Public administration	75					
Real estate	70	527 975	88 449			616 424
Unspecified use		38 269				38 269
Total		865 164	2 157 825	882 264	1 139 488	3 022 989
Urban run-off water		494 836				494 836
Total		1 360 000	2 157 825	882 264	1 139 488	3 517 825

It may be noted that relatively small amounts of wastewater from the manufacturing industry are treated by the MWWTP:s. The dominating industry in this respect is food industry, whose wastewater may sometimes contain quite large amounts of organic matter (BOD₇). The flows from engineering industries (NACE 28-37) to MWWTP:s as well as for example gas stations (NACE 50.5), not shown in the table) are not large but may sometimes contain chemical substances and metals which may be harmful to the quality of sludge.

The volumes of private discharges are much larger. Table 4 below shows some information on the contents of pollution in some of this water.

Table 4 Discharge and pollution content of wastewater (1995), in tons

Industry	NACE	Water discharge directly to nature	Pollution content, tons														
			COD _C	BOD ₇	N	P	As	Hg	Cd	Pb	Cu	Zn	Cr	Ni			
Agriculture	01																
Forestry	02																
Mining and Quarring	10-14	45 306						0	0	0	1	1	14	0	0		
<i>MQ, leakage</i>								(0)	(0)	(0,7)	(2,8)	(21)	(357)	(0)	(0)		
Manufacturing of																	
Food products and beverages, tobacco products	15-16	43 178															
Textiles and textile products, leather products	17-19	8 337															
Wood and wood products	20	16 068						0	0	0	0	0	0	0	0	0	0
Pulp, paper and paper products	21	873 006	328 922	95 803	3 844	419	0	0	1	3	8	89	4	5			
Publishing, printing	22	62															
Coke, refined petroleum and nuclear fuel	23	10	1 000		100		0	0	0	0	0	0	0	0	0	0	0
Chemicals and chemical products	24	488 792	10 000		800		0	0	0	0	0	49	0	0			
Rubber and plastic products	25	16 391					0	0	0	0	0	0	0	0	0	0	0
Non-metallic mineral products	26	8 197					0	0	0	0	0	0	0	0	0	0	0
Basic metals	27	355 181	400		1 500		1	0	0	3	3	9	3	2			
Fabricated metal products, except machinery and equipment	28	11 749															
Machinery and equipment	29	19 666															
Office machinery and computers	30	61															
Electrical machinery and apparatus, radio, television and communication	31-32	4 225					0	0	0	0	0	0	0	0	0	0	0
Instruments, watches and clocks	33	165															
Motor vehicles, transport equipment	34-35	8 687															
Other manufacturing	36-37	266					0	0	0	0	0	5	0	0			
Not possible to disaggregate by sector		5 517															
Electricity, gas, steam and hot water supply	40	116 888															
Collection, purification and distribution of water	41	47 624															
Construction	45																
Wholesale and retail trade	50-52																
Hotels and restaurants	55																
Transport, storage and communication	60-64																
Financial intermediation	62																
Renting and business activities	71-74																
Other, excl. 90.001	80-99																
Sewage disposal	90.001	1 360 000	66 840	13 060	25 940	470	0	1	0	2	17	52	3	8			
Public administration	75																
Real estate	70	88 449															
Total		3 517 825	407 162	108 863	32 184	889	1	1	1	10	29	219	11	15			

The column for water discharges is identical to the column "Private discharges" in Table 3, augmented by the outgoing volume of treated water from the MWWTP:s.

Metal contributions are found for the mining and steel industries. Note however that some contribution also comes from the pulp and paper industry, due to their large volumes of process water. The row for mining leakage has been included for comparison only and is not included in the total. These numbers refer to expert assessments of the leakage from mining deposits in northern Sweden. It may be noticed that these amounts are larger than the total standard emissions through water pipes.

It may also be observed that emissions of oxygen demanding substances, measured by BOD or COD, is dominated by the pulp and paper industry, whose emissions exceed

those of the MWWTP:s. These two sources are totally dominating with regard to this type of pollution.

Concerning phosphorus and especially nitrogen non-negligible contributions are also found for a few other industries. Nitrogen emissions stem from the mining and steel industries as well as some chemical industries, especially plants for production of nitrogen fertilisers. No official estimates of these are available. The figures shown should be interpreted as a rough indication of the magnitude of these contributions.

A few other industries discharge large quantities of water. Some chemical industries use huge amounts of cooling water which is discharged at a higher temperature than the incoming water but which is not believed to differ significantly in chemical composition. In addition to this, much smaller amounts of process water are produced, which may be polluted in various ways. The contents of standard pollution parameters are however very small compared to the pulp and paper industry.

Some remarks on the efficiency of Swedish MWWTP:s.

The design of Swedish municipal wastewater treatment put high priority to reduction of phosphorus and oxygen demanding substances. Usually biological treatment steps are combined with chemical methods, resulting in great reductions of phosphorus and BOD. Reduction rates for nitrogen have been significantly lower and during the last years special steps have been taken introducing extra nitrogen reduction steps, especially by the largest plants.

Traditionally no statistics has been compiled on incoming quantities. These were investigated for the first time 1998. Results are being analysed just now.

In the supplementary table 4.1 regarding 1995, it has been assumed that incoming quantities are equal to those of 1998 as measured by preliminary results from the 1998 survey.

Supplementary table 4.1 Efficiency of Swedish MWWTP:s with respect to removal of phosphorus, nitrogen and oxygen demanding substances.

Parameter, tons	In (1 000 tons)	Out (1 000 tons)	Efficiency (1-In/Out)
Ptot	7,2	0,47	0,93
BOD	207	13	0,94
Ntot	40	25,9	35

It may be remarked that the nitrogen results have been improved between 1995 and 1998.

3.4 Monetary data

The flows of water and wastewater described earlier in this report are accompanied by corresponding monetary flows. In this section the information available on the monetary flows will be presented using the same supply-use structure as for the physical flows.

After discussions with SNA, it was decided that monetary data from The Swedish Water and Wastewater association (VAV) should be used in the calculation together with other surveys made by Statistics Sweden. The information from SNA should not. The reason is that those figures are based on an old edition of "Statistics of intermediate consumption", which makes them less reliable. Discussions regarding a co-operation between SNA and environmental accounts have been initiated.

The monetary data can be divided between market produced and non-market produced goods and services.

Market produced

In Sweden the price on water, supplied by the public waterworks, also cover costs for waste water treatment. Since there is only one meter for incoming water, the price is set in relation to the use of water. By using information from the VAV-survey it is possible to disaggregate production costs for water and wastewater treatment.

Every year VAV make a rather detailed survey about the production costs and investments within public waterworks and MWWTP:s in Sweden. From the 1995 survey information on cost of production of both services have been used. Some adjustments and supplements have been necessary to do, e.g. because of partial non-response.

The term market produced here relates to the trade of the good freshwater and the service wastewater treatment. Monetary data for the market part have been estimated accordingly.

- Total expenditure are taken from VAV. This data have then been adjusted because of the existence of inter-public waterworks and non-response.
- The expenditure have been broken down by NACE with information on the use of water by NACE as a distribution key, after adjustments have been made for the public waterworks own use of water, and the fact that their revenues do not fully cover the costs

Supplementary table 5a.1 Total costs for watersupply and wastewater treatment (1995) in million SEK

Production costs;	Waterworks	Sewage treatment	Total
Total cost, million SEK	4 127	5 981	10 108
Production	1 159	1 968	3 126
Distribution	1 028	1 131	2 159
Distribution (pressure intensification)	99	299	397
Administration	375	479	854
Consumption of fixed capital	1 466	2 105	3 571
Total investments, million SEK	583	1 220	1 803
Distribution system	373	563	936
Reservoir	28	89	116
Waterplants	178	563	742
Purchased	4	6	9

The total cost of production of freshwater and wastewater treatment above have been distributed between the NACE groups by the physical data on the use of "market produced water" (Table 2) as distribution key. With the addition that the amounts of water used within public waterworks were not included in the calculations of a distribution key (Table 2). The reason is that the costs for this amount of water must also be covered through the fee for freshwater and wastewater management.

The production costs in public waterworks and MWWTP:s for supplying freshwater and wastewater treatment shall (in principle) be financed through one fee for both services. But according to the "Municipal accounts 1995" the gross receipts from the fee do not cover the total costs for producing the services. The difference of 7 per cent is a subsidy from municipalities to their customers. This has been taken into account in the distribution of costs.

Non-market produced

Rather many enterprises/households also provide these goods and services by themselves. They invest in water plants and equipment and therewith become both supplier and user at the same time. These costs of production are not incorporated in VAV:s statistics.

When it comes to wastewater treatment, useful information is available from the survey "Environmental protection expenditure in industry 1997". From this survey information about manufacturing industries' own production costs for wastewater management has been used. But the information on payments to MWWTP:s for wastewater treatment has not been incorporated. Instead the calculations described above based on the figures from VAV have been used.

There are no available statistics or information on how expensive the production of own water is. To get this information special surveys have to be done.

In this report a calculation of costs for abstraction of irrigation water in the agricultural sector has been made. In the report "Irrigation 2000" data about irrigation are available. Farmers mostly produce their own water for irrigation and therefor they are both suppliers and users of the water. The report indicated limited changes in used quantities of

water for irrigation within agriculture since 1985. Therefore the prognosis for supply and use in Sweden under 1996 is used as reference to 1995 in this report. The total cost for irrigation is calculated partly from expenses i.e. use of groundwater or surface water, and partly to the need of water if there was a dry summer. The combined fixed and variable price for abstraction of groundwater is 1 452 SEK per m³ and 1 362 SEK per m³ for surface water. This resulted in a total cost of 125 million SEK for irrigation during a dry season.

The costs for market produced and non-market produced goods and services are described in Table 5a and 5b.

Table 5a (fresh water) and 5b (wastewater treatment) Monetary data (1995) in million SEK

Industry	NACE	Table 5a		Table 5b		Total	Total	Total	Total
		Supply	Investments	Supply	Use				
		Public waterworks	Others	Public waterworks	Others	Public waterworks	Others	Public waterworks	Others
Agriculture	01		*						
Forestry	02								
Mining and Quarrying	10-14		7			4	4	10	4
Food products and beverages	15-16		132			93	93	191	93
Textiles and textile products, leather products	17-19		12			8	8	18	8
Wood and wood products	20		6			5	5	9	5
Pulp, paper and paper products	21		17			383	383	24	383
Publishing, printing	22		13			1	1	18	1
Coke, refined petroleum and nuclear fuel	23		1			11	11	2	11
Chemicals and chemical products	24		96			136	136	139	136
Rubber and plastic products	25		5			1	1	7	1
Non-metallic mineral products	26		14			5	5	20	5
Basic metals	27		44			102	102	63	102
Fabricated metal products, except machinery and equipment	28		21			36	36	31	36
Machinery and equipment	29		28			9	9	40	9
Office machinery and computers	30		2			0	0	3	0
Electrical machinery and apparatus, radio, television and communication	31-32		17			40	40	25	40
Instruments, watches and clocks	33		5			1	1	8	1
Motor vehicles, transport equipment	34-35		33			57	57	47	57
Other manufacturing	36-37		4			21	21	5	21
Not possible to disaggregate by sector			33					48	48
Electricity, gas, steam and hot water supply	40		34			6	6	49	6
Collection, purification and distribution of water	41		4 127						
Construction	45								
Wholesale and retail trade	50-52								
Hotels and restaurants	55								
Transport, storage and communication	60-64		728					1056	1056
Financial intermediation	62								
Real estate, renting and business activities	71-74								
Public administration	75								
Other, excl. 90.001	80-93								
Sewage disposal	90.001							5981	
Households	70		2681					3886	3886
Unspecified use			194					282	282
Total cost			4 127	4 127	583	919	6900	5 981	919 6 900

* Cost for irrigation is 125 million SEK at a dry season

Table 5a shows the costs associated with the supply and use of freshwater. Here we see that the total cost of producing the 936,3 Mm³ (Table 2) of the market good freshwater is 4 127 million SEK. These production costs are referred to NACE 41. The second column shows payments from other NACE to NACE 41 for the use of the freshwater. Please note that the lump sum for construction etc include a subsidy from the municipalities to all other economic sectors of 256 million SEK.

Table 5b shows costs associated with wastewater. It could be interpreted as costs associated with supply and use of the environmental protection service wastewater treatment. Total supply of this service consist of the marketed service provided by MWWTP:s and production for own account.

The total value of the marketed service is 5 981 million SEK. This is the total cost of production in MWWTP:s for treatment of the total discharge to the public wastewater system. The use column MWWTP show the payments from the users of this service in industry and households, which finance this activity. Please note that the lump sum for construction etc include a subsidy from the municipalities to all other economic sectors of 371 million SEK.

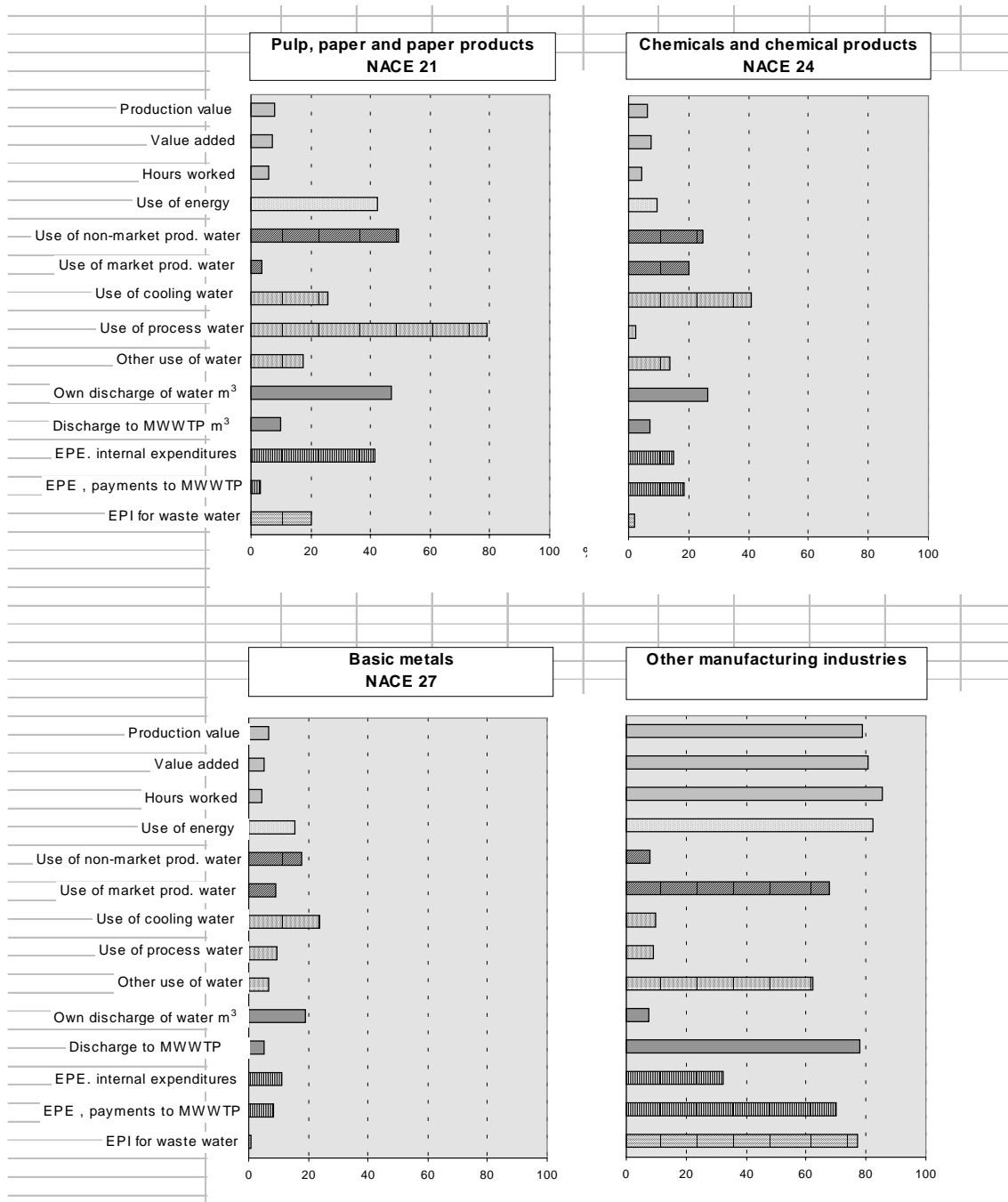
The total value of the non-marketed service (ancillary activity) is 919 million SEK and relates to the mining-, manufacturing- and energyindustry only. As this is own production for own use, by definition, these figures relate to supply and use at the same time and the same figures are therefore entered in both columns.

3.5 Environmental - economic profiles for some manufacturing industries

In this pilot project the focus has been on the framework and data availability for the water accounts. The analyse of the physical and economic data on the use of water and waste water treatment should be further elaborated. In the annex to this report data from SNA showing production value, value added and hours worked is presented for the same NACE groups as in tables 1-5 in the report. Because of the revision of the national accounts it is at the moment not possible to show the full National Accounting Matrix. But at a later stage we will be able to present the data on water together with the National Accounting Matrix.

In this report we give an example of how to present economic and environmental data for the manufacturing industries using the concept with economic-environmental profiles. The profiles are shown for the three industries which are the main users of water and for 'all other manufacturing industries'. The results should be further analysed.

In the profiles are shown economic data such as production value and value added and input factors such as hours worked, use of energy and use of water. Other data related to water is discharge to water and environmental expenditures and investments related to wastewater treatment. The profile shows the specific industry as part of the total for the whole manufacturing industry.



4 DATA SOURCES

4.1 Physical data

Water abstraction and water use

The technical description of data sources, compilation methods and data quality is based on whether the water abstraction are made by public waterworks or by private abstraction.

Market produced water from public waterworks

VAV is yearly collecting statistics on public waterworks and MWWTP:s. A questionnaire is send to all municipalities with questions on:

- total population
- population connected to public water system
- population connected to public wastewater system,
- water abstraction from groundwater or surface water,
- purchase or sale of water to other municipalities,
- use of water in industry, households, public use e.g. schools or recreation purpose, own use in the waterworks and losses
- number of waterworks and wastewater treatment plants.
- quantity on treated wastewater

In the questionnaire for 1995 information was missing from 16 of the 286 municipalities in Sweden. For the missing data Statistics Sweden made estimations by using information on population and average abstraction and use in the country. In the same questionnaire VAV asks about investments, production costs, distribution costs and capital expenditure separately for waterworks and wastewater treatment plants.

Non-market produced / self supply

Most of the water used by the **manufacturing industry** comes from own private withdrawals only 5 per cent are delivered by the public waterworks. In 1995 Statistics Sweden carried out a survey to the manufacturing-, mining and electricity, gas, steam and hot water supply industry. The survey covered 930 establishment with 1 280 000 employed and was sent to all industries with considerable water abstraction. For the rest of the establishments (7 512 with 470 900 employed) the abstraction and use of water was estimated by coefficients for industrial sector, among others the size of the establishment and use of water by employed . The coefficients are based on a survey on water use in 1983. Of the total use of water in the industry, 90 per cent was used by the 930 establishments in the survey.

The results were presented in the Swedish industrial classification 1969, SNI69, and for adjusting the data to environmental accounts a recalculation to NACE rev 1 has been done.

For **households** not connected to public water systems, which are mostly population in rural areas, estimations on abstraction/use of water are made using the average use (189 litre /day) by person connected to public water supply. This might be a small overestimation.

Estimation on water use in leisure houses are based on information in the real estate assessment register where there is information on type of real estate and connection to public water and wastewater system. Water abstraction /use of water is estimated by the following coefficients based on a research study by the Royal Institute of Technology in Stockholm.

Supplementary table 2.2

	Litre/person and day		
	Connection to public wastewater system	Private wastewater system	No wastewater system
Private water supply	200	200	50
Summer water	100	100	50
No water	50	50	50

Each leisure house is assumed to be used by three person during 60 days per year.

The use of water in leisure houses is probably underestimated mostly depending on difficulties to enumerate the number of leisure houses. Leisure houses on real estate assessed as other type of real estate i.g farm estate, one-family houses, are missing. In the assessment there are 423 000 leisure houses assessed as real estate with buildings but approximately 600 000 buildings are used as leisure houses.

In **agriculture** water is used for irrigation and for the livestock

A survey on water used for **irrigation** in Swedish agriculture was carried out 1985. After that there has not been any full-scale survey. In 1991 the Swedish board of agriculture got an assignment to investigate the future need of irrigation in agriculture and a questionnaire was sent to about 800 farming enterprises. The result from the last survey indicated only limited changes in the quantities used for irrigation compared to 1985, so therefore we have in the statistics on use of water in Sweden used the data from 1985. The data refer to amounts needed in a dry summer. The monetary data on water abstraction for irrigation are based on the preliminary assumptions on costs for irrigation during 1996.

The water needed for the **livestock** is estimated by the number of different animals and their yearly water needs. Data on the number of animals are taken from agricultural statistics

Supplementary table 2.3 Estimated need for water by different livestock

	m ³ /year
Dairy cow	30,0
Sucker cows, heifers, Calves	16,0
Horse	16,0
Boars, sows	13,0
Fattening pigs	0,875
Piglets	0,05
Sheep	2,5
Laying hens	0,1
Young fowls, slaughter chickens	0,04

Wastewater treatment and discharge to water

By Swedish environmental protection law, all large point sources of emissions to air and water are required to report their main emission parameters in annual environmental reports to their supervision agency, which is generally a local authority. Estimates are generally based on measurement programs. Reporting unit is generally the local plant rather than the enterprise. The supervision agencies are required to deliver copies of the reports to the County administrative boards for the largest plants, referred to as A-plants. Such copies are also delivered to the Swedish Environmental Protection Agency (Swedish EPA). Routines for producing statistics from this material differs among industries.

Results for the *pulp and paper industry* are assembled and published annually in a survey conducted by Swedish EPA. These data have also been used in this report. (Swedish EPA 1996b). Emissions have been aggregated for 65 plants whose production methods differ quite a lot. Estimates of nitrogen discharges for some other industries were taken from Swedish EPA (1996b), which actually refers to the year 1994.

MWWTP:s are required to produce an environmental report if they serve more than 2 000 persons (or rather i.e. which is in Sweden defined as 70 grams of BOD₇ per day). There exist in Sweden almost 500 plants of this type and they are believed to treat more than 90 per cent of the total wastewater. The 25 largest, each serving more than 100 000 i.e. treat around half the water volume. A survey of these plants is usually made every second or third year. Data for this report was taken from such a survey (Statistics Sweden 1997b).

Actually, some treatment parameters are reported annually in the VAV survey on the municipality level, namely the total number of treatment plants (including the small ones), their total volume of treated water as well number of served i.e. In addition to this, VAV asks for the number of people permanently living in the community which are served by the treatment plants.

In this report we have shown figures stemming from the large point sources but we have not tried to estimate the pollution content of smaller sources. We have already remarked that something like 10 per cent of the total amount of non-industrial wastewater may fall below the cut-off line for the surveys. Similarly, a non-negligible part of the private industrial discharges might fall outside of the environmental reporting system. Concerning the former category, an effort to estimate its contents of pollution is intended to be made in the current MWWTP survey.

4.2 Monetary data

In Sweden, as in many other countries, the pricing system for freshwater and wastewater services is combined into one price for both services. Enterprises and households are charged a fee related to the amount of water they use, and in that fee the price for wastewater management is included. The fact that expenditure for both freshwater and wastewater are mixed together makes dividing of the costs for each type of service difficult.

Four different sources with monetary figures for water and/or wastewater have been analysed and used in the line of this project.

- Information in SNA(1995)
- Data collected by VAV (1995)
- The survey "Municipal accounts 1995", made by Statistics Sweden.
- The survey "Environmental protection expenditure in industry 1997" made by Statistics Sweden.

The monetary data can be divided between market trade and non-market produced goods and services.

Market produced

As mentioned in chapter 3.4 the market produced services relate to the trade of the good freshwater and the service wastewater treatment. In SNA, the costs for freshwater and wastewater are mixed together and it is not possible to divide them. SNA uses data from VAV (for the current year) on total costs for freshwater and wastewater, and an old edition of "Statistics of intermediate consumption" (as distribution key) to divide the total costs between the NACE codes. This means that in SNA there are monetary data related to the total cost for the production of water and wastewater services, and the use of these services in different NACE classes. After discussions with representatives from SNA, it was decided that these are less reliable than the calculations based on physical information on the use of water made in this project. These could be used in the future for improvement of SNA data.

The procedure of estimating data for the market produced goods and services is summarised below. Then a more detailed description of the procedure follows.

- Total expenditures are taken from VAV. These data have then been adjusted because of the existence of inter-public waterworks and non-response.
- The expenditures have been broken down by NACE with information on the use of water by NACE as a distribution key, after adjustments have been made for the public waterworks own use of water, and the fact that their revenues do not fully cover the costs

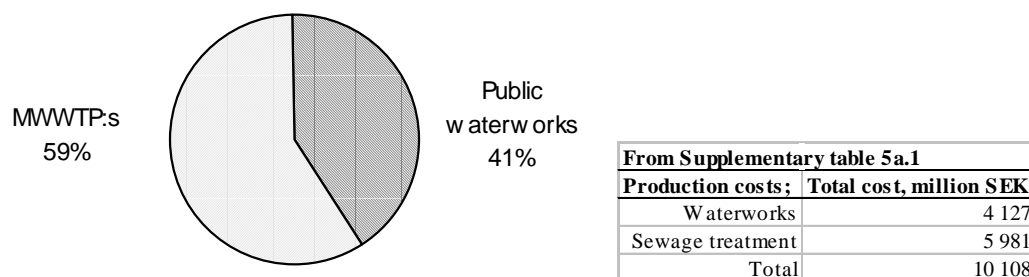
VAV collects information on production costs for producing freshwater and wastewater treatment annually. The problem is that all municipalities do not report their costs to VAV, and some municipalities also buy these services from inter-municipal enterprises. So it was necessary to do some adjustments to the data from VAV.

First must all inter-municipal enterprises of freshwater be removed from the data. The reason is that they do not have any customers registered in VAV:s data. Instead they have the different municipalities as customers. It is important for the calculations to see how many registered customers there are to each municipality to be able to adjust the total production cost to those municipalities that do not account for some of the variables. The registered customers are used as distribution key to these costs. Thereafter is it possible to calculate how the costs for public waterworks and MWWTP:s are distributed.

The total production costs are shown in Supplementary table 5a.1. These are the basis of the calculations.

The distribution of the cost of production within public waterworks and MWWTP:s are on average 40 per cent for public waterworks and 60 per cent for MWWTP:s, and these shares are rather stable according to VAV. This might be used as a distribution key for splitting expenditure in SNA or in the municipal accounts.

Figure 15. Distribution of production costs according to VAV.

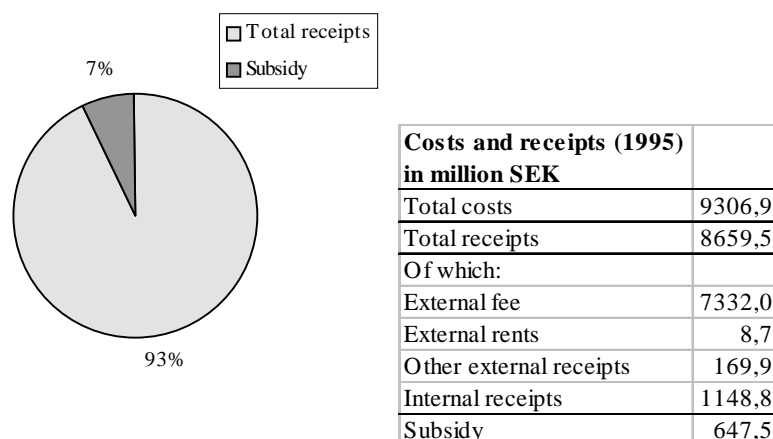


The next step is to use the physical data on the use of market produced water as a distribution key to divide the costs from VAV between the NACE groups. The public waterworks must get coverage for its total expenses though. Therefore own use of water and the rather big amounts of water lost through the water systems should be adjusted for.

The amount of water registered on NACE group 41 (180 596 m³) was not incorporated in the total amount of market produced water (936 301 m³). Thereafter the use of market produced water within each NACE group was divided by the total amount of market produced water (without NACE 41) to get the percentage between the NACE groups as distribution key. The results are described in Table 5a and 5b.

In the municipal accounts, data are divided according to purpose/function. One function is water and wastewater. Here there are information on total production costs divided into cost types, total revenue divided by revenue type, and capital expenditure and financing. The total production cost in the municipal accounts amounts to 9307 million SEK, which could be compared to the 10108 million from VAV. One possible explanation for this difference is the treatment of replacement investments. VAV include these in the production costs, while at least those financed via the capital budget is treated as capital expenditure in the municipal accounts. Another possible reason could be that inter-municipal enterprises are incorporated in VAV:s data and not in the municipal accounts.

Figure 16 and supplementary table 5b.1. Estimation of subsidy (1995), in million SEK



The production costs for supplying freshwater and wastewater treatment shall in principle be covered through one fee for both services. In reality, the total receipts from the fee do not cover the total costs for producing both services. Information from the municipal accounts above show that the difference amounts to 7 per cent of the total production costs. The difference should be regarded as a subsidy and be treated as government final consumption.

The figure below show the quantities and shares of total market produced water by NACE. The shares by NACE have then been adjusted for to take into account the subsidy of 7 per cent. This could be seen as a 7 per cent subsidy from the public sector to all other NACE categories. These shares have then been multiplied by the total costs for freshwater and wastewater respectively.

Supplementary table 5b.2; Total intermediate consumption (1995), in million SEK

Industry	NACE	Market produced water, in thousands m ³	Per cent of total market produced	Per cent of total cost	Cost for freshwater	Cost for wastewater	Total cost
Agriculture	01						
Forestry	02						
Mining and Quarring	10-14	1312	0,002	0,002	7	10	16
Food products and beverages	15-16	25917	0,034	0,032	132	191	322
Textiles and textile products, leather products	17-19	2459	0,003	0,003	12	18	31
Wood and wood products	20	1249	0,002	0,002	6	9	16
Pulp, paper and paper products	21	3327	0,004	0,004	17	24	41
Publishing, printing	22	2466	0,003	0,003	13	18	31
Coke, refined petroleum and nuclear fuel	23	271	0,000	0,000	1	2	3
Chemicals and chemical products	24	18891	0,025	0,023	96	139	235
Rubber and plastic products	25	995	0,001	0,001	5	7	12
Non-metallic mineral products	26	2716	0,004	0,003	14	20	34
Basic metals	27	8592	0,011	0,011	44	63	107
Fabricated metal products, except machinery and equipment	28	4164	0,006	0,005	21	31	52
Machinery and equipment	29	5473	0,007	0,007	28	40	68
Office machinery and computers	30	406	0,001	0,000	2	3	5
Electrical machinery and apparatus, radio, television and communication	31-32	3385	0,004	0,004	17	25	42
Instruments, watches and clocks	33	1025	0,001	0,001	5	8	13
Motor vehicles, transport equipment	34-35	6446	0,009	0,008	33	47	80
Other manufacturing	36-37	695	0,001	0,001	4	5	9
Not possible to disaggregate by sector		6469	0,009	0,008	33	48	80
Electricity, gas, steam and hot water supply	40	6681	0,009	0,008	34	49	83
Sum Manufacturing Industry		102939			523	758	1280
Collection, purification and distribution of water	41						
Construction	45						
Wholesale and retail trade	50-52						
Hotels and restaurants	55						
Transport, storage and communication	60-64	86522	0,114	0,176	728	1056	1784
Financial intermediation	62						
Real estate, renting and business activities	71-74						
Public administration	75						
Other, excl. 90.001	80-93						
Sewage disposal	90.001						
Households	70	527975	0,699	0,650	2681	3886	6568
Unspecified use		38269	0,051	0,047	194	282	476
Total cost		755705	1,000	1,000	4127	5981	10108

Another possibility to calculate the costs for freshwater and wastewater distributed between the NACE codes is to use information from VAV on the variable and fixed prices for freshwater. According to VAV the average variable price for freshwater (in 1999) is 13,31 SEK/m³, the fixed cost 2 000 SEK per meter and an assumption of one meter per household or establishment.

Together with information on how many customers there are in each NACE group, and how much water they use, it is possible to calculate the distribution of costs within the manufacturing industry (see supplementary table 5b.3).

Supplementary table 5b.3 Calculation and distribution of total costs (1995), in million SEK

NACE code	Number of establishments	Amount of water, in thousands m3	Fix cost in	Variable cost	Total cost
10-14	153	1312	0	17	18
15-16	847	25917	2	345	347
17-19	310	2459	1	33	33
20	668	1249	1	17	18
21	246	3327	0	44	45
22	850	2466	2	33	35
23	13	271	0	4	4
24	350	18891	1	251	252
25	304	995	1	13	14
26	389	2716	1	36	37
27	227	8592	0	114	115
28	1174	4164	2	55	58
29	1151	5473	2	73	75
30	54	406	0	5	6
31-32	458	3385	1	45	46
33	186	1025	0	14	14
34-35	400	6446	1	86	87
36-37	413	695	1	9	10
40	207	6681	0	89	89
Other NACE	42	643	0	9	9
Total	8442	97111	17	1293	1309

The distribution of freshwater and wastewater costs among the NACE codes vary only slightly between the different calculations. The information on how the costs are distributed within the manufacturing industry is rather good, while a detailed distribution outside the manufacturing industry is much more difficult to make.

Non-market produced

Information on own produced services for own use are more difficult to get. For wastewater there is information in the survey of environmental protection expenditure in industry 1997. This survey includes all current and capital expenditure in enterprises within the environmental domain wastewater. This includes expenditure for measures which aim to reduce emissions to water in general, not only expenditure related to wastewater treatment. Current expenditure includes both payments for external services (to MWWTP:s), and expenditure in the form of energy, chemicals and labour linked with own treatment.

Total current expenditure amounted to 1094 million SEK. Expenditure for internal measures equalled 919 million, and payments of wastewater charges only amounted to 175 million SEK. The latter is an underestimation. This is partly because many enterprises did not conceive of the water(wastewater) charges as part of environmental protection expenditure, partly because of the difficulties to separate the wastewater part. The payments of 175 million could be compared with the calculations from VAV which equalled 758 million for these industries. But it should be noted that 35 per cent of the VAV expenditure relates to consumption of fixed capital. This was not included in the expenditure survey.

In this project we have decided to use VAV as data source for payments, and complement this with information on internal measures and investments from the 1997 industry survey. It might be possible to exclude payments of wastewater charges from the industry survey in the future, and instead calculate this in a similar fashion as presented in this report.

Supplementary table 5b.4 Data from "Environmental protection expenditure in industry" (1997), in million SEK

Industry	NACE	Own	Payed	Total cost	Investments
Mining and Quarring	10-14	4	1	5	13
Food products and beverages	15-16	93	71	164	48
Textiles and textile products, leather products	17-19	8	26	34	15
Wood and wood products	20	5	3	8	10
Pulp, paper and paper products	21	383	5	387	537
Publishing, printing	22	1	1	2	12
Coke, refined petroleum and nuclear fuel	23	11	0	11	0
Chemicals and chemical products	24	136	11	148	47
Rubber and plastic products	25	1	2	3	2
Non-metallic mineral products	26	5	4	9	3
Basic metals	27	102	10	112	23
Fabricated metal products, except machinery and equipment	28	36	7	43	57
Machinery and equipment	29	9	6	15	29
Office machinery and computers	30	0	0	1	0
Electrical machinery and apparatus, radio, television and communication	31-32	40	6	46	16
Instruments, watches and clocks	33	1	3	4	0
Motor vehicles, transport equipment	34-35	57	8	65	11
Other manufacturing	36	21	6	28	3
Not possible to disaggregate by sector					
Electricity, gas ,steam and hot water supply	40	6	5	11	15
Total cost		919	175	1094	840

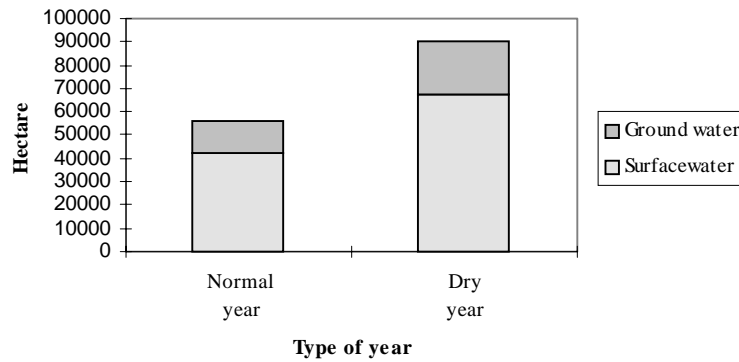
Agriculture

As mentioned in chapter 3.4 calculations of costs in the agricultural sector have been made. In the report "Irrigation 2000" information about use of waster within agriculture is available.

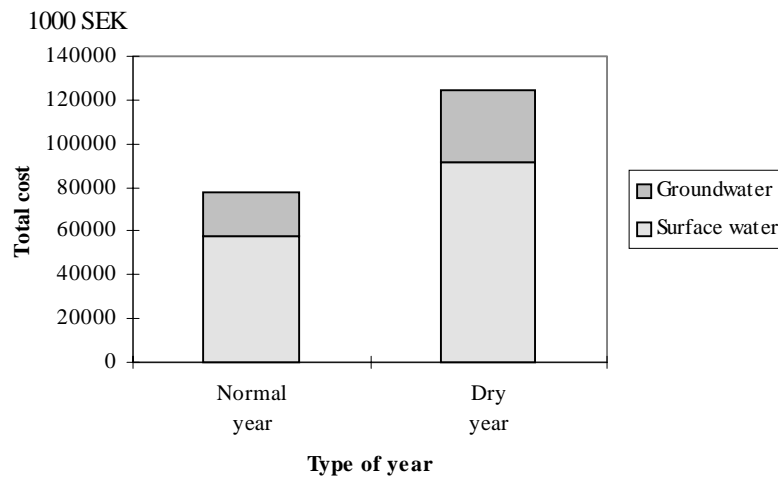
A survey on water used for irrigation in Swedish agriculture was carried out 1985. After that there has not been any full-scale survey. In 1991 the Swedish National Board of Agriculture got an assignment to investigate the future need of irrigation in agriculture and a questionnaire was sent to about 800 farming enterprises. The result from the last survey indicated only limited changes in the quantities used for irrigation since 1985.

The figures used in this study, to estimate the cost for irrigation under 1995, are those estimated for a dry season under 1996 in "Irrigation 2000". The reason is that there are indications that changes between the years was limited.

The area in 1996 which needed irrigation was estimated to 56 000 hectares at a normal year and around 90 000 at a dry year. The distribution between the types of water was estimated to be around $\frac{3}{4}$ surface water and $\frac{1}{4}$ groundwater.

Figure 17. Irrigated area (1996)

The total costs for irrigation depends partly on the variable and fixed costs and partly on type of water abstraction (surface water/groundwater). For surface water the fixed cost per hectare is 1 100 SEK and the variable cost is 262 SEK per hectare. For groundwater 1 200 SEK per hectare for fixed cost and 252 SEK per hectare for the variable cost. The total cost per hectare is then 1 362 SEK for surface water and 1 452 SEK for groundwater. The total costs for irrigation could then be estimated to 78 million SEK for a normal year (minimum of irrigation) and 125 million SEK for a dry year (maximum of irrigation).

Figure 18. Total costs for irrigation (1996)

5. CONCLUSION AND FUTURE WORK

The objective of the project has been to do pilot work on developing environmental accounts for water in Sweden. To set up and test a framework for abstraction and use of water, generation and treatment of wastewater, and to investigate data availability, both as regards physical and monetary data.

We have used the NAMEA framework for the water accounts and found it a very useful tool to analyse the physical flows of water and to link economic data to the physical flows. In the project we have focused on setting up supply and use tables for physical and monetary data on water abstraction, use of water, waste water generation and waste water treatment. In the line of this project it has only been possible to give a few examples of indicators combining physical and monetary data. These results have to be further analysed in follow-up work.

By using available data from many different sources we have been able to evaluate deficiencies in the different statistical sources. One main result is that our work with physical data on water use will most likely be used to improve the information in SNA on expenditures for intermediate consumption of water and wastewater treatment services. It is also likely that the estimations of payments of wastewater charges from the manufacturing industries will be used as input into environmental protection expenditure statistics in the near future. So far we have compiled data for one single year but the objective is to develop time series combining physical and monetary data. This would allow a test of the soundness of some of the estimations made in this project, in particular as regards the monetary data.

There are still data gaps on the use of water and discharge to water for other industries than the manufacturing industry. Some of these industries can be important regarding both use and discharge to water e.g. Petrol stations /car wash (NACE 50.5) and Live stock slaughtering (NACE 15.11). These industries do not have top priority in the national surveys of environmental reports. There are no data on discharge to water from households not connected to the public wastewater system and we will have to further investigate if there are reliable coefficients that we can use for estimations of emissions of nitrogen and phosphorus.

In future work on water accounts, we will continue to develop the supply and use tables. Having traced some of the deficiencies in the basic environmental statistics that have been used in the water accounts, it is in the future important to try to influence the forthcoming statistical investigations to be better adopted to the needs for the water accounts.

Today there is no information on water resources, or water quality, or abstraction, linked to areas with excess or scarcity of water, this regional disaggregation would be very useful to develop in the accounts in the future.

ANNEX

SNA: Production value, value added and hours worked by Industry (1995 with 1991 prices) in million SEK and 10 000:ends hours

Industry	NACE	Production value	Value added	Hours worked
Agriculture	01	29 440	12 257	15 257
Forestry	02	24 497	20 317	5 112
Fishing	05	1 099	638	747
Mining and Quarring	10-14	10 972	4 324	1 581
Food products and beverages	15-16	106 405	30 318	11 268
Textiles and textile products, leather products	17-19	11 607	5 015	2 928
Wood and wood products	20	45 631	12 630	6 437
Pulp, paper and paper products	21	74 626	22 654	7 462
Publishing, printing	22	50 655	23 427	9 782
Coke, refined petroleum and nuclear fuel	23	25 574	7 812	518
Chemicals and chemical products	24	60 765	24 602	5 567
Rubber and plastic products	25	22 334	9 456	3 684
Non-metallic mineral products	26	17 105	7 482	3 218
Basic metals	27	63 165	16 388	5 767
Fabricated metal products, except machinery and equipment	28	54 067	23 542	11 964
Machinery and equipment	29	102 207	39 948	19 337
Office machinery and computers	30	4 160	1 615	1 157
Electrical machinery and apparatus, radio, television and communication	31-32	114 911	37 925	10 112
Instruments, watches and clocks	33	25 400	11 870	3 932
Motor vehicles, transport equipment	34-35	126 409	39 092	16 081
Other manufacturing	36-37	24 664	9 329	8 216
Electricity, gas ,steam and hot water supply	40	54 358	35 878	5 024
Collection, purification and distribution of water	41	8 544	4 672	879
Construction	45	152 153	80 773	37 876
Wholesale and retail trade	50-52	212 955	143 368	83 197
Hotels and resturants	55	39 126	21 547	13 852
Transport, storage and communication	60-63	131 545	59 904	39 830
Post and telecommunications	64	50 347	30 460	8 680
Financial intermediation	65-67	96 980	69 129	14 187
Real estate, renting and buisness activities	71-74	158 629	88 526	39 471
Education, Health and social work	80-85	13 420	9 203	20 655
Other community, social and personal service activities	90-93	34 143	23 104	17 177
Households	70	223 946	157 186	9 681
Total		2 171 839	1 084 391	440 636

REFERENCES ▶

Books and publications

National accounts (1995), Input-output tables - preliminary data

National Atlas of Sweden (1995), Climate, Lakes and Rivers

Statistics Denmark (1999), NAMEA with water extraction and use

Statistics Sweden (1996a), Municipal accounts 1995 (in Swedish)

Statistics Sweden (1996b), Water use in the Swedish industry 1995 Na 16 SM 9601 (in Swedish)

Statistics Sweden (1997a), National accounts 1980-1996 N 10 SM 9701 (in Swedish)

Statistics Sweden (1997b), Discharges to water and sludge production in 1995. Municipal waste water and some coastal industry.
Na 22 SM 9701 (in Swedish)

Statistics Sweden (1999), Environmental protection expenditure in industry 1997 - results of a Swedish pilot study (in Swedish)

Statistics Sweden (1999), Statistical Yearbook of Sweden 2000 (in Swedish)

Statistics Sweden (1999), Waterwithdrawal and water use in Sweden 1995 Mi 27 SM9901 (in Swedish)

Swedish EPA and Statistics Sweden (1998), State of environment in lakes and watercourses Na 39 SM 9801 (in Swedish)

Swedish National Board of Agriculture (1992), Irrigation 2000 (in Swedish)

Swedish Water and Wastewater Association (1997), Waterworks and wastewater treatment plants 1995 VAV S95 (in Swedish)

Swedish EPA (1996a), Large Point Sources
Report 4587 (in Swedish., Annex 1, page 3-4)

Swedish EPA (1996b), Emissions to water and air from the pulp and paper industry in 1995
Report 4657 (in Swedish.)

Internetaddresses

Swedish EnviroNet (<http://smn.environ.se>)

The Swedish Water and Wastewater association (<http://www.vav.se>)