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Documents

**Water Use in Mining, Quarrying
and Manufacturing Industries**

A pilot study

Preface

This report is the result of a pilot study under the Eurostat Grant Programme on Environmental Accounts. The study was partly financed by the Commission of the European Communities, represented by Eurostat through contract no. ESTAT 200471401002.

During the first two quarters of 2004 Statistics Norway conducted a sample survey for 2003 on mining and quarrying (NACE 10 – 14) and the manufacturing industries (NACE 15 – 37). The calculation methods applied and **preliminary results** of the survey are presented in this report.

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Abstract

Norway's reporting to the Inland Waters OECD/EUROSTAT Joint Questionnaire (JQ) tables has been very limited with respect to water resources and water supply and use. This project intends to contribute to the establishing of water accounts for Norway at the national level, and to improve the ability to report on the JQ.

A sample survey conducted on the industries in mining, quarrying (NACE 10 – 14) and manufacturing industries (NACE 15 – 37) for the year 2003, has resulted in statistics on water abstraction and water use for these industries. The statistics is broken down by: industries at the division level, water source, supply and purpose of the water use.

Preliminary calculations show that in 2003, a total of 2.004 billion m³ of water (fresh water, sea water and brackish water) was abstracted (taken out of the water source) by the industries in NACE 10 – 37. The total amount of water used (consumption at end of pipe) was 1.977 billion m³, of which 47 per cent fresh surface and ground water. The difference between abstraction and use represents to some extent incomplete reporting.

Compared to a similar survey for the reference year 1999, on the industries in NACE 15 – 37 (mining and quarrying was not included), preliminary estimates show that the use of water has increased by approximately 14 per cent.

Based on the water-use-statistics for 2003, there has been put up a set of distribution factors for water use. Until a new sample survey on water use has been conducted, the factors will be applied to data sets on water abstraction for the years subsequent to 2003, in order to estimate the water use.

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1. Introduction

1.1 Background

This project is a part of Statistics Norway's work on the quantitative description of water stocks and flows in Norway, describing both the hydrological system and the water flows within the economy.

A long-term goal for Statistics Norway is to produce statistics on water resources, use and emissions, which will also include reporting to the water accounts tables. Work began in 2003 on identifying available national data sources from different agencies and ministries in Norway.

One area where data has been deficient is water use by the manufacturing industries. A pilot data collection was made in 1999. The results have been presented in reports as preliminary figures.

Statistics Norway has attempted to develop a methodology that can be applied on a yearly basis to produce statistics for water abstraction and use in the mining, quarrying (NACE 10 – 14) and manufacturing industries (NACE 15 – 37). For the reference year 2003, a sample survey encompassing ca. 1800 units covering the NACE codes 10 – 37 was conducted. The following variables were included in the survey:

- Water **abstraction** (to extract or take water from a given source) by
 - water source (surface, ground, sea, brackish)
 - supply (public or self supply)
- Water **use** (processing, cooling, in products, sanitary, leakage, other) by
 - water source (surface, ground, sea, brackish)
 - supply (public or self supply)

In order to reduce costs, questions on water abstraction and use were included as a separate section in a sample survey on industrial waste carried out for the same reference year. By including the water variables in the waste survey it was possible to take advantage of synergies during data entry and data revision. Although the additional water variables increased the costs of the survey, these are considered marginal in comparison to a full-scale sample survey on these industries for water only.

For the years 2004 and 2005 a set of questions exclusively on water abstraction has been included in a yearly sample survey on environmental protection expenditures, waste and water use in the manufacturing, mining and quarrying industries. This will provide data on water abstraction by source and supply. The plan is to use the 2003-data on water use, and similar data for 1999, to calculate factors for distribution of water use by different purposes, and then apply these factors on data for the years between two sample surveys covering water use. It seems suitable that the next sample survey, similar to the one conducted for 2003, could be for reference year 2007.

1.2 Objectives

The expected results for the pilot study were to:

- Produce water use statistics for the mining, quarrying and manufacturing industries for 2003, broken down by NACE groups at the division level.
- Develop a sample survey methodology that can be used on a regular basis for the establishment of water use statistics for the industries mentioned above.
- Contribute to improvement of the reporting to Eurostat on Water Accounts and the OECD/Eurostat Joint Questionnaire on Inland Waters.

2. Description of data collection

2.1 The collection process

The questionnaires were distributed accompanied by an introducing letter and instructions for filling in the questionnaire. The letter contained two questionnaires, one on waste and the other on water abstraction and water use. The letter was sent to a sample of establishments found in the Central Register of Establishments and Enterprises (at the local-kind-of-activity-unit level) on the 26. January 2004. Final date was 1. March 2004.

Within one week after the final date the responses from 938 establishments were registered. All questionnaires registered during that week were regarded as received before first final date. The response rate before final date has been calculated to 54.6 %. Between final date and the sending of the first reminder, 147 respondents were registered. The overall response rate was 75.1 % (1 351 establishments).

After final date efforts were made to remind overdue establishments of their reporting obligations. Contact was taken by letter on the 26. April 2004, and the establishments were kindly asked to submit the missing data. After this reminder 173 establishments responded within the period of May to November. Then, after a long period, the next reminding letter dated 4. January 2005 warned about a possible fine of € 420,- if the questionnaire was not submitted. After this letter 93 establishments submitted their data. Finally, 23 establishments were fined.

For practical reasons, the main period of registration of data had to end in October 2004. After January 2005 the revision was in such a good progress that the last responses, for practical reasons, were not included in the data set used further in the project. A 75 % response rate was considered satisfactory.

2.2 The questionnaire

The questionnaire was available in both official languages in Norway. The questionnaire was, unfortunately not electronically readable, and the data was registered manually (a translated version of the questionnaire is included in the appendix). In addition, on the Statistics Norway-web site, an Excel-spread sheet available was available for downloading. Information about this was given in the letter. The number of respondents using the spread sheet-response-option: 134 (9.9 per cent of the respondents).

In order to minimize the burden on the establishments, there was put in an option for establishments using water for sanitary purposes only (“simplified-response-option”). They could respond without having to submit any figures, only tick off for two questions.

2.3 Quality check

An Access-based application was developed as a working tool for the quality check and revision. Explanations to which actions taken and comments to the revision performed are documented in the revision tool.

After registration the data was manually revised or checked for quality according to a set of instructions. Focus was on establishment-identification, inconsistencies between marked “check-boxes” and that the reported values were added up correctly in the form.

After the initial check described above, the dataset was checked for doublets, outliers and inconsistencies. The doublets were identified as entries with identical organisation numbers. Outliers were, at this stage of data handling, identified by simple sorting of the data by industry. Inconsistencies, such as no water

reported for sanitary purposes or no cooling water for establishments in manufacture of basic metals, were, when possible, corrected after contacting the establishments.

2.4 Population

The sampling frame consists of establishments in the Central Register of Establishments and Enterprises in the industries 10 – 37, according to the Standard Industrial Classification (corresponds to NACE 10 – 37). In addition, certain requirements concerning activity have to be met for an establishment to be eligible. There were 20 662 eligible establishments at the time of sampling.

Table 1. The manufacturing industries according to the Standard Industrial Classification (SIC)

Industry (NACE)	Explanation
10	Mining of coal and lignite; extraction and peat
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
12	Mining of uranium and thorium
13	Mining of metal ores
14	Other mining and quarrying
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel, dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of pulp, paper and paperboard
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastic products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office machinery and computers
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture, manufacturing n.e.c.
37	Recycling

Source: <http://www3.ssb.no/stabas>

2.5 Sample size, size groups and allocation

The sample size is 1 800, and it is stratified by industry (2 digits). The industries 15 and 16 are grouped together. Consequently, we have 26 industries. Within each stratum (except the take-all strata) the establishments are sorted by county and drawn systematically.

Size groups:

- 0 - 0 employees (is not drawn)
- 1 - 1 - 9 employees
- 2 - 10 - 19 employees
- 3 - 20 - 49 employees
- 4 - 50 - 99 employees
- 5 - 100 or more employees

In the largest size groups, all establishments are surveyed. In the industries 20, 21, 24, 26, 27, 32, 35, the take-all stratum consists of size groups 4 and 5, in the other industries it consists only of group 5.

Allocation

The sample size in each stratum is determined such that establishments with a large turnover are sampled with higher probability, but at the same time a reasonable number of establishments in each stratum have to be ensured.

In addition to the establishments with more than 100 (or 50 for some industries) employees, establishments whose turnover constitute more than 10 per cent of the total turnover in the industry, are also drawn with probability one.

The total sample size minus the number of must-take establishments is divided by 2. One half is equally distributed between the strata, the other half is distributed proportional to the strata's turnover.

A certain number of establishments in each stratum are drawn from the sample of the previous survey.

2.6 Coverage

The sample drawn according to the plan above covers 71 per cent of the total turnover and 62 per cent of the total employment in the population.

2.7 Difficulties encountered in data collection

Establishments (448) were taken out of the survey due to a variety of reasons. In most cases the establishments had been closed down. Since the sample was drawn quite a long time before the survey was conducted, many establishments had changed ownership and consequently register information pre-printed on the questionnaire was incorrect.

Many letters were returned to sender because establishments had been renamed or moved to a new address after the sample was drawn. There were not resources available to track down the new addresses for these establishments.

In the instructions for filling in, there were given advice on how to include the right establishment-information. These instructions were quite often disregarded, which made it difficult to identify the establishments with regard to the initial sample.

In several cases establishments were phoned in order to check the quality of data reported. Such actions are highly time consuming and generally not recommendable, but sometimes necessary in order to ensure a data set of satisfactory quality.

3. Development of calculation methods

3.1 Grossing up to the national level by weights

Weighting coefficients

We essentially use a ratio estimator within in each industry, where the auxiliary variable is the number of employees. The sample can be divided into a take-all stratum and a probability sample. In the take-all stratum, the establishments are drawn with probability one, and are given weight one.

In the probability sample, the responding establishments are divided by industry. Within each industry, outliers are identified. Outliers are establishments with deviating values on the response variables (here; water use), as compared to the number of employees. Technically, this is done by regressing the response variable on the number of employees. Observations that have a very high influence on the estimates are considered outliers. These are given weight one. Such observations are identified with DfFits outside the interval [-2,2] (DfFit: *The change in the predicted value of the dependent variable if the current case is omitted from the calculations*).

The remaining establishments in the industry are given a weight equal to the number of employees in the population divided by the number of employees in the sample. Establishments with weight one are not counted. Due to no or very few observations in industries 12 (no establishments), 13, 16 and 30, they are grouped together with an adjacent industry. This also provides sufficient confidentiality.

The correlation between the number of employees and water use is relatively poor. However, no better correlation has been identified, so far. Many establishments have “0” on the response variable, and a few have very large values. This leads to a high variance of the ratio estimator.

Table 2. Number of establishments and number of employees, for the whole population, respondents in the take-all stratum and in the probability sample, and outliers. Weights

Industry (NACE)	Number of establishments				Number of employees				Weights
	Population	Take-all	Probability sample	Outliers	Population	Take-all	Probability sample	Outliers	
Total	22 917	629	680	14	304 356	114 440	19 328	959	
10	14	1	5	0	265	22	15	0	16.2
11	343	27	15	2	30 103	9 301	722	298	48.4
13/14	721	11	19	0	3 849	950	385	0	7.5
15/16	2 417	83	151	1	53 425	19 624	5 549	130	6.2
17	764	8	25	1	4 122	700	641	65	5.8
18	593	5	12	0	1 477	341	187	0	6.1
19	72	7	2	0	418	310	9	0	12.3
20	2 212	51	36	1	15 360	5 024	649	34	16.8
21	134	27	14	1	8 266	5 486	367	49	8.6
22	3 650	39	52	1	30 979	8 339	1 537	95	15.6
23	12	2	4	0	1 055	769	9	0	31.7
24	322	46	21	0	13 105	7 147	384	0	15.5
25	484	10	33	0	5 897	1 181	1 045	0	4.5
26	1 015	37	27	0	10 033	3 816	504	0	12.3
27	204	39	14	1	13 701	9 014	271	5	17.6
28	2 476	18	55	1	20 380	2 688	1 757	54	10.4
29	2 718	31	53	0	23 191	6 894	1 664	0	9.8
30/31	606	19	29	1	7 753	2 588	797	60	6.9
32	152	26	11	1	4 576	2 949	275	41	6.8
33	553	11	15	0	6 709	2 034	291	0	16.1
34	158	14	22	1	5 198	3 333	730	99	2.8
35	1 198	100	26	1	31 950	19 241	466	9	27.8
36	1 944	15	32	1	11 519	2 633	965	20	9.4
37	155	2	7	0	1 027	7	110	0	8.8

Example - Calculation of the weight for industry 17:

Number of employees in the population, except those with weight 1 = 4 122 - 700 - 65 = 3 357

Number of employees in the sample, except those with weight 1 = 641- 65 = 576

Weight: $3357/576 = 5.828$

3.2 Estimation of sanitary water for establishments applying the simplified-response-option

There were 549 establishments that benefited from a simplified-response-option in the 2003 sample survey. They only used water for sanitary purposes. They could respond without having to submit any figures, only tick off for two questions. For these establishments a coefficient for water use by employee was calculated in order to estimate the amount of sanitary water used in 2003.

Several establishments reported “0” or blank for the sanitary water variable, although there were employees registered in the Central Register of Establishments and Enterprises. These establishments were excluded in the calculation of the coefficient for sanitary water. One establishment was identified as an outlier, and was left out in the calculation. Around 570 establishments in the sample submitted data on water volumes that could be used in the calculation of a coefficient for sanitary water. In this study we have approached this coefficient-challenge from two angles: 1) *One single average coefficient for all industries in NACE 10 – 37*, and 2) *Industry-specific coefficients*.

3.2.1 The average coefficient approach

Data from the “regular” respondents was aggregated and set up in the table shown below. It illustrates the diversity in use of sanitary water that was reported in the questionnaire.

Table 3. Calculation of coefficient for sanitary water

Sanitary water, by supply and source from 570 establishments in the sample. Number of employees in the industries.							
Industry (NACE)	Public supply	Self supply			Employees	Coefficient Sanitary water(m ³)/employee/year	
	Water works (m ³)	Surface water (m ³)	Ground water (m ³)	Sea or brackish water (m ³)			
10	73 000	0	0	0	242	301.7	
11	122 826	0	0	0	3 993	30.8	
13	:	:	:	:	:	134.4	
14	20 712	20 000	8 223	0	659	74.3	
15	642 629	38 742	3 893	0	13 188	52.0	
16	:	:	:	:	:	19.9	
17	32 665	0	0	0	734	44.5	
18	1 513	3 634	0	0	184	28.0	
19	1 837	50	0	0	156	12.1	
20	70 698	900	760	0	3 342	21.7	
21	296 370	317 636	100	0	5 049	121.6	
22	56 016	0	0	0	2 871	19.5	
23	394 005	0	0	0	731	539.0	
24	237 768	152 500	0	0	4 982	78.3	
25	107 817	0	0	0	1 496	72.1	
26	151 692	3 698	0	0	3 666	42.4	
27	967 820	262 635	9 375	0	8 196	151.3	
28	31 866	15 050	0	0	2 011	23.3	
29	233 594	0	0	0	5 418	43.1	
30	:	:	:	:	:	27.0	
31	72 664	0	0	0	1 321	55.0	
32	43 121	0	0	0	1 406	30.7	
33	15 476	0	0	0	437	35.4	
34	259 424	0	0	0	3 385	76.6	
35	247 572	100	0	0	9 340	26.5	
36	24 827	0	0	0	1 364	18.2	
37	490	0	50	0	92	5.9	
Total	4 161 912	815 445	22 401	2	75 028		
Total volume for sanitary purposes, all supply categories (m³):					4 999 760	Average:	77.2
Total vol. of sanitary water/Total no. of employees (m³/employee):					67	Median:	42.4

The total volume of sanitary water for all 570 establishments divided by all employees in the group is:

$$\text{Total volume of sanitary water} / \text{Total number of employees} / \text{year} = \text{m}^3/\text{employee}/\text{year}$$

$$4\,161\,912 \text{ m}^3 / 75\,028 \text{ emp.} / \text{year} = 66.64 \approx \underline{67 \text{ m}^3/\text{employee}/\text{year}}$$

If we, for the case of simplicity, assume 220 working days per year in manufacturing, a calculation with the coefficient $67 \text{ m}^3/\text{emp.}/\text{year}$, will result in an average consumption for sanitary purposes of 304 litres/employee/day. Compared to figures published by Statistics Norway on use of water in households (Statistics Norway 2004) this seems reasonable. For 2004 it has been estimated that the average household consumption is 216 litres/person/day.

There are of course differences between the water use regimes in households and manufacturing industries, but also similarities. Both establishments in manufacturing and the households use water for cleaning, personal hygiene, toilets, preparation of food and dishwashing. Not all of the categories mentioned here apply to the same extent to all establishments, but in many cases they do.

One important element in evaluating how well this coefficient suits the various water use activities in the industries is, whether the 570 establishments are representative of the other establishments in the sample with respect to use of sanitary water. It is difficult to determine if a reported value “0” or “blank” means that the establishment does not know how much it uses or if it does not use any water. In most cases we must assume that water is used for sanitary purposes, especially if there are employees (0 employees were not drawn in the sample). In a country like Norway and most other similar countries, it is imperative that the employees are able to satisfy their demands in terms of personal hygiene, cleaning of the premises, coffee-brewing and other activities related to preparation of food. Then it is a question of finding out how much sanitary water, on average, does one employee consume per year in the various industries.

Applied to the data set estimations using **$67 \text{ m}^3/\text{employee}/\text{year}$** gives us a total volume of ca **2 255 000 m^3** of sanitary water for the “simplified” responses, before grossing up to the national level. When doing so we assume that any of the 570 establishments are representative of all subclasses in the sample in terms of sanitary water.

The coefficient should be used in estimations for a rather diverse range of industries; in terms of water use and other aspects. Since the correlation between the number of employees and water use is relatively poor, and that the coefficient should be applied in estimations at the establishment-level, we found it adequate to determine if there were other ways to estimate the sanitary water.

3.2.2 The industry-specific-coefficient approach

When investigating this we needed to see if the industry-specific coefficients in table 3 (right column) were sufficiently representative of their respective industries. A standard deviation test on the coefficient for each establishment was expected to bring us closer to the answer. The test gave the following results:

Table 4. Standard deviation test on coefficients for sanitary water

Industry (NACE)	Sanitary water (m ³ /employee/year (coefficient)	Number of establishments in the test sample	Standard deviation
10	302	1	0
11	31	17	8
13	134	4	194
14	74	11	25
15	52	116	14
16	20	:	0
17	45	14	8
18	28	6	6
19	12	2	5
20	22	35	5
21	122	27	101
22	20	22	3
23	539	2	189
24	78	38	32
25	72	23	23
26	42	45	10
27	151	38	40
28	23	27	4
29	43	30	6
30	27	:	0
31	55	12	14
32	31	9	13
33	35	4	10
34	77	17	15
35	27	49	4
36	18	17	3
37	6	3	2

First of all, we noticed that several of the coefficients were smaller than the average of 67 m³/employee investigated above. In addition, their standard deviations were relatively small. This was the case for NACE 11, 17, 18, 19, 20, 22, 26, 28, 29, 31, 32, 33, 35 and 36. With so many industries in this sample showing potential for being representative, it was interesting to do a new estimate based on the industry-specific-coefficients. The result was a total volume of ca 1 172 000 m³ of sanitary water, before grossing up to the national level. This is nearly 50 % less compared to the estimate, based on 67 m³/employee/year, for all industries. This indicated rather clearly that industry-specific coefficients had to be applied to a certain extent.

For the industries with only one establishment in the applied sample the standard deviation-method is not applicable and the value is 0 in table 3. It can not be assessed whether these coefficients are representative or not. There were not enough establishments in the sample included in this particular calculation.

Some industries came up with rather high coefficients and standard deviations. This is the case for NACE 13, 21 and 23. For these particular industries we concluded that the best available coefficient describing the average water use for sanitary purposes is the overall average of 67 m³/employee/year.

Thus, the final set of coefficients for estimating the sanitary water for establishments that used the simplified-response-option is:

Table 5. Coefficients for sanitary water applied in calculations

Industry (NACE)	Coefficient (Sanitary water (m ³)/employee/year)
10	302
11	31
13	67
14	74
15	52
16	20
17	45
18	28
19	12
20	22
21	67
22	20
23	67
24	78
25	72
26	42
27	151
28	23
29	43
30	27
31	55
32	31
33	35
34	77
35	27
36	18
37	6

3.3 Coefficients for water use

One important part of our work in this study is to come up with a set of water-use coefficients for the different manufacturing industries with regard to the various main activities in each industry; such as processing-water, cooling, leakage, evaporation and other water consuming activities or processes.

When applied to datasets from sample surveys carried out after 2003, the coefficients representing the activities and processes in the industries must be industry-specific in order to reflect the water use of the particular industry. Manner of supply and sources of abstraction for each industry will be evident from the questionnaires used in the years 2004, 2005 and so forth (the questions for 2004 and 2005 are included in the appendix).

The data set for 2003, with its distribution of water use by the categories: “processing”, “cooling”, “in products”, “sanitary”, “leakages and evaporation” and “other”, has been transformed into a set of distribution factors. Sanitary water has been included, although a set of industry-specific coefficients have been recognized for estimating sanitary water in establishments with no other use of water. These coefficients were mainly intended for estimates on this particular group of respondents in sample surveys. In the future, having worked on data sets for the period 2004 – 2007, we expect to gain more experience in the field of statistics on water for the manufacturing industries, and we expect to be able to investigate the possibility of making reliable coefficients for all the water use categories mentioned above.

The distribution factors we intend to apply for the 2004 and 2005 data sets are presented in the table below. The factors add up to 1 per industry. The set of factors reflect the water use in 2003, and can only be applied for a limited number of years before it has to be adjusted according to new information gathered (for example a new sample survey). Otherwise, use of such factors will imply too much uncertainty.

Table 6. Distribution factors for water use. 2003

Water use (distribution factors) – part 1.								
Industry (NACE)	Sanitary water				Processing			
	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water
10	0.682	-	0.076	-	0.241	-	-	-
11	0.002	-	-	-	0.000	-	-	-
13	0.001	0.000	-	0.000	0.001	0.994	-	-
14	0.018	0.003	0.002	-	0.000	0.006	0.386	0.073
15	0.026	0.001	0.001	-	0.166	0.010	0.001	0.224
16	:	:	:	:	:	:	:	:
17	0.132	0.000	0.002	-	0.515	0.088	-	0.010
18	0.444	0.050	-	-	0.183	0.297	-	-
19	0.029	0.000	-	-	0.005	0.578	-	-
20	0.093	0.000	0.001	-	0.023	0.142	0.001	0.001
21	0.002	0.002	0.000	-	0.009	0.392	0.000	-
22	0.707	-	0.005	-	0.087	-	-	-
23	0.001	-	-	-	-	0.013	-	0.154
24	0.001	0.004	-	0.000	0.004	0.076	-	0.006
25	0.188	-	-	-	0.160	0.057	-	-
26	0.017	0.000	-	-	0.100	0.448	-	-
27	0.005	0.001	0.000	-	0.039	0.032	0.000	0.257
28	0.132	0.006	0.003	-	0.048	0.011	-	-
29	0.590	-	0.030	-	0.070	0.004	-	-
30	0.547	-	-	-	-	-	-	-
31	0.284	-	0.011	-	0.011	-	-	-
32	0.663	-	-	-	0.298	-	-	-
33	0.907	-	-	-	0.023	-	-	-
34	0.096	-	0.001	-	0.048	0.001	-	-
35	0.492	0.002	0.035	-	0.116	-	-	-
36	0.542	-	0.007	-	0.314	-	-	-
37	0.001	-	0.000	-	0.003	0.846	-	-

Water use (distribution factors) – part 2.								
Industry (NACE)	Cooling				In products			
	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water
10	-	-	-	-	-	-	-	-
11	0.000	-	-	0.215	0.000	-	-	-
13	0.003	-	-	-	-	0.000	-	-
14	0.008	0.033	-	-	0.004	0.008	-	-
15	0.061	0.018	0.000	0.412	0.026	0.000	0.002	-
16	:	:	:	:	:	:	:	:
17	0.105	-	0.004	-	0.130	-	-	-
18	-	-	-	-	0.000	-	-	-
19	-	-	-	0.388	-	-	-	-
20	0.038	0.086	0.000	0.060	0.004	0.004	-	-
21	0.000	0.447	-	0.127	0.000	0.005	-	-
22	0.154	-	-	-	0.029	-	-	-
23	-	-	-	0.823	-	-	0.000	-
24	0.004	0.638	0.103	0.157	0.001	0.002	-	-
25	0.206	0.059	0.011	0.236	0.001	-	-	-
26	0.029	0.213	0.101	0.036	0.013	0.002	-	-
27	0.069	0.198	0.000	0.277	0.000	-	-	-
28	0.064	0.721	-	-	0.003	-	-	-
29	0.075	0.000	-	0.013	0.004	-	-	-
30	0.437	-	-	-	-	-	-	-
31	0.684	-	-	0.006	-	-	-	-
32	0.008	-	-	-	0.003	-	-	-
33	0.019	-	-	-	-	-	-	-
34	0.662	0.144	-	-	-	-	-	-
35	0.031	-	-	-	0.104	-	-	-
36	0.048	-	0.018	-	0.002	-	-	-
37	0.000	0.150	-	-	-	-	-	-

Water use (distribution factors) – part 3.								
Industry (NACE)	Leakages and evaporation				Other use of water			
	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water
10	0.001	-	-	-	-	-	-	-
11	0.000	-	-	-	0.001	-	-	0.783
13	-	-	-	-	0.000	-	-	0.000
14	-	-	-	-	0.010	0.443	0.004	-
15	0.009	-	-	-	0.038	0.001	0.002	0.005
16	:	:	:	:	:	:	:	:
17	0.000	0.000	-	-	0.011	-	-	0.003
18	0.002	-	-	-	0.002	0.023	-	-
19	-	-	-	-	-	-	-	-
20	0.002	0.007	0.000	0.003	0.100	0.297	0.002	0.133
21	0.000	0.016	-	-	0.000	0.000	-	-
22	0.002	-	-	-	0.016	-	-	-
23	-	-	-	-	-	-	-	0.009
24	0.000	0.002	-	-	0.001	-	-	-
25	0.002	-	-	-	0.079	-	-	-
26	0.008	0.013	-	-	0.003	0.000	0.000	0.015
27	0.000	0.018	0.000	0.001	0.000	0.000	-	0.101
28	0.001	-	-	-	0.011	-	-	-
29	0.028	0.000	-	-	0.187	-	-	-
30	0.016	-	-	-	-	-	-	-
31	0.000	-	-	-	0.004	-	-	-
32	0.001	-	-	-	0.027	-	-	-
33	-	-	-	-	0.051	-	-	-
34	0.018	0.027	-	-	0.002	-	-	-
35	0.012	0.002	-	-	0.188	0.018	-	-
36	0.042	-	-	-	0.027	-	-	-
37	-	-	-	-	0.001	-	0.000	-

4. Results

4.1 Changes in the manufacturing industries

Compared to a similar survey for the reference year 1999, on the industries in NACE 15 – 37 (mining and quarrying was not included in 1999), the use of water has increased by approximately 14 per cent. The difference is mainly to be found in manufacture of food products and beverages. The calculated total water use in 1999 was ca 1.4 billion m³. The total for 2003 has been calculated to 1.6 billion m³.

4.2 Quantities of water - by industries, sources and supply

The statistics on water abstraction and use in the manufacturing industries, mining and quarrying are broken down by industries (NACE) at the division level, source and supply. The figures in this report are preliminary, since some work on the calculations and data revision remained undone when the pilot study expired.

For public supply we have assumed the source to be fresh water, both surface water and ground water (table 7). Information on the distribution between the two sources is so far not available.

In the figures for water abstraction the estimated volumes of sanitary water are included (table 8).

Table 7. Water use in the mining, quarrying and the manufacturing industries. By source and supply. 2003

Water use, by source and supply (m ³)					
Purpose	Total	Public supply	Self supply		
		Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water
Sanitary water	13 828 258	10 327 321	3 210 364	287 516	3 057
Processing-water	388 095 168	34 662 469	184 644 698	3 528 564	165 259 437
Cooling	1 249 035 717	37 883 133	563 909 579	67 126 302	580 116 703
In products	6 102 169	3 440 633	2 510 614	150 922	-
Leakages and evaporation	13 305 322	1 435 037	11 356 892	3 505	509 888
Other use of water	306 726 977	4 925 869	4 923 816	176 481	296 700 811
Total	1 977 093 610	92 674 461	770 555 963	71 273 290	1 042 589 896

Table 8. Total amounts of water abstraction, use and the difference between abstraction and use in mining, quarrying and the manufacturing industries. By industry. 2003

Total abstraction, use and difference (m ³)			
Industry (NACE)	Fresh water, marine and brackish water		
	Abstraction	Use	Difference
10	192 861	192 861	-
11	325 959 057	325 874 464	84 593
13/14	48 725 649	48 725 349	300
15/16	82 684 434	73 406 297	9 278 137
17	1 153 411	1 153 411	-
18	73 320	73 320	-
19	207 734	173 811	33 923
20	3 074 375	2 861 641	212 734
21	174 049 129	173 891 330	157 799
22	698 771	636 523	62 248
23	304 651 347	307 281 347	- 2 630 000
24	630 250 514	630 806 616	- 556 101
25	1 922 168	1 911 857	10 310
26	17 403 108	17 335 974	67 134
27	396 664 383	377 911 606	18 752 777
28	2 723 697	2 653 649	70 048
29	1 665 885	1 084 362	581 523
30/31	10 031 114	853 668	149 446
32	194 379	190 462	3 917
33	235 508	230 177	5 331
34	4 601 347	3 968 243	633 104
35	1 694 217	1 427 929	266 288
36	333 773	310 051	23 723
37	4 159 574	4 138 662	20 912
Total	2 004 321 758	1 977 093 610	27 228 148

The difference between abstraction and use reflects mainly two things. The most obvious is that some establishments have reported an amount of abstracted water and no use of this water. We have not looked into how this could be adjusted for in the calculations of water use. This should be a topic for further work.

In cases of negative differences (in *italics* in table 8); which means more water used than abstracted; the most likely reason is recycling of water (for example cooling water). For establishments in industries 23 and 24 (refining of petroleum products and manufacture of chemical products) this is an established practice, which also is apparent in the difference-column in the table above. The smaller amounts for the industries 11 and 16 are most likely reporting-errors. But, since the instructions for filling in the questionnaire points out that recycled water should be included in the available categories of water use, we can not rule out the possibility of recycled water for the industries 11 and 16.

**Table 9. Water abstraction, use and losses in mining, quarrying and the manufacturing industries.
By industry. 2003**

Industry (NACE)	Fresh water, marine and brackish water (m ³)			Losses; per cent of abstracted water	Losses; per cent of used water
	Abstraction	Use	Leakages and evaporation		
10	192 861	192 861	120	0.062	0.062
11	325 959 057	325 874 464	4 836	0.001	0.001
13/14	48 725 643	48 725 349	-	-	-
15/16*	82 684 434	73 406 297	649 804	64.859	64.733
17	1 153 411	1 153 411	300	0.026	0.026
18	73 320	73 320	122	0.166	0.166
19	207 734	173 811	-	-	-
20	3 074 375	2 861 641	36 465	1.186	1.274
21	174 049 129	173 891 330	2 847 866	1.636	1.638
22	698 771	636 523	1 200	0.172	0.189
23	304 651 347	307 281 347	-	-	-
24	630 250 514	630 806 616	1 529 758	0.243	0.243
25	1 922 168	1 911 857	4 094	0.213	0.214
26	17 403 108	17 335 974	378 947	2.177	2.186
27	396 664 383	377 911 606	7 608 540	1.918	2.013
28	2 723 697	2 653 649	1 529	0.056	0.058
29	1 665 885	1 084 362	30 220	1.814	2.787
30/31	1 031 114	853 668	234	1.574	1.578
32	194 379	190 462	150	0.077	0.079
33	235 508	230 177	-	-	-
34	4 601 347	3 968 243	178 057	3.870	4.487
35	1 694 217	1 427 929	20 094	1.186	1.407
36	333 773	310 051	12 986	3.891	4.188
37	4 159 574	4 138 662	-	-	-
Total	2 004 321	1 977 093	13 305 322	0.664	0.673

* In this group we find manufacture of tobacco products. Nearly 65 per cent losses is an outstanding portion compared to the other industries, and NACE 16 accounts for most of it. It is evident that this industry needs to get rid of large amounts of water in order to make a flammable product. The tobacco production involves several stages of humidifying and drying.

In the sample survey questionnaire for 2003 leakages and evaporation was included in the same value. This makes it somewhat difficult to assess the results to full extent.

According to the instructions, loss of water should not be reported for establishments that buy water from public or private water works. Because, it can hardly be expected that establishments know how much is lost from the pipelines before the water enters the premises.

Consequently, the figures on losses of water accounted for in this report should only represent what is lost in self-supplied establishments. As we can see from the results presented in the tables above losses have been reported also for establishments with public supply, for example NACE 16, 30, 32 and 33. These industries are easy to spot, since they have abstracted water from one source only. Obviously, the instructions have not been followed by establishments in the four industries mentioned here, and we can only expect that this is the case also for the rest of the industries.

This implies that for establishments with only public supply, the figures on loss of water contain most likely evaporation. And, in the table we find a very illustrating example that supports this conclusion. In NACE 15/16 we find nearly 65 % loss of water and the tobacco production accounts for most of it. This is an outstanding portion compared to the other industries, but it is evident that the tobacco industry needs to get rid of large amounts of water in order to make a flammable product. The tobacco production involves several stages of humidifying and drying.

In public water supply estimates of leakages are often in the magnitude of 20 – 30 per cent. In this study we find most values for leakages and evaporation in the range of 0.001 – 4.5 per cent. It should be determined if the loss of water here is mainly leakages or evaporation. The leakage- and evaporation-figures have not been investigated in detail, but this could be a topic for future work. In future sample surveys, questions on loss of water should be split up in different categories.

Table 10. Abstraction of water in mining, quarrying and the manufacturing industries. By industry, source and supply. 2003

Abstraction (m³)						
Industry	Public supply	Self supply			Total	
	Water works	Surface water	Ground water	Marine and brackish water	Fresh water	Fresh water, marine and brackish water
(NACE)						
10	178 219	-	14 642	-	192 861	192 861
11	934 057	-	-	325 025 000	934 057	325 959 057
13/14	585 516	43 960 403	-	-	48 065 649	48 725 649
15/16	32 721 779	2 130 082	430 909	47 401 664	35 282 770	82 684 434
17	1 029 525	102 336	6 977	14 574	1 138 838	1 153 411
18	46 195	27 125	-	-	73 320	73 320
19	5 794	134 440	-	67 500	140 234	207 734
20	795 340	1 587 676	14 037	677 322	2 397 053	3 074 375
21	2 160 234	149 888 787	108	22 000 000	152 049 129	174 049 129
22	695 494	-	3 278	-	698 771	698 771
23	411 162	3 940 000	185	300 300 000	4 351 347	304 651 347
24	7 788 394	454 857 715	65 212 197	102 392 208	527 858 306	630 250 514
25	1 227 323	222 567	20 856	451 421	1 470 746	1 922 168
26	3 014 670	11 739 376	1 755 062	894 000	16 509 108	17 403 108
27	61 612 796	94 239 700	215 601	240 596 286	156 068 097	396 664 383
28	758 376	1 958 072	7 249	-	2 723 697	2 723 697
29	1 614 773	4 196	32 516	14 400	1 651 485	1 665 885
30/31	988 972	-	9 142	5 000	998 114	1 003 114
32	194 379	-	-	-	194 379	194 379
33	235 508	-	-	-	235 508	235 508
34	3 634 709	962 349	4 289	-	4 601 347	4 601 347
35	1 614 090	30 657	49 471	-	1 694 217	1 694 217
36	326 097	-	7 676	-	333 773	333 773
37	40 238	4 118 843	493	-	4 159 574	4 159 574
Total	122 613 642	769 904 323	71 304 417	1 040 499 376	963 822 382	2 004 321 758

Table 11. Water use in mining, quarrying and the manufacturing industries. By industry and purpose. 2003

Industry (NACE)	Total water use (m ³)						
	Fresh water, marine and brackish water	Sanitary water	Processing	Cooling	Water in products	Leakages and evaporation	Other use of water
10	192	146 211	46 530		-		-
11	325 874	563 908	6 836	70 001	4	4	255 292 661
13/14	49 725	161 187	43 748 185	476	131	-	4 107 406
15/16	73 406	2 002 888	29 414 201	35 976	2 078	649	3 284 064
17	1 153	154 160	707 623	125	150		15 390
18	73	36 169	35 198				1 813
19	173	5 056	101 255	67	-	-	-
20	2 861	271 397	477 657	527	23	36	1 524 932
21	173 891	690 687	69 621 469	99 739	913	2 847	78 380
22	636	453 351	55 541	97	18	1	10 015
23	307 281	411 162	51 240 000	253 000		-	2 630 000
24	630 806	3 148 937	54 206 143	568 958	2 350	1 529	611 943
25	1 911	359 521	416 168	978	2	4	151 232
26	17 335	300 632	9 503 960	6 569	263	378	319 890
27	377 911	2 071 432	124 236 713	205 861	3	7 608	38 130 257
28	2 653	374 370	155 917	2 084	7	1	29 967
29	1 084	671 771	79 873	95	4	30	202 718
30/31	853	253 337	9 483	587	-		3 046
32	190	126 261	56 776	1			5 135
33	230	208 710	5 360	4	-	-	11 682
34	3 968	386 977	196 109	3 198	-	178	9 087
35	1 427	754 964	165 859	44	148	20	294 109
36	310	170 214	97 428	20		12	8 388
37	4 138	3 957	3 510 883	618	-	-	4 863
Total	1 977 093	13 828 258	388 095 167	1 249 035	6 102	13 305	306 726 977

Table 12. Water use in mining, quarrying and the manufacturing industries. By industry, purpose, supply and source. 2003

Industry (NACE)		Sanitary water				Processing			
		Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water
10		131 569	-	14 642	-	46 530	-	-	-
11		563 908	-	-	-	6 836	-	-	-
13/14		210 784	31 680	19 721	2	61 844	39 563 500	3 462 841	660 000
15/16		1 906 339	38 742	57 807	-	12 175 193	714 316	60 165	16 464 527
17		151 824	260	2 077	-	594 118	101 846	-	11 659
18		32 535	3 634	-	-	13 398	21 800	-	-
19		5 006	50	-	-	787	100 468	-	-
20		266 252	1 263	3 882	-	66 772	405 800	1 650	3 435
21		372 951	317 636	100	-	1 507 972	68 113 488	8	-
22		450 074	-	3 278	-	55 541	-	-	-
23		411 162	-	-	-	-	3 940 000	-	47 300 000
24		617 381	2 528 500	-	3 055	2 571 059	47 993 924	-	3 641 160
25		359 521	-	-	-	306 456	109 712	-	-
26		292 969	7 663	-	-	1 738 098	7 765 863	-	-
27		1 727 554	262 635	81 244	-	14 778 005	12 276 152	3 900	97 178 656
28		351 603	15 518	7 249	-	126 501	29 416	-	-
29		639 255	-	32 516	-	75 873	4 000	-	-
30/31		244 195	-	9 142	-	9 483	-	-	-
32		126 261	-	-	-	56 776	-	-	-
33		208 710	-	-	-	5 360	-	-	-
34		382 687	-	4 289	-	191 696	4 413	-	-
35		702 709	2 784	49 471	-	165 859	-	-	-
36		168 166	-	2 049	-	97 428	-	-	-
37		3 907	-	50	-	10 883	3 500 000	-	-
Total		10 327 321	3 210 364	287 516	3 057	34 662 469	184 644 698	3 528 564	165 259 437

Water use (m ³) – part 2.								
Industry (NACE)	Cooling				In products			
	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water
10	-	-	-	-	-	-	-	-
11	1 369	-	-	70 000 000	4 855	-	-	-
13/14	183 420	292 705	-	-	36 887	94 560	-	-
15/16	4 451 966	1 321 792	1 765	30 200 900	1 925 181	3 000	150 737	-
17	121 038	-	4 900	-	150 000	-	-	-
18	-	-	-	-	18	-	-	-
19	-	-	-	67 500	-	-	-	-
20	107 313	246 700	1 000	172 499	11 765	11 913	-	-
21	43 745	77 695 507	-	22 000 000	1 658	912 019	-	-
22	97 919	-	-	-	18 497	-	-	-
23	-	-	-	253 000 000	-	-	185	-
24	2 316 621	402 682 066	65 212 197	98 747 983	891 883	1 459 087	-	-
25	393 041	112 855	20 856	451 421	2 668	-	-	-
26	500 678	3 686 789	1 752 000	630 000	233 043	30 035	-	-
27	26 138 527	74 768 179	127 957	104 827 000	3 000	-	-	-
28	171 136	1 913 138	-	-	7 592	-	-	-
29	81 197	147	-	14 400	4 035	-	-	-
30/31	582 568	-	-	5 000	-	-	-	-
32	1 500	-	-	-	640	-	-	-
33	4 425	-	-	-	-	-	-	-
34	2 627 156	570 857	-	-	-	-	-	-
35	44 563	-	-	-	148 340	-	-	-
36	14 836	-	5 628	-	571	-	-	-
37	115	618 843	-	-	-	-	-	-
Total	37 883 133	563 909 579	67 126 302	580 116 703	3 440 633	2 510 614	150 922	-

Water use (m³) – part 3									
Industry (NACE)	Leakages and evaporation					Other use of water			
	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water	Public or private water works	Fresh surface water	Fresh ground water	Marine and brackish water	Marine and brackish water
10	120	-	-	-	-	-	-	-	-
11	4 836	-	-	-	292 661	-	-	255 000 000	-
13/14	-	-	-	-	92 278	3 977 957	37 169	-	2
15/16	649 804	-	-	-	2 770 067	52 232	129 370	332 394	-
17	70	230	-	-	12 475	-	-	2 915	-
18	122	-	-	-	122	1 691	-	-	-
19	-	-	-	-	-	-	-	-	-
20	4 571	21 000	1 005	9 888	285 932	851 000	6 500	381 500	-
21	7 730	2 840 136	-	-	68 380	10 000	-	-	-
22	1 200	-	-	-	10 015	-	-	-	-
23	-	-	-	-	-	-	-	2 630 000	-
24	303 358	1 226 400	-	-	611 943	-	-	-	-
25	4 094	-	-	-	151 232	-	-	-	-
26	146 947	232 000	-	-	50 657	2 233	3 000	264 000	-
27	177 348	6 928 692	2 500	500 000	36 615	3 642	-	38 090 000	-
28	1 529	-	-	-	29 967	-	-	-	-
29	30 171	49	-	-	202 718	-	-	-	-
30/31	234	-	-	-	3 046	-	-	-	-
32	150	-	-	-	5 135	-	-	-	-
33	-	-	-	-	11 682	-	-	-	-
34	72 457	105 600	-	-	9 087	-	-	-	-
35	17 310	2 784	-	-	269 048	25 060	-	-	-
36	12 986	-	-	-	8 388	-	-	-	-
37	-	-	-	-	4 420	-	443	-	-
Total	1 435 037	11 356 892	3 505	509 888	4 925 869	4 923 816	176 481	296 700 811	296 700 811

Total water use (m³) – part 4.					
Industry (NACE)	Fresh water			Marine and brackish water	Fresh water, marine and brackish water
	Public or private water works	Fresh surface water	Fresh ground water		
10	178 219	-	14 642	-	192 861
11	874 464	-	-	325 000 000	325 874 464
13/14	585 212	43 960 403	3 519 730	660 004	48 725 349
15/16	23 878 550	2 130 082	399 844	46 997 821	73 406 297
17	1 029 525	102 336	6 977	14 574	1 153 411
18	46 195	27 125	-	-	73 320
19	5 793	100 518	-	67 500	173 811
20	742 606	1 537 676	14 037	567 322	2 861 641
21	2 002 436	149 888 787	108	22 000 000	173 891 330
22	633 245	-	3 278	-	636 523
23	411 162	3 940 000	185	302 930 000	307 281 347
24	7 312 244	455 889 976	65 212 197	102 392 198	630 806 616
25	1 217 013	222 567	20 856	451 421	1 911 857
26	2 962 391	11 724 582	1 755 000	894 000	17 335 974
27	42 861 049	94 239 300	215 601	240 595 656	377 911 606
28	688 328	1 958 072	7 249	-	2 653 649
29	1 033 250	4 196	32 516	14 400	1 084 362
30/31	839 526	-	9 142	5 000	853 668
32	190 462	-	-	-	190 462
33	230 177	-	-	-	230 177
34	3 283 084	680 870	4 289	-	3 968 243
35	1 347 829	30 629	49 471	-	1 427 929
36	302 375	-	7 676	-	310 051
37	19 325	4 118 843	493	-	4 138 662
Total	92 674 461	770 555 963	71 273 290	1 042 589 896	1 977 093 610

4.3 Assessment of the results

In the figures on abstraction there are several examples of large round amounts of water. Obviously, the establishments have not been able to report more accurate values. The aggregated and weighted figures reflect the reporting, and based on this we must conclude that many of the figures are uncertain.

Uncertainty also occurs when it comes to assessment of the total amounts of water used. One major issue is the inclusion of leakages and evaporation in the total for water use. One can argue that it should be included since it is impossible to determine from the questionnaire if the leakage occurred before or after the water had been used by the establishments for one or several purposes. There is a potential for double counting involved in this, which has not been investigated. In future surveys one should seek to eliminate the possibility of double counting.

For public supply we have assumed the source to be fresh water, both surface water and ground water. Information on the distribution between the two sources is so far not available. In future work this should be investigated more.

Marine and brackish water accounted for approximately 50 per cent of all water abstracted in 2003. Most of the salty water was used as cooling water (roughly 50 per cent). The rest was used for other purposes and in processing. The large amount of sea or brackish water (255 000 000 m³) used by the oil industries (NACE 11) for other purposes should be subject to more thorough studies. Future work should attempt to look into the “other” category and determine if it can be accounted for in more detail.

5. Conclusions and further work

5.1 Conclusions

A sample survey conducted on the mining, quarrying and manufacturing industries (NACE 10 – 37) for the year 2003, has resulted in preliminary figures on water abstraction and water use for these industries. The figures are broken down by industries at the division level, water source, supply and purpose of the water use. In 2003 the industries in NACE 10 – 37 abstracted a total of 2.004 billion m³ of water (fresh water, sea water and brackish water). The total amount of water used was 1.977 billion m³ (fresh water, sea water and brackish water).

Based on the water-use-figures for 2003, there has been put up a set of distribution factors for water use. The factors will be applied to data sets of water abstraction for the years subsequent to 2003, until a new sample survey on water has been conducted.

5.2 Further work

As mentioned earlier in this report, for the 2004-data-collection a much simpler approach was applied. With 1999 and 2003 as reference years, we concluded that for 2004 and subsequent years, it was necessary to collect only four variables on water abstraction and supply in the manufacturing industries.

The data was collected through an already established yearly sample survey on environmental protection expenditures in the manufacturing, mining and quarrying industries. The survey was extended with four variables on water and four on waste. We will look into other ways of calculating water volumes, also using coefficients based on surrogate-data like production data, number of employees or other information that describes the level of activity and consumption of water in the various industries. The two sample surveys of 1999 and 2003 could function as a sort of “frame of reference” for this work.

A parallel study on water-use coefficients has been carried out (ESTAT agreement no. 71301.2005.001-2005.014) covering NACE 15 – 16 and NACE 50 - 99. The methodological approach in the other study is to obtain information about supply of water from water works, in order to produce industry specific coefficients on water use. The two studies must be compared to see if any method seems more preferable than the other, in terms of work load on both the industries and Statistics Norway, in terms of data quality and quality of the statistics.

In the future, after having worked on data sets for the period 2004 – 2007, we expect to have gained more experience in the field of statistics on water for these industries, and we expect to be able to develop industry specific coefficients for water use for all categories of current interest (not only sanitary water). Even further on, the possibility of developing industry specific factors for water abstraction should be considered.

In future sample surveys; only questionnaires that can be scanned will be used. This will improve data quality and reduce costs. A web-based electronic version of the questionnaire is also likely to be developed.

In addition, the following more specific topics for further investigation have been mentioned in the previous chapter:

- The leakage and evaporation figures reported in the questionnaire, which tended to be far lower than information collected from other sources, i.e. public water supply.
- The distribution of ground water versus surface water in water supplied from public sources, of which there is no information available at present.
- The questionnaire category "other sources", and in particular the large amount of brackish and sea-water reported in this category by the oil industry.

References

Statistics Norway 2004: Municipal water supply. 2004
http://www.ssb.no/english/subjects/01/04/20/vann_koetra_en/

The Standard Industrial Classification
<http://www3.ssb.no/stabas/ItemsFrames.asp?ID=3152101&Language=en>

Appendix 1: Questions on water in the 2003-sample survey

1. Did the establishment in 2003 use water for other than sanitary purposes? Check for Yes or No.

Yes <input type="checkbox"/>	→	Go to question 3
No <input type="checkbox"/>	→	2. Where did the water for sanitary purposes come from? Check for water source

Public or private water works <input type="checkbox"/>	Self supply		
	Fresh water		Sea water/brackish water <input type="checkbox"/>
	Surface water <input type="checkbox"/>	Ground water <input type="checkbox"/>	

→ **Go to question 4**

3. How much water was used by the establishment in 2003? Distribute by source and use.
This question is only for those that have answered "Yes" in question 1.

	Public or private water works (m ³)	Self supply		
		Fresh water		Sea water/brackish water (m ³)
		Surface water (m ³)	Ground water (m ³)	
Total water abstraction				
<i>Distribute by use and source. Reused water should be included.</i>				
Process water				
Cooling water				
Water in the products				
Sanitary water, canteen etc.				
Leakage/evaporation				
Other type of water (Please describe in the box below)				
<i>Description "Other type of water":</i>				

4. Comments and remarks:

5. How long did it take to fill in the form?

Include the time spent on finding the necessary data, read the information letter etc.

minutes

6. You have completed the form. Thank you for being so helpful!

Appendix 2: Instructions for filling in the 2003-questionnaire

A. Administrative information

No particular remarks to this part of the questionnaire. Errors in the pre-filled information can be corrected in the questionnaire.

B. Water use by the establishment1. Did the establishment use water for anything else than sanitary purposes in 2003?

Tick for “Yes” or “No”. If the answer is “No”, then go to question number 2. If the answer is “Yes” skip question number 2 and go to question number 3.

2. Where did the water for sanitary purposes come from?

Put a mark in the correct box in the table. By public or private water works we mean installations that are public or private property, and that sell water to establishments or households. If the establishment is self supplied we kindly ask you to report this under “From own water source”.

3. How much water was used by the establishment in 2003?

If the establishment recycles water or uses the water for more than one purpose, total use for each purpose must be reported. Then use will exceed abstraction. The excess water will represent recycled or water used for more than one purpose.

Total water abstraction, m³:

Report all water abstracted from all sources in 2003. By public or private water works we mean water works publicly or privately owned, and sell water to establishments or households. If the establishment has its own water source this should be reported under the category “Self supply”. Report values in m³. If exact information is not available, we kindly ask you to estimate the consumption of water based on information of pump-capacity and hours.

Processing-water:

Chemically or physically contaminated water from processes, including scrubbers. For example: Reject water from paper industry, water from cleansing of gasses and regular cleaning water.

Cooling water:

Water only been subject to heat, without being contaminated or chemically altered.

Water in products:

For example water in soft drinks or ready-cooked meals.

Sanitary water:

Water for toilets, restrooms, cantinas, cleaning and similar purposes.

Other water:

Water inapplicable to the other categories. Describe in designated box. Examples would be cleaning of machinery, paved areas and watering of gardens.

Leakages and evaporation:

Applies only to self supply. We kindly ask for estimates based on information on water abstraction and use.

Appendix 3: Questions on water in the 2004- and 2005-sample surveys

For 2004 and 2005 the following questions were included in the survey on environmental protection expenditures, waste and water use in manufacturing, mining and quarrying industries:

	m ³
How much water was bought from water works?	
How much water was abstracted from sea or brackish water?	
How much water was abstracted by the establishment from surface water?	
How much water was abstracted by the establishment from ground water?	

