Water Management in Helsinki

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Helsinki is located on the northern shore of the Gulf of Finland. The main water systems in the area are the Gulf of Finland and River Vantaa, which runs through the city and into the sea at Helsinki.

Water supply

Helsinki Water (Helsingin Vesi) has been responsible for the water supply and sewerage of the greater Helsinki area for more than 120 years. Helsinki Water is a municipal business enterprise owned by the City of Helsinki /2 /.
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Source of I **Map 2 Sources of Raw water**

Raw water is led via a 120-kilometer-long rock tunnel (Table 1.) from Lake Päijänne. Lake Hiidenvesi acts as a backup system. As raw water is taken from a depth of 26 meters at a distance of 350 meters from the shore, the temperature of the water remains stable. This has a positive effect on the quality of the water and on the condition of the water tunnel.

Annually over 70 million cubic metres of water are drawn from Lake Päijänne. As this amount is only one per cent of its natural discharge, it has no harmful effect on the lake.

Because the lake is located on a higher altitude, gravity helps the water flow in the tunnel. At the midpoint of the tunnel, the Kalliomäki power plant turns the excess flow energy into electric power as a form of eco-energy. /4/.

Table 1.Technical information about the Päijänne tunnel /5/.

Length	120 km
Cross-section area	13.5 - 18 m^2
Volume	2 million m^3
Capacity without pumping	10 m^3/s
Capacity with pumping	20 m^3/s
Rate of use	25 %
Altitude difference between the start and the end of the tunnel	36 m
Power production	830 kW

In the 1997 a portion of the tunnel collapsed, and a bypass tunnel 150 in length was constructed to repair the damages.

Water treatment

Raw water is i and in Vanhakaupunki.

Map 3. Water Distribution system

The water ur The alkalinity is raised through the addition of carbon dioxide and the pH value is regulated with lime water so that it remains constant at pH 8.5. This is followed by humus precipitation with aluminium sulfate. The sludge is directed to the wastewater treatment plant. Ozone kills micro-organisms in the water and improves the odour and taste of the water. As a last step, the water treated with chlorine-amine in order to preserve its purity on its way to the consumer /3/. The newest part of the process is activated carbon filtration which was taken in use in 1998 improving further the quality of drinking water /3/.

The consumption of the water in Helsinki has decreased about 40 % during past 20 years and the retention time in the pipes has almost doubled. This has caused some bacterial growth in the network. Activated carbon filtration has solved this problem by removing

organic matter and decreasing the activity of bacteria in the water, so that today the water quality remains good in the pipes. This treatment has made it possible to decrease the use of chemicals, for example of chlorine, by almost half /2 /. Helsinki tap water meets the quality standards of Finland and the EU.

Table 2. Consumption of chemicals in the water treatment plants 1998 / 2 /.

Consumption of chemicals in the Helsinki water treatment plants 1998				
	Pitkäkoski		Vanhakaupunki	
Amount of chemicals	Total	Average g/m^3	Total	Average g/m3
Aluminium sulphate	1307	31.3	1172	32
Lime	1207	29	971	26.5
Carbon dioxide	977	23.4	725	19.8
Sodium hypochlorite,100% Cl_2	26.2	0.7	12.1	0.3
Ammonia,100% NH_3	7.7	0.2	3.9	0.1

Water network

The total length of water pipeline network in the City of Helsinki is about 1100 km (1998), and about 120 km of those are large (DN 600 – 1000 mm) main pipelines (Map 3). The most important main water pipelines are built inside the bedrock at depths ranging between 30-80 meters. Owing to the stability of the conditions it is possible to monitor the condition of the pipelines. 80 % of the pipeline network is cast iron. Coated with bitumen outside and with concrete interiors these pipes can effectively resist corrosion under the conditions that prevail in Helsinki. The smaller pipelines are plastic or steel /6/.

There are six water reservoirs in Helsinki with a total volume of 101,000 m^3, which is about 70 % of daily consumption. The role of the reservoirs is to maintain stable pressure, to store water for emergencies, to optimise pumping and regulate consumption

peaks. The water towers and the most important pressurising stations and gridiron valves are remote-controlled.

Fire fighting has also been taken into consideration when building the pipeline network. The network is constructed to ensure water under all circumstances. There are about 7000 fire hydrants within the network.

In the 1998 there was 144 leaks of street water pipelines, which is 8 % less than in the 1997. The 1998 figures correspond to one leak per 7.5 km of street pipeline.

Water consumption

Figure 1. Materials of the pipeline network /6/.

Water consumption in Helsinki has decreased about 40% in the past 20 years.
In 1998 the average consumption of drinking water in Helsinki was about 190 liters per day. About one third of the treated water is sold to neighboring municipalities. The City of Vantaa buys over 90 % of its drinking water and the city of Espoo about 60 % from Helsinki. Losses caused by leaks, damage to the network and free distribution were approximately 11 %. /7 /. Water rates in Helsinki are shown in Table 3.

Figure 3. Distribution of water consumption in households 1998

Figure 2. Distribution of water

Table 3. Water charges /8/.

	Basic charge	VAT 22 %	Total charge
Water	FIM 2.25/m3	FIM 0.49/m3	FIM 2.74/m3
Sewage	FIM 6.52/m3	FIM 1.43/m3	FIM 7.95/m3
Total	FIM 8.77/m3	FIM 1.92/m3	FIM 10.69/m3 (+ basic charge)

Figure 5. Amounts of wastewater

Figure 4. Length of sewerage network

Sewerage system

Sewer network

The total length of the sewer network in 1998 was 1760 km. There are two sewerage systems. In the combined sewerage system the waste and rainwater is led through the same sewer to the treatment plant. In Helsinki about 14% of the sewers are part of the combined system. In separate sewer systems, only wastewater is led to the treatment plants and the rainwater is returned to the waterways. 770 km of the total length of the sewer network is wastewater sewers, 737 km rainwater sewers and 253 km combined sewers. At the end of 1998 there were 112 wastewater pump stations /2/.

Wastewater treatment

In the 1970s there were 11 wastewater treatment plants in Helsinki.
A completely new era of wastewater treatment began when a new wastewater treatment plant started operating in 1994 in Viikinmäki. This treatment plant ensures wastewater treatment in the future for the almost one million inhabitants of the

metropolitan area. The Viikinmäki wastewater treatment plant will also treat wastewater from Vantaa, Kerava, Tuusula and Sipoo. The City of Espoo has its own wastewater treatment plant in Suomenoja. The Viikinmäki plant is one of Finland's most significant recent environmental projects.

The Viikinmäki wastewater treatment plant uses an activated sludge process. The treatment process includes three stages: mechanical, biological and chemical treatment. In the mechanical treatment suspended solids are separated from the wastewater with screens and sedimentation.

The biological activated sludge process removes fine organic matter. Excess sludge is removed from the system. Introduction of nitrogen removal has added a nitrification-denitrification process, in which nitrogen is transformed into gaseous form. Phosphorus is removed by ferrous sulphate precipitation.

All sludge separated from the process is digested in a temperature of 36-37 °C. This process lasts about three weeks, after which the sludge is hygienic enough for further treatment. It is dewatered and composted. The gas produced in the process (about 65 % methane and rest CO_2) is converted to energy for use in the wastewater treatment plant. This feature permits the plant to be totally self-sufficient in producing its own heat and 65 % of its need of electrical power /9/.

In the Viikinmäki wastewater treatment plant 95% of the solid substances and other materials which consume oxygen and phosphorus are removed. Since the beginning of 1998 nitrogen removal was improved to 50%.

The goals set for wastewater treatment have been successfully met in Helsinki. During the past ten years the loading of phosphorus into the sea has been reduced to a third and the organic load to less than a half.

Figure 7. Sludge treatment

Figure 6. Wastewater treatment

Recipient

All the treated effluent is conducted through a 17-km-long rock tunnel into the sea, at Katajaluoto, 8 km off the coast of Helsinki . Thanks to that tunnel, the quality of the shore water near Helsinki has improved since the 1980s and because of effective wastewater treatment the situation is still improving.

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