VESIENTUTKIMUSLAITOKSEN JULKAISUJA
PUBLICATIONS OF THE WATER RESEARCH INSTITUTE 39

VESIHALLITUS — NATIONAL BOARD OF WATERS, FINLAND
Helsinki 1980

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ISBN 951-46-5307-6
ISSN 0355-0982

Helsinki 1981. Valtion painatuskeskus

HYDROLOGICAL DATA REGISTERS OF THE WATER RESEARCH INSTITUTE

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HENTTONEN, J., MALIN, V. & VERTA, M. 1980. Hydrological data registers of the Water Research Institute. Publications of the Water Research Institute, National Board of Waters, Finland, No. 39.

The water Research Institute of the Finnish National Board of Waters has four data registers containing data from lakes, rivers and coastal sea areas. These are the registers of water quality, toxic substances, water levels and water discharges. In this paper the data collection systems, development of the registers, information stored in the registers, data processing systems and data utilization are discussed.

Index words: Data register, hydrology, water quality, toxic substances, water level, water discharge.

1. INTRODUCTION

The Water Research Institute of the National Board of Waters maintains four registers of hydrological data: the Water Quality Register (WQR), the Register of Toxic Substances (TSR), the Water Level Register (WLR) and the Discharge Register (DR). All these registers are separate and storage is on magnetic tapes except in the case of TSR, which uses mass-storage. The data from different registers may be combined.

In WQR are stored data obtained by the water authorities and by the laboratories carrying out the monitoring required by concessions and permits. These data are mainly physical and chemical data connected with water quality. In TSR, the results of analyses of sediments and water biota by water authorities and many other institutions are stored. Daily values of water levels and discharges are stored in WLR and DR. WQR and TSR are maintained by the water research office and WLR and DR by the hydrological office, both with the co-operation of the Finnish State Computer Center.

2. STATUS OF HYDROLOGICAL DATA COLLECTION SYSTEMS

The Water Research Office of the Water Research Institute is responsible for most of the national water quality monitoring programmes (Table 1). In practice, these are carried out by the water district offices. The objectives at the national level are research and planning, including co-ordination of regional management plans. The samples are analysed in the water district laboratories and in the research laboratory of the Institute in Helsinki.

The water district offices are responsible for the regional networks, consisting of about 1 000 stations under systematic monitoring in 1980. The programmes are planned by each water district office mainly for supervision purposes.

All industries and municipalities having permits to discharge into watercourses are required to maintain certain monitoring programmes. These programmes must be approved by the water administration, which also supervises the laboratories carrying out the monitoring. This kind of monitoring took place at about 2 800

stations in 1980.

An automated water quality monitoring system is at present operating at five river stations on the River Kymijoki. This system utilizes a central computing unit consisting of a PDP 11/35 computer located at the Helsinki offices of the National Board of Waters. The system was taken into service in September 1977. Two mobile stations, operating on the same principles and measuring the same parameters as the Kymijoki monitoring system, are also available.

The Hydrological Office of the Water Research Institute is responsible for the monitoring of hydrological parameters. About 1 000 observers situated around the country serve the hydrological office. The networks at the national level are presented in Table 2.

3. DEVELOPMENT OF HYDROLOGICAL DATA REGISTERS

In 1971 the National Board of Waters and the Finnish State Computer Center signed an agreement by which the Computer Center developed a computer system for storing monitoring data on water properties in the WQR. The programmes for maintaining the register became available in 1972. The oldest results stored in WQR are from the 1940's, while a fuller set of results exists from 1962 onwards. By January 1980 WQR contained data from 415 000 water samples from 27 400 different observation sites. Data from 45 000–50 000 samples are added to the WQR every year.

The planning of a register for storing data

Table 1. The national monitoring programmes on water quality and water biota being conducted in 1980.

Project	Started	Number of stations	Observations per year	Notes
Rivers	1962	187	4	continuous
Lakes	1965	165	2	continuous
Sea and coastal areas	1965	111	1–4	continuous
Matter discharged by rivers to the Baltic Sea	1966	21	4–12	continuous
Small drainage basins	1962	21	5–12	continuous
Precipitation	1973	38	12	continuous
Ground water	1973	54	4–12	continuous
Plankton research	1963	400–670	1	1963, 1965
Plankton research		180–370	3	1971, 1977
DDT, PCB and heavy metal residues in fish	1978	89		every four years
Deep-frozen water samples	1974	1 500		last year 1979
Deep-frozen fish	1970	200		continuous

Table 2. Monitoring networks of the hydrological office in 1980.

Parameter	Started	Number of stations	Observations per year
Water level	1847	660	365
Discharge	1862	390[a]	365
Precipitation	1911	230	365
Water content of snow cover	1936	150	4–8
Soil frost	1911	137	18–26
Ground water	1962	103	24–52
Ice thickness	1911	67	9–12
Surface water temperature	1911	50	150–210
Pan evaporation	1958	19	130–150
Soil moisture	1973	54	4
Deep water temperature	1951	6	24–36
Lake evaporation	1971	4	120–150
Air temperature	1958	10	365
Solar radiation	1968	10	365

a Of these, 140 are electric power stations or regulation dams; elsewhere the discharge is determined with the aid of natural control or rating curves.

from the analysis of toxic substances in water biota and sediments was started in 1977. The programmes for handling this register were developed by the Finnish State Computer Center in 1978. The register has a format and a set of programmes similar to those of the WQR. In January 1980 the register contained data from 7 400 samples.

The development of the WLR and DR was started by the data branch of the Board of Civil Engineering at the end of the 1960's. In 1972 all recorded values of water level and discharge observations had been punched on cards and transferred to magnetic tapes. Since 1972 the Finnish State Computer Center has maintained the registers and has developed the programmes for their utilization. In January 1980 the WLR contained some ten million observations and the DR nearly four million.

4. INFORMATION STORED IN THE REGISTERS

In WQR and TSR one record (information from one sample) consists of data from sampling sites and from the samples themselves. The following data can be recorded for each sample:

- date
- administrative area
- institute
- co-ordinates
- river basin or sea area
- project
- 24 characters of alphabetical information (the name of the sampling site, literature references etc...)
- maximum depth at the site
- secchi disc transparency
- air temperature
- cloudiness
- wind direction and velocity
- ice and snow cover thickness
- sampling depth (only in WQR)
- specification of the sample (only in TSR)
- organ or part of the sample (only in TSR)
- reference matter (only in TSR)
- information on how the sample was stored (only in TSR)
- sex (only in TSR)
- the codes and the measured values of different variables

In WLR and DR one record contains the data for one year from one station. The record consists of the following data:

- river basin
- number of the observation station
- year
- monthly means
- daily observed values
- maximum and minimum values for the year
- date of freezing
- date of break-up of the ice cover

Two auxiliary registers are used in connection with WLR and DR. One contains the rating tables and the other information of the observation stations. The latter contains data concerning the station, such as the number and name of the river basin concerned, number and name of the station, its co-ordinates, drainage area, lake percentage, elevation of the zero-point etc. The data in the observation station register are primarily used for printing out table headings and for general information. The rating table register contains rating curves in tabular form to facilitate conversion of water stages into discharges.

5. DATA PROCESSING

The material to be fed into the registers is written on magnetic tapes at the National Board of Waters. The runs for updating and utilizing the registers take place at the Finnish State Computer Center with an IBM 370/168 computer system or a UNIVAC 1108 computer. Copies of the registers may also be run with the PDP 11/35 minicomputer of the National Board of Waters.

The computer programmes for the WQR and the TSR have been written in FAS language developed by the Finnish State Computer Center. The programmes for WLR and DR were first written in PL 1 and ASSEMBLER languages and later in FAS.

The data flows of WQR and TSR are presented in Fig. 1. When updating the registers the consistency of the sampling site data is checked. The analytical data are also compared with alarm limits. Simultaneously with the updating, the checking list and the list of all samples added to the registers are produced.

The data flow of the WLR and DR is presented in Fig. 2. Simultaneously with the updating,

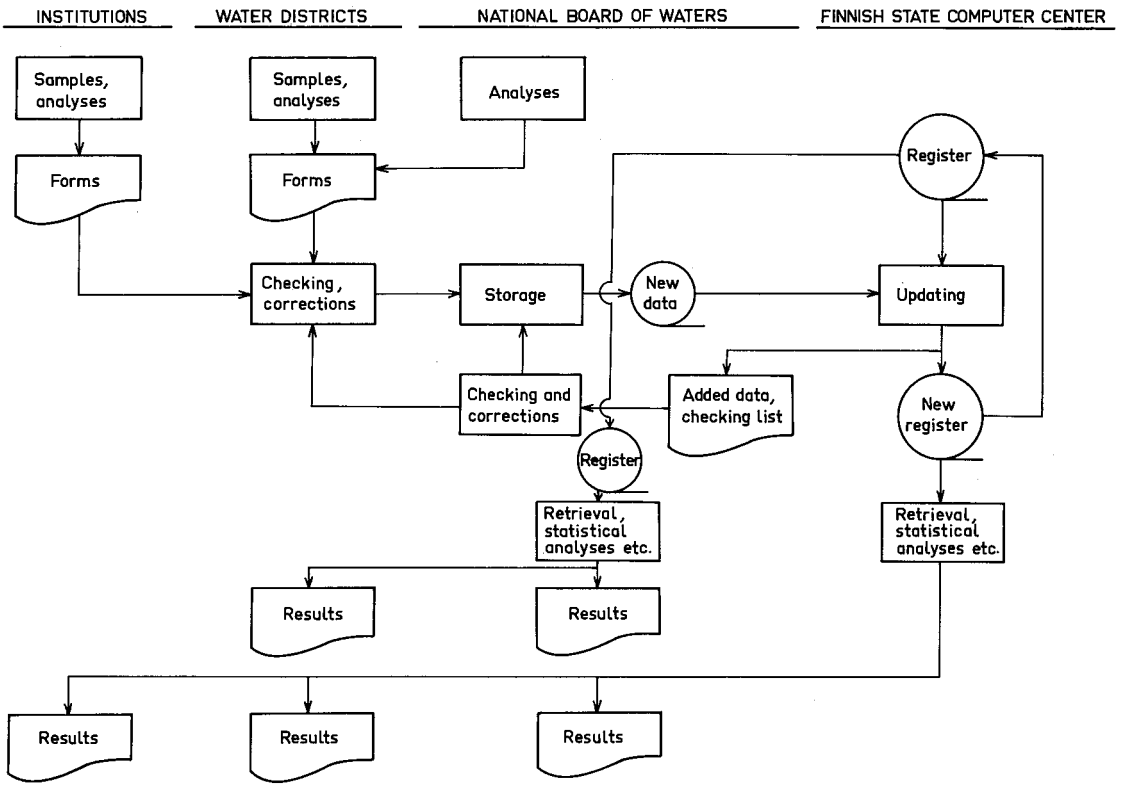


Fig. 1. Data processing of the Water Quality and Toxic Substances Registers.

the water stages are converted to discharge figures with the aid of the rating curves. The data set of the current year is updated each month and the data set for the whole year is added to the register at the end of the year. The updating programme provides for a printout of the monthly statistics. Each year the annual statistics sheet is printed out for each station.

Error hunting in WLR is accomplished by restricting the permissible difference between two subsequent daily readings. If the predetermined limit is exceeded, the observations are printed out on the error list for special checking. In addition, the annual statistics sheets are checked visually.

Discharge values which have been computed with the aid of rating curves must be corrected for ice damming. This is performed manually and the corrected values are later entered into the discharge register.

6. DATA UTILIZATION

The information obtained for particular locations, including all data stored in the registers, is available through retrieval searches. The retrieved data may be listed on magnetic tape, microfiches or paper sheets etc.

After retrieval, specific data reports can be generated in the form of lists, statistical summaries, plots, loadings of cumulative mass flows etc. These can be accomplished by many library programmes as well as by a set of programmes developed especially for the registers.

A list containing information on the sites sampled for the WQR and both a list and a map (Fig. 3) showing the location of the sites analysed for toxic substances, are produced annually. The printing output of the lake monitoring is presented in Fig. 4 as an example of the reporting programmes.

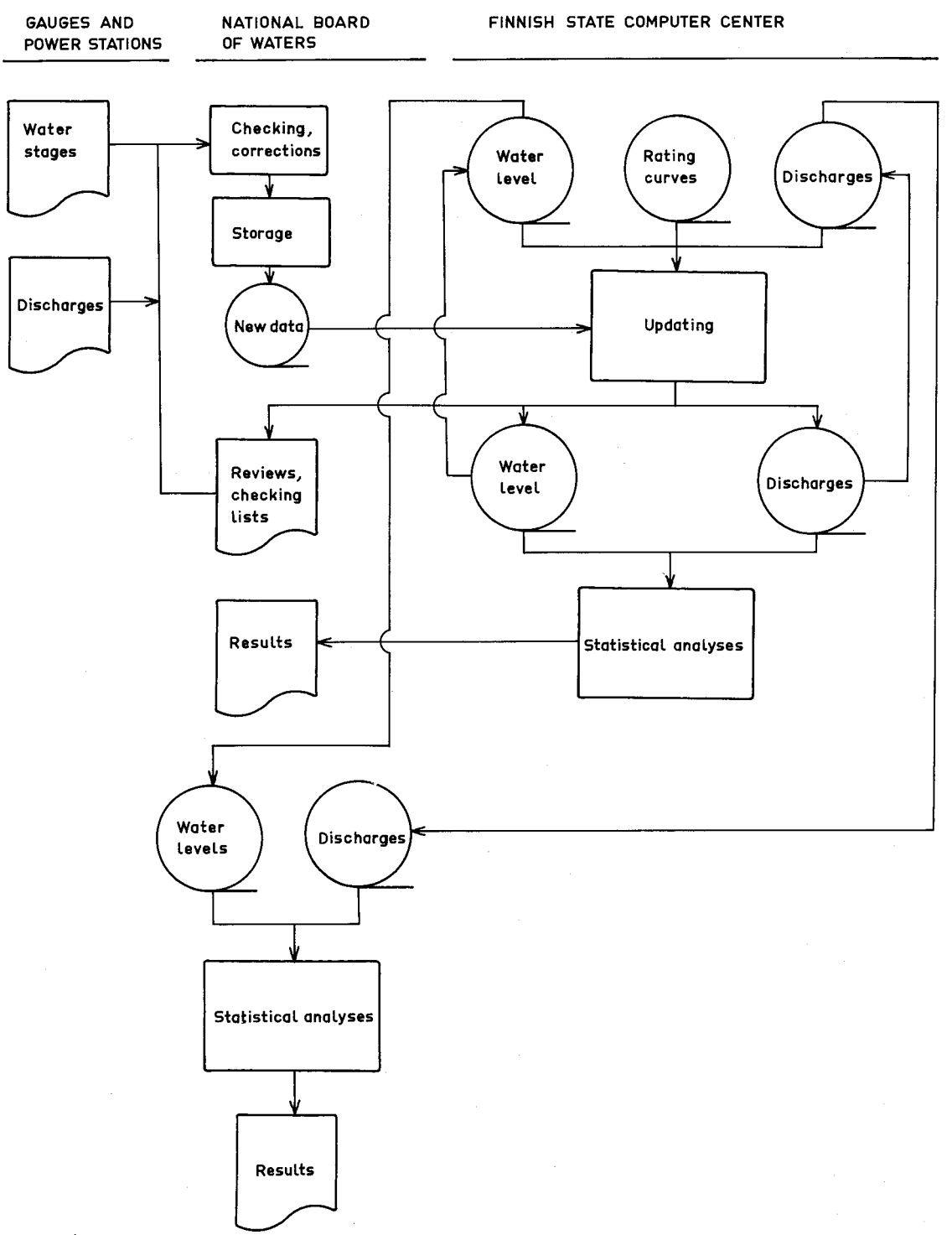
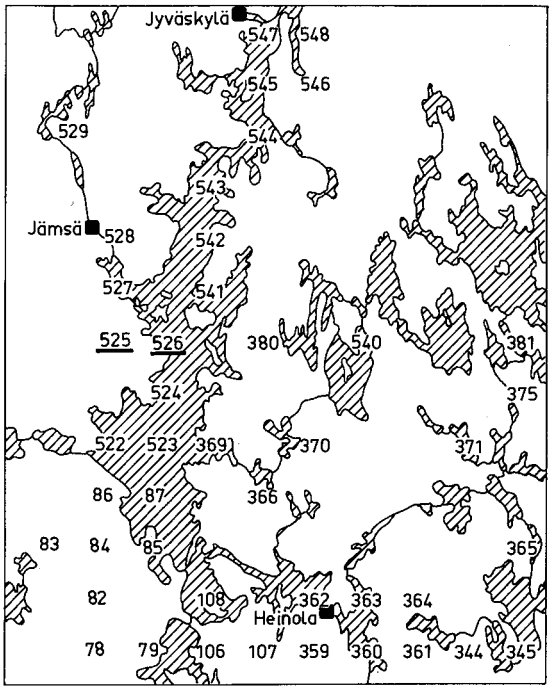
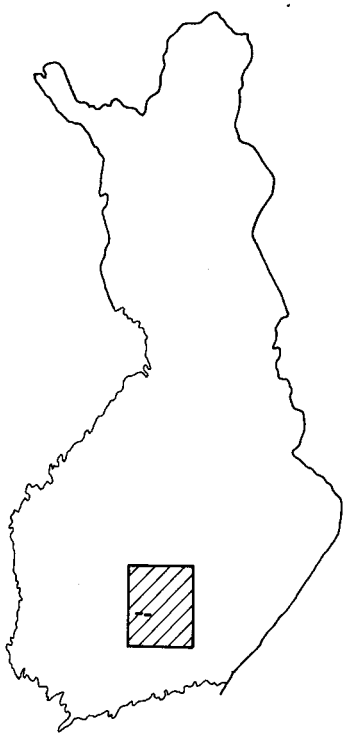


Fig. 2. Data processing of the Water Level and Discharge Registers.





YMPÄRISTÖMYRKKYREKISTERIN HAVAINTOALUELUETTELO 1980

HAV.AL AREA	VP WATER	KOORDINAATIT CO-ORDINATES	KUNNAT COMMUNITIES	VESISTÖALUEET WATER COURSES	TUTKIMUSLAITOKSET INSTITUTES
525	09	2–684–56	182	14.22	17

HAV.VUODET/ YEARS OF SAMPLING	NÄYTTEITÄ NO.OF SAMPLES	ELOHOPEA MERCURY -69	70-72	73-75	76-79	MUUT RASKASMETALLIT OTHER HEAVY METALS -69	70-72	73-75	76-79	KLOORATUT HIILIVEDYT CHLORINATED HYDROCARBONS -69	70-72	73-75	76-79
VESI/WATER	0	0	0	0	0	0	0	0	0	0	0	0	0
SEDIMENTIT/SEDIMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
POHJAELÄIMET/ZOOBENTHOS	0	0	0	0	0	0	0	0	0	0	0	0	0
PLANKTON/PLANKTON	0	0	0	0	0	0	0	0	0	0	0	0	0
VESIKASVIT/WATER PLANTS	0	0	0	0	0	0	0	0	0	0	0	0	0
KALAT/FISH	0	0	0	0	0	0	0	0	0	0	0	0	0
NISÄKKÄÄT/MAMMALS	0	0	0	0	0	0	0	0	0	0	0	0	0
LINNUT/BIRDS	20	0	20	0	0	0	0	0	0	0	20	0	0
YHTEENSÄ/TOTAL	20	0	20	0	0	0	0	0	0	0	20	0	0

526	09	2–684–57	291	14.22	17 37

HAV.VUODET/ YEARS OF SAMPLING	NÄYTTEITÄ NO.OF SAMPLES	ELOHOPEA MERCURY -69	70-72	73-75	76-79	MUUT RASKASMETALLIT OTHER HEAVY METALS -69	70-72	73-75	76-79	KLOORATUT HIILIVEDYT CHLORINATED HYDROCARBONS -69	70-72	73-75	76-79
VESI/WATER	0	0	0	0	0	0	0	0	0	0	0	0	0
SEDIMENTIT/SEDIMENT	9	0	2	7	0	0	0	0	0	0	0	0	0
POHJAELÄIMET/ZOOBENTHOS	91	0	42	49	0	0	0	0	0	0	0	0	0
PLANKTON/PLANKTON	12	0	4	8	0	0	0	0	0	0	16	18	0
VESIKASVIT/WATER PLANTS	28	0	0	0	0	0	0	0	0	0	7	21	0
KALAT/FISH	515	1	120	304	0	0	0	0	0	0	152	202	0
NISÄKKÄÄT/MAMMALS	0	0	0	0	0	0	0	0	0	0	0	0	0
LINNUT/BIRDS	102	0	0	0	0	0	0	0	0	0	41	55	0
YHTEENSÄ/TOTAL	757	1	210	425	0	0	0	0	0	0	220	304	0

Fig. 3. A map and a line printer output from the Water Quality and Toxic Substances Registers showing the number of samples analysed for toxic substances in two areas of one hundred square kilometers.

JÄRVISYVÄNTEET MINIMIT, MAKSIMIT, KESKIARVOT, KESKIHAJONNAT JA
KOLMEN VUODEN LIUKUVAT KESKIARVOT/MINIMA, MAXIMA, MEANS, STANDARD DEVIATIONS AND
THREE-YEAR MOVING AVERAGES

HAVAINTOPAIKKA 42/ SITE 42

SYVYYSLUOKKA/DEPTH LAYER

	MINIMI MIN	MAKSIMI MAX	KESKI-ARVO MEAN	KESKI-HAJONTA S.D.	HAV LKM N	KOLMEN VUODEN LIUKUVAT KESKIARVOT / THREE-YEAR MOVING AVERAGES 65–67	66–68	67–69	68–70	69–71	70–72	71–73	72–74	73–75	74–76	75–77
KIINTOAINE/SUSPENDED SOLIDS																
MG/L																
1 M	0.0	3.0	0.7	0.8	11	0.2	0.7	1.4	1.4	1.1	0.2	0.4	0.7	0.7	0.6	0.3
5 M	0.0	2.8	0.9	0.8	11	2.8	1.9	1.8	0.8	0.8	0.4	0.5	0.8	0.8	0.9	0.4
H	0.1	1.2	0.7	0.3	10	0.2	0.6	0.7	0.8	0.8	0.7	0.7	0.8	0.8	1.0	0.4
2H–1	0.1	1.2	0.6	0.3	10	0.4	0.8	0.5	0.7	0.4	0.5	0.4	0.6	0.8	0.8	0.5
KLORIDI/CHLORIDE																
MG/L																
1 M	1.8	2.9	2.3	0.3	13	2.0	2.1	2.2	2.2	2.3	2.4	2.5	2.6	2.7	2.6	2.5
5 M	1.8	2.6	2.2	0.2	13	2.0	2.0	2.1	2.0	2.2	2.3	2.4	2.4	2.5	2.5	2.5
H	1.9	2.8	2.3	0.2	13	2.1	2.1	2.2	2.1	2.3	2.4	2.4	2.4	2.6	2.6	2.5
2H–1	1.8	2.7	2.2	0.2	12	2.0	2.1	2.1	2.1	2.1	2.2	2.4	2.5	2.6	2.5	2.4
KOK.FOSFORI/TOT.PHOSPHORUS																
MIKROG/L																
1 M	0	10	5	3	13	3	5	5	6	5	4	3	6	8	8	9
5 M	0	11	5	3	13	3	5	5	5	3	3	4	6	8	8	10
H	0	10	5	2	13	3	5	5	5	3	3	3	5	7	7	8
2H–1	4	20	8	4	12	11	6	5	5	5	5	5	7	8	11	9
KOK.RIKKI/TOT.SULPHUR																
MG/L																
1 M	2.4	3.4	2.7	0.3	11	2.4	2.7	2.8	3.0	2.7	2.9	2.7	2.9	2.8	3.0	2.8
5 M	2.2	3.6	2.7	0.3	12	2.7	2.8	2.8	2.6	2.7	2.9	2.8	2.9	2.7	2.8	2.7
H	2.6	3.5	2.9	0.2	11	2.6	2.6	2.9	2.9	3.0	2.9	3.0	3.0	3.0	3.1	3.0
2H–1	1.6	3.2	2.6	0.5	10	2.3	2.5	2.2	2.5	2.4	3.2	2.9	2.9	2.8	2.9	3.0
KOK.TYPPI/TOT.NITROGEN																
MIKROG/L																
1 M	30	1100	480	248	12	210	366	466	500	500	493	490	493	500	530	825
5 M	100	540	419	110	13	300	300	400	400	400	406	443	486	526	520	496
H	200	520	403	107	13	233	300	400	433	433	416	440	480	486	500	470
2H–1	300	850	467	136	12	516	366	433	433	450	415	445	486	490	486	433

Fig. 4. A line printer output of a lake monitoring site consisting of extreme and mean values, standard deviations and three-year moving averages from the periods March 10 to April 10 in 1965–1977 (M = depth in meters, H = middle depth water layer).

The data stored in WLR and DR are published in condensed form in the Hydrological Yearbooks (in Publications of the Water Research Institute), containing the monthly means and the annual maximae and minimae taken from the annual statistics. In addition, computer-calculated systematic analyses for the different observation stations have been published. These analyses (mean values and extremes, persistence and return times) have been published as copies in reduced scale of the computer line printer output complemented with diagrams (Figs. 5 and 6).

LOPPUTIIVISTELMÄ

Vesihallituksen koordinoimat veden laadun seurannat maassamme voidaan jakaa kolmeen osaan. Koko maan kattavista seurannoista vastaa Vesientutkimuslaitoksen vesitutkimustoimisto, alueellisista vesipiirien vesitoimistot ja paikallisista velvoitetarkkailuja suorittavat tutkimuslaitokset vesiviranomaisen hyväksymien ja valvomien ohjelmien puitteissa. Vesistöjen vedenkorkeuksien ja virtaamien sekä lukuisten muiden koko maata kattavien hydrologisten ilmiöiden seurannoista vastaa Vesientutkimuslaitoksen hydrologian toimisto.

Vesientutkimuslaitos ylläpitää yhteistyössä Valtion tietokonekeskuksen kanssa useita rekistereitä, joihin mm. edellä mainittujen seurantojen tulokset kootaan. Suurimmat rekisterit ja niihin kerättävät tiedot ovat:

Vedenlaatu-rekisteri	—vesistöjen, merialueiden ja pohjavesien fysikaalis-kemialliset ominaisuudet
Ympäristö-myrkkyrekisteri	—sedimenttien ja vesieliöiden sisältämät haitalliset ja myrkylliset aineet
Vedenkorkeus-rekisteri	—vesistöjen päivittäiset vedenkorkeudet
Virtaama-rekisteri	—vesistöjen päivittäiset virtaamat

Vedenlaatu- ja ympäristömyrkkyrekistereihin kerätään seuranta-aineiston lisäksi runsaasti erillistutkimusten tuloksia. Vedenkorkeus- ja virtaamarekistereihin sen sijaan kerätään yksinomaan seurantatutkimusten tuloksia.

Vedenlaatu- ja ympäristömyrkkyrekisterissä tietue (yhtä näytettä koskevat tiedot) sisältää sekä näytettä että havaintopaikkaa koskevia tietoja. Näytettä koskevia tietoja ovat vedenlaaturekisterissä:

- näytteenottopäivämäärä
- näytteenottosyvyys
- määritystulokset

ja ympäristömyrkkyrekisterissä:

- näytteenottopäivämäärä
- näytekoodit (laji ja rinnakkaisnäytteen numero)
- näytteenosa
- pitoisuuden ilmoitustapa
- näytteen säilytystapa
- sukupuoli
- määritystulokset

Havaintopaikkatietoina voidaan vedenlaatu- ja ympäristömyrkkyrekistereihin tallentaa näytteenottopaikan maantieteellisen aseman ilmaisevien tietojen lisäksi myös säätilaa koskevia tietoja.

Vedenkorkeus- ja virtaamarekistereissä tietue koostuu yhden havaintoaseman yhden vuoden tuloksista. Rekisteröitäviä tietoja ovat:

- vesistöalue
- havaintopaikan numero
- vuosi
- kuukausittaiset keskiarvot
- päivittäiset havaintoarvot
- vuoden maksimi- ja minimiarvot
- jäätymisajankohta
- jäitten lähtöajankohta

Vedenkorkeus- ja virtaamatietojen käsittelyssä käytetään vedenkorkeus- ja virtaamarekisterien lisäksi asteikkorekisteriä, joka sisältää tietoja havaintoasemista sekä niiden yläpuolisista valuma-alueista, ja purkautumistaulukkorekisteriä, joka sisältää taulukoituja purkautumiskäyriä.

Rekistereistä voidaan poimia tietoja useiden eri muuttujien rajaamina. Jatkokäsittely voidaan suorittaa kirjasto-ohjelmistoilla tai rekistereitä varten tehdyillä erityisohjelmilla, joiden tulosteista on esimerkkejä kuvissa 3—6.

VEDENKORKEUSASEMA STATION		VUOSI YEAR	KUUKAUSI/MONTH I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
04 01400 VUOKSI	K. ARVO/MEAN	134.1	123	113	100	97	147	181	176	151	133	126	131	132
NURMES	MAX	266	197	169	145	176	262	266	249	212	195	200	213	206
0 = NN +92.06M	MMAX	195	128	117	106	114	173	190	185	162	142	135	137	135
0 = M	MMIN	86	117	107	93	89	113	170	162	140	125	117	125	127
F = 13710KM2, L = 14.3 %	MIN	35	51	45	36	35	50	84	107	95	85	68	64	60
JAKSO/PERIOD 1941–1950	VUOSIA/NO.OF YEARS	10												
04 01400 VUOKSI	K. ARVO/MEAN	144.5	137	125	110	101	147	187	184	168	151	140	143	140
NURMES	MAX	268	215	190	166	140	240	268	260	216	192	186	222	221
0 = NN +92.06M	MMAX	205	144	131	117	113	177	194	192	182	160	148	149	144
0 = M	MMIN	92	130	118	103	96	110	177	174	151	141	132	135	135
F = 13710KM2, L = 14.3 %	MIN	66	104	102	85	78	79	122	115	103	85	74	73	66
JAKSO/PERIOD 1951–1959	VUOSIA/NO.OF YEARS	9												
04 01410 VUOKSI	K. ARVO/MEAN	186.3	175	155	135	124	187	232	230	215	197	189	198	198
PIELINEN, NURMES, LM	MAX	307	240	209	185	191	258	277	287	307	299	283	274	266
0 = NN +91.67M	MMAX	250	186	165	145	139	225	240	237	226	206	198	206	206
0 = N60 +91.85M	MMIN	117	165	145	126	117	138	221	220	204	187	179	189	189
F = 13710KM2, L = 14.3 %	MIN	91	122	119	97	91	109	191	175	150	132	123	134	144
JAKSO/PERIOD 1961–1970	VUOSIA/NO.OF YEARS	10												
04 01500 VUOKSI	K. ARVO/MEAN	156.5	150	136	122	118	174	209	198	169	160	148	151	152
LIEKSA	MAX	297	220	196	170	215	297	296	269	216	183	205	232	232
0 = NN +91.98M	MMAX	223	157	143	129	140	200	217	212	182	158	158	157	155
0 = N60 +92.13M	MMIN	106	143	129	115	110	142	197	183	156	144	139	145	147
F = 13710KM2, L = 14.3 %	MIN	79	91	90	80	79	104	166	162	139	119	100	96	97
JAKSO/PERIOD 1912–1920	VUOSIA	9												
04 01500 VUOKSI	K. ARVO/MEAN	167.5	156	143	127	121	169	222	218	190	168	160	167	167
LIEKSA	MAX	322	226	225	204	197	286	322	322	268	219	212	236	236
0 = NN +91.98M	MMAX	242	163	149	135	134	208	232	230	204	177	171	174	173
0 = N60 +92.13M	MMIN	108	150	135	119	113	132	208	204	177	160	153	160	162
F = 13710KM2, L = 14.3 %	MIN	87	118	108	91	87	103	170	138	125	115	116	121	130
JAKSO/PERIOD 1921–1930	VUOSIA/NO.OF YEARS	10												
04 01500 VUOKSI	K. ARVO/MEAN	162.7	158	144	129	120	168	203	199	178	159	159	167	168
LIEKSA	MAX	286	238	205	175	163	243	276	286	265	218	257	273	265
0 = NN +91.98M	MMAX	220	165	149	137	133	197	210	208	190	169	168	172	173
0 = N60 +92.13M	MMIN	109	150	137	122	116	134	194	188	165	150	149	160	161
F = 13710KM2, L = 14.3%	MIN	89	110	105	96	90	89	142	129	115	104	95	93	109
JAKSO/PERIOD 1931–1940	VUOSIA/NO.OF YEARS	10												
04 01500 VUOKSI	K. ARVO/MEAN	145.1	134	123	111	108	159	192	186	161	143	137	142	143
LIEKSA	MAX	278	209	178	154	189	274	278	257	224	205	212	222	216
0 = NN +91.98M	MMAX	205	139	128	117	125	185	199	195	174	151	145	146	146
0 = N60 +92.13M	MMIN	97	128	117	104	100	125	182	174	150	137	131	136	139
F = 13710KM2, L = 14.3 %	MIN	48	63	55	49	48	56	98	117	106	100	81	74	70
JAKSO/PERIOD 1941–1950	VUOSIA/NO.OF YEARS	10												

Fig. 5. A line printer output showing extreme and mean values of daily water stage.

KESÄKUIVAKAUDEN KESKIVIRTAAMAN NQ1–NQ120 TOISTUMISAIKA TR. 1.6.–30.11.
RETURN PERIOD TR OF DRY SPELL MEAN DISCHARGE NQ1–NQ120. JUNE 1 TO NOV. 30.

65 1700 KEMIJOKI KEMIHAARA, KUMMANIVA F = 8715KM2 L = 0.7 % 1921–1973

	TR VUOTTA	NQ1 M3/S	PVM/DATE V KK PV	NQ5 M3/S	ALKU/FROM V KK PV	NQ30 M3/S	ALKU/FROM V KK PV	NQ60 M3/S	ALKU/FROM V KK PV	NQ90 M3/S	ALKU/FROM V K PV	NQ120 M3/S	ALKU/FROM V KK PV
1	41.00	20.00	1960.11.18	20.00	1960.11.18	20.86	1960.11.01	31.75	1960.10.02	41.15	1942.06.24	45.19	1973.08.03
2	20.50	30.00	1921.11.21	33.00	1942.07.23	34.30	1973.11.01	38.23	1930.07.04	41.74	1973.09.02	48.16	1930.06.14
3	13.66	33.00	1942.07.23	33.00	1973.11.24	34.70	1942.07.17	38.25	1942.07.07	42.27	1960.09.02	48.89	1960.08.03
4.	10.25	33.00	1959.07.27	33.80	1941.11.26	37.13	1930.07.19	38.30	1973.10.02	43.44	1930.06.16	52.35	1942.06.09
5	8.20	33.00	1941.11.30	34.80	1956.11.26	37.66	1941.11.01	47.36	1933.08.18	50.73	1933.07.23	53.67	1933.07.25
6	6.83	33.00	1973.11.24	35.00	1959.07.25	43.03	1956.11.01	48.06	1941.10.02	53.41	1922.09.02	56.05	1922.08.03
7	5.85	34.00	1956.11.29	36.00	1930.07.26	45.00	1933.09.11	48.53	1929.06.27	57.53	1941.09.02	58.79	1956.08.03
8	5.12	36.00	1930.07.26	36.00	1921.11.17	45.16	1929.07.26	49.63	1937.07.13	57.65	1924.07.25	61.25	1924.07.27
9	4.55	39.00	1936.07.11	42.20	1927.11.26	45.90	1937.08.03	52.71	1924.07.18	57.97	1956.07.03	62.71	1937.07.09
10	4.10	41.00	1927.11.30	43.20	1936.06.30	46.93	1924.08.07	53.21	1922.10.02	58.50	1939.08.24	63.90	1939.08.03
11	3.72	43.00	1934.08.08	43.40	1926.07.29	47.93	1927.11.01	54.65	1959.06.26	58.91	1937.06.14	65.88	1941.08.03
12	3.41	43.00	1922.11.29	43.60	1933.08.19	48.10	1922.11.01	56.33	1956.07.20	62.98	1929.07.02	68.10	1929.06.25
13	3.15	43.00	1926.07.31	43.60	1922.11.26	48.53	1936.06.18	57.68	1939.10.02	63.17	1934.07.26	68.31	1934.07.29
14.	2.92	43.00	1933.09.22	44.00	1929.08.19	50.56	1959.07.02	59.40	1927.07.04	65.34	1959.06.01	68.50	1927.08.03
15	2.73	44.00	1924.08.07	44.20	1934.08.06	50.86	1968.11.01	62.45	1934.07.28	67.60	1927.06.30	76.75	1959.06.15
16	2.56	44.00	1929.08.19	44.40	1924.08.05	51.20	1926.07.06	65.30	1969.07.05	69.48	1935.07.04	79.22	1936.06.15
17	2.41	45.00	1935.07.21	45.00	1935.07.21	51.56	1935.07.13	65.91	1925.10.02	71.37	1969.06.30	79.23	1969.07.26
18	2.27	45.00	1925.11.29	45.60	1937.08.22	52.50	1939.10.19	68.48	1935.07.12	73.53	1958.08.03	80.29	1968.08.03
19	2.15	45.00	1968.11.29	45.80	1968.11.26	53.66	1925.11.01	70.06	1958.08.13	77.10	1968.09.02	80.60	1958.08.03
20	2.05	45.00	1937.08.08	45.80	1925.11.26	54.26	1969.08.01	71.20	1936.06.02	81.50	1936.06.06	84.73	1935.06.30
21	1.95	46.00	1928.11.30	48.00	1928.11.26	56.33	1934.09.13	71.40	1923.07.07	82.85	1925.09.12	86.44	1926.07.18
22	1.86	47.00	1923.08.18	48.80	1969.08.16	56.86	1940.06.26	72.61	1926.07.16	83.04	1938.06.19	89.40	1925.08.03
23	1.78	47.00	1931.07.31	49.00	1923.08.15	59.26	1921.11.01	72.71	1968.10.02	84.87	1928.09.02	90.30	1921.08.03
24	1.70	48.00	1970.11.29	49.20	1970.11.26	59.56	1923.08.04	72.80	1940.06.03	84.91	1926.07.13	93.64	1938.06.26
25	1.64	48.00	1969.08.18	50.00	1939.11.08	61.13	1970.11.01	72.83	1928.10.02	85.85	1921.09.02	94.22	1928.08.03
26	1.57	50.00	1939.11.08	51.80	1931.07.29	66.66	1972.07.27	75.16	1938.07.18	87.34	1923.07.02	98.23	1971.08.03
27	1.51	51.00	1932.11.28	52.40	1932.11.26	67.50	1928.11.01	81.85	1921.09.30	93.02	1931.09.02	101.64	1923.07.09
28	1.46	53.00	1940.07.14	53.20	1940.07.13	71.06	1971.11.01	86.63	1931.09.13	94.21	1972.06.22	115.34	1972.06.19
29	1.41	53.00	1958.08.28	56.40	1958.08.24	71.06	1971.11.01	86.63	1931.09.13	94.21	1972.06.22	114.35	1972.07.30
30	1.36	56.00	1972.08.23	57.80	1964.07.26	72.70	1938.07.24	87.48	1971.10.02	99.11	1940.06.11	115.76	1967.06.18
31	1.32	56.00	1964.07.29	58.00	1972.08.20	73.03	1957.07.16	91.50	1964.06.26	102.91	1970.06.15	118.90	1963.06.01
32	1.28	59.00	1971.07.12	60.20	1971.07.09	74.26	1931.10.17	94.58	1970.07.11	106.30	1963.06.01	123.95	1970.08.03
33	1.24	60.00	1938.08.16	61.40	1938.08.14	77.86	1943.06.23	96.71	1963.06.30	113.06	1967.07.18	125.03	1955.08.03
34	1.20	62.00	1957.07.30	62.20	1957.07.29	78.06	1932.11.01	99.91	1943.06.10	123.45	1964.06.13	129.96	1966.08.03
35	1.17	64.00	1963.07.11	64.20	1963.08.13	78.40	1963.07.30	107.13	1967.08.16	130.11	1943.06.11	133.38	1931.07.18
36	1.13	64.00	1943.07.01	64.80	1943.06.29	78.96	1964.07.07	109.60	1957.07.12	132.84	1966.09.22	144.39	1957.06.27
37	1.10	69.00	1966.11.30	71.20	1966.11.26	81.06	1966.11.01	115.20	1955.10.02	134.22	1957.07.12	150.50	1932.08.03
38	1.07	70.00	1955.08.27	71.80	1955.11.26	88.00	1955.08.06	116.75	1966.10.02	134.96	1955.08.03	150.78	1964.06.27
39	1.05	74.00	1965.11.30	75.80	1965.11.26	93.03	1967.09.14	121.48	1965.10.02	135.33	1965.09.02	151.89	1943.06.12
40	1.02	82.00	1967.09.21	83.60	1967.09.19	115.40	1965.11.01	137.03	1932.07.27	148.28	1932.09.02	158.87	1965.08.03

Fig. 6. A line printer output showing the return period of dry spell mean discharge for the periods June 1 to Nov. 30 in 1921–1973.