

# *Water: a Matter of Life*

Long-term strategic thinking in water services



Petri S. Juuti, Tapio S. Katko & Riikka P. Rajala

# Water: a Matter of Life

Petri S. Juuti, Tapio S. Katko & Riikka P. Rajala (eds.)

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### Keywords:

Water supply and sanitation, sewerage, evolution, water services, environmental history, history of technology, public-private cooperation, local governments, strategic thinking, decision-making, path dependence, water policy, futures research

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# Foreword

This book is about the provision of water and wastewater services, which is a crucial issue for public health and the environment around the world. As the editors explain, declarations of the United Nations have raised the profile of water services and made nations more aware of needed actions at home and in other regions. These declarations are timely because with increases in world population and water-related disasters, our shared dependence on safe and effective water services has never been greater.

Teams at the University of Tampere and Tampere University of Technology have prepared this volume about the policies and management practices of water and wastewater services that have made water governance in Finland a model for others to follow. The book includes papers about how these services evolved in Finland, how they compare with those in selected countries, and how management trends such as privatization are affecting them.

As the editors point out, water-related services in Finland are in good condition relative to those of developing countries. In fact, Finland's services are rated near the top in the world in the fields of water and the environment. However, even a relatively secure country like Finland can have difficulty with vulnerable infrastructure, as was shown recently by contamination of the water supply in the City of Nokia. This difficulty with operations and maintenance functions has been mirrored by similar incidents in the US and underscores the importance of vigilance in water management.

Occasional problems like this in advanced countries do not compare in severity with the difficulties faced by people in many countries who lack even basic access to safe water and sanitation. While technical and financial problems are important in these countries, the most significant problems are institutional, and experiences of Finland and other advanced countries often have limited applicability in some nations where human rights and access to basic services are formidable challenges.

Even advanced countries face significant water management challenges. For example, in the US, polls show that water and wastewater utilities are concerned about regulatory factors, source water supply and protection, business factors, infrastructure, and their graying workforces. Maintaining current levels of service in the face of these challenges will require significant management improvements, particularly among the thousands of small utilities here. Countries like Finland, with stable but aging populations, will lose tacit and explicit knowledge about how

to manage their complex systems. Most middle income countries do not lack population but are faced with financial and human resources challenges, as well as developing effective public services in their rapidly-growing cities.

While the global water industry often seems slow to change, its future promises important developments in delivery of water services. As the industry evolves, important changes will occur in public concern for about health and the environment; in adoption of new technologies; in water treatment and monitoring; in infrastructure; and in utility business models. The industry's workforce must adapt to these changes at the same time that it renews itself amidst a wave of baby-boomer retirements. Due to its importance and ability to adapt, the water services industry will continue as an important component of national public services and will provide interesting and stable opportunities for its participants.

Neil S. Grigg

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# Introduction: Evolution and futures of water management: strategic decisions, challenges and effectiveness

## BACKGROUND, SIGNIFICANCE AND MAJOR CONTENTS OF THE BOOK

Water is a matter of life. At its 58th session, the United Nations General Assembly adopted a draft resolution, without a vote, proclaiming 2005 to 2015 as the International Decade for Action – Water for Life. This recommendation, which came at the close of the International Year of Freshwater 2003, called for a greater focus on water-related issues and for actions to ensure the participation of women in water-related development efforts. It also recommitted countries to achieving the water-related goals of the 2000 Millennium Declaration, the 2002 Johannesburg Plan of Implementation and Agenda 21.

*The goal is to halve by 2015 the proportion of people unable to reach or afford safe drinking water who also lack access to basic sanitation. We, the editors, think that the goal is justified on many grounds although it is unlikely to be achieved as such.*

The Decade is to focus on water-related issues at various levels and on the implementation of programmes and projects, and the furtherance of cooperation on all levels, in order to help achieve the internationally agreed water-related goals. The goal is to halve by 2015 the proportion of people unable to reach or afford safe drinking water who also lack access to basic sanitation. ([www.gdrc.org/uem/water/decade\\_05-15/index.html](http://www.gdrc.org/uem/water/decade_05-15/index.html)) We, the editors, think that the goal is justified on many grounds although it is unlikely to be achieved as such. Yet, we remain hopeful that the goal will for its part help provide the necessary water and sanitation to as many people in the global village as possible.

This is the second time that water issues have been highlighted as part of a UN Decade. The UN declared 1981-1990 as the International Drinking Water Supply and Sanitation Decade with the aim of providing safe drinking water and adequate sanitation systems for all people by 1991. The official start of the 'Water for Life' Decade was on World Water Day, 22 March 2005. ([www.gdrc.org/uem/water/decade\\_05-15/index.htm](http://www.gdrc.org/uem/water/decade_05-15/index.htm))

In Finland water-related issues are now in good order. It is true that the relatively large water resources and small population of Finland favour the provision of water services in comparison to many other countries. On the other hand, the large number of dispersed settlements is a challenge. Yet, abundant water resources are

not the determining factor behind Finland's success in several international water and environment-related comparisons since they also take into account many other factors besides natural conditions. Issues related to the governance of water services have also been considered – they also constitute the special emphasis of this book and the related research project “Evolution and futures of water management: strategic decisions, challenges and effectiveness (EFWAM)”.

The first section of the book, *Local development*, consists of the following five articles:

Juuti P.S. & Katko T.S. & Rajala R.P. & Seppälä O.T. 2007. Evolution of water and sewerage services in Hämeenlinna, Finland, 1800–2000.

Juuti P.S. & Rajala R.P. 2007. Water Services in Espoo from the 1930s to the 2000s – Rapid Population Growth Poses a Challenge.

Juuti P.S. & Rajala R.P. 2007. The Rivers of Vantaa.

Katko T.S. 2007. Water – Our Common Cause! The Tuusula Region Joint Municipal Authority for Water Supply 1967-2007.

Juuti P.S., Katko T.S. & Nygård H.V. 2006. Local conditions need local solutions: Water and Sanitation Services in Vaasa, Finland from the 1700s to 2005.

Several international comparisons have rated Finland among the top, or as the top country, in the world in the field of water and the environment. The comparisons include the “water quality index” ([www.unesco.org/water/wwap](http://www.unesco.org/water/wwap)) which emphasises water pollution control and quality, the “water poverty index” ([www.nwl.ac.uk/research/WPI](http://www.nwl.ac.uk/research/WPI)) focusing on the availability and management of water resources, the “transparency index” ([www.gwdg.de/~uwvw/icr.htm](http://www.gwdg.de/~uwvw/icr.htm)) indicating transparency and level of corruption, the “environmental sustainability index” measuring environmental protection and sustainability ([www.ciesin.columbia.edu/indicators/ESI](http://www.ciesin.columbia.edu/indicators/ESI)) as well as the European comparison of water pollution control called “name, shame and fame” ([www.europa.eu.int/comm./environment/nsf/index.htm](http://www.europa.eu.int/comm./environment/nsf/index.htm)).

For instance, according to the Water Poverty Index (WPI) published in 2002, Finland was the highest-ranking country with a WPI of 77.9 points. The WPI evaluated performance in the following five categories: resources, access, capacity, use and environmental impact (Lawrence et al 2002). Even though the Finnish institutional arrangements may not be replicable as such, they present an example of an enabling environment for successful water governance (Hukka et al 2006).

Another example of international interest towards Finnish development is the annual development report of the World Bank (2005) which monitors social equality and its development. Finland's contribution to the report consisted of a study on factors that enabled the quick progress of Finland into an egalitarian welfare state. Similar interest has also been shown by OECD and the American



Society of Civil Engineers (Heikkilä 2005). Finnish comprehensive education has also received top marks in PISA assessments ([www.oph.fi/english/SubPage.asp?path=447,65535](http://www.oph.fi/english/SubPage.asp?path=447,65535)).

Yet, during the compilation of this book we Finns received a reminder of how vulnerable our infrastructure can be. Although lives were not directly lost as a result of the contamination of the water supply in the City of Nokia, all the other consequences were really troublesome for the whole community. The incident proved again that all technical systems linked closely to the environment are subject to errors of various types, particularly in operation and management.

An analysis of the long-term experiences and futures of the water sector has not yet been made. There is reason to believe that such a study would improve understanding and produce research-based knowledge. Research on the development and strategies of Finnish water supply and sanitation would be relevant since the country's development in that sector was among the fastest after WW II. Besides, the tacit knowledge of the experts involved in the development is still available for analysis.

The first article by Juuti, Katko, Rajala & Seppälä describes the evolution of water and sewerage services in Hämeenlinna, Finland in 1800–2000. According to the authors, development was quite steady there even though the launching and planning phases were exceptional for Finland. There was even opposition to the construction of the waterworks which never occurred elsewhere in the country.

The focus of the next article by Juuti & Rajala is on the development of the second biggest and fastest growing city of Finland, Espoo. The history of the water supply and sanitation of that city is quite colourful. The authors write that there have been several crises but all major problems have been solved by now. It was interesting to learn how the present state of affairs was achieved.

The third article by Juuti & Rajala looks at the historical phases of Vantaa, another city bordering on the Capital, Helsinki and its historical progress towards sustainable development and a modern infrastructure. The tacit knowledge of the experts involved in the development of the water sector was of particular interest.

The fourth article by Katko focuses on the Tuusula Region Joint Municipal Authority for Water Supply (TSV) and its evolution over 40 years. Currently the authority operates as a bulk water supplier to four municipalities. Decision making at TSV is and has been democratic and the authority has been managed for the common good. As common in Finland, TSV has purchased design and contracting services, equipment as well as other services from the private sector on a competitive basis.

In the final article of section one, Juuti, Katko & Nygård analyse the evolution of water services in Vaasa, on the western coast of Finland. Prior to the launching of the actual planning of the water works, the foremost experts in Europe were

engaged to assess the groundwater resources, reasonableness of the preliminary plans and implementation possibilities. The unique natural conditions of the coast of the Gulf of Bothnia – like the continuous land rise, limited quantity and poor quality of ground water resources and reliance on the Kyrönjoki River – will remain challenges to the utility also in future.

The second section of the book, *National and regional development*, consists of four articles. In historical perspectives water management, both services and resources, is substantially a local issue. Some of the strategic decisions have proved to have a long-term impact and, thus, to create strong path dependence – negative or positive. In several cases the decisions have been made in an unhistorical context. The following articles are included:

Juuti P.S, Katko T.S. & Hukka J.J. 2006. Revisiting Private Water Proposals and Concessions of the 1870-80s in Finland.

Katko T.S, Juuti P.S. & Pietilä P.E. 2006. Key long-term decisions and principles in water services management in Finland, 1860-2003.

Juuti P.S. & Mäki H.R. A Brief History of Water Supply in Finland and South Africa – two case studies.

Katko T.S. & Juuti P.S. Evolution of water services in 29 European cities from 1800 to 2004.

The first article of the section by Juuti, Katko & Hukka introduces several private proposals and concessions granted for establishing waterworks in Tampere and Helsinki, Finland in the late 1800s, as well as their consequences. The paper refers to decisions, arguments and policies that largely resemble those presented over one hundred years later, in the 1990s, when privatisation was again promoted by international financial bodies. However, the objective of this paper is not to compare the economic or other performance of various undertakings but to question the ethics and feasibility of selling and reselling the concessions for water services or ownership of water undertakings.

The second article by Katko, Juuti & Pietilä describes the key long-term strategic decisions related to the evolution of water services in Finland from the 1860s to 2003. The study was conducted in two phases: the first one entailed a literature survey which identified 44 key decisions while the second one ranked 24 decisions viewed as the most important ones by 13 senior national experts. According to the experts, decisions concerning water legislation were most important. Indirectly the paper also shows the continuous changes in water use purposes and their priorities over time. Although future options may seem abundant, the potential development paths are largely restricted by historical strategic decisions.

The third article by Juuti & Mäki discusses water supply development in South Africa and Finland from the late 19th to the early 20th century. The focus is on one South African town, Durban and one Finnish town, Porvoo. The specific subjects

of study are the development of water supply, water use and sanitation services, patterns of governance, access to clean water and proper sanitation in different areas of cities and used technical solutions.

The fourth paper by Katko and Juuti compares the evolution of water and sewerage services in 29 European cities in 13 countries over the last 150 years. The diverse roles of local governments in Europe largely explain the water services management systems applied. The demand for water services has been created by various factors based on local conditions.

*The first known Greek philosophical thinkers and medical writers also recognised the importance of water for the health of people.*

The third section of the book expands to *Global development*. Water is life, and all life on earth is linked to water. Our existence is dependent on water or its scarcity in many ways, and we could say that all human culture and civilization is built on the use of water. The experience of humankind from the very beginning testifies to the importance of pure groundwater as a water source. The way in which water supply and sanitation was organised was essential for early agricultural societies. If wells and toilets were in good shape, health problems and environmental

risks could be avoided. The importance of pure water for people was emphasised already in the myths of ancient cultures. Religious cleanliness and water were also valued by various ancient cults. The first known Greek philosophical thinkers and medical writers also recognised the importance of water for the health of people. The following three articles describe the developments from the earliest times to the present:

Pietilä P.E. & Katko T.S. Ontology of water services.

Hukka J.J., Juuti P.S., Katko T.S. & Seppälä O.T. 2006. Many Ps needed for sustainable water services – expansion of the scope of public-private partnerships.

Vuorinen H.S., Juuti P.S. & Katko T.S. 2007. Water and Health – From Ancient Civilizations to Modern Times.

The first article by Pietilä and Katko describes and discusses the special features of water services compared with other commodities. They satisfy a basic need and are a prerequisite for all economic activity, a natural monopoly, and highly susceptible to local conditions. This paper further analyses the multifaceted nature of water services using the PESTEL (political, economic, socio-cultural, technical, environmental/ecological, and legal) framework.

The second article by Hukka, Juuti, Katko & Seppälä discusses public-private partnerships (PPPs) which are promoted particularly by international financial bodies. The paper argues that the scope of PPPs, which now includes only private operators, should be expanded. The paper proposes a long list of policies, principles and practices for viable and sustainable water and sanitation services. They must be assessed in a long-term perspective rather than in a historical vacuum.

The last article of the book is written by Vuorinen, Juuti & Katko. It presents the general outline and some of the main results of two multi- and cross-disciplinary projects, the GOWLOP project and the Environmental History of Water project by Petri S. Juuti, Tapio S. Katko, and Heikki S. Vuorinen. Special emphasis is given to the initial urbanisation of ancient civilisations with a focus on ancient Greece and Rome.

## **OBJECTIVES AND METHODS OF THE EFWAM PROJECT**

*The aim of this EFWAM research project was to explore thoroughly what kinds of policies, strategies, principles and practices have contributed to the water sector development and the high quality of services and effective governance. Later, a study will be conducted to show how Finland can further develop its water sector and acquire essentially higher international visibility in the sector.* The project examined the long-term *principles and strategic choices* of Finnish water supply and sewerage providers and the related water resource-related issues that are responsible, at least according to international comparisons, for the high quality of services and governance. Special emphasis was on the principles of sustainable development and the citizen's viewpoint.

The project looked mainly at community water supply and sanitation and water pollution control by communities, while industrial and agricultural needs were just touched on. Water supply and sewerage was studied on the levels of: regional systems, works of municipalities and population centres, smaller water associations, on-site solutions, and the interrelationships between them.

The key research questions of the EFWAM project were:

- (i) What are the key strategic decisions and choices in Finnish water supply and sewerage and impacts have they had?
- (ii) Which key long-term operating principles cannot be explained by individual decisions but rather as slowly accumulated practices?
- (iii) How do the views of different parties on the above-mentioned key strategic decisions and operating principles differ and why?
- (iv) What were the so-called weak signals of the past that later became operating principles or strategic guidelines?
- (v) In what respects have the strategic decisions and operating principles of Finnish and Swedish water supply and sewerage been similar and what are the major differences?
- (vi) To what extent did the so-called overall water resources planning of the 1970s and '80s affect water supply and water pollution control, and what are the lessons for the Integrated Water Resources Management (IWRM) of the 21st century?

(vii) How has Finnish water legislation developed and taken various water uses into account, especially in community water supply and water pollution control, compared to other countries?

(viii) What will the future operating environment of Finnish water supply and sewerage look like (10–20 years hence), how has it developed, and how can foreseeable challenges be met strategically in the long term?

(ix) What challenges will the expected climatic change pose especially to water utilities and their operation?

(x) What actions does the water sector as a whole have to undertake in order to renew itself in a controlled fashion and to gain essentially higher visibility and impact internationally across the board?

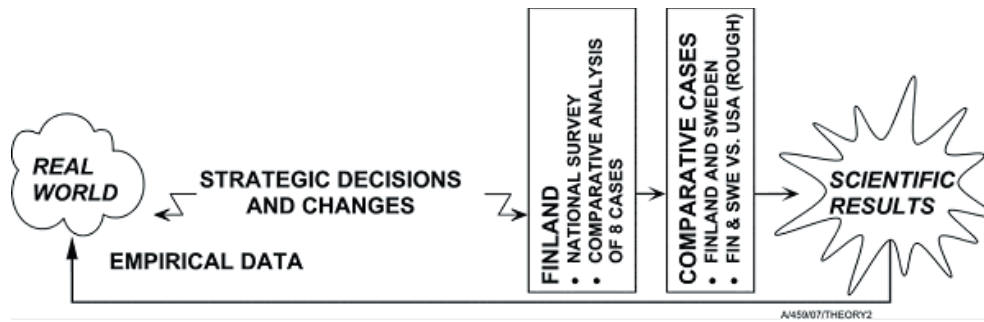
*Water: a Matter of Life* does not try to answer all of the above questions. Instead we focus on the key strategic decisions and operational principles.

## **HYPOTHESES, APPROACH AND THEORETICAL BASE, AND METHODS**

Past decisions concerning water supply and sanitation systems may have longer term impacts than generally realised. The potential and available development paths, or future options, are constrained by path dependencies that may have positive or negative impacts. Decision-making and future activities certainly require identifying such limitations. It is obvious that some of these decisions are largely hidden or their impact is hardly visible. In any case, the deterministic view of development is not applicable in this study. Besides, it seems that certain episodes may rather be continuing chains of decisions.

The history of technology, social development, water management, and futures research approaches are clearly interconnected. Especially in history of technology research, the role of theories and models has been more prominent than in other more socially-oriented historical research. A partial objective of this project was to explore the applicability of various research theories to analysing empirical sources. The applicability of these theories will later be tested through methodological triangulation.

The overall approach of the study is shown in Figure 1. Empirical data from the real world was collected through literature surveys and, especially, through semi-structured theme interviews of sector experts. The latter were conducted as part of the several projects that explored the evolution of water and wastewater utilities over the long-term in Finland. The total number of interviews of representatives of the case cities presented in the first section of the book was as high as 100 (Hämeenlinna 26, Espoo 17, Vantaa 14, Tuusula 15, Vaasa 28). It has often been noted (Stähle et al. 2003) that documented, available information often constitutes only a fraction of the information on a sector, organisation or expert while the bulk is undocumented so-called *tacit knowledge*. This survey also aimed to collect such undocumented knowledge through the interviews described above.



**Figure. 1** Research approach: connections between empirical data of the case studies and national survey of Finland, strategic decisions and changes, and some tentative comparative findings on Sweden.

In “Water: a Matter of Life” we used primarily the New Institutional Economics Approach. The Nobel Prize Laureate Douglass C. North (1990, p. 3-4), a driving force behind the approach, defines institutional development as follows: “institutions are the rules of the game in a society, or the humanly devised constraints that shape human interaction” while “organisations are groups of individuals bound to some common purpose to achieve objectives”. Using the analogy of soccer, institutions are the rules of the game while organisations are the players (North 1990, p. 3).

In addition, a rough analytical *comparative analysis* of the strategic long-term decisions and operating principles of the Swedish and Finnish water sectors was made, including a one-week mission to Sweden to interview ten highly knowledgeable experts in August 2007. Some of the tentative findings are included in the final analysis.

In a later phase of the EFWAM project the findings on the Finnish cases will be explored based on various theories on technology development and history of technology. Furthermore, we hope to expand the study to comparative studies on the key strategic decisions on WSS services at the national level in Finland, Sweden and the United States.

## EDITORS IN ALPHABETICAL ORDER

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as well as for the business world. His major area of interest is environmental history, especially the urban environment, city-service development, water supply and sanitation, urban technology, pollution, and public policy. His interests also cover development studies, social and economic history and political history. He is the author or co-author of 15 scientific books and some 15 peer reviewed papers. His latest books are Brief History of Wells and Toilets (2005), Water, Time and European Cities (2005, with Tapio Katko), and Environmental History of Water - Global views on community water supply and sanitation. IWA Publishing, London, 2007 (eds. Juuti P.S., Katko T.S. & Vuorinen H.S.). He has also received the national writers' award.

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This book and research are also an integral part of the work of the Capacity Development in Water and Environmental Services –team (CADWES; www.cadwes.org) at Tampere University of Technology and the International Environmental History Group (IEHG; www.envhist.org) at the Dept. of History, University of Tampere. The aim of the former is to produce useful information about the institutional development of water services and water resources in a broad sense based on inter- and multidisciplinary research: about organisations, administration, legislation, and operating policy including official and unofficial rules. The latter team concentrates on environmental history while many synergies exist between the activities of the two teams.

*Water is both  
a global and a  
local issue...*



Water is both a global and a local issue in many respects. We hope that the following articles will further illuminate this fact. By publishing the papers as a book, we also aim to disseminate the results to promote the thinking that sustainable governance

of water and sanitation systems requires long-term analysis and strategic thinking where pasts and futures influence each other.

### **ACKNOWLEDGEMENTS**

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**Tampere, December 6<sup>th</sup>, 2007, the 90<sup>th</sup> Anniversary of the Republic of Finland**

### **Authors**

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# PART 1

## Local Development

*“Water links us to our neighbor in a way more profound  
and complex than any other.”*

John Thorson



**Figure.** Water tower in Espoo, Finland. (Photo: T. Katko 2005)



# Evolution of Water and Sewerage Services in Hämeenlinna, Finland, 1800-2000

Petri S. Juuti & Tapio S. Katko & Riikka P. Rajala & Osmo T. Seppälä

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## ABSTRACT

This paper aims at discussing key long-term strategic decisions and changes concerning the evolution of water and sanitation services in Hämeenlinna, Southern Finland. After a debate of three decades the construction of the water and sewage works was completed in 1910. In the early 19th century the hygienic conditions in Hämeenlinna were poor since the city was densely built-up and “half marshland, half surrounded by lakes with muddy shores where water flowed so slowly that it appeared to stand still”. Groundwater from the Ahvenisto esker area instead of a lake was selected as the raw water source. Water consumption increased rapidly in the 1950s and a surface water plant on Lake Katuma was constructed in 1955, doubled in 1960 but taken out of use 1980. Since 1976 artificial groundwater has been used. The Paroinen wastewater treatment plant began its operations in 1966 as an activated sludge plant. In addition to Hämeenlinna’s own wastewaters, the Paroinen plant has also purified the wastewaters of Hattula, the neighbouring municipality, since 1974. A supra-municipal water and wastewater services joint-stock company owned by Hämeenlinna Town and neighbouring municipalities, Hämeenlinna Region Water Supply and Sewerage Ltd., was established in 2001. In 2007 the company takes care of water services in the Hämeenlinna region. Water supply is fully based on groundwater or artificial groundwater.

### Keywords

Water supply, sewerage, evolution, services, environmental history, Hämeenlinna, Finland

## INTRODUCTION, OBJECTIVE AND SCOPE

Finland is a country with rich water resources. There are some 56 000 lakes with minimum diameter of 200 meters, and the landscape is largely dominated by lakes, especially in the central and eastern parts. Until the year 1809 Finland was part of the kingdom of Sweden and then attached to the Russian empire as an autonomous Grand Duchy. The country became an independent republic in 1917.

Häme castle was founded at the end of the 13th century and it is one of Finland’s medieval royal castles. Its first well -12 metres deep lined with stones - was built at the same time as the castle. However, waste and rain water leaked into it, polluting the water that could be used only for firefighting purposes. Häme castle started as a fortified camp, but gradually it was built to be a residential castle for its commandant. Curtain wall buildings and a third storey were added at the end of the 18th century. Related to the water supply of the castles, water was rarely drunk as is. It was used to brew beer and boiled. Thus, drinking the water in this form was much safer; several litres of beer per person were consumed each day. Water was also used for defensive purposes. For example, the safety of the Häme castle was increased in the 1770–80’s by digging massive moats around the castle.[1]



**Figure 1.** Location of Hämeenlinna town and its neighbouring municipalities (<http://www.hameenlinna.fi/english/>) (viewed on 3.3.2006).

The City of Hämeenlinna was founded in 1639. At the turn of the 19th and 20th centuries, Hämeenlinna had severe problems concerning wells. Many were placed too close to the cattle yard muck pit, sometimes just 3.5–5 meters away. Since keeping the cattle was still common and sanitation was almost non-existent, domestic waters were polluted. [2]

Nowadays Hämeenlinna Region includes eight municipalities: Hämeenlinna Town, Hattula, Hauho, Janakkala, Kalvola, Lammi, Renko and Tuulos municipalities (Fig.1). Hämeenlinna Region Water Supply and Sewerage Ltd. was founded in 2001 and in May 2006 it took care of water services in the region except for Janakkala.

In the Hämeenlinna region groundwater sources are good and there are also quite many lakes; among others Lake Vanajavesi, Ahvenistonjärvi, Katuma, Alajärvi and many more. So, in the early history of water supply issue was not the lack of water, issue was how to utilize these water resources.

The objective of this paper is to describe the evolution of water supply and sewerage services in Hämeenlinna town from the first initiatives from the 1880s to 2005 and analyse the key strategic episodes and decisions over the years.

This multidisciplinary paper combines the views of historian and water engineering scientists represented by the authors. It uses various types of sources: archives, literature, and project documents. A systematic analysis of the city and waterworks archives and the literature was made. Articles in local newspapers, and available histories of the city were also reviewed. Open-ended theme interviews of



26, present or past, staff members of the waterworks were conducted, representing all levels of the utility. Besides, visits to the works were an essential component of the project. [3]

First, the article describes the early developments in water supply and sewerage in Hämeenlinna before the founding of the actual water and sewage works. To that extent the text is based on historical accounts of the general development of the Town of Hämeenlinna. Thereafter, the needs of fire-fighting water and hygiene as well as the decision of using ground water and far-sighted planning of wastewaters are presented. Early cooperation and even resistance of the system are then presented, followed by rising water consumption and new intakes based first on surface water and later artificial recharge. Gradually the Water and Sewerage Works started cooperation in water buying and selling and sewage receiving, and finally, the recent establishment of a regional water and sewerage company, owned by Hämeenlinna town and its five neighbouring municipalities will be discussed.

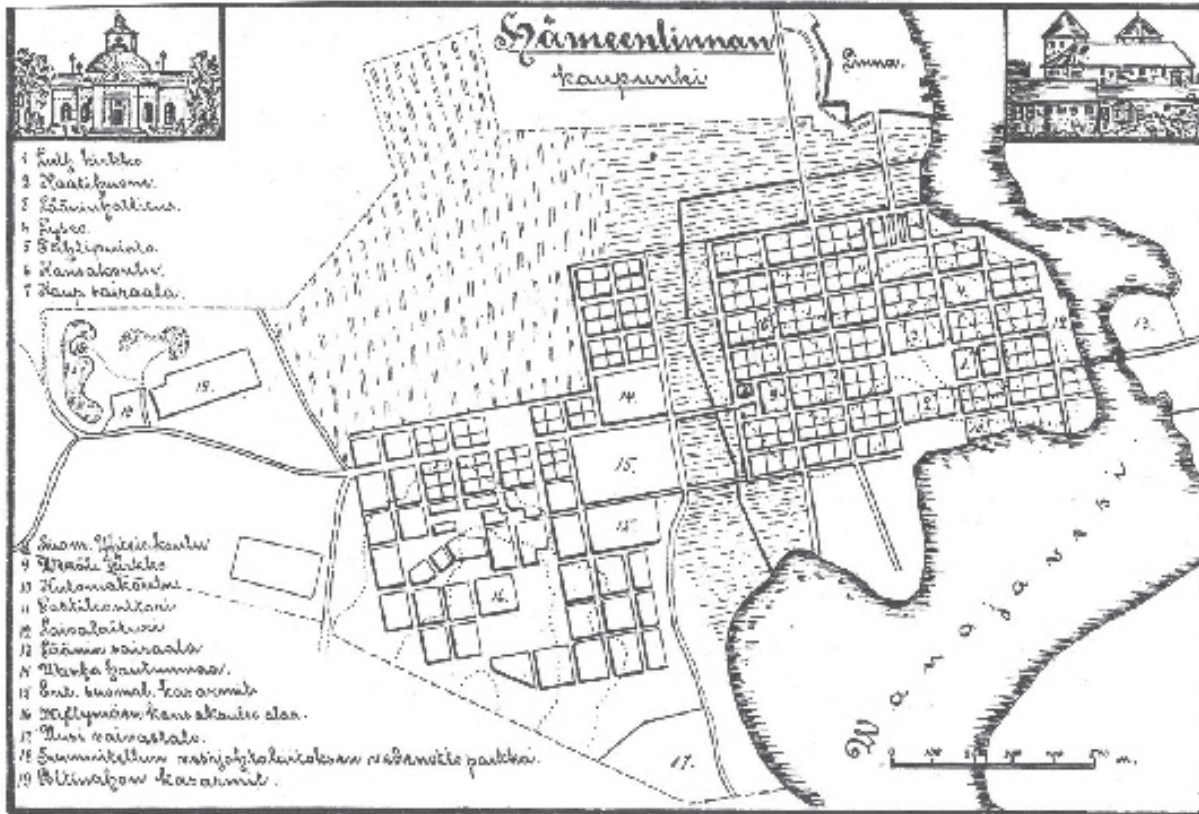
## SELECTED ISSUES AND PHENOMENA

### **Fire-fighting water and hygiene boosted the public system**

Fires, and the water required to put them out, were crucial in making Finnish towns realize that they must develop water supply systems. This was the case also in Hämeenlinna. For instance, a fire that started in December 1876 burned almost out of control as a result of an inadequate supply of fire-fighting water. After the fire, Governor von Ammondt demanded an explanation for the poor outcome of the fire-fighting efforts. It was discovered that in addition to the inadequate water supply, the fire alarm had been given too late.[4]

In the 1880s city fathers started to regard the shortage of water as an increasingly serious problem which resulted in a number of initiatives. The first extensive proposal was prepared by the agronomist Bremer in 1889 commissioned by the town council. He suggested that water be drawn from Lake Ahvenisto, but no action followed. The detailed proposal by the merchant F. Kiuttu for the construction of a water pipe at the end of 1890 had a similar fate.[5]

In August 1880 a Public Health Decree came into force in Finland which required establishing special boards for overseeing public health. The first documented meeting of such a board in Hämeenlinna took place in 1882, while the first authority to oversee sector ordinances, a health officer, assumed office at the beginning of 1890. The poor drinking water situation in the city kept the board busy. Consequently, it suggested to the council already in 1901 that the latter set up a water-works-construction fund that could be enlarged gradually. Yet, the proposal did not receive enough support at the time.[6] The map of the city of Hämeenlinna in 1909 is presented in Figure 2 including the proposed location of water intake (no 18).



**Figure 2.** Hämeenlinna in 1909. 1 Lutheran Church, 2 Town House, 3 Provincial Government, 7 Town Hospital, 9 Russian Church, 11 Post Office, 13 Provincial Hospital, 14 Old Graveyard, 16 Myllymäki, 18 Water intake for planned water works, 19 Military barracks, Linna = Castle. (Manner 1909)

### Groundwater from Ahvenisto esker area

The first implemented plan for a water supply and sewerage system was prepared by engineer Hugo Lilius in 1908. Accordingly, a depression south of Lake Ahvenisto was selected as the location of a water intake plant since a sufficient amount of groundwater, "a layer of at least 20 metres", had been discovered there. The water was under enough pressure to rise through pipes into a concrete reservoir from which it was pumped to a water tower. The tower, again, provided sufficient pressure to serve the entire network. The water supply committee asked the City Engineer of Vyborg, B. Gagneur, for his opinion about the plan. He supported it. Actual construction started in April 1910. The work was supervised by B. Gagneur and building engineer Otto Tolonen was the site foreman.[7]

The decisions made at the founding stage of the water works have proven quite forwardlooking. The selection of groundwater from the Ahvenisto esker area instead of lake water was a sustainable solution, although it was criticized during planning. The rest of the technology, such as pipe materials, also represented the

best available then. The positioning of fire hydrants in the middle of streets was, however, a mistake. They caused problems especially in winter times due to snow. Starting in 1926 they were gradually repositioned on the sides of streets.[8]

### Far-sighted planning for wastewaters

Concurrently with the water works a sewerage system was completed in 1910. This system was planned with a possible wastewater treatment plant in mind, since all the main sewer lines were led to the northern side of the city. A sewage pumping station and a pressurized sewer were also built. The city was also levelled to allow determining the proper routing of the gravity sewer lines. On its completion, the Hämeenlinna water and sewerage works was the eight such a facility in Finland.[9]

### Early cooperation networks

The city medical officer, Viktor Manner, was a key actor in the public health board and the water pipe committee, an expert organ which dealt with plans concerning the water works. Undauntingly he pushed for the establishment of a water works

*... the project was carried out with the help of a wide network of experts.*



stressing its health benefits. Alongside Manner and other municipal actors, several Finnish key water-sector experts such as Huber, Gagneur and Wasenius - other leading water “champions” in Finland that time - were involved in the establishment of the water works. Thus, the project was carried out with the help of a wide network of experts.

However, the local newspaper, Hämeen Sanomat, opposed vehemently the water works promoted by Manner. The critique maintained by the paper was valuable in that the networks were later extended also to the working-class quarter of Myllymäki. Such strong opposition was, however, exceptional in Finland as a whole - it was party-political to some extent.[10] The water and sewerage works was completed in November 1910. After the inauguration ceremony Hämeen Sanomat changed its mind and wrote in positive tone about the water facility.[11] In any case, this episode shows how neglecting proper participation and involvement of all the key stakeholders or considering their interests may raise resistance and unnecessary delays.

In 1921 the Vuorentaa water supply association was established in the Hämeenlinna rural district. A special feature of that association was that the municipality was also a stakeholder. The association served an elementary school and a few farmhouses. The rural district was abolished in 1948 whereby Vanaja municipality became the association’s new home. As the latter was abolished in 1967, the association became part of the City of Hämeenlinna. Finally in 1973 the city’s water works assumed responsibility for the association’s system. [12]

### **Rising water consumption and new intakes**

As the need for water increased (Fig. 3), two new shaft wells were constructed in Ahvenisto esker in 1942, while the original tube wells became backups. Obviously due to the reconstruction after WW II, in 1953 water consumption suddenly increased by nearly 20 per cent which called for a review of the existing master plan for water supply. At that time, the decision to build a surface water plant on Lake Katuma was made. Why a surface water plant? Most probably it was a question of following the prevailing trend of utilizing surface water and a treatment technology called “pulsator”<sup>1</sup>. On the other hand, if the choice had been groundwater, the city would have had to pipe it from a neighbouring municipality. This might have caused some problems or at least challenging negotiations. In any case, change from groundwater to surface water was a clear strategic change. Accordingly, the length of water and sewerage networks constantly increased and the number of water meters doubled from 1940s to 1950 and doubled again in ten years (Fig. 3 and 4). Since 1975 the per capita consumption started to decline following the general pattern in the country. This was largely influenced by the energy crisis and the introduction of wastewater surcharge act enacted in 1974, followed by various actions by the utility, related industry and consumers. One strategic choice has been water metering: from the beginning water billing has based on metering (Fig. 5).

The Katuma surface water treatment plant was inaugurated in 1955, and its capacity was doubled by an expansion in 1960. Three new tube wells were built in Ahvenisto in 1966, and another groundwater intake plant at Kylmälahti - that had been part of the original water intake expansion plans - was taken into use in 1969.[13]

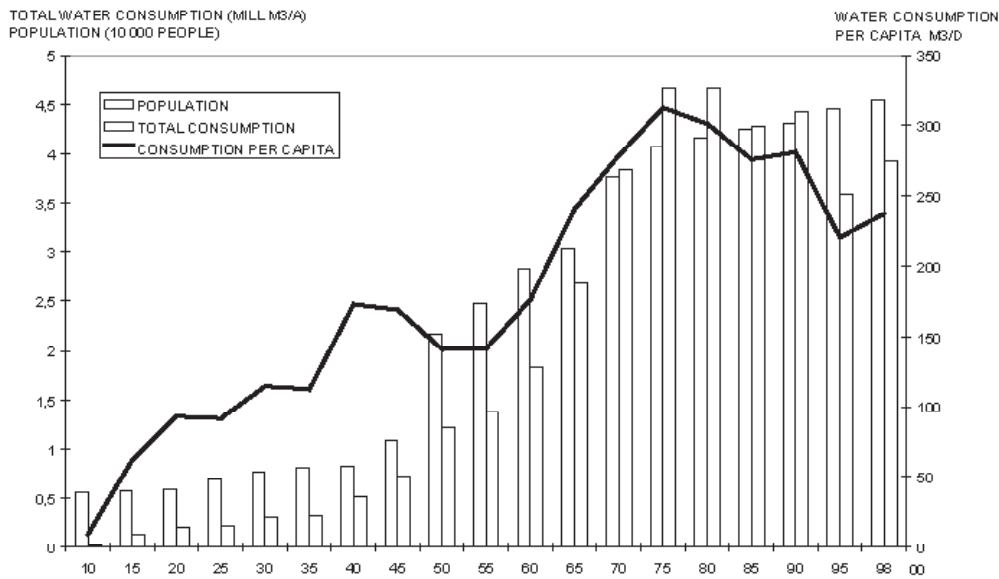
The drawing of groundwater from Ahvenisto esker had gradually lowered the water table. Lake Ahvenisto, which lies on an esker, was also losing its significance as a recreational area. The descent of ground water level was explored, and in 1976 an artificial recharge system was built. In this system water from Lake Alajärvi was pumped into a recharging basin constructed on the esker. This made the water table under the esker area rise, and additional water could be drawn from there. New tube wells were built in the Ahvenisto area in 1976 and 1978 which allowed decommissioning the Katuma surface water intake plant and turning it into a backup facility in 1980.[14] Thus 1980 the city had turned back fully to groundwater.

Since 1976 artificial groundwater has been used in Hämeenlinna, and in 2007 water supply is fully based on groundwater or artificial groundwater. There are sixteen water intakes: three water intakes in Hämeenlinna, Hattula, Renko and

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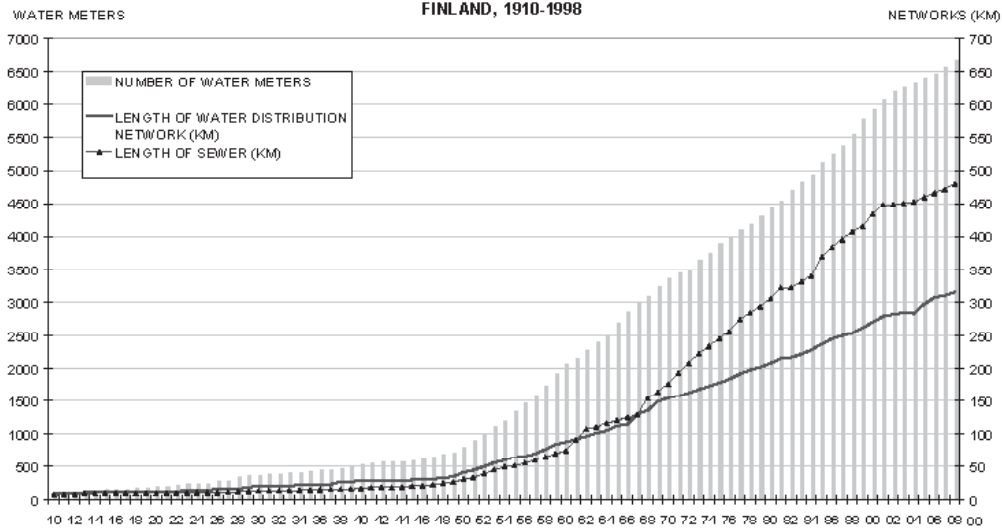
<sup>1</sup> Technology developed in Finland by a leading sector contractor, YIT.

**WATER SUPPLY AND POPULATION OF HÄMEENLINNA, FINLAND, 1910-1998**



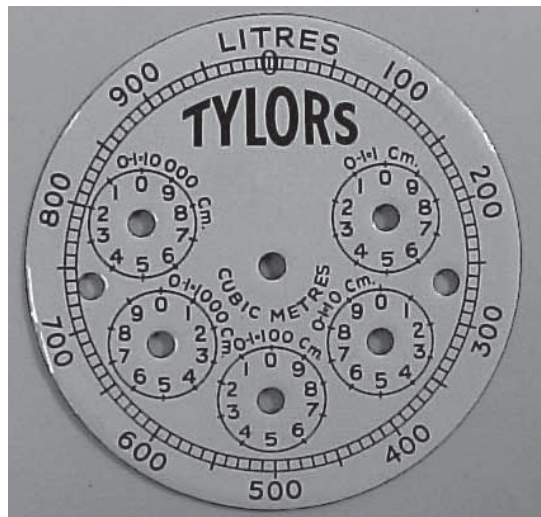
**Figure 3.** Water supply (total water consumption and water consumption per capita) and population in Hämeenlinna, Finland, 1910-1988.

**WATER METERS AND WATER AND SEWERAGE NETWORKS OF HÄMEENLINNA, FINLAND, 1910-1998**



**Figure 4.** Water meters, water and sewerage networks in Hämeenlinna, Finland, 1910-1998.

Lammi each, two intakes in Kalvola and one in Hauho and Tuulos municipalities respectively. Fourteen of them use natural groundwater and two artificial recharge.[15]



**Figure 5.** The display of an old water meter. It was very important to check which way the scale run - clockwise or anticlockwise. (Hämeenlinna Region Water Supply and Sewerage Ltd)

In 1985 a new two-part recharging basin was built on the Ahvenisto esker to increase the volume. In the new basins, the vertical infiltration distance was, however, too short and the quality of the recharged water did not meet expectations. As a result, research on surface irrigation was started. It involves conveying water to the sides of an esker via irrigation pipelines (Fig. 6). With irrigation, there is no need to disturb the topsoil which cannot be avoided when building recharging basins. The places of irrigation pipelines are changed once a year to avoid excess siltation of the surface. The studies on Ahvenisto showed that the quality of groundwater remained very good with the irrigation method. Development and research still continue, and irrigation is likely to be used also in the future. One problem related to water provision in Hämeenlinna has been the high iron-content of well water. An effort has been made to distribute water abstraction from intakes over a wider area by building new wells while also attempting to limit the output of individual wells and the ironcontent of their water.[16]

### **Cleaning neighbours' wastewaters**

Some Finnish cities and townships introduced wastewater treatment in the early 1900s, while the actual momentum started after the Water Act of 1961 that forced to start water pollution control. Yet, in Hämeenlinna sewer network was planned already in 1910 so that wastewater treatment plant can be constructed easily later on in the end of the sewer network.

The Paroinen wastewater treatment plant began operations in October 1966 as an activated sludge plant. The rapid technological development in the sector has meant that the plant has been involved in research, construction and expansion throughout its existence. The first expansion was completed in 1974 starting

phosphorus removal by simultaneous precipitation, very commonly used in Finland. This treatment, as well as the oxidation of ammonium nitrogen, began in Hämeenlinna in 1990 – quite early compared to other Finnish cities.[17]

After the expansion of the sewer system, all of Hämeenlinna's wastewaters - with the exception of a few dispersed settlements - have been led to the Paroinen treatment plant since 1999. Regional cooperation in receiving wastewater for treatment also started early. Since 1974 besides Hämeenlinna's own wastewaters, the Paroinen plant has also purified the wastewaters of Hattula. The wastewaters of Renko municipality have been received since 1993 and those of Hauho Eteläinen since 1996. The municipality of Tuulos also started to convey its wastewaters to the plant in 1997.

### **Hämeenlinna Region Water Supply and Sewerage Ltd.**

The above mentioned development, for its part, paved the way for the establishment of the supra-municipal water and waste water company for Hämeenlinna and its neighbours. A supra-municipal water and wastewater services joint-stock company owned by Hämeenlinna Town and five neighbouring municipalities, Hämeenlinna Region Water Supply and Sewerage Ltd., was established in 2001. In 2006 the company took care of water services in the Hämeenlinna region – except for Janakkala.

At first of the municipalities in Hämeenlinna Region, four joined the drinking water services system of Hämeenlinna Region Water Supply and Sewerage Ltd. (Hämeenlinna, Hattula, Kalvola and Renko), while six joined the wastewater services system (Hauho and Tuulos in addition to the previous). In Hauho and Tuulos municipalities, drinking water services were arranged through Ydin-Hämeen Vesihuolto Oy (Core Häme Water Services Ltd.). Lammi municipality joined the waste water system of Hämeenlinna Region Water Supply and Sewerage Ltd. in September 2005. In addition Hämeenlinna Region Water Supply and Sewerage Ltd bought the capital stock of Ydin-Hämeen Vesihuolto Oy in the autumn 2005 and companies were merged by the beginning of May 2006.

Over the half of the population living in Hämeenlinna Region have their homes in Hämeenlinna Town. The population of Hämeenlinna town and municipalities in Hämeenlinna Region in 2002 are shown in Table 1. Development of population in Hämeenlinna Region from 1970 to 2005 is presented in Table 2.

The successful regional cooperation in the Hämeenlinna region in sewerage and wastewater treatment shows that also small towns and municipalities can be forerunners in wastewater treatment and water protection measures. In the case of Hämeenlinna region, the cooperation – although the development from its initiation to the establishment of the regional joint-stock company also took about a decade – progressed fairly smoothly and in a fairly good consensus between all shareholding municipalities. One explanation for this must have been the central role of Hämeenlinna City and its key “champions” in the development



**Figure 6.** Water is pumped from the Lake Alajärvi to the Ahvenisto esker. Surface irrigation goes on despite of winter time. There is irrigation pipeline in front and one of recharging basins in the background. (Hämeenlinna Region Water Supply and Sewerage Ltd)

and negotiation process. It is obvious that all shareholding municipalities see the joint-stock company as a win-win situation, where Hämeenlinna City as the biggest shareholder foresees long-term economic gains and rationality in terms of technical and environmental benefits, and the smaller municipalities were in many cases able to “avoid” the substantial forthcoming infrastructure replacement and rehabilitation costs.

## DISCUSSION

### Key episodes and public-private cooperation

An overall summary of the development of water supply and sewerage systems in Hämeenlinna from the late 1800s to the 21st century, is shown in Table 3. The expertise of the several Finnish key water-sector experts such as Huber, Gagneur and Wasenius were involved in the establishment of the water works. Thus, the project was carried out with the help of a wide network of experts. The expertise was utilised and adapted to the conditions of Hämeenlinna.

The Vuorentaa water supply association was established in 1921 in the Hämeenlinna rural district. In 1973 the city’s water works assumed responsibility for the association’s system. A joint water and sewage works for the entire area would, however, be too expensive at today’s population density.



**Table 1.** Population of municipalities in Hämeenlinna Region in 31.12.2005.[18]

Municipality	Population
Hämeenlinna Town	47,335
Hattula	9,332
Hauho	3,947
Janakkala	15,871
Kalvola	3,461
Lammi	5,612
Renko	2,352
Tuulos	1,564
Region TOTAL	89,474

**Table 2.** Development of population in Hämeenlinna Region from 1970 to 2005.[19]

Year	Population	Year	Population
1970	79 285	2000	87 583
1980	81 775	2002	88 187
1990	85 247	2005	89 474

The 1879 Public Health Decree required, for instance, the city to measure the relative elevations of different city areas which was a precondition for sewerage planning. Health and environmental issues were the responsibility of a board of health which also saw to it that good quality water was provided for the inhabitants. Water charging was based on metered consumption from the beginning. This allowed viable development of the works which, in the light of examples, would likely have failed with different charging principles. An exception were public standposts, which had been in use for tens of years, and gave water against payment of a fixed fee. The works operated this service at a loss, but it introduced equality into the distribution of water for citizens before the piped network reached the working class neighbourhoods.

Utilisation of groundwater - though returning to surface water for a few decades - was the right solution in light of what was known then. The later problems with iron showed that solutions that appear indisputable are not necessarily sustainable over the long term and now, but one must be prepared for surprises.

Prior to the establishment of the waterworks, the state of the environment in Hämeenlinna had deteriorated endangering the health of the population. The waterworks and the sewerage system improved the condition of the built environment. Because a wastewater treatment plant was not initially built, domestic wastewaters loaded the environment. Since the city started treating wastewaters in 1966, and improved process gradually, the pollution load on water bodies from

domestic wastewater has decreased significantly. Increased population and a higher living standard were a danger to the environment and people's health also in the rural district: example well water quality was often poor. The situation in the rural areas started to improve slowly, for example in Hattula after 1974 when the Paroinen plant has purified its wastewaters.

The selected organisational option in 2001 - a joint-stock company owned by the municipalities - is a common alternative in the regional cooperation of the municipalities in Finnish water services sector, though mainly for wholesale purposes. Based on the experiences elsewhere and on the majority decisions taken by the municipality organs in the Hämeenlinna Region a joint regional company was established. The management and decision making structures of the joint-stock company seem to be well accepted by all shareholding municipalities. Yet, this may be largely due to the incentive: Hämeenlinna town owns 75 per cent of the shares, while the smaller municipalities have a joint voting majority in the Board.

Table 4 presents a summary of the private sector involvement in providing major construction contracts, consultancy services, goods and equipment for Hämeenlinna City Water and Sewage Works, 1910-2002. It shows that there has been over thirty outsourced contracts in planning – general planning or design - and over sixty contracts in construction.

### Future challenges

One future challenge will be to secure sufficient groundwater resources for Hämeenlinna. The risk of their contamination has been diminished by moving oil tanks from groundwater areas to protected indoor spaces or by introducing completely new heating modes. The at-risk locations in Hämeenlinna were surveyed in 1994, and a groundwater protection plan was devised in that same connection. Education and research are also used to minimize the threat posed by the de-icing salt spread on roads in winter and other threats external to the water works. A new approach to safety issues will have to be taken in a unifying Europe.

*One future challenge will be to secure sufficient groundwater resources for Hämeenlinna.*

The water works has traditionally had good contacts with domestic and foreign research and educational institutions and enterprises ever since its planning started. The works has grown as part of society and has played a key role in the provision of safe water and sanitation services to inhabitants. The big basic decisions made early in the 20th century have proven sustainable: the population of Hämeenlinna can still enjoy the high quality groundwater of the Ahvenisto esker and the waterways traversing the city are also in good shape.

**Table 3.** Key long-term decisions on Hämeenlinna water and sewerage services, 1869–2002 [20]

Year	Event	Reason	Outcome	Organisational change	Stakeholders
1869	1st City Police Order	Inadequate cleanliness	City's cleanliness improved		Various groups among local councillors
1882	1st Health Committee (board) meeting	Public Health Decree of 1879	City takes control over environmental and health matters	Health Committee (board)	Various groups among local councillors
1889 and 1890	A. Bremer and Fr. Kiuttu's proposals for waterworks	Need of firefighting and household water, pollution and wastes control	Proposals postponed, several committees and small improvements	Several committees	Various groups among local councillors, experts
1908	H. Lilius' plan for water and sewerage systems	Need of Firefighting and household water, health, pollution and wastes control	Modern waterworks in 1910	1st City Waterworks in 1910	Various groups among local councillors, city council, waterworks, consumers, experts
1910	Metering based billing	Control of use	Billing based on actual use		Waterworks, customers
1910	1st phase of sewers		Pollution of surface waters in the long run, better quality of city life in the short term		City council, experts
1953	Plan for surface water plant	Inadequate quantity	1955 Katuma plant, more capacity, used until 1980		City council, waterworks, experts
1966	1st wastewater treatment plant at Paroinen	Health and environmental aspects, Water Act of '1961	Receiving WW from Hattula since 1974; from Renko municipality since 1993	Based on bilateral contracts	City council, waterworks, consumers, the state, experts, Hämeenlinna, Hattula, Renko
1976	Alajärvi artificial recharge	Inadequate quantity	More capacity		Waterworks, experts
2001	Hämeenlinna Region Water Supply and Sewerage Ltd	Foreseen benefits, favourable conditions	Supra-municipal services	Supra-municipal company	Several municipal councils, Reg. Env. Centre, Regional Council of Häme

The regional joint-stock company, Hämeenlinna Region Water Supply and Sewerage Ltd, still has huge challenges ahead – despite the promising start and good acceptance by shareholders and majority of its customers. Challenges are mainly related to the economic and financial sustainability of the company, bearing in mind that the company has substantial nominal debts to the shareholding municipalities. The foreseen debt service costs together with inevitable high infrastructure rehabilitation costs put high pressure on future tariff structures and revenue collection levels.

## CONCLUSIONS

The following key principles and findings of the evolution of water and sewerage services in and for Hämeenlinna have been identified:

- (i) The waterworks and the sewerage system improved dramatically the condition of the constructed environment.
- (ii) One reason for the working class's opposition to water schemes in the 1910s arose from their political association with the renter classes. During this period expenditure on water was probably rejected because it would result in an increase in municipal rates, which would in turn be reflected in rising rents.
- (iii) Another reason to oppose water schemes was lack of information. As it is also seen today, if the scheme - whatever it is - is not well informed to all shareholders and public relations are not done properly, there is for sure, strong opposition. This was the case also in Hämeenlinna. And it seems like lack of information has been one main reason why some citizens have expressed strong opposition to the planned artificial recharge plants in Turku and Tampere regions.
- (iv) There was an alliance of 'conservative' property owners and householders with working class against 'liberal' commercial interests. The 'conservatives' resisted major reforms because they realised they would have to pay for them. The working class rejected water schemes because they feared an increase in rents, and same time saw water schemes to be in the benefit only of the merchant and commercial interests.
- (v) Because a wastewater treatment plant was not built initially, domestic wastewaters loaded the environment. Since the city started treating wastewaters in 1966, and improved the process gradually, the pollution load on water bodies from domestic wastewater decreased significantly.
- (vi) At the beginning the selection of groundwater from the Ahvenisto esker area instead of lake water was a far-reaching and open-minded solution, though surface water was also used for a few decades.
- vii) The successful regional cooperation in the Hämeenlinna region in sewerage and wastewater treatment shows that also small towns and municipalities can be forerunners in wastewater treatment and water protection measures.
- viii) Future challenges are probably related to economical and financial sustainability.

**Table 4.** Private sector involvement in providing major construction contracts, consultancy services, goods and equipment for Hämeenlinna City Water and Sewage Works, 1910-2002.

	WATER		SEWERAGE	
<b>1. GENERAL PLANNING</b>				
	1920	PRIVATE EXPERT	1951	CONTRACTOR
	1940-41	CONTRACTOR	1952	CONTRACTOR
	1946	CONTRACTOR		
	1966	CONSULTING COMPANY	1966	CONSULTING COMPANY
	1974-75	CONSULTING COMPANY		
<b>2. DETAILED PLANNING &amp; DESIGN</b>				
<b>WATER INTAKES AND TREATMENT</b>			<b>SEWAGE TREATMENT PLANT</b>	
	1952-53	CONTRACTOR	1957	CONSTRUCTION
	1952-53	CONTRACTOR	1962	CONSULTING COMPANY
	1960	CONSULTING COMPANY	1962	CONSULTING COMPANY
	1966	CONSULTING COMPANY	1962-63	CONSULTING COMPANY
	1968	CONSULTING COMPANY	1970	CONSULTING COMPANY
	1976	CONSULTING COMPANY		
	1980-81	CONSULTING COMPANY		
	1985	CONSULTING COMPANY		
<b>WATER PUMPING STATIONS</b>			<b>SEWERAGE PUMPING STATIONS</b>	
	1954	CONTRACTOR	1953	CONTRACTOR
	1954	CONTRACTOR	1968	PRIVATE EXPERT
	1964	PRIVATE EXPERT		
	1964	CONSULTING COMPANY		
	1982	CONSULTING COMPANY		
<b>GROUNDWATER INVENTORY</b>			<b>OTHERS</b>	
	1941	CONTRACTOR	1966	CONSULTING COMPANY
	1944	CONTRACTOR	1970	CONSULTING COMPANY
	1961	CONSULTING COMPANY	1978	CONSULTING COMPANY
	1995	CONSULTING COMPANY		
	1999	CONSULTING COMPANY		
<b>3. CONSTRUCTION</b>				
<b>WATER INTAKES AND TREATMENT PLANTS</b>			<b>SEWAGE TREATMENT PLANT</b>	
	1954-55	CONTRACTOR	1963	CONTRACTOR
	1954-55	CONTRACTOR	1965-66	CONTRACTOR
	1965-66	CONTRACTOR	1965-66	CONTRACTOR
	1968	CONTRACTOR	1967	CONTRACTOR
	1969	CONTRACTOR	1967	CONTRACTOR
	1969	CONTRACTOR	1967	CONTRACTOR
	1976	CONTRACTOR	1972-73	CONTRACTOR
	1980-81	CONTRACTOR	1978	CONTRACTOR
	1980-81	CONTRACTOR		
	1980-81	CONTRACTOR		
	1999	CONTRACTOR		
<b>WATER TOWER</b>			<b>SEWERS</b>	
	1910	CONTRACTOR	1954	CONTRACTOR
<b>WATER PIPES</b>			1956	PARTLY FUNDING BY INSTITUTIONAL CUSTOMER
	1920	PRIVATE WATER PIPE	1967	CONTRACTOR
	1924	PRIVATE WATER PIPE	1972	CONTRACTOR
	1937-38	PARTLY FUNDING BY INSTITUTIONAL CUSTOMER	1972	CONTRACTOR
	1947	CONTRACTOR		
	1956	PARTLY FUNDING BY INSTITUTIONAL CUSTOMER		
	1970	CONTRACTOR		
	1971	CONTRACTOR		
	1971	CONTRACTOR		
	1972	CONTRACTOR		
	1973	CONTRACTOR	1972	CONTRACTOR
	1976	CONTRACTOR	1973	CONTRACTOR
<b>WATER PUMPING STATIONS</b>			<b>SEWERAGE PUMPING STATIONS</b>	
	1929	CONTRACTOR	1970	CONTRACTOR
	1959	CONTRACTOR	1972	CONTRACTOR
	1960-61	CONTRACTOR		
	1964	CONTRACTOR		
	1965	CONTRACTOR		
	1966	CONTRACTOR		
	1982	CONTRACTOR		
<b>QUALITY CONTROL OF SUPPLIED WATER</b>			<b>HPAC (HEATING, PLUMBING, AIR-CONDITIONING)</b>	
	1956	CONSULTING COMPANY	1965-66	CONTRACTOR
<b>HPAC (HEATING, PLUMBING, AIR-CONDITIONING)</b>			1979	CONTRACTOR
	1939	CONTRACTOR		
	1950	CONTRACTOR		
	1954-55	CONTRACTOR		
	1955	CONTRACTOR		
	1969	CONTRACTOR		
	1980-81	CONTRACTOR		
<b>ELECTRICAL WORK</b>			<b>ELECTRICAL WORK</b>	
	1969	CONTRACTOR	1965-66	CONTRACTOR
	1971	CONTRACTOR	1967	CONTRACTOR
	1980-81	CONTRACTOR	1972	CONTRACTOR
			1978	CONTRACTOR
<b>OTHERS</b>			<b>OTHERS</b>	
	1970-71	CONTRACTOR	1970-71	CONTRACTOR
	2002	CONTRACTOR	1978	CONTRACTOR
			1978-79	CONTRACTOR

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# Water Services in Espoo from the 1930s to the 2000s – Rapid Population Growth Poses a Challenge

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## **ABSTRACT**

The development of an organised public water supply system in Espoo began in 1934. The path to today's situation in water services, which is good from the viewpoint of clients and the environment alike, has been long and at times rocky. The City of Espoo is young, modern, and relatively large in Finnish terms. It is the second largest city in Finland, with a population exceeding 230,000 inhabitants. Espoo has grown very rapidly; in the early 1950s, there were still fewer than 30,000 people living there. (Table 1)

In 2005, about 70 percent of the water pumped into the pipes of Espoo Vesi was purchased from Helsinki, i.e., the water came from Lake Päijänne via the 120 km rock tunnel and the Pitkälampi water treatment plant. The remaining 30 percent came from the City's own Dämmän surface water plant, which treats water from Lake Pitkälampi in Nuuskio, northern part of Espoo. Wastewater purification was concentrated in the Suomenoja wastewater treatment plant, where the first process expansion based on total nitrogen elimination was completed in 1997. There are numerous challenges for the future as well; according to official estimates, by the year 2040 the population of Espoo will increase more than in any other Finnish municipality, by a total of as many as 54,000 people.

## **BACKGROUND AND SOURCES**

A systematic analysis of the city and waterworks archives and the literature was made. Open-ended theme interviews of some 17, present or past, staff members of the waterworks were conducted, representing all levels of the utility. Visits to the works have been an essential component of the project. Articles in local newspapers, and the available histories of the city were also reviewed. <sup>1</sup>

## **FIRST STAGES OF THE EMERGING WATER SERVICES**

Well into the 20th century, water supply in Espoo was based on wells. Things finally began to happen in the 1930s. In the spirit of the times, many unemployed people found a job on a number of construction projects. At the beginning of the decade, these public employment programmes were used to improve and construct roads, to implement agricultural and forestry projects, and to dig wells and firewells in Espoo. In 1934, a well on hospital premises, a bridge and a water main to Jorvaksentie in Stenvik, a.k.a. Kivenlahti, nowadays known as Vanha Jorvaksentie, or the Old Jorvas road, were built as public works projects. As of 1934, nearly all construction matters were overseen by Mr. Albin Andersson, Construction Site Supervisor. The period between 1934 and the 1950s was known as the Albin Andersson era within the construction sector in Espoo.<sup>2</sup> Although the 1934 projects related to water services were not particularly extensive, they did differ significantly from earlier years.

**Table 1.** Espoo in a nutshell. (www.espoo.fi)

- Espoo received its town charter in 1972
- Population 227,472 (2005)
- Area of Espoo 528 sq.km (land territory 312 sq.km, water 216 sq.km)
- Nearest airport: Helsinki-Vantaa Airport 25 km,
- Neighbouring municipalities: Helsinki, Nurmijärvi, Vihti, Kirkkonummi, Kauniainen (within Espoo)
- Mean temperature (2004) 6.2 degrees Celsius  
(Warmest month August, mean temperature 17.2 degrees Celsius,  
Coldest month January, mean temperature -5.7 degrees Celsius)
- Population by language: Finnish-speaking 85.6%, Swedish-speaking 8.8%, other languages 5.6%
- Main employers by number of staff on 1 January 2005: The City of Espoo, Nokia, University of Technology, Jorvi Hospital

Around that time, the Westend area was being designed by Dr. Arne Grahn. He wanted to offer access to water and sewers for all those buying a lot in the area. The detailed plan of Westend was completed in 1934. Dr. Grahn commissioned ground water surveys and water supply contracting from Yleinen Insinööritoimisto Oy (YIT). The large well and pump room along Pihlajatie Road functioned as Westend's waterworks. Wastewater was led untreated into the Gulf of Finland. Water main lines were constructed simultaneously with roads in the area. <sup>3</sup>

### **ESTABLISHMENT OF A LIMITED COMPANY TO IMPROVE WATER SERVICES**

Building of water mains began on a larger scale in other parts of Espoo in the 1950s, when the construction projects in Otaniemi and Tapiola called for implementation of general water services. The City of Helsinki began the distribution of water in Otaniemi in 1951 and in Tapiola in 1953. The Finnish State and the Housing Foundation of Finland were in charge of covering the costs of the water mains network construction and for the operation of the sewage system in its entirety. One of the reasons given by the then Helsinki City Board for construction of the water main network from Munkkiniemi to Otaniemi and further on to Tapiola was that the areas would sooner or later be annexed with Helsinki anyway. The people of Espoo were spurred by circumstances and population growth: Espoon Vesihuolto Oy was founded in 1957, and the actual construction of the water supply network was launched by the company in December 1957. <sup>4</sup>

During the first five years of its operation, Espoon Vesihuolto Oy built 47 kilometres of water pipes, most of it water mains. Thirty-six kilometres of sewers were also built. In addition, the first phase of the Bodom water treatment plant was completed. The Municipality of Espoo had a strong role in the company from the start, and in 1959 it gained the majority of the shares in Vesihuolto Oy.<sup>5</sup>

*As late as the 1990s, the Bodom water treatment plant provided one fourth of the water needed in Espoo.*

The Bodom surface water treatment plant marked the beginning of Espoo's own water production in 1961. In fact, the history of the Bodom plant can be traced back to 1954, when the Municipality of Espoo appointed a committee to make preparations for general water services in Espoo. The committee finished its work in November 1955. The key content of its report was the general plan drawn up by Mr. Eino Kajaste, Senior Engineer, which included Lake Bodom as one of the water supply lakes during the first stage.

The biggest problem was the growth of algae in the lake. As late as the 1990s, the Bodom water treatment plant provided one fourth of the water needed in Espoo. The Bodom plant was closed down in 1998.<sup>6</sup>

Discussion on turning Vesihuolto Oy into a municipally owned company began as early as in 1959, and the final decision on this was made in 1964. The municipality bought all the equipment and facilities owned by the company. Unfortunately, the final stages of Vesihuolto Oy were associated with widespread economic irregularities.<sup>7</sup>

## **MUNICIPAL WATERWORKS**

After the waterworks became a municipal utility, the operation of water services was managed by municipal waterworks. The majority of the staff of Espoon Vesihuolto Oy stayed on in the employment of the municipal water utility, some moved on to the Technical Department and some to the private sector. Right from the start, the municipal waterworks commissioned a large number of projects from private enterprises.<sup>8</sup>

In the 1960s, drastic forecasts of an endless increase in water use were made in Espoo, as in other parts of the country. At that time, it was believed that Espoo's own water reserves would not suffice to cover water needs in the 1970s. The Municipality of Espoo and Helsingin maalaiskunta joined the raw water programme of the City of Helsinki. In the summer of 1965, the so-called three-party agreement was signed. It was believed that it would guarantee sufficient water supplies for Espoo well into the 1980s. In addition, a contract was made with the City of Helsinki on buying tap water from Helsinki.<sup>9</sup>

The municipal waterworks showed a loss in the 1965 balance sheet. Net loss was a typical feature of the water utility of a growing community. There were lots of capital expenses, but little income compared to construction capacity. In Espoo,

the long distance between the areas where the water was consumed and the water treatment plants also played a role in this; this meant longer feeding lines and higher energy costs. However, it was expected that the problems would be solved as the area of water consumption expanded and once the water treatment plants operated on full effect.<sup>10</sup>

Espoo's second water catchment area, i.e., the Dämman surface water treatment plant, was completed on 1 June 1967, when it began its operation. Even though the plant marked a clear improvement, problems still abounded. The majority of inhabitants still had to do with traditional wells. There were also problems with water quality, especially due to algae. The need for even greater decisions was already evident. In addition to its own surface water treatment plants, some small surface water intake facilities have operated in Espoo, serving their immediate vicinity.<sup>11</sup>

*The first water tower in Espoo was built in Kauniainen in 1964.*



The first water tower in Espoo was built in Kauniainen in 1964. The Haukilahti water tower, intended to improve the distribution on water in south-eastern Espoo, was completed in 1968. The construction of the Otaniemi water tower was delayed by difficulties caused by demanding foundation work. It was finally completed in 1971. The Espoonlahti tower is the most recent built in Espoo. It was taken into use in 1995.<sup>12</sup>

As of the beginning of March 1966, the Espoo municipal waterworks took over the water network in Tapiola. This meant that the amount of water purchased from Helsinki increased. In 1966, a dramatic rise was seen in water consumption compared to the previous year – in the area served by Espoo waterworks, about 74 percent more water was consumed than the year before. Pumping of water from Lake Bodom increased by as much as 53 percent.<sup>13</sup>

Because of the city's rapid growth, Espoo's water services required greater reliability and more water. An agreement on cooperation was signed by the three cities of Helsinki, Vantaa and Espoo on 22 January 1970. At the time, the agreement was probably the most comprehensive cooperation contract in the field of Finnish water services. It included features such as the construction of the Päijänne tunnel, a joint treatment plant and joint feeding line, as well as joint use of local water supplies, so that the water needs of each of the three cities could be met in the 1970s as well as later, if needed.<sup>14</sup>

The organisation of the Päijänne project was decided on in 1972. The councils of the cities taking part in the project approved a limited company solution. On 20 October 1972, the Ministry of Trade and Industry gave its approval to the by-laws of the limited company called "Pääkaupunkiseudun Vesi Oy – Huvudstadsregionens Vatten Ab". Espoo's share of the water flowing via the Päijänne tunnel was 1.9 m<sup>3</sup>/

s, and that of the company's shares and water reservations about 16.3 percent. The construction of the Päijänne tunnel commenced in December 1973, and was finally completed in 1982.<sup>15</sup>

## CONCRETE ENVIRONMENTAL PROTECTION MEASURES

As late as in the early 1960s, the wastewater from Tapiola and its environs was treated in a separate treatment plant in Tapiola. In addition, Espoon Vesihuolto Oy also had purification plants in Iso Huopalahti, Lähderanta, Niittylä and Viherlaakso. In the 1960s, the focus of wastewater purification began to shift to Suomenoja. The first purification plant there was a modest 840-metre ring channel built in the early 1960s, which was linked to a pond purification plant in 1963. That same year, a discharge pipe to the sea was built from the pond, and another 4-kilometre parallel pipe was taken into use in 1967. In the general plan, concentration of wastewater treatment to Suomenoja was continued, while construction of a mechanical purification plant was being planned. The purification plant that was completed in the autumn of 1969 was the largest single construction project undertaken in the municipality until then.<sup>16</sup>

*... the expansion of nitrogen elimination was awarded first prize by the Association of Finnish Civil Engineers ...*

A new wastewater discharge tunnel was completed in spring 1974. After that, wastewater could be led via a rock tunnel measuring 7.5 km to the sea outside the island of Gåsgrundet, where the conditions for dilution were clearly superior to the earlier discharge location, the open sea area of Bodö. After its completion, the Suomenoja purification plant has continuously been developed and renovated. In 1975, chemical precipitation was introduced. Five years later, the use of biological process was adopted, while in 1997,

nitrogen elimination was taken into use. In 1988, the expansion of nitrogen elimination was awarded first prize by the Association of Finnish Civil Engineers in their engineering construction competition. Espoo's own sewer network grew rapidly from the 1960s onwards. On average, more than 20 kilometres of sewers were built each year. In addition to Espoo's own sewage, wastewater from the eastern parts of Vantaa, Kauniainen and Kirkkonummi gradually began to be directed to Suomenoja.<sup>17</sup>

In 1974, the waterworks and the sewage works were fused in connection with the reorganisation of the Technical Department. This was a significant change, because from the point of view of efficient water services it is beneficial if the same organisation manages the operation throughout the process, from one end of the cycle to the other. The next major administrative change took place in 1994, when the waterworks became a municipal enterprise with net budgeting. The public utility based on business accounting began its operation on 1 January 1995.<sup>18</sup>

## BOLDLY TOWARDS THE FUTURE – DEVELOPMENT PLANS AND CONSTANT VIGILANCE

The Espoo water supply action plan, drawn up in accordance with the 2001 Water Services Act, was completed at the beginning of 2004. The plan covers the period from 2004 to 2010. The measures described in the action plan mostly focus on the area of operation of Espoon Vesi, where about 99.8 percent of the inhabitants using the service of the water supply plants in Espoo live. The area of operation of Espoon Vesi will expand considerably during the period covered by the plan, 2004 – 2010. The expansion targets the key areas in the vicinity of the current area of operation that are not yet covered by planning, as well as new areas to be planned. The action plan makes it possible to remove eight local water supply plants from use and to link them to the water service system of Espoon Vesi.<sup>19</sup>

The share of the total population of Espoo who use the services of the water supply plants will increase from the current 97.5 percent to an impressive 99.0 percent. At the end of 2004, some 6,200 local residents lived outside the area of operation of the water supply plants; at the end of the period, this number is expected to be down to 2,100.<sup>20</sup> In the near future, new decisions on wastewater purification must also be made: in 2006, a survey was underway concerning the transfer of the entire Suomenoja purification plant into a rock cave.

Provision of water services calls for continuous maintenance and development. At the moment, the water supply system in Espoo is operating very smoothly. The establishment of this comprehensive system has called for major investments and innumerable man years of labour. There has been a desire to solve the problems that arise in the best possible manner. The maintenance and development of the system also calls for continuous upkeep, well-motivated and skilful staff as well as new investments. In Espoo, particular challenges have been posed by the long distance between water supply plants and consumers as well as rapid population growth. Over the years, giant steps have been taken in wastewater purification, and Espoo has always been in the forefront of development.

*... water services should be properly supervised and municipally owned.*

The sad end of Vesihuolto Oy with its economic irregularities shows that water services should be properly supervised and municipally owned. When people's well-being and lives are at stake, there is no room for the slightest irregularities.

Espoo has not lacked the courage to look well into the future. Massive investments have been made in the past decades, and when needed, there has also been the courage to discard less fortunate solutions. The main phases of the development of Espoo water services are shown in Table 2. Even very successful solutions cannot be relied on exclusively, since constant vigilance is called for when dealing with systems interacting directly with the environment. For example, the Päijänne tunnel cannot be the only option in future scenarios, simply for reasons of safety. The City's own water supply plants

**Table 2.** The nine main phases of the water services in Espoo and the motives behind them.

<b>NAME OF PHASE</b>	<b>YEAR</b>	<b>HISTORICAL PHASE</b>	<b>MOTIVES</b>
<b>I</b>	1934-	Beginning of organised water services both by the municipality and the private sector	Providing employment, investments in water services of municipal institutions, housing comfort
<b>II</b>	1951-1953	Helsinki builds water services in Otaniemi and Tapiola	Helsinki built water services because it was thought that the areas would later be annexed with Helsinki
<b>III</b>	1957-1964	Espoon Vesihuolto Oy	Private company, mostly owned by the municipality Limited company to manage water services
<b>IV</b>	1961-1967	Espoo's own water production begins	Raising the level of self-sufficiency, safety 1961-1998 Bodom and 1967-Dämman surface water plant
<b>V</b>	1965	Water services becomes a municipal service	Irregularities at the Limited company and rapid population growth, among others
<b>VI</b>	1969-	The era of centralised wastewater purification begins	Environmental protection, health and hygiene
<b>VII</b>	1970-	Three-party agreement (among others, the Päijänne tunnel)	Cooperation with neighbouring municipalities, greater reliability and more water needed due to the rapid growth of the city. Päijänne tunnel was completed in 1982.
<b>VIII</b>	1974	Waterworks and sewage works fuse	Reorganisation of the Technical Department, the same organisation manages the water over the entire cycle
<b>IX</b>	1994	Waterworks becomes a public enterprise	Other alternatives were fusion with electricity company and incorporation. Municipal enterprise = the City retains ownership and decision-making power. Costs were cut at the same time. One of the reasons behind the move was the recession.

and water supplies must be kept in good condition. Customers must also be kept satisfied. All this can only be achieved through good team spirit, which is based on a positive operating environment, an independent and strong organisation, and well-motivated and highly competent employees in particular.

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# The Rivers of Vantaa

## – Evolution of Water and Sewage Services in Vantaa, Finland

Petri S. Juuti & Riikka P. Rajala

Juuti P.S. & Rajala R.P. 2007.

The Rivers of Vantaa – Evolution of Water and Sewage Services in Vantaa, Finland.

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## ABSTRACT

A lot of water has flown through Vantaa,” says a Finnish proverb. This usually refers to something that takes a long time coming or to something that has happened years and years ago. The proverb is ideal for describing the history of Vantaa’s water management with its colorful phases - ranging from such unusual events as falling over of the well and burning down of the water tower. Despite these and numerous other adversities, the development of water management from its beginning in the 1950s has, for the most part, been positive and successful.

Vantaa is widely known for its International Airport, and it has a strong position as the hub of Finland’s logistics. Vantaa has the shortest route by air to Asia within the European Union. Vantaa has around 190,000 residents and each year witnesses the birth of 2,500 new Vantaa citizens. On the very first day of the year 2006, the number of inhabitants amounted to precisely 187,281, a figure that a year later was as high 189,711. The city has two official languages: Finnish and Swedish. Vantaa has the future firmly in its sights but is also very interested in its history. The earliest traces of human habitation in Vantaa date back 7,000 years, and the first recorded mention of Helsinge - today’s Vantaa - is from 1351. Vantaa became a city in 1974.<sup>1</sup>



**Figure 1.** Vantaa has the shortest route by air to Asia within the European Union. (www.vantaa.fi)

**Table 1.** Population in Vantaa. (www.vantaa.fi)

<b>Population, January 1</b>	<b>No. of residents</b>	<b>Percentage of Helsinki Metropolitan Area</b>
1950	14,976	3,7 %
1960	41,906	7,6 %
1970	72,215	10,4 %
1980	129,918	17,2 %
1990	152,263	18,6 %
2000	176,386	18,7 %
2001	178,471	18,7 %
2002	179,856	18,6 %
2003	181,890	18,7 %
2004	184,039	18,9 %
2005	185,429	18,9 %

## **BACKGROUND AND SOURCES**

A systematic analysis of the city and waterworks archives and the literature was made. Also articles in local newspapers, and the available histories of the city were reviewed. Open-ended theme interviews of some 14, present or past, staff members of the waterworks were conducted, representing all levels of the utility. Visits to the works were an important component of the project. <sup>2</sup>

## **HISTORY OF THE RIVER VANTAA**

In the history of the River Vantaa, the decades of water management are but a short while, since the river found its channels thousands of years ago. Likewise, human habitation along the river dates back thousands of years. These early inhabitants did not burden the river, because there were so few of them. Besides passage, the river offered them food and a source of livelihood. In addition to fishing, the environs of the river offered good hunting grounds. The water from the River Vantaa was used for water acquisition and management up to 1982 when the Päijänne Water Tunnel was taken into use. Even today, the water from the river is used for water management, whenever required by maintenance of the Päijänne Water Tunnel. <sup>3</sup>

As a geographical area, Vantaa is mostly low-lying terrain, divided by rivers. The River Vantaa flows through West Vantaa, whereas East Vantaa is divided by the River Kerava, a tributary of the River Vantaa. A little bit of seashore can be found in the southeastern corner of the city, but there are few lakes - and the ones

that exist are small. The Silvola artificial lake is the biggest lake, and it was designed for the metropolitan area's water-management system. East Vantaa's Kuusijärvi is a well-known outdoor recreation and exercise area. <sup>4</sup>

*The 1960s saw the River Vantaa in a really bad condition because of, among other things, agriculture and industrial wastewaters.*

The 1960s saw the River Vantaa in a really bad condition because of, among other things, agriculture and industrial wastewaters. Furthermore, communities and scattered settlements played a major role in water pollution. In 2007 things are so much better and this recent pollution of the River Vantaa is, for the most part, a thing of the past. Environmental protection and water purification have succeeded in making significant changes. Vantaa's first water treatment plant was the Emscher well, completed in 1955. Vantaa gradually gave up water treatment plants of its own, and now the city's wastewater is directed to

the two neighboring cities, specifically to Viikinmäki water treatment plant in Helsinki, completed in 1994, and Suomenoja water treatment plant in Espoo, completed as early as in 1969. The City of Vantaa has acquired a share of both the above-mentioned water treatment plants. <sup>5</sup>

In 2007, Vantaa (Vanda in Swedish) has the fourth biggest population in Finland. This old Helsinge Parish changed its name into Helsinki Rural District in 1865 and further into Vantaa Township on 1 January, 1982. Vantaa became a city in 1974. Vantaa has experienced a breathtaking population growth (figure 2). The city's population is projected to grow strongly also in the future. <sup>6</sup>

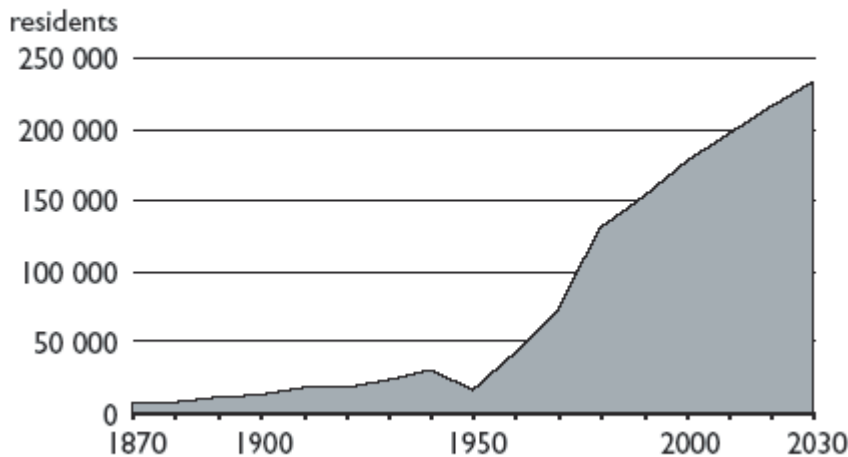
## MAIN STAGES IN THE DEVELOPMENT OF VANTAA WATER MANAGEMENT

The development of Vantaa water management can be roughly divided into five stages: <sup>7</sup>

1. Groundwater surveys in Vantaa conducted by Helsinki City Water Works. One of the most promising sites was later used as a groundwater intake basin in Vantaa.
2. Planning and debating water management in the 1940s and early 1950s.
3. Constructing the first stage in water management in the mid-1950s.
4. Dominance of groundwater from the 1950s to 1982.
5. Era of surface water, Päijänne Water Tunnel and intercommunal cooperation, 1982-.

Vantaa water management's long history gives an excellent example of water knowing no limits. As early as the late 1800s, Helsinki City Water Works conducted in-depth surveys of, for instance, the water in the Tikkurila area. A fine fountain was found there, which could have easily satisfied the metropolitan area's ever-increasing thirst. Nevertheless, Helsinki decided to keep on using surface water

## Population from 1870 up to a forecast for 2030



**Figure 2.** In the early 1980s, Vantaa had less than 5,000 residents. The change in the population took place in the 1940s, caused by an annexation in 1946 when parts of Helsinge Rural District (present Vantaa) were annexed to the City of Helsinki. Due to the annexation, the City of Helsinki quintupled the size of its area. In the annexation of 1946, Vuosaari remained part of the rural district, but was annexed to Helsinki in 1966.

as its raw-water supply.<sup>8</sup> This decision was due to a number of reasons, such as doctrinal disputes and making processing of surface water more efficient. The above surveys and decision were ideal for Vantaa's later needs. When decisions on Tikkurila water management had to be made half a century later, a good and well-examined supply was already known. Even though new surveys had to be made, a lot of time and money was saved thanks to the older ones. Historical data had been saved and was utilized.

Looking into the past when making decisions on the future is not made often enough. Past decisions, choices and rejections make an impact on the options we have at our disposal when making decisions on the present and the future. The people responsible for deciding on Vantaa's water management were far-seeing enough not to discard the earlier surveys and experiences, which translated into an immense aid in realizing the city's well-functioning water management. In the beginning, i.e. in the 1950s, Valkealähde was the best and most thoroughly researched water supply to satisfy the needs of the city's increasing population.

Also later on Vantaa has open-mindedly crossed municipal borders, when making wide-ranging policy decisions on water management. Vantaa participates in all large-scale water arrangements in the metropolitan region, for example, the Päijänne Water Tunnel and the Suomenoja and Viikinmäki water treatment plants, which are all clear examples of Finnish intercommunal water management. Vantaa additionally participates in Helsinki Water's water treatment plants as well as in

the railway municipalities' joint water-works system whose wastewater tunnel passes Central Vantaa on its way from Pihlajamäki pumping plant to Viikinmäki treatment plant.

Even worldwide, the Päijänne Water Tunnel is a massive project to which Vantaa committed itself from the very beginning.<sup>9</sup> In the long run, these kinds of voluntary cooperation arrangements, originating from the residents' needs, constitute the best way to implement intercommunal cooperation. Solutions based on coercion or external factors have often proven to be unsustainable; there are plenty of examples to be found from, for instance, the stock-exchange history over the past few years.

The future challenges of Vantaa Water consist of:

- Metropolitan area cooperation on water management: one giant plant or several independent ones?
- How can the soon-to-retire long-term professionals in water management be replaced?
- Water management under unusual conditions, preparing for risks;
- Climate change;
- Residents' increased requirements and population growth;
- Increased profit demands;
- Increased renovation work as networks age;
- Expanding the operations into small-house areas requires that investments be made worth at least €1,000,000 per year, until 2016.

Fourteen Vantaa water management professionals with extensive careers were introduced for this research. According to the interviewees, the most important future challenges include the following: maintaining Vantaa Water as Vantaa Water; increased need for renovations; access to trained and motivated personnel to replace retirees. That truly is a tall order!

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# Water – our common cause! 40 years of the Tuusula Region Joint Municipal Authority for Water Supply, Finland.

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Katko T.S. 2007.

Water – our common cause!  
40 years of the Tuusula Region Joint Municipal Authority for  
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Modified from the original summary chapter of the book: Katko  
T. 2007. Yhteistä vettä (Joint water). Tuusulan Seudun Vesi  
Kuntayhtymä 1967-2007 (The Tuusula Region Joint Municipal  
Authority for Water Supply). In Finnish, Summary in Swedish  
and English. 185 p. [www.tsvesi.fi/historia.htm](http://www.tsvesi.fi/historia.htm)



## BACKGROUND, GOAL AND IMPLEMENTATION

The Tuusula Region, north of the Greater Helsinki Area, Finland is best known domestically for the artist community that emerged there around the turn of the 20th century. The Tuusula Region Joint Municipal Authority for Water Supply (TSV) provides drinking water to consumers in Järvenpää, Kerava, Sipoo and Tuusula through an integrated pipe network (Fig. 1). At the beginning of 2007 the system included altogether 13 groundwater and artificial recharge plants, around 20 regulating and pumping stations, seven water towers, and 160 km of pipeline connecting built-up areas. The network supplies drinking water to 110,000 private users and, for instance, the Sinebrychoff Brewery in Kerava and the Ingman Dairy in Sipoo. Kellokoski Hospital and Mäntsälä City became regular customers along with the founding municipalities in 2001. The water and sewage works of the partner municipalities take care of water supply within their areas while sewerage and water protection are the responsibility of the Keski-Uusimaa Region Joint Municipal Authority for Water Protection.

*The first small, utility-type waterworks for Tuusula Region was built on the grounds of the Kellokoski Hospital at the end of the 1930s.*

The first small, utility-type waterworks for Tuusula Region was built on the grounds of the Kellokoski Hospital at the end of the 1930s. In 2001 ownership transferred to TSV. Another early water supply scheme involved the first water intake for Kerava township in the early 1950s. In the 1960s the Tuusula municipality began to build centralised water supply and sewerage networks for its commercial centres. In 1958 a field investigation was conducted around Hyrylä to find a source of water supply for Hyrylä and Kirkonkylä. The next year investigations and pumping tests concerning water intakes were launched in

Jäniksenlinna, Kellokoski, Rusutjärvi and Perä-Hyrylä. Water and sewer pipes were laid in Järvenpää already in the 1950s, if not earlier.

Joint municipal authorities for water supply have been set up for Finnish regions since 1954 when the Raisio-Naantali Federation of Municipalities for Water Supply on the south-western coast of the country was established (Stenroos, 1997). A similar federation was formed for the Tuusula Region towards the end of 1967. At the time, organisations based on wholesale water supply also started to emerge especially in the river valleys of Ostrobothnia. They operated as intermunicipal joint-stock companies instead of as joint municipal authorities.

The aim of this historical account of the 40-year history of Tuusula Region Joint Municipal Authority for Water Supply (previously a federation of municipalities) is not only to describe its gradual development, but also to set forth the joint municipal authority as an alternative for intermunicipal cooperation. The book (Katko, 2007) combines different types of materials. Initially 15 people involved in the development of the facility were interviewed. They represented elected officials of the authority, sector experts who had monitored the authority's development



**Figure 1.** Location of Tuusula Region Joint Municipal Authority for Water Supply in Finland.

as well as employees of the authority over the years. Key literary sources have also been utilised including the facility's annual reports, articles in trade journals, writings and presentations of staff as well as the informative collection of newspaper clippings and versatile pictorial material compiled by the facility.

### INITIAL PHASES OF THE FEDERATION OF MUNICIPALITIES

In 1964 the National Board of Roads and Waterways was assigned the urgent task of drawing a general plan for domestic water supply in southern Finland in cooperation with the region's municipalities and industry. In September 1964 negotiations on joint water supply between Helsinki Rural District, Järvenpää, Kerava and Tuusula began in Tuusula. In the third meeting it was proposed that Tuusula, Kerava and Järvenpää should constitute a separate northern planning area.

In 1965 an investigation was made of the region's groundwater resources. Tuusula was found to have the most untapped resources. Comments regarding the form of regional cooperation were requested from the Association of Finnish Cities and the Association of Finnish Rural Municipalities, both of which favoured a federation of municipalities. The Raisio-Naantali Federation of Municipalities for Water Supply probably served as a sort of model.

The Tuusula Region Joint Municipal Authority for Water supply is officially considered to have been established on 12.10.1967 as the charter of the federation was adopted. The facility was assigned the task of supplying water to member municipalities and acquiring water abstraction areas as well as building and maintaining water intakes and conduits. The federation was also to strive to secure the water supply of its members by searching for any possible groundwater



**Figure 2.** The 120-km long Päijänne Tunnel in 1977. Since 1982 it has supplied raw water to the Greater Helsinki Area, Finland including the Tuusula region. (Photo: TSV)

deposits and by participating in water supply schemes for southern Finland. The facility was to operate on a self-sufficient, non-profit basis. It was to charge the municipalities a cubic-metre price for water sold – a uniform rate.

The Tuusula Region Federation of Municipalities for Water Supply began operations at the beginning of 1968. Martti Myllyvirta, M.Sc. (Eng), was appointed as its first full-time managing director on 15.8.1968. The Fira groundwater intake plant was inaugurated in February and the Jäniksenlinna intake in November of 1970. Although the latter was, at the time, far removed from built-up areas, it was nevertheless already threatened by the nearby Terrisuo landfill.

### **THE PÄIJÄNNE TUNNEL AND ARTIFICIAL RECHARGE PLANTS**

In February 1971 the introductory meeting of the Päijänne Tunnel project was held in Tuusula as part of the general plan for water supply in southern Finland. In summer 1972, TSV became a shareholder in Pääkaupunkiseudun Vesi Osakeyhtiö set up to implement the plan. Tests were conducted in the Jäniksenlinna area to ensure that the water flowing through the tunnel could be processed into drinking water.

The 120-km long Päijänne Tunnel was built in three stages in 1973–82 (Fig. 2). On the completion of the second stage in 1979, water could be conducted via it to the Jäniksenlinna area for infiltration. The tunnel played a crucial role in the water supply of Keski-Uusimaa and entire southern Finland. Though water consumption forecasts were too high, water supply for the entire region could not have been secured reasonably by other means. (Harjula, 1982)



**Figure 3.** Use of spray irrigation as a recharge method in the Rusutjärvi area in 1998. (Photo: TSV)

However, in 1999 a cave-in occurred in the tunnel. The tunnel structure previously believed to be 100 per cent secure had to be renovated as to its upper section by reinforcements in autumn 2001. The tunnel proved not to be an everlasting solution. TSV was nevertheless able to supply water by special arrangements. The southern section of the tunnel is likely to be renovated in 2008.

#### **IMPROVEMENT OF TECHNOLOGY**

Since the establishment of TSV, the aim was to bring the water intakes within its operating area under the ownership of the federation of municipalities, which happened in 1986. TSV has developed different methods for treating groundwater and making artificial groundwater. Key methods in chronological order of introduction have been the VYR method, basin recharge (Saarinen, 1980), slow sand filtration (Hatva, 1989), limestone filtration (Rontu, 1992), spray irrigation as a recharge method (Fig 3), UV treatment and rapid sand filtration.

TSV has improved protection of its groundwater resources and wells as well as continually implemented expansions and modifications. In 2006 TSV sold an average of 24,260 cubic metres of water daily. Artificial groundwater was produced in Jäniksenlinna and Rusutjärvi; it accounted for 72 per cent of the total volume. (TSV, 2006)

TSV has used and developed automation systems which allow it to operate across an area measuring about 50 x 50 km. Its solutions include:

- I The Oy Siemens Ab remote monitoring equipment in 1972.
- II Hooking up with the Tuusula municipal-engineering radio telephone network in 1977.
- III A microprocessor system in 1983.
- IV 3rd generation software for the computer control room of the water supply system in 1987.



**Figure 4a, b.** Impacts of afforestation in the old Valtionummi gravel pit: in 1999 on the left and in 2006 on the right. (Photo 4a, left: TSV; Photo 4b: Tapio Katko)

V Own radio telephone frequency and renewal of radio telephone network in 1992.

VI New water-intake remote operation system in 1994.

VII Automatic groundwater level measuring system in 1998.

VIII Complete renewal of remote operation system in 1999 due e.g. to the Y2K problem.

IX Fire wall protection of information systems in 2003.

## STRUGGLE OVER GROUNDWATER RESOURCES AND AREAS

Since its early years, TSV has strived to protect groundwater areas from polluting activity by buying them and by reconditioning old gravel extraction areas. In 1981 there were plans to build a leisure centre for motor sports in the gravel pit next to

*In 1981 there were plans to build a leisure centre for motor sports in the gravel pit next to the Fira water intake which was successfully blocked in time.*

the Fira water intake which was successfully blocked in time. The Terrisuo landfill was a threat to the groundwaters of Jäniksenlinna already in the 1970s. After heated public debate, an order was issued to close down the landfill on 30.6.1987. Yet, Tuusula City Council gave permission to build a new landfill in the same area, which marked the beginning of a new lively public debate.

In March 1992 it was found that road de-icing salt posed a threat at least to the water intakes in Söderkulla and Koskenmäki. In 1993 the Söderkulla plant had to be decommissioned due to a high solvent content.

A sort of turning point came in August 1995 as Tuusula City Council decided to redeem the extraction rights of the Valtionummi and Terrisuo real property units. Towards the end of the decade refilling of old gravel pits and their reconditioning



**Figure 5.** Scrapbook of newspaper articles on TSV. (Photo: TSV)

by afforestation was launched (Fig. 4a, b). In September 2000 Uusimaa Regional Environment Centre awarded its annual environment prize to Tuusula Region Joint Municipal Authority for Water Supply. Thereby it received public recognition of its active work especially in the protection of groundwaters. During the writing of this, the most recent plans for protecting groundwaters are in the making. A nearly 40-year war, or at least a battle, has been fought to protect groundwater areas and to take them into public use. Future challenges will be posed by town planning and increasing traffic.

### **WATER USE IS BECOMING MORE EFFICIENT AND THE NETWORK IS EXPANDING**

In the early years, the specific water consumption of TSV (litres per capita per day) increased in line with the rest of Finland: in 1974 it reached 348 l/capita/day. Subsequently, it has decreased settling at 175 litres, which is about half of the maximum value.

Initially the pipes were of cast iron; today their share is just 10 per cent. The first plastic pipes were laid in 1971; asbestos- cement pipes were installed only in 1974–86. Especially since the late 1980s PVC pipes have increased their share which in 2006 was about three quarters of the pipelines in use. The structure of the trunk water supply network has changed from tree-like to loop-like, the latter being considered more reliable.

The combined storage capacity of the water towers under the responsibility of TSV in 2006 was 6,600 cubic metres which equals about 27 per cent of average daily consumption. The figure is quite low compared to other waterworks. In 2007 new water towers are under construction in Hyrylä and southern Kerava.

## **JOINT MUNICIPAL AUTHORITY AS AN OPERATOR OF PUBLIC WATER SUPPLY**

Until 1996 the council and board of the joint municipal authority were elected for four-year terms. Since then, the board has been appointed for two years at a time. The positions of elected officials at TSV continue to be held in high value and are sought after. A key form of operational development has been seminar visits primarily by the board. They have included tours of the target city waterworks, lectures on topical subjects and group work.

TSV has provided its staff opportunities to take part in training to improve skills and know-how. Representatives of the waterworks have actively lectured at courses and conferences. Since its first construction project, TSV has purchased design and contracting services, equipment and other services from the private sector on a competitive basis while also cooperating with the member municipalities. TSV has over the years participated in R&D projects both on the national level and at its own plant. In addition to the seminar trips abroad by the board, the waterworks has also established other international relations. In 1981 it joined the Finnish Water and Waste Water Works Association.

Social and recreational activity at TSV has been quite diverse considering the size of the works. Since 1968 it has systematically maintained a scrapbook of newspaper articles on TSV (Fig 5). It has traditionally hired pupils and students as summer trainees or to write their scholarly theses. Sector professional from Finland and abroad as well as groups of students and pupils have toured the works. On 23.3.1999 TSV was granted ISO 9001 quality certification as the first Finnish water utility.

The examples of the joint municipal authority's participatory and democratic decision making, expert visits to the facility, diverse social and recreational activity and related cooperation as well and proactive information activity and other visibility all reflect the strong spirit of togetherness within TSV.

### **KEY OBSERVATIONS**

The following emerged as the key long-term strategic choices or events based on interviews and conversations: I Location of groundwater deposits in the 1960s. II Laying of trunk pipelines: municipalities use them and pay a compensation for the use. III Uniform water rate. IV Raw water supply through the Päijänne Tunnel. V Joining of Sipoo in 1982. VI Purchase of water intakes from municipalities in 1986. The following key observations can be made about the 40-year development of TSV:

- (i) joint municipal authority is well suited for a geographic area like this where groundwater deposits are located on one side and water resources are in short supply elsewhere.

(ii) Decision making at TSV is and has been democratic. Water has not, however, been a party-political issue, but has been managed and promoted for the common good.

(iii) Development of technology and utilisation of automation are the key factors behind TSV being and having been able to operate across such a wide area.

(iv) The waterworks has always been run with a small staff.

(v) Critical views about groundwater protection have been voiced since the early 1970s which is why the waterworks has had to publicly defend its position on the issue despite the opposition of some member municipalities.

(vi) The waterworks has from the beginning bought a lot of design and contracting services and equipment from private enterprises based on competition.

(vii) TSV has engaged in active and proactive dissemination of information since the 1960s.

(viii) The joint municipal authority is an alternative for regional cooperation in water supply worth considering.

TSV draws most of its raw water from the Korpimäki pumping station in Nurmijärvi. In that same general area the Finnish national author Aleksis Kivi pondered the water supply of the day in the words of Lauri, one of the brothers in his novel "Seven Brothers", published in 1870: *"To my great relief, I've never been a thief; nor have I fouled a well in my life, or embraced another man's wife"*.

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# Local Conditions Need Local Solutions: Water and Sanitation Services in Vaasa, Finland from the 1700s to 2005

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Local Conditions Need Local Solutions: Water and Sanitation Services in Vaasa, Finland from the 1700s to 2005.

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## INTRODUCTION AND OBJECTIVES

This paper describes the evolution of water supply and sanitation in Vaasa, a small city on the western coast of Finland with some 57,200 people at the end of 2005. Since its earliest days, the city has been a major hub of commerce and shipping due to its favourable location. The sea has always offered the opportunity to communicate with overseas countries. The city's position at the narrowest point of the Merenkurkku Strait – with Umeå, Sweden just 80 km away – has enabled diverse and smooth co-operation for centuries (Fig. 1). Besides opportunities, the seaside location has also posed challenges especially to water supply and sewerage.

In 2006 the City of Vaasa reached the age of 400 years. A King's Manor was built by order of King Gustavus Wasa already in the 16th century on a site that was later to become part of the Town of Vaasa. The town itself was founded in 1606 by King Charles IX; Finland was part of Sweden at the time (and until 1809). The present city is situated some seven kilometres north-west of its original site. The old town was nearly completely destroyed by fire 1852 and rebuilt by decision of the Russian tsar some years later on the present site nearer to the sea. One reason for the new site was land uplift which made it impossible to use the old harbour.

The Bothnian Gulf area, where Vaasa is situated, is the epicentre of the northern European crustal area with a land uplift of about one centimetre per year. This results in constantly fluctuating surface and ground water conditions. The land has risen 250 metres since the last Ice Age and is expected to rise about another 180 metres in the future (Fig. 2). In addition to land rise, the so-called acid sulphide soils pose a special challenge to the coastal region. Those deposits formed during the Litorina Sea stage (7500-1500 BC) when temperature, salt content, and nutrient levels were higher than today (Voipio & Leinonen 1984). Sulphide acid soils often affect the quality of the region's ground water negatively. Thus, the geological history of the area forms an important framework for present and future development of water services.

In 2006 the region was added to UNESCO's World Heritage List, called as a High Coast/Kvarken Archipelago. The threshold level of the strait is about 25 metres at the writing of this history, but in the year 4600 – 2600 years from now – land uplift will have joined Sweden and Finland. The process will turn northern Gulf of Bothnia into the largest inland lake in Northern Europe that will seek a path toward the southeast and, finally, toward Lake Ladoga. This will take place on a geological time scale. The impacts of global warming prior to these events are another issue.

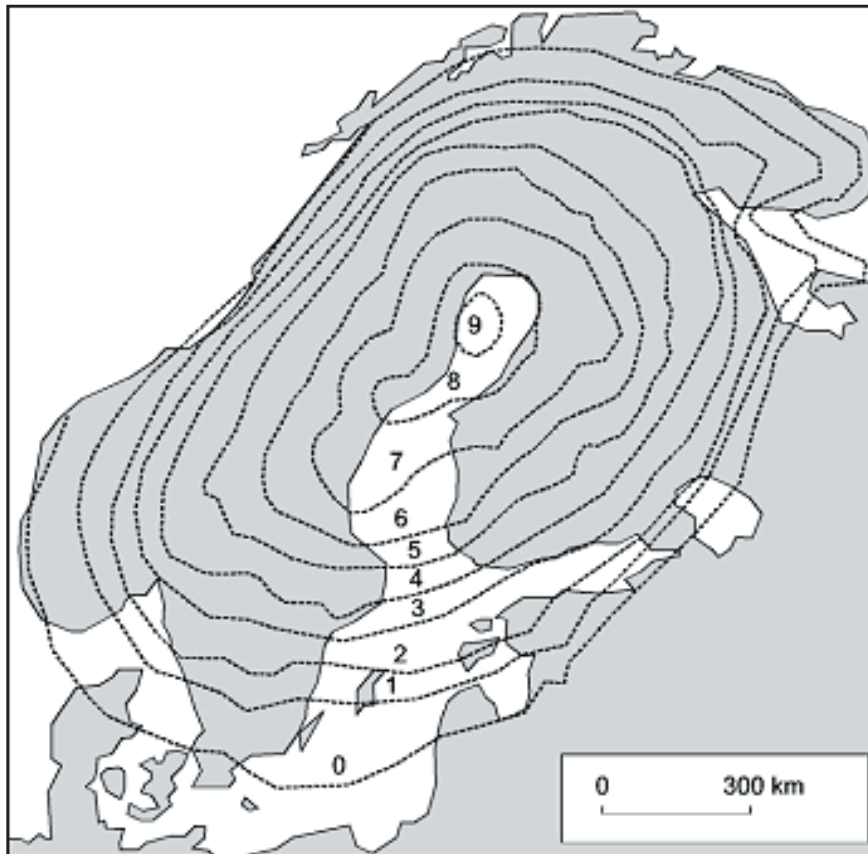
This paper is largely based on a recent book on the history of water supply and sewerage in Vaasa, finished aptly during the city's jubilee year. The book presents for the first time in a single volume the development phases of the city's water supply and sewerage over the 400 years of its existence. In addition to studying archives and conducting a literature review, the authors also visited the various



**Figure 1.** Location of the City of Vaasa on the western coast of Finland, with the key cities cited in the text.

facilities of the water company and interviewed altogether 28 persons: former or present staff of the Water Company and representatives of its collaboration partners. This made it possible to collect so-called tacit knowledge and to get a better understanding of the arguments related to key decisions over the years. The rebuilding of the city on a new site in the 1860s also provides an extraordinary opportunity to analyse the general conceptions about public water services in the 19<sup>th</sup> century and the practical role of water supply in the rebuilding of the city.

The City of Vaasa has expanded – most recently due to the merger with another municipality in 1973. Only as recently as 1940, the area of the city was less than a quarter of the present. The residential areas of Vaasa have expanded especially since WWII and the subsequent reconstruction. The development of the water and sewage works should also be viewed as part of this change.



**Figure 2.** Current annual land uplift in the Gulf of Bothnia region (mm); in Vaasa it is about 8 mm (Photo: Ekman 1992).

Vaasa Water Works can be considered to have commenced operations on 1.4.1915 when the entire system was officially inaugurated and a public standpost was taken into use in the market square. The Vaasa Water Works is the 14th oldest in Finland; Vaasa got its sewage works already in 1904 as one of the first 10 Finnish cities.

The boundary conditions for water supply and sewerage in the Vaasa Region are set by the described geological history involving land uplift, land use and, naturally, the available ground and surface water resources – in the vicinity of Vaasa as well as throughout the Kyrönjoki River Valley. Significant changes have occurred in the exploitation of water resources as to emphases and uses over a few centuries.



**Figure 3.** Ruins of old Vaasa after the Great Fire of 1852 (Photo: T. Katko).

### THE OLD TOWN: MEDIEVAL TRADITIONS IN WATER SERVICES

Most houses in the old town appear to have had a private well already in the 1600s. For instance, Magistrate Baltzar Baltzarson, who lived “below his means”, had a beautiful well in his yard. The 1658 inventory of property indicated that Chaplain Peter Jesenhausen even had a draw well in his yard. The 1695 inventory, again, showed that Niilo Maununpoika Kalm, a wealthy “shopkeeper, had both a well and a privy. (Luukko 1971, 536–39) Initially, each household was responsible for its own service.

In the days preceding the water works wells were not significant just as a source of water but also as meeting places and landmarks. The fact that they were marked on town maps also indicates their importance. For instance, a map drawn in 1750 by Town Surveyor Jonas Cajanus shows the public well located by the northern toll fence. Even private wells were occasionally marked on maps. (Luukko 1971, 29–52; Luukko 1979, 30–31)

It was quite common for houses in the town area to have cattle. During dry spells, when wells ran dry, people were offended by the use of the scarce water resources to water cattle. The following is an excerpt from a newspaper article which, despite having been written in the 1880s, aptly describes the problem: *“There is not a single well in town that provides truly clean and tasty water, and*

*there is no guarantee that the water in many of them is safe for kitchen uses and drinking by townspeople. Moreover, some (perhaps most) run completely dry in the dry season. No doubt, it would be better if the amount of clay mixed into the water was much smaller, and if it contained less matter originating from animals and plants. Yet, it is presently possible for anyone in Vaasa to freely draw any amount of water from any public well for any purpose. For instance, there is a story about a householder who drew [...] water from one of the best wells in a single day to water his nearby vegetable garden. Some use wells to wash their clothes, to water cattle, and for other major household needs – purposes for which other towns oblige inhabitants to fetch water from outside town limits, unless they have a well of their own [...]" (Wasabladet, no. 67, 25.8.1880)*

The population of the city was quite small at that time, meaning that nutrients were recycled for the most part – for instance, manure and human faeces were used as fertiliser. Minor problems must have occurred locally when the well had been dug too close to the cattle shed (Luukko 1979, 33–34) – it was typical of the times to fear especially diseases thought to be caused by offensive odours and vapours from rotting. Unorganised waste disposal and deficient street cleaning in particular contributed to the deterioration of the quality of domestic water and contamination of ground water.

At times wastes and surface waters also flowed into wells. The wells of the day were quite typical dug wells: they were often timber-lined – the square timber cribs were made with the same timber blocking technique as residential buildings and outbuildings. The dug well is still the most common well type in the world, albeit in its round form. (Juuti & Wallenius 2005, 14)

The bucket was the basic unit of water supply and waste disposal: it was used to carry water into the house and sewage out of the house. Fire-fighting water was also transported by bucket from the water source to the scene of the fire. That's where "bucket brigade" derives from. Such a system, however, becomes inadequate when a city starts to grow and population density increases. Vaasa experienced its first painfully concrete water shortage during the 1852 Great Fire (Fig. 3) when nearly all of old Vaasa burned, partly due to the lack of fire-fighting water.

## **NEW SITE POSES NEW CHALLENGES**

When a new site was surveyed for the town after the fire, special attention was given to an ample supply of water. Thus, the city plan also considered the needs of fire fighting. Especially the fire of Vaasa in 1852, but also the Pori fire the same year, contributed to the Act of 1856 which required nationwide adoption of the city plan system to prevent the spread of fire developed in the meantime. The main principle of the Act of 1856 was to divide a city into several smaller sections by planting protective zones of deciduous trees in between to make it easier to contain a fire within a zone. Fire safety was a major factor behind the division of the new Vaasa by 36 metre wide streets, lined with a minimum of two rows of

deciduous trees, into smaller sections, generally no larger than one half square kilometres. Blocks within the sections were separated by streets at least 18 metres wide, and in every other block plots were separated from each other by protective zones of deciduous trees. Generally, the protective zones were to form together a 12 metre wide belt which could be even wider at the centre line of the block. The buildings in the core city were to be, at least partially, of stone, and there were to be a sufficient number of wells and other sources of water equipped with lifting devices in each city sector. Yet, there is no mention of sewerage. (Juuti & Wallenius 2005, 14)

The new city was built on the Klemetsö peninsula seven kilometres northwest of the old town in 1862. The new location on the seashore was perfect for a seaport, but even though the city plan was drawn in accordance with the ideals of the day, water supply and sanitation was based on traditions and methods dating back centuries.

The local daily gives an even better description of the construction of the new city than documents of city administration. In 1855 it wrote: *“Clearing work started on 31st May last year. Drainage to dry out existing shallows, where water from higher ground collected due to moss growth and rotting trees, was launched simultaneously. [...] It was decided to build initially four public wells in locations deemed appropriate: one on the southern and northern sides of both the Market Square and the Church Square. The one on the southern edge of the Market Square is now finished and is an ample source of water [...].”*

The primary concern was land drainage and securing the availability of drinking water from public wells. Yet, the new Nikolainkaupunki (town named after Tsar Nicholas I; Finland was an autonomous Grand Duchy under the Russian Tsar in 1809–1917) did not have enough water for its population. Water shortage and contaminated wells started to pose a grave threat to the safety and health of the new city in the last decades of the 1800s.

*The primary concern was land drainage and securing the availability of drinking water from public wells.*

The newspaper Wasabladet was a keen observer of the situation and carried an article titled “Water shortage” where it pointed out that:

“Our city has not only had a shortage of the “noble” stuff – distilled spirits – but also of another liquid in short supply, namely potable drinking water. City wells have run nearly dry, and the water drawn from those few that still yield water has been thick and ill-tasting. As a result, vending of drinking water has increased, and people have been forced to buy water from as far

away as the old town. A snowy winter would solve this and many other problems [...]” (Wasabladet, no. 7, 13.2.1864)



Some years later the same local newspaper paid attention to the misuse of public wells (Wasabladet, no. 25, 19.6.1869): "It is said that the new well at the head of Sepäkyläntie street has been built improperly. Due to defective insulation horse manure and other less pleasant substances leach into the well. The number of wells in our city with potable water is so small that they ought not to be spoiled by slipshod work." Thus, new solutions were needed desperately and urgently.

## PIONEERING GROUND WATER USE IN FINLAND

The first comprehensive mappings of ground water resources and field investigations in Finland were conducted in Vaasa before the end of the 19th century. In 1901 a pilot plant was built for making artificial ground water with the help of domestic and international experts – also a first in Finland. Removal of iron was also tested in the same connection.

As early as on 18.11.1885 health authorities suggested to Vaasa City Council that a water pipe be laid from the place where test drillings had been made under the engineer Robert Huber. (Vaasa City Council, 18.11.1885, § 5) The only result was that a committee was established to study the water supply and the condition of wells in Vaasa. In February 1887 the council decided that the above-mentioned committee was to continue its studies and prepare a plan and cost estimate concerning rock drillings. (Vaasa City Council, 9.2.1887, § 2)

Based on the decisions of the city council, extensive ground water inventories were made in Vaasa from 1896 to 1897, presumably for the first time in Finland, and again at the turn of the 1900s and during the first years of the 1900s.

Most knowledge and expertise was drawn from abroad, mainly from Sweden and Germany, while some domestic experts were also used. At that time there were different, partly contradictory schools of thought on how to assess the safe yield of ground water deposits. There was the German-based school of Thiem using estimates based on soil transmissivity and the geological "bird's-eye-view" school. It is obvious that a combination of these two approaches could have yielded better results (Katko 1996). On the other hand, around that time chemical treatment methods had also been introduced which made surface water treatment a realistic alternative to ground water (Vaasa Health Board 1901; Vaasa Water Committee 1918; Juuti & Katko 1998, 101-108).

*Several top experts had studied the ground water situation in Vaasa.*

Several top experts, including the Germans Thiem and Printz and the above-mentioned engineer Gagneur, had studied the ground water situation in Vaasa. The last-mentioned described in 1916 how the geological conditions in Vaasa affected water quality: "Ground water in Vaasa has a high iron content. The iron would have to be removed by the old-fashioned open iron-removal system which provides no protection

*against water pollution – rather the opposite is true. On the other hand, I believe that if the water intake remains in its present location, the chlorine content of the water will reach a detrimental level.”* (Gagneur 1916)

The high iron content of ground water in Vaasa, which was probably the biggest problem, was known to Gagneur. It should be noted that Gagneur, who had worked for long as the city engineer of Vyborg, participated actively in the professional discussion about Vaasa’s water supply although no actual plans were commissioned from him. The same well-known experts designed the water works of most Finnish cities at that stage.

Gagneur was also a pioneer of public sanitation. He had familiarised himself with cities drainage systems and the operation of urban slaughterhouses, for instance, in Germany. As engineer and consultant for several cities, he had also studied the practical sides of issues and followed the political discussions related to projects. His active involvement with Vaasa can also be viewed as part of a wider discussion which sought to solve all – even social – problems of the city by drainage, waste disposal service and a new type of water supply and sewerage system.

## **PLANNING THE FIRST WATER WORKS**

The first ideas and plans for organised water supply in Vaasa were based on the use of ground water. During the first decade of the 20th century, people from Vaasa toured Europe to learn about the best and most widely known solutions to water supply and sewerage as well as corresponded actively with top international professionals. Domestic experts and their experiences were also used to advantage. Although there was cooperation especially with the Swedes and Germans since the early planning phase, a Finnish top expert was selected to oversee the building of the facility and to manage its implementation.

The manager of the first water works project, the engineer Kaarlo Tavast, had prior to coming to Vaasa gained the necessary experience in cities like Vyborg and Lahti. Since the first utility in Vaasa was a pioneering undertaking as to many of its solutions, problems were faced frequently. Thanks to his valuable international and domestic networks and know-how, Tavast was able to overcome the construction-phase difficulties that at times appeared unsurpassable. On its completion in 1915, the water works incorporated the leading edge solutions of the day.

## **FIRST PLANS FOR SEWERAGE AND SOLID WASTE MANAGEMENT**

As the search for a solution to the water shortage continued, the problem of what to do with solid wastes and waste water also came under scrutiny. In 1889 the city council invited the city engineer of Helsinki, O. Ehrström, to prepare a plan for a sewer system covering the entire city. That is why Ehrström visited Nikolainkaupunki in early summer. His visit resulted in a plan that suggested

chanelling all streets in the city. Tenders for implementing the plan were invited from Finland as well as several European countries including Germany, England and Sweden. (Wasabladet No. 99, 11.12.1889)

A proposal for a waste disposal system had been made in Helsinki already in 1878 by the then city engineer Tallqvist. It suggested that a sewerage system be built and collection of solid wastes be organised. For the first time in Finland, the plan brought to the focus of attention the two opposing ideas in the European waste disposal debate: the barrel system and the water-flushing system. In both cases the primary question was how to handle the human excreta. The following debate regarding waste disposal highlighted all the elements included in the complex group of factors which influenced the choice of a sanitation system: the etiological motivation, the economic context, changing opinions regarding the pollution of water, waste disposal practices and technological development. All these elements came up also in the Vaasa discussions (Nygård 2004).

The lessons learned from the Helsinki sewer system were, however, utilised elsewhere in the country, and Helsinki city engineers were used as experts, for instance, in Vaasa. The key parts of the Vaasa plan prepared by Helsinki city engineer Ehrström were also published in *Wasabladet*. His plan reflects the discussion about the right shape of sewer pipes going on in Europe at that time: *"[...] clay pipes available in Germany and England as well as Sweden. [...] yet, it is worthwhile buying them [...] from Stromberga in Sweden despite their slightly higher price compared to commonly available English pipes. These pipes are round, and I have suggested using them up to the size of 18 inches, but not larger, since pipes of larger cross section are so flexible at the bottom that, in the worst case, they will do not flush themselves or accumulate sediments. In areas with greater discharge it is necessary to use egg-shaped pipes with the narrower end downward which keeps the bottom clean even with a smaller water volume – as during dry periods. Pipes like this can be laid of iron reinforced cement bricks; today concrete blocks may also be used since they cost no more, or even less, are highly durable and easier and quicker to lay as their production length is 3.5 feet. In general, they save time and labour. There is presently a factory owned by Helsingin Sementtivalimo manufacturing a wide range of sewer pipes, and it is willing to work also in other regions. At their request I have designed three different egg-shaped pipes for sewers that need piping in excess of 18 inches in diameter."* (Wasabladet No. 99, 11.12.1889)

Thus, the plan did not consider the cheapest pipes, but Ehrström decided in favour of the so-called Chadwick model, that is, modern egg-shaped or oval pipes. The plan also included preparations for rain water removal.

*Any city with a water main could build a water closet system.*

Any city with a water main could build a water closet system. A debate about the introduction of water closets in Finland started during the 1880s, and they were accepted 20 years later. The debate in Finland was marked by the same opposition as

elsewhere in Scandinavia: the people who were for the system praised its cleanliness and comfort whereas the opposing side highlighted the risk of contaminated waters and also pointed out that the farming community needed manure. However, the 1895 building by-laws of Helsinki paved the way for the water closet although the restrictions on the construction of water closets limited and postponed the introduction of the system. At the start of the 1920s water closets were still banned by a few cities (Nygård 2004).

In 1896 a committee appointed by Vaasa Technical Society submitted its report concerning the establishment of a public sanitation facility for the city. The committee considered the water closet system the best solution but noted that it would be feasible only after a water works is built. That seemed “hopelessly far in the future”. Instead of the best alternative, the committee suggested a system where the wastes of different households are hauled in barrels to dumps and the barrels are disinfected after emptying. Wastewaters were to be led into a sewer where possible. The City Building Code stated that a privy or the manure shed of a stable or animal shelter, or any other outhouse emitting foul odours, must not be built along avenues, treeless streets, market places or other public places. Spouts, pipes and culverts from porches, kitchens, baking rooms, washhouses and workshops discharging dirty water onto streets or into gutters were banned altogether.

In addition, the committee stated: *“All outbuildings that include a stable and animal shelter and a privy and a waste shed, made of logs or planks, are to have a properly built and plastered foundation wall on the side of the neighbouring plot, and the walls must also be tight enough to keep any impurities from escaping to the neighbour’s side.”* (Vaasa City Council, M Collection, Water works, report of committee established by the Technical club concerning organising of sanitation in the city, Vaasa 28.2.1896)

In theory the sewer system had no practical connection to the handling of waste. Sewers were meant only to facilitate the drying of soil and removal of surface water. Yet, in practice, excrement was being discharged into the sewers. This practice based on convenience led to abuse of the water supply and sewerage system which, in turn, led to the biggest problem related to the waste disposal system – the exclusion of the handling of human excreta from the administrative and practical functions which constitute waste disposal (Nygård 2004).

*... old attitudes  
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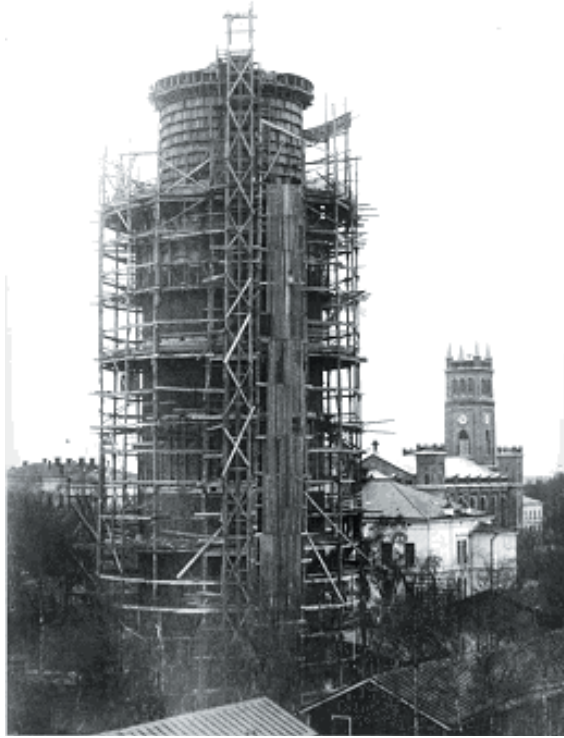
Although Ehrström’s technical solutions were up to date, old attitudes and doctrines remained deep-rooted. The above quote and the understanding of the origin of diseases that can be read between its lines are consistent with the miasma theory. The bacteriological view of the origin of diseases took another few decades to win over the professionals, and considerably longer in the case of laymen.

Although the theoretical background of the problem was not the most modern possible, the solutions leave no room for complaint: *”The situation can be ameliorated by building sewers to collect most impurities. Even if liquid impurities are collected in cesspools, ground and rain water nevertheless end up in pits and leach from them into the environment, which is why they should be kept as dry as possible. Impermeable pit latrines dug into the ground are out of the question in preventing impurities from leaching into the environment and water from leaking in since they have already been generally rejected for many reasons. It is impossible to make them impermeable enough since the impurities accumulate into a substance that quickly corrodes cement and asphalt and other possible materials. The best acknowledged way to collect, transport and utilise impurities is to separate them by type: human faeces, cattle manure, trash and kitchen refuse. Appropriately planned, it does not involve especially high construction or maintenance costs, and a cheaper procedure can be followed initially if there appears to be too little time for complete overhaul [...]. This procedure would involve collecting faeces, kitchen refuse and trash into above-ground wooden boxes that could then be placed over filled up pit latrines. The boxes could be made smaller than the privies used today which have to be emptied often; then the emptying process would not be as unpleasant and costly since all liquid impurities would go directly into the sewer and the solid impurities in the boxes [...].* (Wasabladet No. 99, 11.12.1889)

Separation of different types of wastes and faeces was sensible and well grounded. The suggestion was workable also with respect to privies as it called for separation of urine and solid faeces. In this respect Ehrström’s plan reflected the trends of the times in Europe and America. An entire sewer system was, however, a huge undertaking that would not come cheap according to him. Ehrström also suggested that the location of the sewer should be considered already when selling new plots to have them in the best possible position with respect to the sewer line.

Everything indicates that Ehrström was well aware of the international reform movement launched in England aimed at improving the hygienic conditions of cities. Different sections of his plan reflect the principles of the movement’s spiritual father, Edwin Chadwick, for flushing filth out of the city through sewers. He also espoused the ancient concept of the origin of diseases based on the miasma theory, still dominating at the end of the 1800s. The measures suggested in the plan as such were not flawed although the theory behind it was. Construction of the sewer system began as planned in 1889. The work was considered finished in 1904 – 15 years later. Yet, the quality of well water did not improve, and the bay where wastewater was discharged also started to get polluted. Vaasa was the eighth city in Finland to receive a sewer system.

The waste disposal and cleansing solutions were borrowed from Sweden since there was a long-standing close relationship between the cities and people of the two countries. Both countries had similar legislation, and their local government acts were almost identical. Through technical literature and educational visits



**Figure 4.** The water tower of the first water works under construction in 1914. It has been in operation since its completion. (Photo: Vaasa Water)

physicians and engineers of Vaasa gathered up-to-date information on the progression of Swedish waste disposal systems. Sweden was seen as the pioneer in Scandinavia, and the waste disposal system of, for instance, Denmark was considered to be of a lower standard. Thus, it can be said that European ideas and methods for cleansing were adapted to Nordic circumstances in Sweden which is why they could also – at least theoretically – be copied almost as such in Finland.

#### **FIRST WATER WORKS AND TURNING TO THE SURFACE WATERS OF KYRÖNJOKI RIVER**

One of the conditions of the General Fire Assistance Company, when granting Vaasa a loan of half a million marks for laying a water pipe, was that a water tower of 500 cubic metres be built high enough for the top water level to be 55 metres above the mean sea water level. A design competition was organised for the water tower which attracted a total of 66 proposals<sup>1</sup>. That is Finnish, if not also a world record. The panel of judges placed first the proposal by Jussi Paatela and Toivo Paatela (Fig. 4).

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<sup>1</sup> According to Kallio there were 64 proposals. Kallio 1914. 39-40, bilder 32-38.

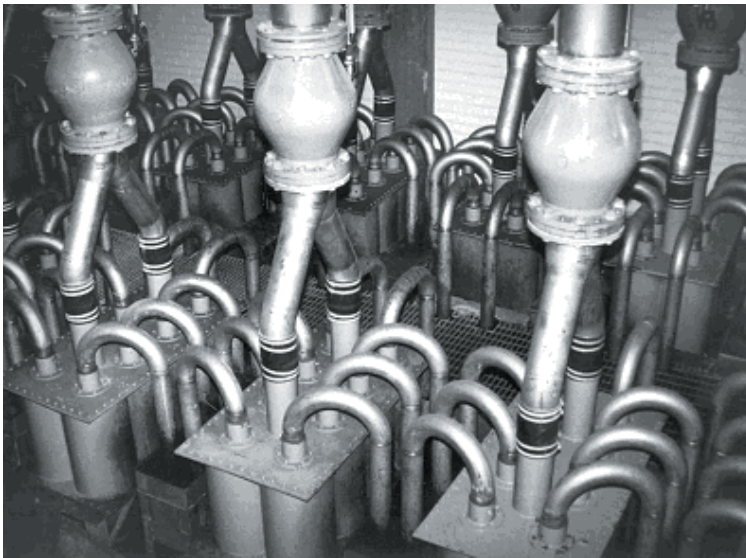
Water shortages were not totally eliminated in Finland by the introduction of modern water works. For example, there were problems with water quantity in the 1920s in several cities such as Vaasa, Turku and Porvoo during dry summers. The dry summers in 1941–1942 also caused shortages (Stenroos et al. 1998, 89-98; Juuti et al. 2005; Juuti & Katko 2006.; [http://www.fmi.fi/saa/tilastot\\_99.html#6](http://www.fmi.fi/saa/tilastot_99.html#6)).

Ground water conditions in Vaasa are a challenge; especially dry summers have often been problematic. For instance, in 1940 there was a severe water shortage. Water was drawn from Kyrönjoki River for the first time towards the end of 1952 to ease the situation. The quality of the water left a lot to be desired, but as consumption increased steadily, the residents were happy just to have sufficient supply. Water consumption started to decrease only after the oil crisis of the early 1970s at which time attention shifted more to quality. Kyrönjoki River was at the time a quite poor source of raw water as untreated or insufficiently treated wastewaters were discharged into it, and sludges and other loading leached from fields, in the upper reaches. The situation with Kyrönjoki River started to improve in the early 1990s. The slow-filtering unit and the pre-precipitation of raw wastewater implemented in the early 1990s as well as diversion of part of the surface runoff from the natural discharge area of the Pilvilampi Pond improved raw water quality essentially. More effective protection of the waters of Kyrönjoki River also improved the situation for Vaasa. The city's treated drinking water has ever since been as good as that of any other Finnish water works.

Mankind has impacted water bodies in several ways. In Ostrobothnia, rapids have been cleared, lake water levels lowered, structures for floating logs, mills and power plants have been built, embankments have been raised along shores, channels have been straightened, artificial lakes have been built and water flow regulated. As the needs of society and people have changed, earlier ways of doing things have been given up partly or totally. Table 1 summarises the main water uses from water mills in the 1500s to raw water source for Vaasa since the 1950s.

**Table 1.** Use of Kyrönjoki River waters from the 1500s to the 2000s.

Period	Main water use
1500s to 1950s	Water mills
1700s	Tar production and transport
1700s to 1900s	Timber floating
1800s	Lowering of lake levels
since the 1910s	Hydropower
late 1800s to 1980s	Drainage of swamps and forests
1900s to 2000s	Peat production
1953-2004	Hydraulic constructions on Kyrönjoki River
1952-	Raw water supply for Vaasa



**Figure 5.** Multistage pressure swirl concentrators specially designed by Seppo Rynnänen for Pätt wastewater treatment plant. They were in operation from 1985 to 2001. (Photo: Häkkinen et al 1987)

### NEW INNOVATIONS

Water supply and sewerage networks expanded strongly in the 1950s and '60s. At the time sewer pipes were still mainly of concrete while water pipes were Mannesmann pipes. The precursor to KWH-Pipe in Vaasa, Wiik & Höglund, started to manufacture plastic piping already in the 1950s. Vaasa was among the first cities in Finland to switch rapidly to the use of plastic piping in the 1960s since it was available nearby and easy to procure. The first plastic pipe was laid in Vaasa in 1964, and already at the turn of the 1970s all service pipes were built of the material. For instance, Helsinki introduced plastic pipes only decades later in the early 1980s. Finland is a leader in the use of plastic piping, and far ahead of Sweden, which has often been quicker to adopt new practices. Renovation of networks has gradually increased in the last few decades.

The water supply network incorporates a ground-level reservoir built in 1968 that is an exceptional solution in Finland. A few years earlier plans for a new water tower intended for Palosaari were commissioned from architect Viljo Revell. Yet, the idea was abandoned and a ground reservoir built in its stead – largely due to the high level of know-how that local industry has concerning various electrical, automation and pumping technologies. The imposing 500 cubic metre water tower in the Kirkkopuistikko Park (Fig. 4) nevertheless remains in use.

Wastewaters were a problem already at the beginning of the 1900s and contaminated Onkilahti Bay quite badly. The first quite modest treatment plant erected in Hietalahti Bay in 1953 served until 1973. One of the biggest changes in the history of the works was the inauguration of the Pätt central wastewater treatment plant in 1971 next to the sea shore (Fig. 6). Subsequently, gradually increasing amounts of wastewater were led to the Pätt plant while several smaller plants in Vaasa were decommissioned.



Vaasa has been known for brisk action, especially in introducing new technology, know-how and materials. For instance, Vaasa was among the first to use plastic pipes, inspect sewers with TV cameras and reline existing sewers. Technical solutions have been developed together with companies. For example, flushing with compressed air was started with the equipment of a private company – later the works purchased similar equipment. The first prototypes of the fire water stations installed on bigger distribution and transmission lines to replace conventional small fire hydrants were built in Vaasa and quite soon entered industrial business-driven production. One unique example were the pressurised multistage swirl concentrators designed for grit removal in pre-treatment of sewage (Fig. 5). The centre of Vaasa still has combined sewers which is why the amount of grit discharged with the inflow to the plant has been remarkably high.

The innovativeness and strive for thought-through solutions of the early days have survived until today and exist on every level of the organisation. In the late 1990s excess sludge from the wastewater treatment plant was taken to Stormossen solid waste station; it had one of the first underground anaerobic reactors in the country for solid waste treatment.

Fig. 6 shows the overall cycle of Vaasa water. Raw water is pumped from Kyrönjoki River, except during flood peaks that typically occur in spring. In Kalliolampi pond the water is pretreated chemically while it is stored and partially aerated in Pilvilampi pond, before conveying it to the actual treatment plant. The treatment process itself has developed over the years. In the early 1990s slow sand filtration was introduced for tertiary treatment and removal of tastes and odours, while more recently a modern high rate flotation system was introduced to replace the earlier upflow clarification. Water is distributed through the supply network, and pumping stations pump wastewaters to the Pätt wastewater treatment plant, with the final. Several small water associations established and promoted earlier by the city have gradually been taken over by Vaasa Water. Since the late 1970s the city has also entered into bilateral agreements for buying and selling water and receiving wastewaters for treatment from her neighbouring municipalities.

## **DISCUSSION AND CONCLUDING REMARKS**

Past success does not eliminate future challenges. Many problems that caused headaches historically still remain. For instance, ground water and artificial recharge were debated vehemently already a hundred years ago. Yet, they remain topical issues, even nationally. Managing Director Ilkka Mikkola said it in a nutshell: "Some think that the solution is to substitute ground water for surface water. It's not that simple. Ground water abstraction must not be an end in itself. The main thing is to supply people with water of good quality."

The future of wastewater treatment remains a key challenge of the future. The extent of required nitrogen removal remains to be seen. The largest mass of assets owned by the water works, the network, requires constant maintenance and



**Figure 6.** The overall cycle of water through the water supply and sewerage systems of Vaasa in 2005.

renovation which requires trained and motivated personnel. Yet, people fresh out of an educational institution are not able to run plants and maintain pipe networks. The same applies to management.

Vaasa is a city nearly 400 years old but still mentally alert. Its readiness for action and energy equal those of a person having just reached middle age while its experience matches that of an elder statesman. That is a good combination – the long and illustrious history is to be seen as a strength, not an impediment. Vaasa has remained dynamic through active relationships, commerce, shipping and other forms of contacts. The townspeople have also valued acquisition of knowledge and education throughout the city's history. Even water supply and sewerage have been international from the very beginning. Prior to the launching of the actual planning of the water works, the foremost experts in Europe were engaged to assess the ground water resources, reasonableness of the preliminary plans and implementation possibilities.

Local conditions have posed tough challenges for environmental services in Vaasa. Especially in the case of water supply, the city has been forced to develop new means of ensuring a sufficient supply of quality water for its inhabitants.

Early artificial water surveys, utilisation of water from Kyrönjoki River and daring experimentations with new materials and methods are an indication of innovative adaptation to difficult conditions.

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## PART 2

# National and regional development

*“Battles over water in the west are always about something more. At their most elemental, they are about survival.”*

Bettina Boxall, 2007



**Figure.** Water tower in Budapest, Hungary.  
(Photo: T. Katko 2005)



# Revisiting Private Water Proposals and Concessions of the 1870 and 1880s in Finland

Petri S. Juuti, Tapio S. Katko & Jarmo J. Hukka

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Revisiting Private Water Proposals and Concessions of the 1870 and 1880s in Finland

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## ABSTRACT

The paper questions the ethics of buying and reselling the concessions of water undertakings at the expense of consumer-owners. In Tampere, in 1866, an industrialist proposed a concession which would have provided him a good guaranteed return with the town assuming all risks. In Helsinki, in 1871, a concession of 75 years was signed with a private businessman. He did not even try to start operations but sold the concession further to a German company making a fortune. Due to the European-wide recession, the city bought back the concession. In 1885, the same entrepreneur got the horse-driven tram concession – tried this time to operate it but was unsuccessful. Some 110 years later several donors started to promote the idea of water concessions and other private operating contracts as a “new innovation.” By the early 21st century, it became clear that private water multinationals are not willing to take the risk of making such investments in developing and transition economies. Before making such strategic decisions cities should make proper feasibility studies and compare the pros and cons of various options.

## Keywords

Privatization, concession, water history, water policy, Finland

## INTRODUCTION

In the 1860s, Finland still had no modern waterworks. Water was drawn from wells and natural sources, including “holes” cut in ice in the winter. Yet, in those days the population of urban centers was increasing due to migration. This, together with the start of industrialization, created demand for basic infrastructure as well as development of municipal administration. Due to the wooden houses typical of those days, piped water supply in Finland was required first and foremost for firefighting (Juuti, 2001; Hietala, 2002) although the need for good household water and a healthier environment also helped create the demand for these services. The latter factors were relatively more important e.g. in England and the continental Europe especially in cities with much higher population than those in Finland that time (e.g., Goubert, 1989).

The objective of this paper is to discuss several private proposals and granted concessions for establishing waterworks in the biggest Finnish cities of those days, Tampere and Helsinki, as well as their consequences. The paper refers to decisions, arguments, and policies that largely resemble those presented over one hundred years later, in the 1990s, when privatization was again promoted. However, the objective of this paper is not to compare economic or other performance of various undertakings, but particularly to question the ethics and feasibility of selling and reselling the concessions or ownerships of water undertakings.

In this paper, a few early private proposals on concessions in the late 1800s are first presented. Thereafter, the case of concessions in Helsinki from the 1860s to 1880s are described in more details, followed by discussions in the 1910s and more recent examples in the 1990s. Although the examples from Finland are not necessarily applicable as such to other countries, public ownership of water utilities is argued to be a sustainable principle.

## EARLY PRIVATE PROPOSALS

In Tampere, the growing and later the leading industrial centre of Finland, the industrialist William von Nottbeck offered to build a water pipe at the request of the municipal authorities in 1865. He proposed that a wooden pipe be constructed from Mältinranta at the head of Tammerkoski Rapids to the Central Square at a cost of 7,500 silver roubles (105,000 euros). In his second proposal, a network covering the whole town would have cost 28,000 roubles (400,000 euros). He was then asked to submit his conditions for running the water supply. These conditions, consisting of ten paragraphs, actually meant that the industrialist would make a tidy amount of money and the town would take all the risks (Katko et al., 2002).

Although the implementation of the plan would have been a considerable financial risk for the town, revenue from the planned water pipe would have been only a tiny fraction of the enormously rich aristocrat's income. His dividend income alone was in six figures at that time (Juuti and Katko, 1998). The town decided, however, not to accept his offer and started developing the waterworks as part of the municipal administration (Katko et al., 2002).

*A similar proposal was made in Sundsvall, Sweden, in 1874.*



A similar proposal was made in Sundsvall, Sweden, in 1874. Industrialist J.W. Bergstrom from Stockholm made an offer to build a water pipe for 250,000 rikstaler (5 million euros). The town, however, approached J.G. Richter from Gothenburg and asked him to make a plan for both a water pipe and a sewer. On the other hand, in Linköping, another Swedish town, a private water system was constructed in the 1870s based on a 30-year concession. There may have been a few similar

arrangements in other Swedish municipalities, but the works have for the most part been under municipal administration including Stockholm as early as in the 1850s (Isgard, 1998).

## THE CONCESSIONS IN HELSINKI

In 1812, Helsinki became the capital of Finland that was an autonomous Grand Duchy of Russia, from 1809 till 1917, when the country gained independence. In 1866, a proposal for the establishment of Helsinki waterworks was made, originally at the request of the Senate. Later, the entrepreneur W.A. Abegg from St. Petersburg offered to implement the approved plan making his offer in 1868.



In his offer, Abegg wanted to receive annual payments from municipal and government authorities and the university. During the first ten years, Abegg would have received 280,000 in today's Euros annually, then 266,000 Euros for the next five years, and another 248,000 Euros for another five years. Besides, he suggested that he would have the water distribution monopoly for 50 years (Anon, 1875a; Herranen, 2001).

At this stage, city officials decided to accept the proposal while the university was against it. The university consistory argued that an annual bill of 25,000 in today's Euros was too much for the university while the other clauses of the proposal were not that good either. But if the city itself would assume control and ownership of the waterworks, the university would accept the annual payments (Anon, 1875a; Herranen, 2001).

In 1870, Abegg made another, revised proposal (Anon, 1875a; Herranen, 2001). The conditions of this proposal, however, were even more binding: now he wanted a water monopoly for 75 years. This time there was no request for annual payments but the concessionaire was to collect consumer fees only.

*After lengthy negotiations the town signed a concession with Abegg on February 22, 1871.*

After lengthy negotiations the town signed a concession with Abegg on February 22, 1871. The contract was very detailed. The list of conditions with 28 paragraphs considered all potential major risks, for example paragraph five stated: "Should a fire break out, the concessionaire has the right to stop distribution of water until the danger has passed" (Anon, 1875b). In accordance with the agreement, the concessionaire undertook to build a water pipe. He was also given a special permit to distribute water against payment.

## **PRIVATE CONCESSION SOLD FURTHER**

In 1871, the concession was given for 75 years. But before starting the construction of the works, Abegg sold the concession to the Neptun Company based in Berlin in the summer of 1872. Abegg made quite a fortune, since Neptun paid him about 540,000 today's Euros. (Anon, 1875a). Eravuori (1976: 13) noted that "for reasons not quite clear, Mr. Abegg handed over the concession."

Newspapers ran numerous articles on the waterworks issue. Herranen (2001) points out how the city's Swedish newspaper *Helsingfors Dagbladet* and the local government supported enthusiastically this private waterworks, while the Finnish newspaper *Uusi Suometar* was strongly against it. The Finnish speaking population of Helsinki was intentionally excluded from the discussion, since all official papers and reports that time were still in Swedish, the dominant administrative language of that time. Politics played a big role and the newspapers were bitter competitors (Anon, 1875a; Herranen, 2001: 24-25).

## BUYING BACK THE CONCESSION

Under the direction of the engineer Robert Huber, the Neptun Company started to construct the waterworks. Yet, due to the European-wide recession, the project could not be completed within the agreed time (Norrmen, 1979; Turpeinen, 1995). Neptun faced financial difficulties and had to stop its water pipe construction in several towns including Helsinki, where the construction halted almost completely in 1874. Consequently, the company submitted a proposal to the municipal authorities, promising to assign ownership of the already completed works and the concession to the town for compensation. The company was willing to finish the work under certain conditions, if an agreement could be reached. It proposed 6.7 million in today's Euros as the price of the completed water pipe. After long negotiations, the town bought back the concession and the water pipe for 4 million in today's Euros, while the company made a commitment to complete the construction work (Waselius, 1954; Norrmen, 1979).

At first, Neptun operated the waterworks and was paid by the town. The company also got a monopoly to build house connections and, together with three other companies, a monopoly for plumbing installations. In 1879, the company established a special plumbing unit which was the beginning of the Huber Plumbing Company. Yet, in July 1880, the town of Helsinki assumed the operational responsibility for the water pipe which ended the company's monopoly and the agreement. The operation of the works was now given to Robert Huber, the former Neptun local director, for an agreed annual payment. Huber took care of the works operations until December 1882, but in the beginning of 1883 the town started to operate the system (Lillja, 1938; Herranen, 2001).

In a sarcastic article dated May 14, 1875, *Uusi Suometar*, the local newspaper, put the whole Abegg adventure in its right place:

Before we start to evaluate this contract, we must tell our readers, that mister Abegg has nothing to do with the whole matter anymore. When he had signed the contract, he left the country and sold his right to build the waterworks to a German company called Neptun for 150,000 marks [authors note: 500,000 in today's Euros]. That was indeed a good deal at the expense of the stupid Finns. As we innocently wondered about Mr. Abegg's generosity, who wanted to build a waterworks for us, Mr. Abegg explained to his fellow citizens in Berlin the real nature of the contract. As a result of his convincing story he was paid 150,000 marks [500,000 in today's Euros] for that piece of paper. We think that this minor deal will encourage Mr. Abegg also in future to let us enjoy his company here and to provide similar piped water services for other Finnish towns, too.

In spite of these, at least from the public's point of view questionable experiences, politicians seem to have short memories. Abegg was active and successful also in other sectors in Helsinki: he was one of the owners of the Helsinki city tram monopoly. In this quite similar case, Abegg and his partner got the horse-driven

tram monopoly for 30 years in 1885 – just thirteen years after he had sold the water concession. Yet, this time they did not sell the rights immediately further but tried indeed to start city traffic services by themselves. Since they did not get it started, the city of Helsinki cancelled the license in 1888.

The factors that created the demand for improved water and sanitation in Finland can be summarized by the need for fire-fighting water, safe drinking water, and improved health conditions, while the emphasis in many Central European cities with higher population rates was more on the last factor.

The Local Government Act enacted in 1876, followed by the Health Decree in 1879 made the cities plan and later implement water and sewerage systems. This happened in Finland a decade or so later than the establishment of the first urban water and sewerage systems first in England, followed by Germany and France and later by Sweden. When planning these systems Finnish experts established quite active contacts with these countries and also foreign advisors and experts were invited to the country. (Hietala 1987; Laakkonen et al., 1999; Juuti, 2001).

*The issue of water and sewerage services was probably considered more as a practical than ideological question.*

Compared with England and continental Europe, a respective debate on “municipal socialism” in Finland cannot be traced. The issue of water and sewerage services was probably considered more as a practical than ideological question. The question of establishing country’s first industries since the mid-1800s, basic infrastructure systems in the 1860s, and gradually the national identity took the major interests. While the health legislation seems to originate from the English and later Swedish tradition, municipal legislation is closer to the German tradition (Nygard, 2004).

## **SOME LATER EXAMPLES:**

### **Discussion in 1912**

Three decades later, at the first Finnish Municipal Days in Helsinki in September 1912, Bernard Wuolle, then the Managing Director of Helsinki Electricity Works, gave a speech, in which he described municipalities, technical enterprises, and technical basic services (Wuolle, 1912; Hukka and Katko, 2003). Wuolle dealt with municipal business activities, especially the centralized management and delivery of water, lighting and energy, tramlines and town railways. According to Wuolle, waterworks differ from the other activities “especially in that in their establishment the main emphasis is not on economic viability or, at least, they are not absolutely required to make a profit, but the emphasis is on their health impacts and other indirect benefits.”

In 1912 there were 24 municipal and 15 private electricity works in Finnish towns. The private electricity works bought electricity from nearby industrial plants and distributed it only to a few private customers. According to Wuolle, many of the municipality-owned electricity works were originally privately owned and were bought by towns only in the early 1900s. In addition, Wuolle states that the general trend in the beginning of the 1910s was towards municipalities taking over both gas and electricity works and tramlines, or at least the delivery of gas and electricity in their areas. (Katko and Hukka, 2002).

In many countries, e.g. England, establishment of modern water systems was largely based on private initiatives. Yet, the evidently unsatisfactory nature of private company supplies led to a re-evaluation of the organizational means (Hassan, 1998: 18). From 1861 to 1881 the share of municipal water supply in larger provincial towns in England grew from 40 to 80 per cent, and reached some 90 per cent in 1901.

### **Cases from the 1990s and early 2000s**

In the 1990s, some 120 years after the first deal of Abegg and some 80 years after the speech by Wuolle in Helsinki, several donors like the World Bank started to promote the idea of water concessions and other private operating contracts as a “new innovation.” In the 1990s, there were several such experiments, particularly in Latin America, but later also in other parts of the developing world and transition economies. It can be argued that this was the result of the so-called “Washington Consensus” or could it be merely called the “Washington Confusion” (e.g. Naim, 1999). Certainly it was not a new innovation, but rather an uncritical return to a model that most of the western world had questionable experiences. Had there been any patience to look at the historical experiences, probably a lot of trouble had been avoided.

One of the major arguments in favor of the 1990s “reinvention of privatization” was that this way private funding would be channeled into the sector. Yet by the early 21st century, it became clear that private water multinationals are not willing to take the risk of making such investments in developing and transition economies. Even private companies need proper public sector support, legislation, and rules of the game – in other words, development of the whole institutional framework. In June 2003, it was publicly admitted by one of the World Bank senior water officials that “we and others have vastly over-estimated what the private sector could and would do in difficult markets” (Anon, 2003).

Another recent case from Tallinn, Estonia shows how decision-makers at the city level naively believed that by selling a controlling interest in the municipal water company, the city would really get the needed investments from a private “strategic investor.” In reality, after privatization, the company fairly soon delivered a tiny amount of money in dividends and in the form of a capital reduction. Yet,

after that Tallinn Water (Tallinn vesi) took a loan from the EBRD of the same magnitude in 2002. No wonder the media is asking what really happened (Hukka et al., 2005).

In 2000, just eleven years after the privatization of water and wastewater utilities in England and Wales, Kelda, the owner of Yorkshire Water in July 2000 (Shaoul, 2000) proposed to sell its reservoirs, pumping stations, and network to a Registered Community Assets Mutual (RCAM). The RCAM would have been owned by customers and operated on a not-for-profit basis. Kelda proposed that the RCAM should take over all the debts and be subject to regulation (Lobina and Hall, 2001). The mutual would also have outsourced the management of service production to a Kelda subsidiary for the first five years, and thereafter on the basis of competitive tendering for subsequent five-year terms. Ofwat, however, rejected this proposal (Shaoul, 2000).

The proposal evoked a strong response in the local community. For example, a Yorkshire newspaper wrote (Lobina and Hall, 2001):

Yorkshire Water has amassed colossal debts, the core water supply business is struggling to make a profit, and the share price is depressed. The directors' answer to the mess they have created is to give the business back to the public. Having milked it dry with excessive dividends and excessive wages and share options for themselves, they are walking away. And even then they have the nerve to want to continue to run the company – no doubt at a profit – saddling the public with the GBP 1.4bn debts they have left behind.

Kelda would have received GBP 2.4 billion, which is more than five times the 1989 purchase price, from the sale of the assets created by generations of taxpayers and consumers. Kelda would have been able to pay back Yorkshire Water's and the other subsidiaries' debts and pay up to GBP one billion to shareholders. That would have been more than twice their original investment, and would have come on the top of the paid dividends of GBP 350 million. Considering this case Shaoul (2000) concluded:

Thus the turn to mutualisation, far from presenting a return to a form of public ownership, represents an exit strategy for the infrastructure industries and a mechanism for evading price regulation, at the expense of consumers. We can expect more subtle variants on the mutual theme to surface in the future. That this should happen within 11 years of privatisation is testimony to the failure of the policy.

Thus, the case of Kelda and other recent cases related to the so-called "Washington consensus" as well as the earlier cases of Abegg and others seem to have similar patterns.

## DISCUSSION AND CONCLUSION

Since lessons once learned are not necessarily always, if ever, remembered, it is very important to look back to history when considering key strategic choices for present and future water and sanitation services. Historically private operators have tended to use “hit and run tactics” and have left the real problem solving largely to municipal administrators.

Therefore, what is really needed in water services is public sector reform and visionary management (Seppala, 2004; Juuti and Katko, 2004). Certainly selling of concessions further without even trying to establish and start the systems is unethical and unjustified.

*The  
responsibility  
of organizing  
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sewerage  
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operators ...*

The responsibility of organizing water and sewerage services cannot be left to private operators, since they tend, and are obliged, to think only of the interests of their shareholders, not those of the public. The systematic failures of private concessions in many cases – its inability and unwillingness to construct large and complex infrastructures and massive financing needs prevented the success of private water supply systems. Only in cases like France the private concessions were quite successful but not because of their superiority

but because the local governments were not allowed to have access to cheap public funding like obviously in most other countries was the case. Besides, the very high number of municipalities in France (Hukka and Katko, 2003) – some 36,000 even today – makes it very difficult to develop municipal water and sewerage systems like historically has been the case in most of the developed world.

Unfortunately, in policy-making and, particularly, in political decision-making, the time-frame is just too short for proper analysis. It is for this reason that researchers should take institutional and management issues more seriously instead of concentrating on issues that may seem to bring “easier” scientific merits but are of less societal importance. As for further research the various traditions of water services management in relation to other administrative and legislative traditions could be explored.

Proper policies should be based on sound analysis of experiences and evidence of the viability and sustainability of the selected options and strategies. In the 1870s, as in the 1990s, the adopted strategies were weakly, if at all, justified. Whatever strategies cities and municipalities select, they certainly should make proper feasibility studies to compare and analyze various options of ownership, operational management, and financing before making major strategic selections. Besides, they should not tie their hands with options that will be difficult to get rid of.

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# Key Long-term Strategic Decisions And Principles In Water Services Management In Finland, 1860-2003

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Key Long-term Strategic Decisions And Principles In Water Services  
Management In Finland, 1860-2003

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## ABSTRACT

This paper describes the key long-term strategic decisions related to the evolution of water services in Finland from the 1860s to 2003. The study was conducted in two phases: the first one based on a literature survey identified 44 key decisions while the second ranked 24 decisions viewed as the most important ones by 13 senior national experts. According to the experts, the most important decisions concerned legislation, particularly water pollution control. There is a wide variety of options for organising services in relation to the size and scope of the systems. Although future options may seem abundant, the development paths are largely restricted by historical strategic decisions. Such path dependencies may be positive or negative.

## Keywords

Strategy, decision-making, path dependence, water services, evolution, Finland

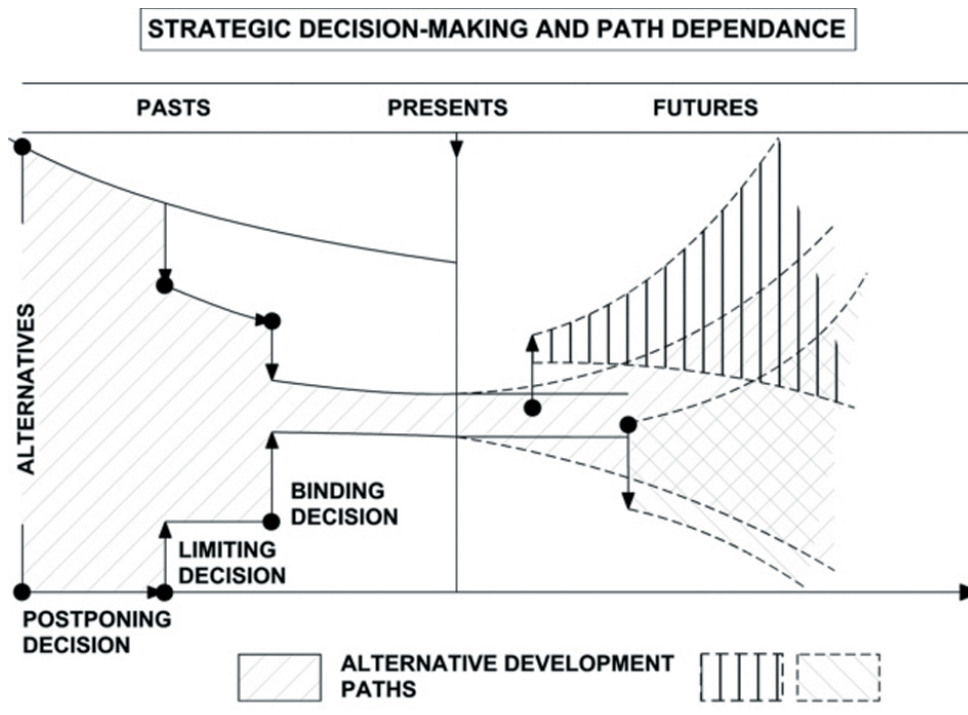
## INTRODUCTION

In international discussions on water policy development and the principles of sustainable water and sanitation services it has often been argued that most of the problems are largely of institutional nature – even though they often lead to technological failures. Already at the dawn of the International Drinking Water Supply and Sanitation Decade (1981-1990), Pacey (1979) pointed out that “technology alone is not enough” but that we also need a variety of criteria for technical, social and economic appropriateness.

In 2005 another International Water Decade was launched which concentrates on wider water governance issues. How to organise and develop water and sanitation services for at least 1.5 billion people lacking safe water and 2.5 billion people lacking safe sanitation is still the biggest challenge. Besides, a recent study showed that worldwide, even in nations and societies where irrigation may take up some 85 % of the amount of water used, community water supply was identified as the most important water use purpose (Katko & Rajala 2005). Thus, the question of providing and producing water and sanitation services is of vital importance.

In Finnish boreal conditions the demand for improved and organised water supply in urban areas was created particularly by the need for fire fighting water but health concerns and other public infrastructure needs also played a role (Hietala, 2002; Juuti, 2001). In rural areas demand was created primarily by the need to water cattle (Katko 1992a, 1997).

In many European countries where the development of water and sewerage services started earlier than in Finland, water supply systems were typically constructed earlier than the actual sewage systems (Juuti & Katko 2005). In Finland urban water supply and sewage systems were often established simultaneously while in rural areas water-borne sewerage was mainly introduced much later than water supply (Suomen kaupunkilaitoksen historia 1983).



**Figure 1.** Interrelationships between the presents, pasts and futures, and the ways in which path dependence affects available future options (Kaivo-oja et al. 2004: 536)

The evolution of Finnish water supply and sanitation services from the mid-1800s till 2000 can be divided into the following key phases (Katko 1997):

1. First initiatives
2. Rise of the first works
3. Diffusion of innovations
4. Second World War
5. Reconstruction
6. Rapid growth
7. Balanced growth
8. Present and futures

In this context the evolution of both water supply and sewerage systems is dealt with while on-site systems, increasingly important in the early 2000s (Mattila 2005), are excluded. In the early phase, water supply and sewerage were typically taken care of by different bodies within the municipal administration, while since the mid-1970s most of the utilities became integrated particularly in urban areas and larger communities.

Figure 1 shows the interrelationship between the pasts, presents, and futures that form the theoretical background of this paper. This framework combines the views of water history, water management and futures research experts (Kaivo-oja et al. 2004).

It is obvious that in the past various types of decisions have affected, and still continue to affect, the available options for our presents and futures. It also seems that there is a lack of convergence between history and futures research. While historian researchers are typically interested only in the past, and in most cases not the recent past, futures researchers are not always interested in history and past decisions. Yet, if we want to have a serious impact on the potential and desirable future development paths, we should be more active in our strategic and visionary thinking rather than just working within a short-term operational or opportunistic framework. Kaivo-oja et al. (2004) point out the plurality of our futures on purpose since instead of one past, present and future only, there are several alternatives depending on our interpretation and understanding of the pasts and our views on the most desirable future paths.

## **OBJECTIVES AND METHODS**

This paper aims at finding out and analysing the key long-term strategic decisions in relation to the evolution of water services in Finland from the 1860s to 2003. Evolution of the services is seen in a wider institutional context based on the definition of North (1990) that covers organisations, management, legislation and policy including formal and informal institutions.

This study was conducted in two phases. The first phase was to identify the key long-term strategic decisions on Finnish water services. It was based on a literature survey done by the authors focussing on several water history related studies, particularly those by Herranen (2001), Juuti (2001), Juuti & Katko (1998, 2004, 2005), Juuti et al. (2000, 2003), and Katko (1992a, 1997). These results were presented at the national seminar on 100 years of water legislation in Finland, held in Helsinki, Finland 17 Oct. 2002, and published in Finnish (Katko 2002).

After the first phase, 13 well-known senior national experts, familiar with the long-term development of the sector, were each asked to rank the decisions and select the ten most important ones. These ten decisions were also to be ranked according to their importance from 10 to 1. The 13 experts included four historian researchers, five mainly engineering oriented researchers and four other sectoral experts. While some of them were obviously better able to comment on the earlier development phases, others were more familiar with the later phases after the Second World War. Although the selection of experts was not fully balanced, it is still probably the best group of experts readily available for such reviews.

## **KEY DECISIONS ON WATER SERVICES OVER TIME**

The evolution of water and sanitation services in Finland is explained and analysed first based on these identified decisions (Table 1). The analysis also covered some of the key written and oral arguments raised by the interviewed experts in the second phase. Thereafter, the paper discusses the key findings of the second phase on the most important decisions and presents implications.

### First initiatives

In Finland, the earliest wells, wooden piped water systems and latrines were constructed for fortresses and manors. Modern water and sanitation services did not start to develop in the country until the 1870s. The first piped water system for community use was constructed in Ilmajoki in 1872 (Turunen 1985). However, the first rural piped systems were quite small but were expanded later (Katko 1997).

*In Tampere the industrialist von Nottbeck suggested in 1865 that he would establish a private water works.*

Several cities or townships in Finland considered and discussed establishing and constructing piped water systems in the mid-19th century. In Tampere the industrialist von Nottbeck suggested in 1865 that he would establish a private water works. He had a list of ten exact requirements which were based on the idea that the city should assume the risks which would guarantee a more or less stable money-flow to his company. After negotiations the city abandoned this option (Juuti & Katko 1998, Katko et al. 2002).

In 1875 the first Finnish Local Government Act, largely based on Swedish experiences, came into force. It meant the beginning of independent local governments and infrastructure services based on municipal ownership.

Finnish urban water and sewerage systems started to develop primarily based on demand for the following key needs: fire fighting water, drinking water, and hygienic and health requirements.

### Rise of the first works

The first urban water system in the country was established in 1876 in Helsinki. In fact, in 1871 the City had made a concession with a private entrepreneur, W.A. Abegg. After a while he sold the concession to a Berlin-based company called Neptun, making a good profit on the sale. He appeared never to have attempted to start building a system. Some time later the Neptun company had to give up the concession due to financial problems, and after long negotiations the city finally bought back the concession (Lillja 1938, Herranen 2001, Juuti et al. 2006). Interestingly enough, an engineer of Neptun, Mr. Robert Huber, established a pipe-laying company in Helsinki and later on also in other major cities of the country. This company became one of the earliest private water services companies in Finland. In 2005 older people still remember the phrase “Huber’s beer” used earlier to refer to tap water, particularly in the dozen or so towns which had Huber branch offices.

In 1879 the Health Decree came into force. It was based largely on Swedish legislation. As for water and sewerage services, this decree required that the elevations of city areas should be levelled (Juuti 2001, Nygård 2004). In practice this made it possible to plan gravity-based sewerage systems.

**Table 1.** Key long-term strategic decisions on Finnish water supply and sanitation with major reasons and outcomes, based on literature and identified by the author (modified from Katko 2002). wss= water supply and sanitation; www = water and wastewater, wwt = wastewater treatment; ws = water supply; wpc = water pollution control; FIWA = Finnish Water and Waste Water Works Association.

Phase	Year	Strategic episode/decision	Reason	Outcome
1	1866	private water supply rejected in Tampere	to prevent private profiteering	city assumed responsibility
2	1871	concession for Helsinki water works	wish to get private funding	difficulties faced
	1872	1st rural piped water system	demand	start of water cooperatives
	1875	Local Government Act	development of local administration	start of local democracy
3	1876	1st urban water works in Helsinki	demand for fire fighting and health	soon expanded
	1877	water meters into use in Helsinki	controlling consumption	levelling, start of sewers
	1879	Health Decree	improvement of sanitation	major pipelaying contractor
	1879	Oy Huber Ab, pipelaying company	replacing the concessor	others cities followed
	1882	Helsinki water works bought back by the city	concessionaire in financial crisis	others cities followed
	1890	metering based billing only, Helsinki	controlling consumption	far-reaching decision
	1890	use of lead pipes forbidden, Helsinki	excess lead dissolution found	promotion of interest
	1892	1st urban ground water system, Vyborg	good quality ground water fairly close	R&D of dry toilet forgotten
	1900	water closets commonly accepted	flushing of human wastes	pollution control enforced
4	1902	Water Rights Act	economic use of water	start of democratic society
	1906	universal and equal suffrage	democracy for state level	rural water cooperatives
	1907	Cooperative Act	rural development	1st ww treatment in Nordic countries
	1910	1st biological wastewater treatment plants	concentrated water pollution	major wss contractor
	1912	1st contractor (YIT), subs. of Swedish AIB	wish to go to Russian market	
	1917	independent republic		
	1920	Tampere rejected ground water	doubts about safe yield	other cities followed
	1938	1st separate sewers	separation of wastewaters	made wwt possible
5	1939–1945	World War II		stagnation of development
6	1949	1st consulting companies (2)	demand for expertise expected	planning of wss systems
	1951	1st Governmental Financing Act	rationalisation of households	financial support to rural centres
	1954	start of domestic plastic pipe manufacturing	need for better pipes	technology jump in rural areas
	1956	FIWA's (1993) predecessor established	interests of small systems	expansion of know-how
	1958	1st overseas export project	expansion of markets	internationalisation started
7	1962	Water Act	need for water pollution control	construction of wwt plants
	1967	1st professor in ws and sanitation	need for sectoral experts	creating sector knowledge
	1967	1st wholesale company	supra-municipal water	companies to river basins
	1968	regional planning for the whole country	planning of societal change	water sometimes recognised
	1968	start of development cooperation in wss	needs of the developing world	building also national capacity
	1970	water administration	multipurpose water planning	forerunner of env. administration
	1974	Wastewater Surcharge Act	fees instead of taxation funds	biological-chemical wwt
	1977	Act on Public Water and Sewerage Systems	modernisation of legislation	integrating www works
	1982	120-km Päijänne rock tunnel	assumed increasing demand	promoted modern forest industry wpc
8	1995	Local Government Act	modernisation of local administration	increase of utility autonomy
	1995	Finland joined EU	security	adoptability of directives?
	2000	Environmental Protection Act	modernisation of legislation	non-point wpc
	2001	Water Services Act	modernisation of legislation	full cost recovery, development plans

As early as in 1877-78 the use of lead pipes was tested in Helsinki, and it was found that excess amounts of lead dissolved into the water. Around 1890 the use of lead pipes in house connections was abandoned completely there and other cities followed suit soon (Lillja 1938 p. 301-302). Now, at the beginning of the 21st century, several of the European countries that were first to introduce water services have a lot of difficulties due to the lead pipes used in house connections whose replacement at once would require huge investments.

In 1890 the City of Helsinki established a metering-based billing system, which can be considered another far-reaching strategic decision. It was largely based on German experiences. The City water works produced their own meters as well as had a repairshop for them (Lillja, 1938; Herranen, 2001).

In Tampere and Oulu, the first piped water systems had relatively low pressure, but later on better materials allowed building higher pressure systems. The first city water works using ground water in Finland was completed in Vyborg in 1892, followed by Turku in 1903, Hanko in 1909, Hämeenlinna in 1910 and Lahti in 1910 (Juuti et al. 2000).

Around 1900, after several years of public debate water-based toilets became gradually accepted in Finland. This was a dramatic decision in terms of increasing water demand as well as pollution of water bodies the effects of which became apparent fairly soon.

### **Diffusion of innovations**

In 1902 the Water Rights Act came into force. This Act emphasised the utilisation of water bodies, particularly for economic purposes, but paid hardly any attention to water pollution control requirements. This was the case despite the fact that several cities had identified water pollution control as a problem already during the first decade of the 20<sup>th</sup> century. Besides, the problems caused by pulp and paper wastewaters were officially recognised by the Sulphite-cellulose committee (Sulfatisellulosakomitea 1909) as early as 1909.

In 1907 the Cooperative Act came into force, and the same year the first official water cooperative was established in Pispala, a working-class peri-urban settlement close to Tampere. Similar informal water cooperatives or partnerships had been established since the 1870s particularly in Ostrobothnia, on the western coast of the country. The tradition of water cooperatives is a special feature of Finland's water management, and it is still argued to have several advantages: being able to utilise local resources and being largely created by demand, particularly by water for cattle (Katko 1992a, 1992b, 1994).

One interesting tradition in elevated water reservoirs -- most often called water towers -- has been the tailor-made principle followed rather than building similar towers in several locations. Steel, for instance, has been used in only a few cases while various types of concrete structures have evolved. The first elevated

reservoirs were buried in the ground, such as the oldest one still in use in Tampere since 1898, while the oldest actual water tower was completed in Hanko in 1910 (Asola 2003).

In 1910 the country's first wastewater treatment plants were constructed in the Cities of Lahti and Helsinki. These treatment plants had septic tanks and trickling filters. In 1913 the City of Lahti was awarded a special certificate of honour at the Russian Public Health Fair held in St. Petersburg, Finland being an autonomous Grand Duchy of Russia from 1809 to 1917. The award was given particularly for utilising ground water as well as the introduction of wastewater treatment to the entire area covered by the town plan of that time. Helsinki, the capital treated just eight percent of its wastewaters that time. The know-how for the earliest water and wastewater services was largely, if not solely, acquired from Central and Western Europe (Torikka 1994; Laakkonen 2001).

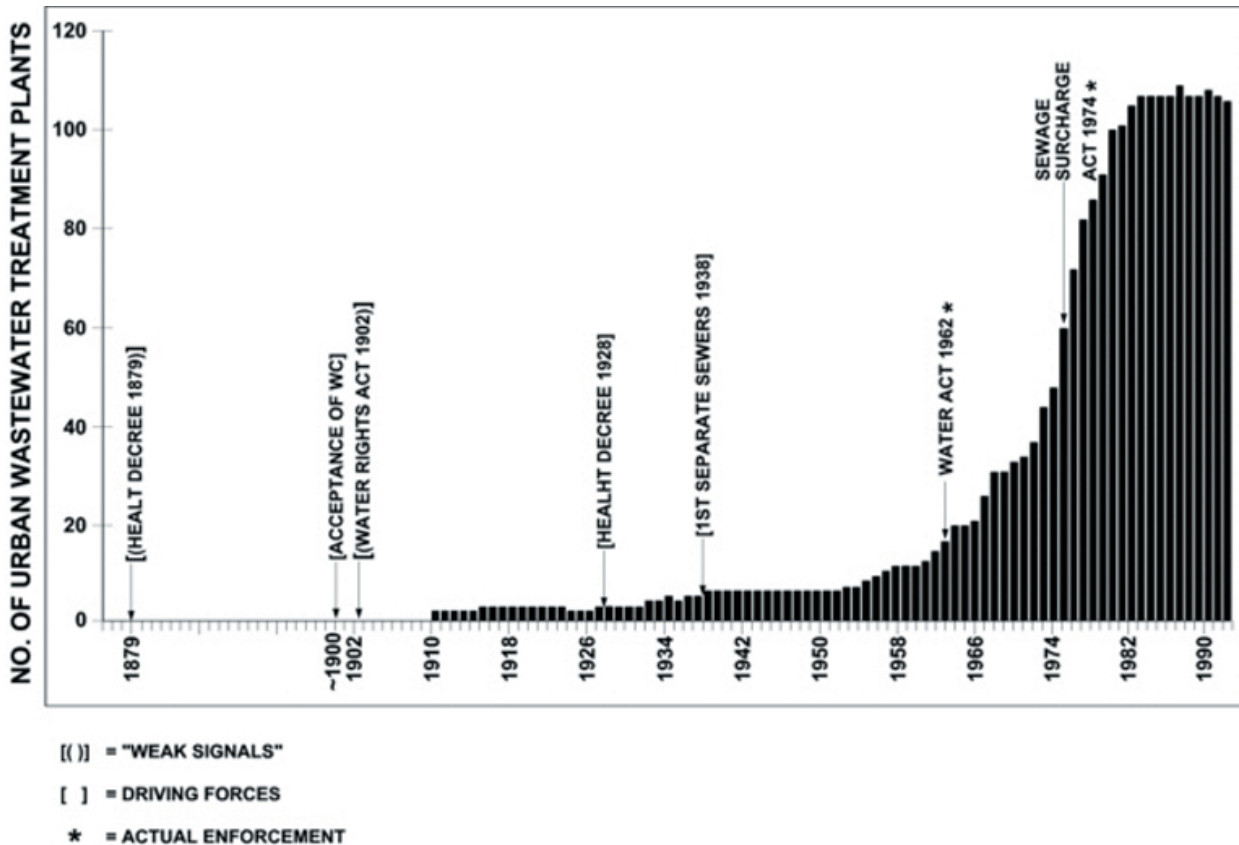
The first actual contractor specialising on the water and sewerage sector started its operation in Finland in 1912 when *Allmänna Ingenieursbyrå*, based in Sweden, established its subsidiary in Helsinki. Later on this company became the biggest water sector contractor in the country under the name Yleinen Insinööritoimisto (YIT). In 1916 due to lack of slow sand filters — despite them being proposed in the original plan for the water works — a typhus epidemic killed almost 300 people and made some 3,000 people sick. The major reason for that was that some sewers discharged their contents into Tammerkoski Rapids upstream i.e. too close to the water intake (Koskinen 1995).

From the very beginning one of the strategic questions in community water supply has been whether to use ground or surface water. In Tampere, the City finally decided in 1920 not to use ground water and obviously many other cities followed example. That decision was probably not considered strategic, but it has obviously had a big impact in the country. Artificial recharge was also experimented with in Vaasa as early as 1901 by the Swedish expert Richter based on experiences from Gothenburg, Sweden (Vaasan kaupunginvaltuusto 1901-03). However, the use of artificial recharge did not gain ground in Finland and was not used in Finland until the 1960s.

As for wastewater treatment, one of the key decisions has been the introduction of separate sewers that started in Helsinki in 1938 followed by other cities after WW II (Katko 1997). This made it possible in practice to start treating wastewaters although a few cities had treated theirs already earlier.

### **Post-war reconstruction**

In 1949 the country's first consulting companies were established, namely Soil and Water and Plancenter Limited, then called the Central Construction Bureau of the Countryside (Lehtonen & Katko 1995).



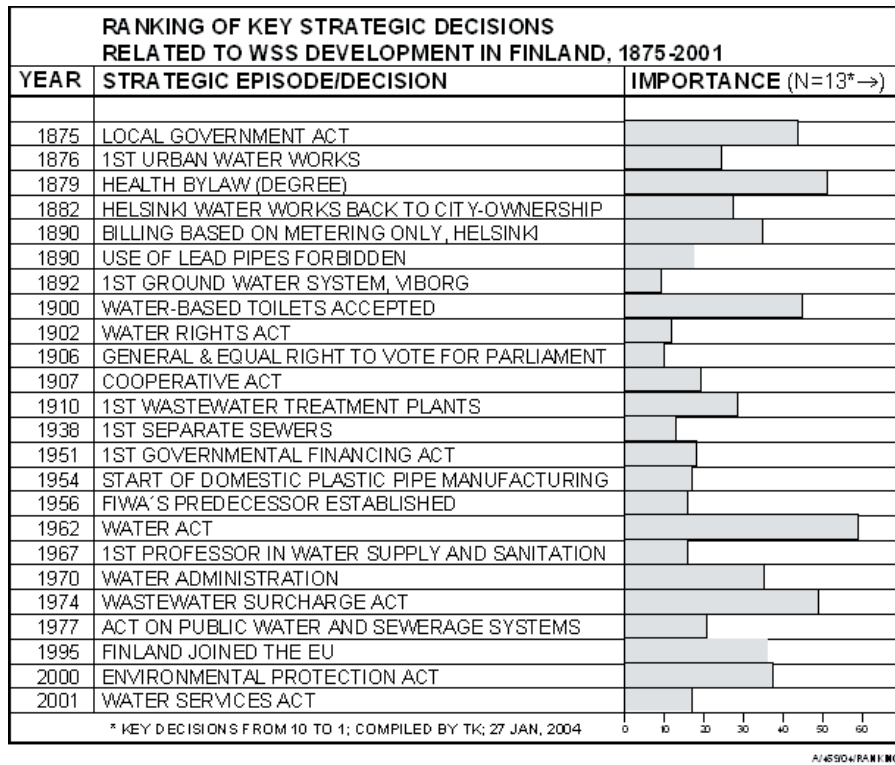
**Figure 2.** Construction of wastewater treatment plants in 102 so-called old cities in Finland, 1910 to 1992, and an introduction to key related legislation. (Modified from Lehtonen 1994: 53)

The establishment of consulting companies was in fact promoted by the first governmental Financing Act that came into force in 1951. One of the wisest strategic political decisions was perhaps that this act was preceded by the establishment of a parliamentary committee for rationalisation of households.

As for technology, since the early 1950s plastic pipes have been used and manufactured in Finland. Domestic plastic pipe manufacturing started in 1954. At first the pipes were used for rural pipelines, gradually in larger communities, and finally in the biggest cities (I. Masar pers. comm.). Nowadays Finland uses proportionately more plastic pipes in water and sewage systems than any other country (Katko 1997).

In connection with the establishment of water systems for rural communities, an association for promoting their interests – the forerunner of the current Finnish Water and Waste Water Works Association – was established. In 1958 the first export projects in water services were launched including the planning of a sewerage system in Reykjavik, Iceland as well as planning and constructing of water works for Karbala, Iraq (Katko 1997).





**Figure 3.** Ranking of 24 most important long-term strategic issues in Finnish water services, 1875 to 2001, assessed by 13 national experts. The length of the bar to the right of each decision indicates the total points given to it. (from Juuti & Katko 2005: 63)

### Rapid and balanced growth

The Water Act that was enacted in 1962 meant the start of modern water pollution control in Finland. The act forced communities and industries to apply for a permit for discharging their wastewaters, and these permits became stricter along with the development of technology and time (Fig. 2). In the 1960s and 1970s, the construction of wastewater treatment plants was very rapid, and thus, within two decades the country had established modern wastewater treatment including in most cases biological and chemical methods.

Treatment of wastewaters was further promoted by the introduction of a special Wastewater Surcharge Act in 1974. This Act allowed water and sewage works to cover the costs of providing sewerage services which were earlier largely covered by municipal taxes. From the mid-1980s the total number of wastewater treatment plants in cities started to decline, when larger wastewater treatment plants were constructed and smaller ones were taken out of use or converted into pumping stations. Interestingly enough, smaller communities and townships introduced wastewater treatment first and the biggest cities often last. Besides, the pulp and paper industries, the largest polluters in terms of biological oxygen demand

(BOD), did not start modern wastewater treatment before the mid-1980s (Katko et al. 2005). From nature conservation point of view is illogical, but it rather shows the reality of decision-making: water pollution control started from the socially “easiest” cases and expanded to the more difficult ones. It also shows the relatively high power that forest industries have had in the country over the years.

The Wastewater Surcharge Act of 1974 together with the energy crisis of 1973 caused specific water consumption to decline. In the 1960s it was still estimated that total water consumption would increase heavily and that even specific water consumption would increase as in North America (M. Murto pers. comm.).

In the late 1960s the first professor’s chair in water sanitation was established, and the same year the first intermunicipal bulk water company was established on the western coast.

In 1977 the Act on Public Water and Sewerage Systems was enacted whereafter many urban water and sewage utilities were gradually combined into a single utility. This is similar to what happened in Sweden and can be considered as the first practical step towards Integrated Water Resources management (IWRM) that is commonly stressed in the early 21st century.

One of the largest water supply investments has been the construction of the 120-kilometre Päijänne rock tunnel. At first the main goal of the project was to supply the expected ever increasing water demand but later on other reasons have superseded that. By the mid-1980s the Helsinki Metropolitan Water Company had become one of the key lobbyists demanding the introduction of modern wastewater treatment also for the pulp and paper industries (Konttinen 1999). One of the first pulp and paper companies that introduced modern waste water treatment was located in Äänekoski upstream of Lake Päijänne from which Helsinki Metropolitan Water Company takes its raw water.

Some more recent key decisions have concerned the reform of the Local Government Act, Finland’s joining the European Union in 1995, the Environmental Protection Act of 2000, and the entry into force of the Water Services Act in 2001. The Water Services Act requires that utilities become autonomous and use netbudgeting. The Act also put municipalities in charge of the development of water and sanitation services within their territories. (Ministry of Agriculture and Forestry 2001)

## **DISCUSSION ON THE MOST IMPORTANT DECISIONS**

Figure 3 presents a summary of the most important decisions ranked by 13 invited experts in the second phase of the study as explained earlier. The invited experts were requested to select the ten most important strategic decisions/episodes (Table 1), and further rank them using a scale where ten points referred to the most important one and one point as the least important one. In addition, most of the experts were interviewed regarding their views, priorities and arguments. There were altogether 24 decisions that received 10 or more total points.

The Water Act of 1962 was ranked by the experts as the most important decision. The Water Surcharge Act of 1974 and the Health Decree of 1879 were ranked the next most important decisions, followed by the decision to accept water-based toilets around 1900 and the Local Government Act of 1875. Thus, according to the experts the most important decisions concerned sanitation or water pollution control rather than water supply.

The first finding related to the ranking of the key decisions is thus the obvious importance of legislation. However, it can be argued that certain acts or decrees enacted in a certain year were not necessarily one-off strategic decisions, but rather culmination points of a longer-term process that had preceded the preparation of certain legislation. From that point of view, the enacted legislation reflects the actual, social and political needs felt by society at certain times. Legislation and requirements on improving sanitation and non-point pollution control in rural areas in the early 21st century are a more recent example of strategic emphasis although not included in the original list of decisions (Table 1 and Fig. 3). This policy was created after pollution from point-sources in communities and industries was properly developed (Mattila 2005).

The key decisions did cover widely the basic framework: political or policy, economic, social, technological, egological/environmental, and legislative dimensions in addition to the identified key strategic decisions (Fig. 3). This will become apparent over the long-term although the finding was not identified as an individual strategic decision.

The above-mentioned principles include the different approaches to developing urban and rural services. Thus, the third finding is that we have a variety of options for organising services in relation to the size and scope of the systems. The very smallest ones are on-site systems both in water supply and sanitation. Rural villages have a long tradition of consumer-managed water cooperatives, and cooperatives have recently been increasingly introduced also into sewerage and small-scale wastewater treatment.

In larger communities and cities integrated municipal utilities typically provide these services. In the European context such integration of water supply and sewerage under one utility is not very common. It seems that many member states of the European Union still have separate water and sewerage utilities (Vehmaskoski et al. 2002; Juuti & Katko 2005). However, cooperation between these services can also be practiced as separate organisations though it might require extra efforts. Various types of supra-municipal systems have also been created since the 1960s both for water supply and sewerage.

The government policy of supporting the evolution and development of sector services has been quite consistent. This is particularly evident if we compare it with the policy on solid waste management where quite dramatic changes have occurred over time (Nygård 2004). Yet, more recent cases make one wonder how long such a paradigm on continuously expanding systems can be justified in a country which still has a remarkable number of permanent rural as well as

increasing number of leisure housing. The theory of large technical systems (LTS) as presented by Hughes (1987) is hardly applicable to water services which are highly dependent on local conditions.

The central government's financial support was smaller than 10 % of total investments (Katko 1997). Municipal funding started through The General Fire Assistance Company of the Grand Duchy of Finland, established in 1832 (Nikula 1972, Nuoreva 1980). The taxes by spirits distilleries were also of significance. Besides, in the early stages utilities also took loans from local banks. More recently central government support has been channelled to various types of technical assistance, planning activities, ground water inventories and advice and help for municipal cooperation. Yet, compared to several other western countries, the share of government funding in Finland is remarkably low, particularly as concerns water pollution control.

The services have from the very beginning been covered by direct consumer charges, particularly water supply, and after 1974 also sewerage services instead of using local tax revenue. While smaller utilities have for long been subsidized through local taxation funding, more currently particularly the bigger utilities are making profit. The latter is based on the Water Services Act of 2001 which allows "reasonable rate of return" for public utilities. The overall rate of cost recovery of 290 water works in the country was found to be clearly over 100 % (Vehmaskoski et al 2005).

Since the early 1880s all the water supply and sanitation utilities in the country have been owned by municipalities, excluding small rural cooperative systems. However, from the very beginning the private sector has been providing various types of services, equipment and goods. Most of the investments in sector services have benefited private sector enterprises. This has also been the case with many operational services over the years (Hukka & Katko 2003; Juuti et al. 2005; Juuti and Katko 2005).

Certain decisions indicate remarkable path dependence. In contrast to the often presented negative cases, positive path dependence has also occurred in water services such as the selection of ground water instead of surface water, metering-based billing, and the introduction of separate instead of combined sewers. A negative dependence was the introduction of flush toilets which discharge nutrients to water bodies instead of agricultural use.

In terms of environment protection, the introduction of water and particularly wastewater services can be seen as the biggest environmental investments in communities. Development and introduction of these services has dramatically improved the safety and environmental state of communities – whether urban or rural. In 2002 Finland was ranked number one in the international comparison on Water Poverty Index, considering the key elements of water resources, access, capacity, use and environment (Lawrence et al. 2002). Yet, the high ranking is not explained by the relatively high amount of water resources available per person but particularly by management related criteria.

Since the 1980s the emphasis in water and wastewater networks has shifted increasingly towards rehabilitation. The demands of the beneficiaries and customers have also increased continuously. Therefore, one of the future challenges will be to improve further the level of services and reduce any environmental risks or major vulnerabilities.

One of the most current policies is the trend of centralising and thus promoting the expansion of water supply and sewerage systems. This may be justified in several cases but obviously such systems will have also limits – it should be now studied how large systems will be feasible in relation to their political, economic, social, technological and environmental aspects. Even these are obviously dependent on local conditions.

## CONCLUSIONS

1. According to the experts, the most important decisions concerned legislation, particularly on sanitation or water pollution control rather than water supply.
2. In any development, the wider institutional framework including various political, economic, social, technological, environmental and legislative requirements must be taken into account.
3. There are a wide variety of options for organising services in relation to the size and scope of the systems.
4. Integration of water supply and sewerage could be one of the first practical steps in Integrated Water Resources Management.
5. The central government policy of supporting the evolution and development of sector services has been quite consistent.
6. The share of central governmental financial support has been always quite small. The support has been channelled to areas deemed to be the most important ones. Municipalities' funding was initially based on fire insurance loans and taxes on spirits. Utilities have since the early days taken loans from private local banks.
7. From the very beginning the costs of services have been covered by direct consumer charges, particularly in water supply, and after 1974 also in sewerage instead of using local tax revenue.
8. Since the early 1880s all water supply and sanitation utilities in the country have been owned by municipalities, excluding small, non-profit rural cooperatives.
9. The private sector has always provided various types of services, equipment and goods. Most of the investments in the sector have benefited private sector enterprises. This has also been true in the case of many operational services.
10. Although future options may seem open, the development paths are largely restricted by historical strategic decisions. Such path dependencies may be positive or negative.

All in all, management of water services should include adequate consideration of strategic and visionary issues. At the same time, utilities and the water sector should be prepared for pro-active actions, particularly pressures that seem to come from outside the water sector. The paper also implies the need for further respective comparative studies in other countries.

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# A Brief History of Water Supply in Finland and South Africa – two case studies

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## INTRODUCTION

The management of water systems and infrastructure requires learning how earlier choices affect or may affect today's options and the development paths of the futures. We can look back to history to pin-point factors of success, turning points and strategic decisions.

This article discusses water supply and sanitation development in South Africa and Finland from the late 19<sup>th</sup> to the early 20<sup>th</sup> century. The main focus is on one South African town, Durban, and one Finnish town, Porvoo. The special subjects of study are the development of water supply, water use, patterns of governance, as well as access to clean water in different areas of the cities. The article deals first with some general developments in South Africa and then focuses on the South African case, Durban. Then it presents the general developments in Finland and comments briefly on the developments in Europe. Lastly, the Finnish case, Porvoo, is presented in detail.

In 1921 the population of South Africa numbered 6,953,000. However, it is quite difficult, if not impossible, to estimate the population of the entire present area of South Africa in 1800, since the first reliable census of the native South African population was not taken until 1904.<sup>1</sup> The Finnish population amounted to only 863,301 in 1810 but was already 3,147,600 in 1920. Thus, the population had increased about 3.6-fold during that period.<sup>2</sup> Migration to towns had not been as large-scale in South Africa as in Great Britain or Germany since only 24.7 percent of people lived in towns in 1911. In Finland 429,937 people out of a total population of 2,943,000 (14.6 percent) lived in towns at that time.<sup>3</sup>

South Africa's economy is based mainly on mining, agriculture and food production. In the early 1930s, the economy started to develop rapidly while industrial relations were still tense because the society was basically feudal.<sup>4</sup> Except

*... water supply  
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problem in  
towns.*



for a few cases in South Africa and Finland, water supply was a major problem in towns. Yet, rapid economic development and urbanization allowed and made it necessary to introduce modern water supply and sanitation systems. In the case of Finland it may sound odd to speak about the lack of good water as

the country has 188,000 lakes and thousands of rivers. The distance between the case countries is also very long, and Finland has no colonial ties. Still, some similarities or analogies can be found. Surprisingly, annual rainfall average is almost the same although seasonal fluctuations are higher in South Africa.

In the 19<sup>th</sup> century great city fires were a big problem in Finland. Even Turku, the capital city at that time, burned down in 1827. The main reasons for the city fires were the wooden buildings and the lack of pressurized water for putting out fires. In South Africa city fires were not as big a problem because buildings were mostly constructed of stone in the bigger cities.

The development of water supply has not progressed linearly from primitive systems to more complicated or from “bad” to “good” ones. The population growth in cities, and especially the preparedness of the community to take responsibility for water supply, have been the key issues. In different time periods subjects of interest and methods have varied according to need, readiness and what has been considered important.<sup>5</sup>

Since 1960, the rapid population growth in Africa has created a great demand for water and food. The population expansion has caused many problems in relation to land use and erosion. The overall expansion of human settlements has increased organic loadings to water bodies and groundwater. Especially small lakes have not been able to absorb effluent loads which has damaged the ecosystem.

While Finland has placed at the top in several water- and environment-related international comparisons<sup>6</sup>, South Africa has provided some technological breakthroughs in water management. Examples from the water history of these two countries can, for their part, explain the current local water crises. Can we find certain patterns, principles and practices that are similar?

## WATER SUPPLY AND SANITATION SYSTEMS

On a general level, water supply and sewerage systems can be divided into three categories and five development stages. The points of comparison must arise from research subjects (in water supply and sewerage) that are not only contemporary but also of similar technological level. The systems divide roughly as follows<sup>7</sup>:

- 1) Bucket systems Involves carrying;
- 2) Protosystems Second best system available;
- 3) Modern systems Best available system.

The purpose of this classification is to show that various feasible solutions existed for the city infrastructure at different times when decisions were made. It also allows us to dispense with the predestined, technologically deterministic view of water supply and sewerage advancing unavoidably towards the modern, “right” solution.

*The bucket system* is associated mostly with the use of buckets or similar vessels to draw, carry, and hold water from wells, springs, and various natural water sources like rivers, lakes, and rainwater. The period of rapid economic growth increased population density and demanded new technical solutions. The densely built blocks of wooden houses, and later the first apartment houses, presented new challenges to both water supply and fire protection.

In the middle of growing environmental problems, the great fires ravaging cities, and heaps of refuse, the *protosystems* were created to hide/solve the problems. This solution demanded recognition of the fact that there were problems, and the will from decision makers to introduce changes. They understood that the community

should take care of these issues. It was typical for the protosystem that water was drawn from outside the city limits. This meant, for instance, building wells and conducting untreated, or primarily slow-sand-filtered, water by gravity through pipes to the consumers. The system's other main features were the building of sewers so that untreated waste- and stormwater could be led via the combined system to nearby water bodies.

*The modern systems* were quite different from the protosystems. They were intended as more sustainable solutions. They used groundwater or treated surface water which was led under high pressure to the consumers, charged for water according to metered consumption, used elevated water reservoirs, and introduced a sewer system separate from wastewater treatment. In this period, the fire hydrant system for the city area supplied fire-fighting water for the regular fire brigades.<sup>8</sup>

## **SOUTH AFRICA**

After the British seized the region of the Cape of Good Hope in 1806, many of the Dutch settlers (the Afrikaners) trekked north and founded their own republics. The discovery of diamonds in Kimberley (1867) and gold in Johannesburg (1886) spurred immigration and intensified the subjugation of the native inhabitants. The Afrikaners resisted British encroachments, but were defeated in the South African War (1899–1902). The Union of South Africa, established in 1910, pursued a policy of separate development of the races.

One of the most obvious processes during the 19<sup>th</sup> century in South Africa was the growth of towns. When the British took over the Cape, there were only 14 urban centers –ten of them within 80 kilometers of Cape Town. By 1870 the number of urban centers in the Cape Colony had increased to 103. In Natal there were 22 towns, villages and hamlets. This growth was mostly attributed to the establishment of service and administrative centers in the annexed areas. In 1870 there were probably only three towns with a population over 10,000. By 1911 the number of such towns had increased to 21, ten of them in southern Transvaal. In 1870 there were 231 towns in South Africa, and by 1911 the number had risen to 336. The respective town population figures were 1.5 and about 6 million.<sup>9</sup>

Early municipal water supplies usually drew water from springs and boreholes. Some of the sources were large, like the springs in the Fountain Valley in Pretoria. The bucket system was typically used with arrangements like this. When the population and industry grew, it became gradually necessary to embark on larger schemes and to go further to get more water. This typically called for protosystems. With varying natural characteristics throughout the area, the problems of supply varied, and town engineers faced many difficulties in this respect.<sup>10</sup>

There is a general pattern of how water supply evolved in many towns and cities in South Africa. Private water supplies were initially augmented by communal schemes. These were modest protosystems at first, complemented later by the construction of large dams and eventually water transfer from neighboring

*Private water supplies were initially augmented by communal schemes.*

catchments. As the systems increased in size, the opportunity for lowering costs by combined, regional-based schemes improved. The Government, which had considerable experience in irrigation water supply, undertook to construct such schemes, and hence to regulate and apportion bulk water supplies. The Government had to embark on water supply schemes of increasingly larger scale because of the increasing mining and industrial demands. Many of these Government water schemes became later interlinked to form large modern supply system networks. The Vaal River System is probably the most important of these.

The main consideration in the way of services required for the old towns were water supply and access to the erven<sup>11</sup>. Water supply was obtained from a river or spring and was led by means of an open furrow through the streets in such a manner as to provide for the irrigation of the erven. At the same time the furrow served to provide the drinking water for animals and the water for the domestic uses. These irrigation furrows usually served as stormwater drains and in many cases were also used to dispose waste water from residential premises. Some of these water supplies still exist in the old towns and in the streets while the conservancy dams were constructed only later. The use of underground water obtained from boreholes developed to any extent only after 1900; earlier most water supplies were from surface-water sources.

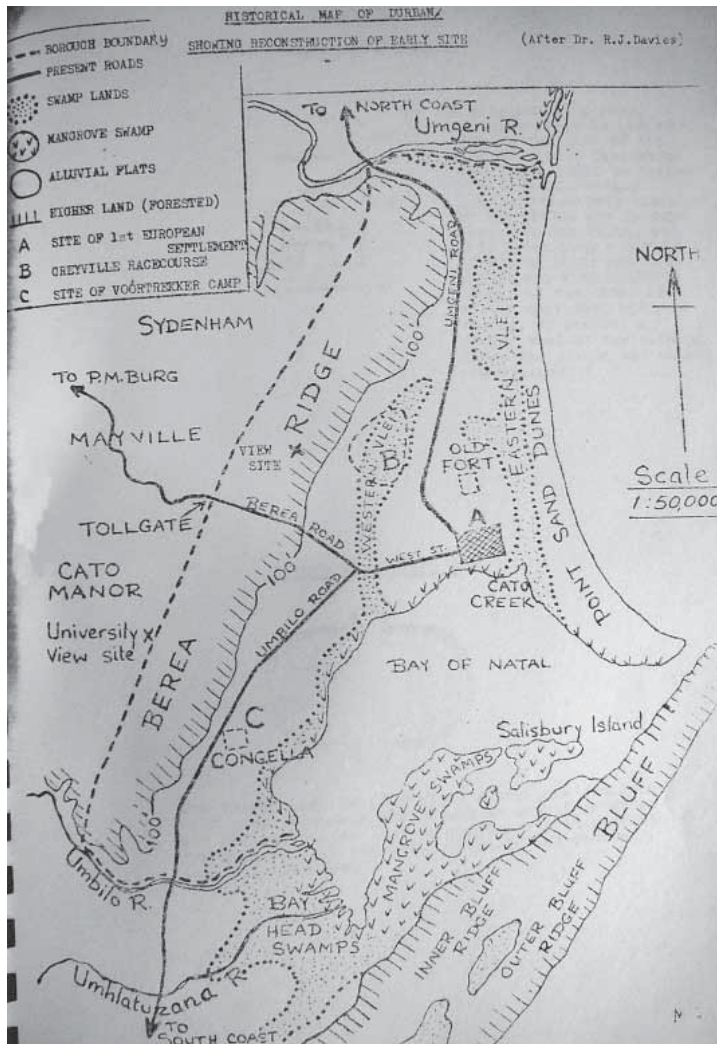
## **DURBAN**

Durban was established in 1824 on the eastern coast of South Africa, where there was plenty of water, but not of the best quality. The water of old Durban did not have a very agreeable taste but was better than rainwater. Water supply was based on the bucket system. The town pump was situated in Old Well Court, in Smith Street and continued in use until long after the Umbilo Waterworks were opened. Similar pumps were later installed in other parts of the Borough. This form of water supply provided about 215 m<sup>3</sup> per day.<sup>12</sup>

Newly arrived (1854) Bishop John William Colenso described Durban as follows:

A greater evil in Durban is the water, which is taken usually from wells that are not sunk deep enough, and, consequently, abounds with decaying vegetable, if not animal, matter, and innumerable animalcules and worms.<sup>13</sup>

In April 1858, the Natal Mercury reported that some of the pumps were out of order and needed attention. In the same year the Town Council discussed its priorities: whether a new town hall or paved roads and pure water was more important for the municipality. A motion for a new town hall was carried by three votes to two.<sup>14</sup>



**Figure 1.** Reconstruction of the early site of Durban. (Bjorvig A.C.1979. The History of Durban Town Council, 1854-1879. M.A. Thesis, University of the Orange Free State.)

In December 1861, the Council requested a report of the feasibility of supplying the Borough with water from the Umgeni River. The Council could not, however, agree to finance the scheme as submitted. In 1873 the Council apologized for any inconveniences because droughts had affected supplies from the wells. Still dreaming about its future water supply, the Council in 1874 considered a proposal that private tenders be invited to provide Durban with the best water supply. In 1875 it was agreed in a public meeting to set up a special committee to consider a variety of schemes proposed. The outcome was that the Borough authorized an expenditure of £500 on an investigation of an artesian source of water.<sup>15</sup>

The water supply continued to be obtained from tanks and wells until the end of 1879. In July 1877, these wells yielded approximately 214 m<sup>3</sup> per day, when the population of the town was over five thousand. With the increasing population and repeated dry seasons, the necessity for providing some other source of supply became imperative. In 1879 the possibility of a shortfall in the water supply became so serious that the Mayor made arrangements with the Railway Department for the supply of water in tanks from the Umgeni River.<sup>16</sup>

Drilling operations for artesian wells were conducted in the course of 1876–77 but only with partial success. However, in 1878 the Council placed the drilling operations entirely under H.W. Currie's control, and he eventually succeeded in sinking a well in July 1879. Storage tanks were erected and water pipes were led into town. That constituted a protosystem and an additional well was sunk in 1883 and a steam pump erected to increase the supply. Another storage reservoir was erected in the Botanic Gardens in 1884. In 1886 the Borough Engineer reported that without this water source there might have been water famine throughout Durban and the Berea during the last two years. This "Currie's Fountain" continued to be the principal source of supply until the Umbilo Waterworks was opened in 1887.<sup>17</sup>

The Borough Engineer J.F.E. Barnes urged that Currie's Fountain be seen only as a temporary measure. In September 1883, Barnes submitted reports and estimates on schemes to supply water from the three neighboring rivers. In December the Council decided that the Umbilo River was the most suitable source. The site selected for the Headworks lay on a bend of the river just above Umbilo Falls. An earthen dam was built across the valley. The attraction of the scheme was two-fold. Firstly, it was within the Borough's financial means and, secondly, it was designed to provide a gravity supply to the growing Berea residential area. The Pinetown Waterworks, as they were usually called, opened on 21 July 1887.<sup>18</sup>

In 1889 the Umbilo scheme was already overtaxed by drought and population growth. As a temporary measure, the Council voted to allow the construction of a plant to pump water from the Umhlatuzana River to the Umbilo River. In January 1890, the new Borough Engineer John Fletcher tabled a report detailing various schemes for supplementing the existing supply. He advocated the tapping of the Umlaas River. The council approved this during 1890. The new waterworks were completed in the following year and formally opened by the Council on 30 July 1891.<sup>19</sup>

This was only a supplementary supply measure carried out before building a permanent gravitation scheme. Until 1894 the Umbilo supply of 910 m<sup>3</sup> per day and the Umlaas temporary pumping plant of 1,100 m<sup>3</sup> per day proved sufficient to supply Durban. The Umlaas gravitation scheme was built in 1894. By 1895 Fletcher could point to the successful completion of the scheme. The Umlaas and Umbilo projects, combined, gave Durban a cheaper and more plentiful supply than either Port Elizabeth or Cape Town, both with bigger populations. Durban had hence

a modern system. Fletcher estimated that to consume the daily delivery of over nine thousand m<sup>3</sup>, Durban's population would have to double from its then 28,000. However, in 1898 the Medical Officer still had to recommend to the people of Durban to boil their drinking water.<sup>20</sup>

Drought and the rapid increase in population during the South African War 1899–1902 put further pressure on Durban's water supply. The Corporation started relief works and a number of men were employed on the construction of the Clear Water Reservoir. It was completed in 1903 and increased the Umlaas scheme's storage capacity by 523,000 m<sup>3</sup>. The specter of recurring droughts led John Fletcher to seek the Council's authority for additional storage in the Umlaas catchment. Work commenced in 1901 on the Camperdown temporary dam, which was constructed in a record time of five months. Even before the temporary dam was finished Fletcher was contemplating a permanent dam.<sup>21</sup>

In the summer of 1902–03 the serious drought extended until April. During this time the Camperdown Dam helped to avoid a water famine. The Camperdown temporary dam stood its first test in December 1903 when a heavy flood, which damaged the Umlaas Intake downstream, left the Camperdown Dam untouched. It was of incalculable value in maintaining water supplies to Durban between 1901 and 1904 during periods when the normal river flow at the Intake Works would have been less than Durban's consumption unless augmented from Camperdown. In 1905 it was decided that the Camperdown temporary dam would be made permanent. Work was started the following year and in 1908 the retaining wall was laid.<sup>22</sup>

The 1917 floods resulted in Durban's existing water supply coming under critical examination. By January 1918 it had been resolved by the Council that a new dam was required and that the town needed the services of an experienced "Water Works" Engineer. It was decided by the Council that the waterworks engineer would be directly responsible to the Council. The main concern of the Water Engineer was the new water scheme. In 1918 investigations were carried out as to the possibility of using various rivers along the Natal coast. The pilot survey resulted in the Council deciding to continue developing the Umlaas River and to proceed with the Shongweni Scheme. Construction of the Vernon Hooper Reservoir started in 1923 and finished in 1927.<sup>23</sup>

## FINLAND

The Finnish case city is Porvoo, a small medieval town on the southern coast of the country. In the early 19<sup>th</sup> century the country's economy was based mainly on agriculture. Finland was an autonomous grand duchy of Russia in 1809–1917 and won complete independence in 1917. Porvoo exemplifies the somewhat problematic growth of a city at a time of the emergence of the water issue, when traditional water sources, i.e. wells, were polluted and their yield was inadequate.

At first the objective was to ensure the supply of fire-fighting water, then meeting the demand for domestic water supply. Thus, fires promoted indirectly the improvement of hygienic conditions along with the sewerage systems. In spite of the prevailing incorrect miasma theory of disease, the adopted solutions, protosystems and a few modern systems, however, advocated the right causes, i.e., the improvement of the environment and the safety of the cities.

The first municipal “water pumping installation” in Finland was most likely founded in Tampere in 1835. It was followed by a low pressure system in 1882, and a high-pressure facility completed in 1898 – the latter was not, however, of the scale planned. Since the slow sand filtration originally proposed was rejected and the outlets of the sewers were too close to the intake pipes, the efficiency of the new facility became also its weakness: later on typhoid fever spread fast over a wide area aided by the water pipe network. In 1916 the death of hundreds of people finally prompted the necessary decisions to be made. It is interesting that Tampere initially chose to use surface water while many other cities such as Hanko, Hämeenlinna, Lahti, Turku and Viipuri (Vyborg) went for groundwater. In some cities, the establishment of a waterworks was postponed far into the 20<sup>th</sup> century – in Savonlinna until 1951.<sup>24</sup>

*At the beginning, towns were largely like farmhouses on a grand scale with pigs and cows and bucket systems.*

At the beginning, towns were largely like farmhouses on a grand scale with pigs and cows and bucket systems. As towns grew, rural living habits began to disappear and towns began to lose their metabolic ties with their surroundings. Nutrients were no longer put back into circulation to be eaten by pigs or to improve the soil. Instead, they were deposited in rubbish heaps, dumps, only to end up later in the water systems along the sewers. Where a network of sewers did not exist, wells started to become polluted, and there was no longer enough pure water (for people).

Polluted water and unhygienic living conditions created a favorable environment for epidemics like typhoid fever. A similar sequence of events occurred also in several other European cities.<sup>25</sup>

The evolution of sewerage began with free-flowing ditches running through towns. As years went by the ditches were straightened, opened and covered. These measures, nevertheless, proved to be insufficient and the dirt and filth continued to spread. The exacerbated problem forced the decision makers to work out a plan for underground sewerage after the hygienic reform started in England and personified by E. Chadwick.<sup>26</sup> Thus began the transition from the bucket system to the protosystem. When the growth of the city accelerated due to industrialization, problems began to accumulate: there was not enough water and what little there was, was of a poor quality. A discussion about improving this bad situation started.<sup>27</sup> The construction of sewers was a way to get rid of it. Thus, the model came directly from England, not from any other city in Finland.<sup>28</sup>



## FIRST WATERWORKS IN FINLAND

The 1879 public health decree obliged cities to prepare a plan for a sewer system commensurate with their estimated population within ten years. City administrators took seriously the deficiencies in sewerage and the demands of the government: starting in the early 1880s municipal health boards repeatedly exhorted cities to expand and upgrade their sewerage systems. At the end of the 1880s, the Finnish people followed closely the development of the bacteriological revolution and hygienic reform started in England. Slowly the miasma theory began to lose ground.<sup>29</sup> In this phase, discussion about the water question also started to get livelier. Frequent fires and various epidemics gave city officials and inhabitants the determination needed to establish water and sewerage systems. For example, Hämeenlinna suffered several big fires in the 1800s.

The new high-pressure waterworks of Finnish towns provided safety and comfort. In cities sufficient water for fire fighting became available only after the emergence of high-pressure waterworks and professional fire-brigades. This was the case with both Tampere and Oulu which initially had low-pressure waterworks. It is probable that the decisions made in Tampere were well known in Oulu as the two cities followed closely developments in each other's water supply and sewerage. In addition, Tampere and Oulu employed the same external experts, like Hausen from Helsinki.<sup>30</sup>

Networking of Finnish water sector experts was quite advanced already in the last years of the 19<sup>th</sup> century. Besides, Finnish experts and civil servants went on numerous fact-finding tours abroad (Sweden, England and Central Europe) to familiarize themselves with foreign solutions. The problems with water quality were largely solved only after the introduction of high-pressure waterworks. The experts had known for years what equipment was needed and the dangers of not having it as a result of the domestic expert network and active foreign connections.<sup>31</sup>

In Helsinki, Hämeenlinna and Lahti water quality problems were not as great as in Tampere because they did not use untreated surface water. Lahti was using good quality groundwater from the Laune spring, Hämeenlinna used groundwater from Ahvenisto and Helsinki used from the beginning surface water treated with slow sand filters. These modern systems were safer than the one used in Tampere. In addition, the other cities were taking care of their wastewaters in a modern way compared to the protosystem in Tampere: Lahti was treating the wastewaters from the entire planned city area already in 1910. The facility in Lahti was the most advanced in Finland at the time. The systems in Hämeenlinna and Turku also surpassed the one in Tampere in most areas since they were using safer groundwater.<sup>32</sup>

The other side of the water question, i.e., sewerage also had to be solved. The public health decree of 1879 obliged cities to do so by requiring leveling of the city areas. Although the wettest areas of the cities were drained and hygiene improved,

lakes were still being polluted since wastewater was not treated. The bucket was replaced by a drainpipe, and the problems were flushed out of sight untreated to the nearest water systems as is typical of protosystems. Luckily wastewaters were not used for irrigation like in Germany and France at that time. This kept the groundwater unpolluted. In 1917, the year of Finland's independence, there were sixteen waterworks in the country.<sup>33</sup>

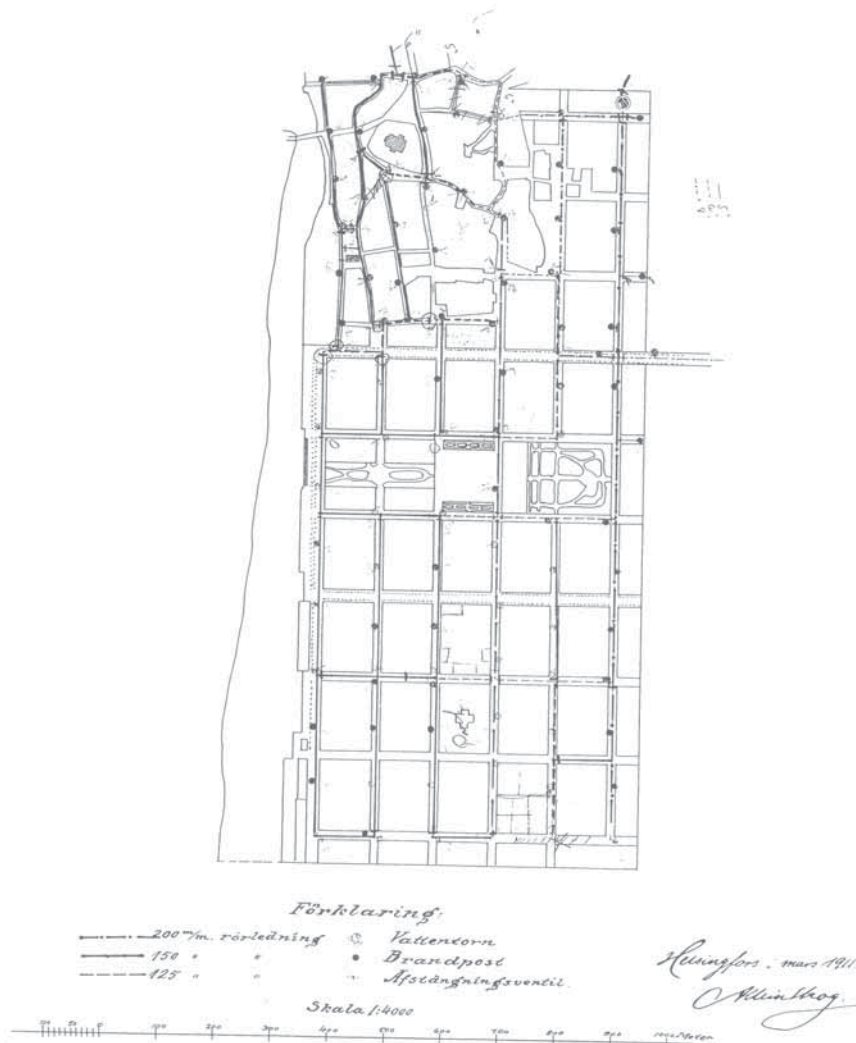
Industry needed vast amounts of water while water supply in cities was still at the bucket system level. Thus, the biggest factories built their own proto-level systems. The provision of water supply was, as a rule, driven by demand. The waterworks were born as a solution to the water question after long discussions, and often after various inadequate and temporary solutions. In terms of quantity, there was enough water, and the selected technological, administrative and economical solutions were also successful. The well-being of people improved compared to the earlier situation and equality between them increased as waterworks expanded and better quality water slowly reached also the working class.

The waterworks were excellently suited for the needs of fire fighting. There were no great fires in the cities after they founded waterworks and fire departments. On the national scale, the health situation improved after the founding of the waterworks, especially typhoid fever cases decreased with the exception of a few epidemics and the civil war period in 1918. In 1919 infant mortality was lower in the cities than in the countryside; earlier the situation was the reverse. At least in this respect, the cities had become healthier places to live than the countryside.<sup>34</sup>

### **PORVOO<sup>35</sup>**

Porvoo is assumed to have been founded in 1346, although the exact year is not certain. What is known with certainty is that Porvoo is the second oldest city in Finland. The Porvoo River got its name in the 14<sup>th</sup> century from the ground fortress built on Linnamäki; it later became the name of the city as well. The name originates from the Swedish word Borgå (borg = castle, å = river). Porvoo originally grew up as a trading centre which has remained an attractive hub of business and commerce until the 21<sup>st</sup> century. The volume of retail trade conducted in Porvoo makes it one of the country's bigger municipal centers.<sup>36</sup>

For centuries the townspeople got along using traditional water sources: wells, springs and surface waters typical of the bucket system. As the population, and population density, increased and water became scarce and the environment started showing symptoms of deterioration, new measures were called for. One such measure was building municipal water supply. At first, gradual construction of a sewerage system was launched at the end of the 19<sup>th</sup> century. It was clearly a protosystem. A waterworks was founded in 1913 following a long period of discussion and planning. Since its establishment, Porvoo City Water Works has been a municipal utility operating in accordance with the economic and operational



**Figure 2.** First plan for water network 1911 in Porvoo. (Juuti, Rajala & Katko 2003. Aqua Borgoensis – Lähteet kertovat / Källorna berättar. (Water of Porvoo) Porvoo. p.70)

goals laid down by the City Council. In keeping with general Finnish practice, a sewerage system was built alongside the waterworks. The first wastewater treatment plants came into being in the 1970s.

Documents mention *Porvoo Parish* already in the early 14<sup>th</sup> century. For hundreds of years the city extracted water from wells, springs and the Porvoo River. Although great fires did not occur in Porvoo as often as in other Finnish cities, the founding of a waterworks was facilitated by the fear of fires and the scarcity and poor quality of well water. The environment also became polluted as habitation spread; the problems came to a head especially in the poor sections of

the city. Before the establishment of the waterworks most houses had a well in the yard. Water was also drawn from the river. Several public wells also existed – the first mention of one dates back to 1622, but it is likely that there were some already earlier.

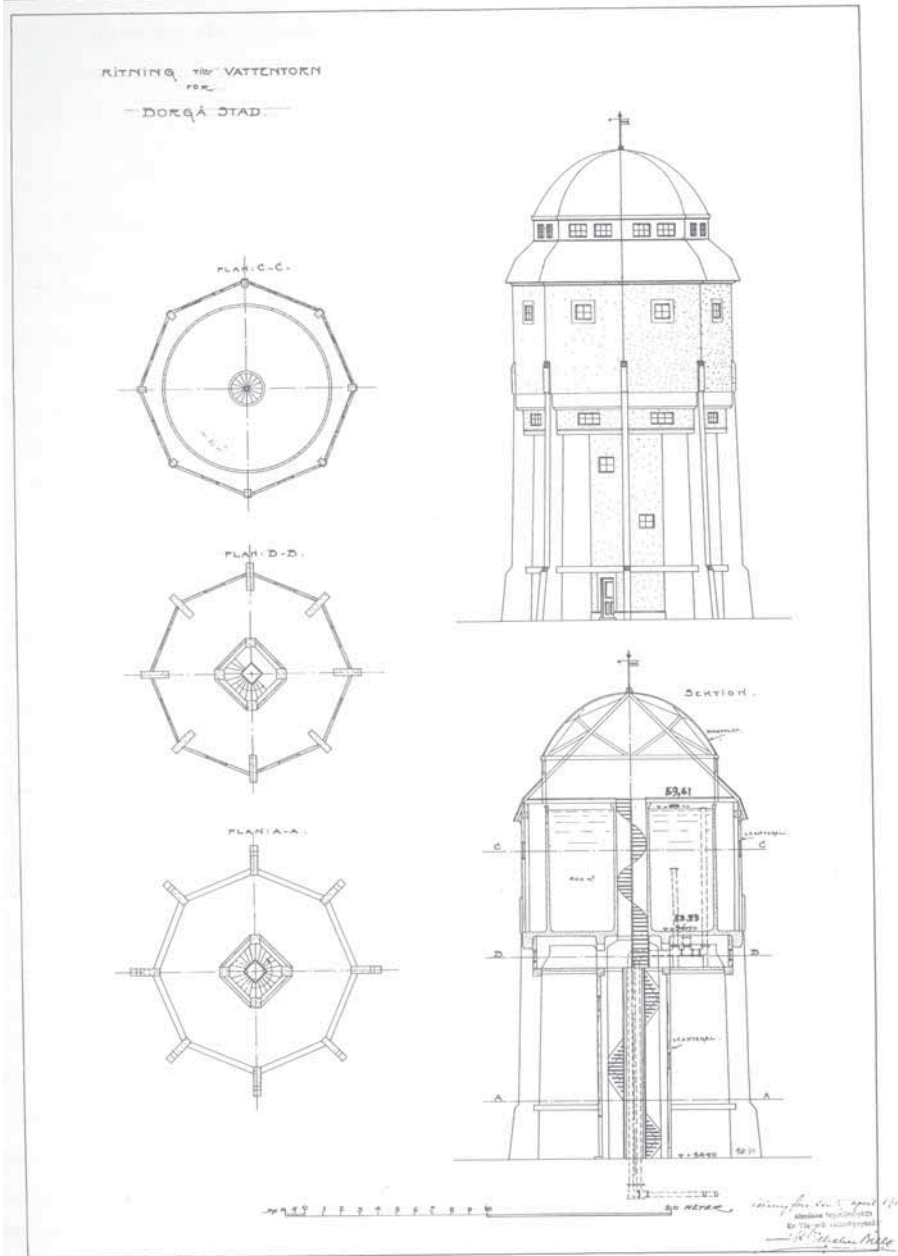
After water quality deteriorated and water levels fell in wells, new ways of satisfying water needs had to be invented. The risk of fires also speeded up the organizing of water supply. Despite various reforms, the bucket remained the key implement of water supply, latrines and waste disposal until the end of the 19<sup>th</sup> century. Sewers were laid to lead off rain waters that otherwise flowed into basements and hindered the movement of people. At that time, people still believed in the so-called miasma theory according to which humidity and dirty air spread disease. Yet, this belief, for its part, also facilitated the introduction of sewerage.<sup>37</sup>

The house owners had an economic incentive to have a public sewerage system in town –earlier they were responsible for the maintenance of ditches and sewers along their section of the street. The organization of water supply was speeded up by the poor quality and shortage of well water and the need for fire-fighting water. The *know-how* to solve the water problem was acquired at least from Stockholm and Helsinki. However, the first initiative came from within Porvoo itself: professor Strömborg, involved in town administration, suggested as early as 1889 that a water-works be established to solve the problems. The house owners also supported the idea. A waterworks utilizing groundwater was completed a quarter of a century later in 1913.<sup>38</sup>

The Porvoo Water Works was designed by the director of Helsinki Water Works, Albin Skog, who also designed the first waterworks of several other Finnish towns. The contractor was Yleinen Insinööritoimisto, YIT – Allmänna Ingeniörsbyrå, AIB. The headquarters of that company was in Stockholm; it established a branch office in Finland in 1912. The Porvoo Water Tower was the company's first actual project in Finland and launched its later growth into a leading sector contractor here. Construction of sewers had started already at the end of the 19<sup>th</sup> century.<sup>39</sup>

The project stayed quite well within budget. The financing arrangements were also skillful and advantageous to the city. However, the initial estimates on the sufficiency of water appear too optimistic in hindsight considering future population growth. During the first few years, it was noticed that the water was not sufficient for the growing needs. The city newspaper *Borgåbladet* often reported about related developments.<sup>40</sup> Still, it was a modern system.

The measures undertaken made the built environment safer and eliminated the immediate problems. Reforms in fire services also increased safety. The evolution of the sewerage system started from open ditches. As the city grew the ditches were straightened, dug open and covered. However, this was not enough, and the increasing problems made the city's decision makers plan an underground sewerage system after the English example. Thus, progress from the bucket



**Figure 3.** Plan for the old Porvoo Water Tower. The Porvoo Water Tower was YIT's first actual project in Finland (Juuti, Rajala & Katko 2003. *Aqua Borgensis – Lähteet kertovat / Källorna berättar. (Water of Porvoo) Porvoo.* p.74)

system to a protosystem began. The development of a sewerage system was well underway even though a wastewater plant had not yet been built along with the waterworks.<sup>41</sup>

The Kaupunginhaka Water Works proved to be an interim solution in hindsight. Yet, its performance improved, and since 1921 the utility turned a profit. Thanks to the selection of the groundwater alternative, Porvoo avoided any major problems such as epidemics which occurred in cities that used surface water. The new facility completed in Linnanmäki in 1923 ended the water shortage, but quality problems, such as the excessive iron content, remained unsolved.<sup>42</sup>

If a house owner wanted to connect to the city's water supply in 1913, he had to submit a written application. A written contract was always required for water supply; the term of notice was three months. The regulations governing the water pipe in the City of Porvoo from 1913 read as follows: "Each plot to which water is led is to have its own pipe extending from the street pipe to the water meter. The waterworks shall procure and lay said pipe at the expense of the house owner, charging the fee confirmed by the council, in the order applications are submitted and as performance of the city's own works allows; the city also undertakes to put right without charge any possible defects in the pipes due to poor workmanship or materials for a period of one year."<sup>43</sup>

Since the beginning water fees were charged based on the readings of the city's meters. The waterworks ordered the meters to be installed so that "basic and surface water cannot penetrate into the dial housing to obstruct its reading, the meter is not exposed to subzero temperatures or other harmful influences, and the meter is accessible enough to allow attaching, reading and removing it without hindrance."<sup>44</sup> If a house owner doubted the accuracy of his water meter, he could ask the waterworks to check it. If the reading error was less than five per cent, the house owner had to pay the costs of inspection. This rule is still in force over ninety years later.

It was not always possible for house owners to connect to the city's water supply network. For instance, in the old town the bedrock lying close to the surface prevented the laying of a water pipe. *Public standposts* were provided for these consumers; the key required to use them could only be given to the occupants of the house. Care had to be exercised in the use of the standposts also in other respects. Persons on poor relief could use water free of charge. In 1914 there were a total of 159 water connections and the annual consumption was around seven cubic meters per inhabitant. In 1952 connections numbered 520 and consumption was up to 38 cubic meters per inhabitant. In 1940, during the Winter War, water consumption dropped significantly since a major portion of the city's population had been evacuated.<sup>45</sup>

In the first half of the 20<sup>th</sup> century the water supply of Porvoo rural municipality depended on private wells. The largest water consumers also started to build their own modest water pipes. The water shortage encouraged cooperation between inhabitants. This led later to consumer-owned and administered water cooperatives and common wells. The rural municipality concentrated on supplying water to its own facilities in the early 1900s as well as maintained a few public wells and latrines.<sup>46</sup>

In the early part of the 20<sup>th</sup> century public health requirements gradually tightened and the importance of hygiene was stressed. The quality of well water was monitored closely, for instance, at schools. Deficiencies were remedied quite promptly. Yet, the state of the environment deteriorated badly in places due to the

high increase in living standards and the spread of flush toilets, etc. For instance, in 1969 the board of health noted that the water bodies were polluted to such an extent that only a few beaches had water that was safe to swim in.<sup>47</sup>

The water supply and sewerage system of Porvoo Rural Municipality has made use of the expertise and services of authorities, other water utilities and the private sector from the beginning. For instance, water analyses were commissioned from Porvoo City Laboratory while design and construction work was outsourced to private companies. Intermunicipal cooperation in water supply and sewerage was also practiced at one time with the City of Porvoo. Initially, the rural municipality bought water from the city's waterworks, but when the Saksanniemi waterworks of the rural municipality became operational in 1975, the roles switched and the rural municipality supplied water also to the city. The Päijänne Water Tunnel was among the most prominent projects involving intermunicipal cooperation in the Helsinki metropolitan area. Porvoo Rural Municipality took part in its financing in order to secure the raw water needs of the local petrochemical industry.<sup>48</sup>

In January 1923 the new Linnanmäki water intake plant was finished in The City of Porvoo. A concrete well eight meters deep was dug in Linnanmäki, and water was pumped by two large centrifugal pumps to the city through a six-inch cast iron pipe 610 meters long. Originally the water was treated only by adding soda lye to increase pH. The water intake plant operated satisfactorily in the first years.

In 1923 about 70 percent, and the next year 87 percent, of the water need was covered by it. The rest came from the Kaupunginhaka pumping station. But the water was quite rich in iron and carbon dioxide. Especially water that sat in the pipe overnight produced thick layers of iron deposits. When the water started to flow again, these "rust specks" worked loose and consumers got "beer-colored" water. The engineer Skog was asked to help, and he designed an iron removal plant incorporating aeration of raw water, iron precipitation by adding lime water, filtration and storage of clean water in a tank.<sup>49</sup>

The original water supply network of the city was built of steel piping. Later cast iron pipes were introduced as they are more durable. Plastic piping became prevalent in Finland in the 1960s, first as water pipes in the countryside and later also in cities. The construction of the city's sewer system actually began as early as in the late 1800s. At the time, larger conduits were made of natural stone and smaller ones of glazed clay pipes. The pipe network was built as a combined sewer while a separate sewer system was introduced only in the 1960s.

Prior to the establishment of the waterworks, the state of the environment in Porvoo had deteriorated quickly endangering the health of the population. The waterworks and the sewerage system improved the condition of the built environment. Domestic wastewaters loaded the environment, because a wastewater treatment plant had not been built initially. Since the city started treating wastewaters in 1973, and the new Hermanninsaari wastewater treatment

plant was completed in 2001, the pollution load on water bodies from domestic wastewater has decreased significantly. Increased population and a higher living standard were a danger to the environment and people's health also in the rural district: e.g. in 1968 only half of the wells contained water of good quality and the swimming waters were polluted. The situation in the rural district started to improve slowly after the first Hermanninsaari wastewater treatment plant started operating in 1974.

The majority of the people were no longer faced with a water shortage after the completion of the first waterworks in 1914, but the needs of the growing population and increasing demand could not be satisfied until 1924. Water quality problems came to a head in the 1960s and 1970s as the network reached the age when rehabilitation became necessary. For consumers this meant an extra drawback: e.g. the service life of hot water boilers was very short. These problems were eliminated by the new Sannainen plant in 1982.

## DISCUSSION AND CONCLUSIONS

In Durban it was self-evident from the beginning that at some point they would have to start supplying water from the rivers flowing in the area. They had wells in the area, but the water in them was not of good quality. This was not yet a problem in the 1850s when the town was small and the supply could be augmented with rainwater. But already in the 1860s the possibility of bringing river water to town was researched seriously. At that time, however, it was economically impossible

The issue was discussed again in the 1870s, but the Borough did not still have enough money for such a big investment. The Town Council, however, authorized drillings for artesian water. After three years hard work these drillings succeeded in 1879 as water was found in the Botanical Gardens area. "Currie's Fountain" helped secure the water supply of the Borough a couple of times during the next eight years as the main water source for Durban.

Durban and its municipal engineering works had grown so much by the 1880s that it became necessary to appoint a Borough Engineer. John F.E. Barnes, who was appointed in 1882, immediately started improving the works and submitted plans for obtaining water from rivers. Of the three possible schemes, the Town Council chose the Umbilo River, mostly because it could also supply the higher parts of the Borough. Of course, it was also financially the most feasible plan. The waterworks opened in 1887.

In the end of the 1880s there was a serious drought lasting nearly three years which, combined with increasing water demand, made it necessary to start looking again at other rivers as possible water sources. The new Borough Engineer, John Fletcher, presented immediately after assuming his post in 1889 proposals for improving the situation and got an authorization for his plans. Pumping of water





**Figure 5.** Currie's Memorial Fountain in Botanical Gardens in Durban. (Photo: H. Mäki)

from the Umhlatuzana River started in 1890, the pumping plant on the Umlaas River opened in 1891, and finally the Umlaas gravitation scheme was became operational in 1894.

The next water supply emergency was created during the South African War in 1899–1902 by people fleeing the war into Durban. The waterworks could actually supply enough water to cope with the situation; what was needed was more storage reservoirs. Consequently, a dam was built in Camperdown in 1901, a clear water reservoir in 1903 and two service reservoirs in the mid-1910s.

Durban's location in the rainiest part of South Africa also directly affected its water supply in the early 20<sup>th</sup> century. Two disastrous floods in 1905 and 1917 destroyed the waterworks and washed away the main pipes. Consequently, the Umbilo Waterworks had to be abandoned in 1905, and in 1917 the need for a new dam and a water engineering specialist was realized.

In Finland, experts were widely used in building waterworks. For instance, in Tampere local expertise was tapped extensively and the application was tailored for local conditions. The dimensioning of the 1898 waterworks proved correct, even though there was some criticism during the planning period. The estimates of the planners and specialists about the growth of the city and the capacity and possibility of expanding the waterworks also proved correct. The know-how of several Finnish key water-sector experts was made use of in the establishment of the Hämeenlinna water works. In Porvoo, the expertise of the director of Helsinki Water Works was utilized and adapted to the local conditions. However, the dimensioning of the first water intake plant was off. The estimates about the growth of the city and the related capacity and expansion needs were too low, and

the planning of a plant expansion had to start almost immediately. Both the first and second town engineers of Durban had earlier worked in England and had the necessary experience for solving the local problems.

*Environmental monitoring* began in its earliest form in Finnish cities with the enactment of the 1879 Public Health Decree. It required, for instance, the city to measure the relative elevations of different city areas which was a precondition for sewerage planning. Health and environmental issues were the responsibility of a board of health which also saw to it that good quality water was provided for the inhabitants. *Water charging* was based on metered consumption from the beginning. This allowed rational development of the works which, in the light of examples, would likely have failed with different charging principles. An exception were public standposts, which had been in use for tens of years, and gave water against payment of a fixed water fee.

The combining of water acquisition, sewerage and environmental protection in Tampere started on the threshold of the crisis of 1909. Ever since that year, the food inspection office of the city has supervised the quality of water in Tampere. It was decided to finance the activity by revenue from metered consumption following the failed system of token-based charging with the low-pressure solution. This has made possible the sensible development of the utility, which probably would not have been possible in light of the examples from other charging principles.

As to the utilization of groundwater, the later problems with iron and salt in Porvoo showed that solutions that appear indisputable are not necessarily sustainable in the long term, but one must be prepared for surprises. The Linnanmäki water works built in 1924 eliminated the old water shortage problem, but quality problems remained a nuisance for decades. It can be said that the perpetual quality problems were only solved by the completion of the artificial groundwater plant in 1982 which did away with the “beer-colored” water.

In Tampere decision makers chose untreated surface water which contained unclean wastewater over better quality groundwater in spite of various warning signals. The result was a catastrophe, from which it took the city a long time to recover. Even then the better quality groundwater was not taken into use – mainly because of quarrels among the specialists. Treated surface water and a better-protected intake area were preferred over groundwater. Only decades later did groundwater become part of the water supply of Tampere. Durban has drawn surface waters from the local rivers from the beginning.

This paper has concentrated on the birth and early development of community water supply and sanitation in South Africa and Finland. The following five key conclusions can be made on the development:

1. Surface water was initially taken from nearby sources, and as these became contaminated, from farther away. The utilization of groundwater started later, and artificial groundwater will likely be produced in the future.
2. Wastewaters polluted the water systems until their efficient treatment started at a relatively late stage. The industry began to protect waters later by increasing cooperation with the waterworks when the time was ripe.

3. When the increase in water consumption leveled off, the emphasis shifted to water quality.
4. Mistakes have been made, but lessons have also been learned. It is better to do something than to do nothing.
5. In environmental matters utilities have played, and will continue to play, a key role in all cases.

## **IMPLICATIONS**

The models and the knowledge in support of the various solutions were collected both from abroad and other facilities in the countries themselves -- South Africa and Finland. The perception of the determining role of capital, even the perception of it as a precursor in this sector, proved to be misleading, if not incorrect. Capital has, of course, played an important, but not necessarily the only and central role.

Because the solutions varied by different areas, the solutions to water demand must be suited to local variations and conditions. Every case and environment is unique. Therefore, ready-made handbook solutions are not available – they must be tailor-made to a large extent based on local conditions. Local conditions, natural resources and traditions vary remarkably even within one country. Community water supply and sanitation probably touch the lives of more people than any other public service. Each community and area may have its own cultural and decision-making traditions. One should recognize and understand local conditions, traditions and history – at least to some extent – when preparing plans.

In spite of local solutions, the growing cities of developing economies seem to be repeating the same general patterns in building their water supply and sanitation systems as Finland and South Africa earlier. First, they build a water pipe to replace wells, then sewerage to replace ditches. At this point, diseases like cholera and, especially typhoid fever, very often plague growing cities. The excessive use of water, charging and the lack of maintenance also cause problems. Only social and political recognition of these problems allows building systems that guarantee good quality of water. A wastewater treatment plant and a more comprehensive water pollution control system and institutions are the last to be introduced – usually after yet further problems.

Examples of successful and durable solutions in water supply are nevertheless available. In this sense, water knows no limits – neither in place nor time. It is noteworthy how similar the problems in many developing countries are at the beginning of the 21<sup>st</sup> century compared to those faced earlier by today's developed economies. The underlying factors seem to be largely the same in both cases: lack of good governance, rapid growth of cities and inadequate resources.

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# Water services evolution in 29 European cities from 1800 to 2004

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Water services evolution in 29 European cities from 1800 to 2004.

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Also in internet: <http://www.watertime.net/docs/wp3/WTEC.pdf>

## **ABSTRACT**

This paper describes the evolution of water and sewerage services in 29 European cities in 13 countries over the last 150 years. In historical perspective water management, both services and resources, is substantially a local issue. The diverse role of local governments in Europe largely explains water services management systems applied. Some of the strategic decisions have proved to have a long-term impact and thus strong path dependence – negative or positive. In several cases decisions have been made in an ahistorical context.

## **Keywords**

Path dependence, Water services, Evolution

## **INTRODUCTION, OBJECTIVES AND SOURCES**

Water and sewerage services are part of the visible infrastructure of our cities and communities and are often taken for granted. Paradoxically their real importance for people and communities is remembered only when something goes wrong with these systems. However, in many cases it has taken a long time – several decades if not centuries – to develop them into modern systems. And it is also still true in the early 21st century that some European cities lack appropriate water and/or sanitation services.

This paper is largely based on a recent study “City in Time” that was to address the historical differences and similarities in cities’ decision-making over the long run and how these affect the decision-making of each case city. This study was published as a book “Water, Time and European Cities: History matters for the futures” (Juuti and Katko, 2005). City in Time- study aimed to use futures research to illustrate the interconnectedness of past, present and future decision-making. It sought to study the development of water systems in a wide institutional context covering the political, economic, social, technical and environmental dimensions and to identify long term patterns in decision-making, as well as the underlying driving and constraining factors.

City in Time explored urban water system reform in 29 cities, in 13 countries – originally in eight EU member and five candidate countries, four of which became full members on the 1st of May, 2004. An early version of this paper was presented at the IWHA Conference in Paris in December 2005 where some valuable feedback was received (Katko and Juuti, 2005).

The major objective of the study was to discover the key strategic decisions that have affected the overall evolution of water and sewerage services in the city. Some of these strategic decisions may at first have seemed less important while later having proved to be of greater importance. The study sought specifically to address the following research questions:

- What were the strategic decisions that have mostly affected the development (binding, limiting, postponing)?
- Who and what factors define and create demand for services?
- How does the historical context constrain potential best practices for the future?
- What limits do technical choices of the past impose on decision-making?
- On what basis have selected strategies been formulated and decided upon in different time periods?
- How has the role of public-private partnership (PPP) changed over the years, and how is it likely to change in the future?

The major sources of data used by City in Time to analyse past and future decision-making included:

Dates and sequence of key decisions on systems, e.g. special public bodies, responsibilities of local government or central government, changes in ownership of systems between private sector, national and local governments; changes in operators between sectors; changes in pricing and charging methods; introduction of water rights;

Local and national (and international) past decisions, which constrain and limit present choices, e.g. bulk water supply sources; boundaries of administrative units; taxation and borrowing powers of local governments;

Factors and interest groups involved in the past, e.g. emergence of public health issues; origins of private sector role; environmental issues and local traditions; economic development; restructurings at entry to and exit from former communist regimes in eastern European countries.

City in Time was an essential part of the WaterTime project, funded by the European Commission under FP5: Energy, Environment and Sustainable Development. The WaterTime project directly contributed to the overall aims of Key Action, City of Tomorrow and Cultural Heritage, by addressing the question of how to maximise the involvement of stakeholders in decision-making, and the effectiveness of decisions in ensuring efficient and affordable water and sanitation service for all citizens.

Considering the original objectives and accessible material and sources of the City in Time study, it is emphasised that the focus had to be more on the historical evolution of water and sewerage services in their wider institutional context rather than on strategic decisions as such. The main reason for that is that achievable historical documents, books, papers and other material tend to overwhelmingly describe the routine technical expansion of systems while they very seldom describe the arguments and reasons for certain decisions of strategic importance and wider institutional issues.



## THEORETICAL FRAMEWORK AND METHODS

Futures Research (FR), incorporating Historical Research (HR), is a decision-making framework, which seeks to integrate both historical and future perspectives into today's decision-making processes. It is believed that much could be learnt from the past mistakes and successes if we would just bother to delve deeper into past decision-making processes and their impacts. Such a dual perspective ensures that the diversities of the past and pluralities of the future are taken into account in decision-making (Jenkins and Witzel, 1999).

*Futures can be classified as possible, credible, and preferable.*



In the pasts or past presents we have made decisions that either have bound, limited or postponed our options (Fig. 1). Presents are bound by laws and regulations, their compliancy and enforcement, and political objectives and decisions that inevitably are related to futures. Futures can be classified as possible, credible, and preferable.

Analogies and path dependencies, for instance, link pasts, presents and futures to each other. There are several theories that are applicable to the study City in Time. Yet, in this context the so-called path dependence theory seems the most useful. Path dependence contends that decisions made in the past are likely to have long-term impacts on water systems by binding, limiting or postponing alternative options. As such, path dependence is linked to history and futures research and their interaction. Path dependence has been offered as an alternative analytical perspective for economics, a revolutionary reformulation of the neoclassical paradigm.

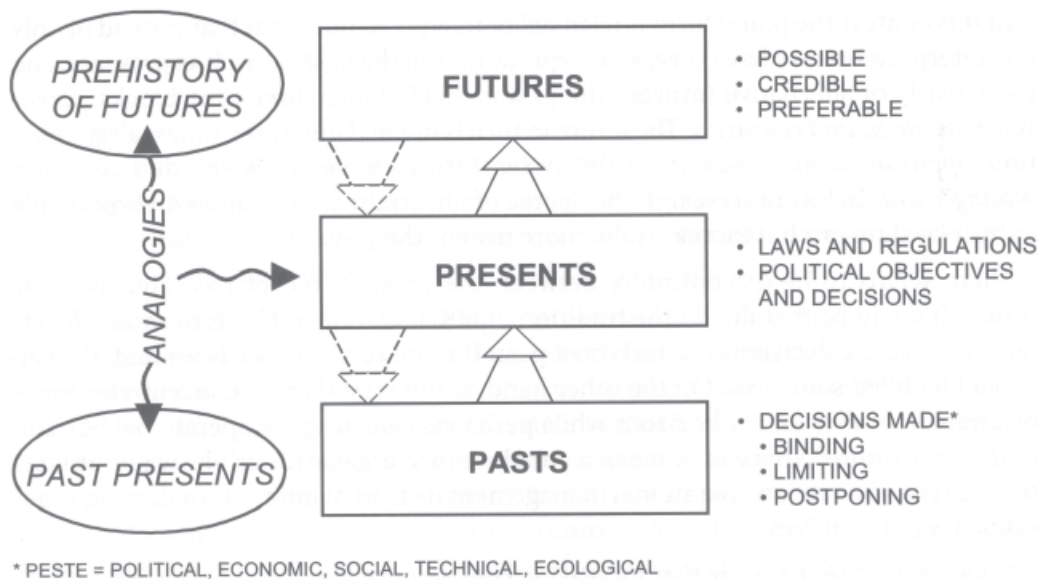
Douglas C. North (1990, vii), one of the pioneers of New Institutional Economics, points out how history matters as “time and context”. This understanding of history, however, is seriously deficient in two closely related aspects. On the one hand, despite their allowance to path dependence, the models and concepts are ahistorical, asocial, timeless, and universal. History, time and context are confined to the random shocks or whatever leads to one rather than another pre-determined, if stochastic, path to be taken.

Because the present is not wholly derived from the past, an effective decision-maker must balance history with an assessment of the present and future. In terms of organisational memory (Neustadt and May, 1986, cited by Walsh and Ungson, 1997, 194–195):

(i) Decisions that are critically considered in terms of an organisation's history as they bear on the present are likely to be more effective than those made in a historical vacuum

(ii) Decision choices framed within the context of an organisation's history are less likely to meet with resistance than those not so framed

(iii) Change efforts that fail to consider the inertial force of automatic retrieval processes are more likely to fail than those that do.



**Figure 1.** Pasts, presents and futures and their analogical relationships (Kaivo-oja et al., 2004).

In several connections it has been emphasised that history is a scientific story that in a sensible way combines the past with the present. However, it is less understood that in many respects we do not have a single history or present but there are various interpretations of pasts and presents. In any case, this current past–present dichotomy could and should be expanded to cover also the alternatives futures — not just one.

This study has progressed through various phases. Since preparing the project proposal, research theories combining history research (HR) and futures research (FR) were explored and developed (Kaivo-oja et al., 2004) largely motivated by the needs of City in Time.

The first phase of the actual study included a literature survey focusing on public-private cooperation and private involvement in the historical context which started in the beginning of the WaterTime project. In parallel with this, collection of basic background data using a standard format guideline was carried out. In addition, a standard table format was developed to show the key strategic decisions and events and their reasons, together with contingent outcomes and organisational changes and the stakeholders involved.

Each of the partners was in charge of collecting the data on their respective case countries and cities as well as preparing the City in Time case studies. In some cases, access to all these data proved impossible. In addition, the emphasis of this basic data was on case cities and particularly the evolution and key decisions

concerning water and sewerage services. This part of the study was of qualitative nature. The research approach can be also seen as constructive since it was largely based on cumulative data and knowledge. Based on the views of external peer reviews, partners and steering committee members, the *City in Time* report was finalised. This study was further developed into a book by the editors.

## **DIFFUSION OF WATER SERVICES AND MANAGEMENT TRADITIONS**

Diffusion of water services and their management are first reflected in relation to administrative, cultural and legal traditions and patterns. This is followed by findings of urban planners, researchers on work-related values and the variety and change of public vs. private relationships.

It is important to understand the current differences and cultures in water resources and services management and their historical background. Barraqué (2003) has formulated a rough typology of water resources management and institutional cultures in Europe. This typology is based on Germanic vs. Roman legal origin and, on the other hand, centralised vs. subsidiary (decentralised) tradition (Table 1). The only three states covered by river-basin institutions are the ones that have historically been centralised monarchies: Spain, England/Wales, and France. Yet, they have evolved differently. Besides, in some countries river basin authorities, like those in the Nordic countries, have been formed on a voluntary basis.

In England and Wales water resources policy has been centralised in the postwar period, particularly after the introduction of River Basin Authorities in 1963. Water supply and sewerage systems became centralised in 1974 with the establishment of ten Regional Water Authorities. The more recent extreme example of water privatisation during Prime Minister Thatcher's regime (1979–1990) sets England and Wales clearly apart from other European countries.

Spain, Portugal and Italy have systems built on Roman law, while those of England, the Netherlands and Germany are based on Germanic law. In Spain, Portugal and Italy the political history of the 20th century explains also largely the ways and emphasis of water resources management. Germany has a long tradition of local drainage associations, while river basin management has not been institutionalised except for the famous *Ruhrgenossenschaft*. Due to the strong subsidiarity, water policy is in the hands of 16 *Länder* (states) rather than with the *Bund* (federation). In the Netherlands historical development has led to water-user associations, and around 2000 wastewater management is largely based on water boards (Uijterlinde et al., 2003). The Nordic countries are perhaps the ones with the strongest subsidiary tradition and do thus fall in the same category with the Netherlands and Germany.

According to Barraqué (2003), it is difficult to place France in any of these categories. On the one hand, France is clearly a follower of Roman law and the centralised tradition. Yet, the six water basin authorities have become largely

**Table 1.** A rough typology of water institutional cultures in Europe (Barraqué, 2003; modified by the authors).

(Predominantly)	Roman origin	Germanic origin
Centralised	Spain	England
Subsidiary	Portugal, Italy	Netherlands, Germany Nordic countries

subsidiary institutions. As for water services, the role of municipalities has declined over time. Several Central European, as well as the Baltic, countries were subject to the highly centralised Soviet tradition of state water management after WWII. It will be interesting to see to what extent they will “go back” to the municipal tradition, or whether they will choose the private company tradition for the short or long term. Although the typology described above applies mainly to water resources management, it also explains the differences in subsidiarity tradition, and thus the role of local governments. This difference is crucial when we take a closer look at the evolution and strategic decisions concerning the management options for water and sewerage services.

An interesting comparison between the European countries by Newman and Thornley (Newman and Thornley, 1996) presents five “families” in terms of their legal and administrative traditions. They argue that there is general agreement in the literature that European countries fall into five key categories: British, Napoleonic, Germanic, Scandinavian and East European. This may be valid as a rough classification, although e.g. Hungary does not fit to the East European category.

According to Newman and Thornley (1996, 30), the British legal style is largely isolated from the others. Yet, the Scottish legal system maintained its identity because Scotland was an independent kingdom until the early 18th century. In contrast to the isolated development of English law, Scottish law developed into a combination of local customary law and Roman law. This also partly explains the fact that water services in Scotland have developed somewhat differently from those of England and Wales.

When comparing the trends and developments of local governments in Europe, Batley (1991, 216) recognised three main types of reforms in terms of service delivery. One is the trend to expand the role of local government, and to free it from restrictions: examples are the shift to general grants in the Netherlands and Norway; a more dramatic one is the deregulation and free commune experiments in Scandinavia. The second type relates to the improvement of public service practices including, e.g., the setting of performance standards, staff training for greater responsiveness, strengthening user influence and neighbourhood decentralisation.

The third one is the incorporation of business methods and competitive practices into the public sector, such as devolution of budget responsibilities, contracting out and charging fees for services.

In the early 1990s, according to Batley (1991, 216) a clear distinction was made between the services where contracting out, franchising and business methods are appropriate and those that should remain under direct administration or the voluntary sector. At the same time Stoker (1991) pointed out how the establishment of local government in Eastern Europe is seen as central for establishing and maintaining a democratic process. Stoker also reminded how post-war growth in public spending, especially in connection with the welfare state, increased service provision and local government activities. Yet, the more difficult economic climate from the mid-1970s on led to a concern about public spending. However, as Stoker (1991) mentions, the challenge of local government is broader than the “fiscal crisis” — a wider economic and social change affecting the operational environment of local governments. The challenge facing local government is to find more responsive and effective organisational forms.

Urban planners often point out that, in fact, water and sanitation have often been the first public infrastructure systems and services in urban areas. In the last 100 years urban planning seems to have come full circle. According to Pakarinen (1990), so-called modern urban planning covers the period from the mid-1800s until today, although the history of urban building goes far back in history. The early phase of modern urban planning is placed between 1870–1914/1922, followed by the expansion phase from the 1930s to the 1950s. The practise was continued until the 1970s, while criticism was also presented. The change in the 1970s involved, for instance, lengthy discussions on democracy and participative planning. By the 1980s most agreed that urban planning was in a crisis. In the early phase urban planning was seen more as a physical planning exercise which could ignore all social aspects. The planning of growing urban centres was for long based on the so-called satellite paradigm. Then, the participatory planning approach was introduced.

In the 1980s, instead of unified planning approaches, communities set out on different development paths. This was followed by the introduction of market economics and approaches that were looming already at the turn of the 1990s. In the 1980s urban studies started to pay attention to local governments and communities. As for the history of urban planning, Pakarinen (1990) recognises two major traditions: the German and the Anglo-American one. In the German tradition urban planning is seen as an applied science, while the Anglo-American tradition pays more attention to policies and policy changes. Peter Hall (cited by Pakarinen, 1990) calls the latest planning phase “city enterprise”. By 1990 the emphasis on reformist regulation started clearly to give way to the promotion of market economics. According to Kurunmäki (2005, 19–20) urban planning in recent decades has shifted from “town planning” to “urban development”, the latter described by the concepts of policy-implementation, structure-agency, government-governance, and public-private relations.

Hofstede (1994, 236) points out that the main cultural differences among nations lie in values. Research on these values has “shown repeatedly that there is very little evidence of international convergence over time, except for an increase of individualism for countries that have become richer”. Thus, in spite of globalisation and increased contacts, the value differences described a century ago still existed in 2000, and, according to Hofstede, that cultural diversity will remain for the next few hundred years. Water being largely a local issue, it is no wonder that even in a country like Finland, with only five million people, different cultures exist. It proves that the management methods found appropriate in one environment do not necessarily fit others.

*As for public-private partnerships - recently presented and lobbied as something unique, new and innovative - have historical roots.*

As for public-private partnerships - recently presented and lobbied as something unique, new and innovative - have historical roots. In the mid-1800s most of western nations, if not all, started to develop urban water and sewerage services by privately owned companies or private operators. Yet, in most countries the utilities were fairly soon taken over by municipalities. Only in France private operators, such as Veolia Water (earlier Vivendi) and the Compagnie Générale des Eaux, have survived and expanded since 1853. This is largely due to the fact that even today there are some 36,000 municipalities in France. It is impossible to imagine individual municipality-owned

utilities managing their water services. There are several other policy instruments that have favoured, and still favour, the use of private operators. In some places, such as Barcelona and Venice, private companies have maintained concessions for over a century (Katko et al., 2003).

Urban environmental history, as pointed out by Schott (2004) also draws attention to the ‘software’ dimensions of environmental problems: “certain patterns of wasteful and inefficient resource use and pollution have developed as the result of social and cultural adaptations to historically new technologies”. Thus, a combined approach, considering both the material infrastructure as well as the related manifestations in law, administration and urban culture is to be considered.

In any case, our historical and long-term experiences show that there are, on the one hand, obvious traditions of WSS services related largely to the role of local government and subsidiarity, and, on the other hand, external pressures that seem to completely ignore local conditions. In the following we will compare these trends with the actual findings on the case countries and cities.

## COMPARATIVE ANALYSIS AND DISCUSSION

Based on the case studies and the key strategic long-term decisions and episodes by country and by city some of the key results of comparative analysis are presented below.

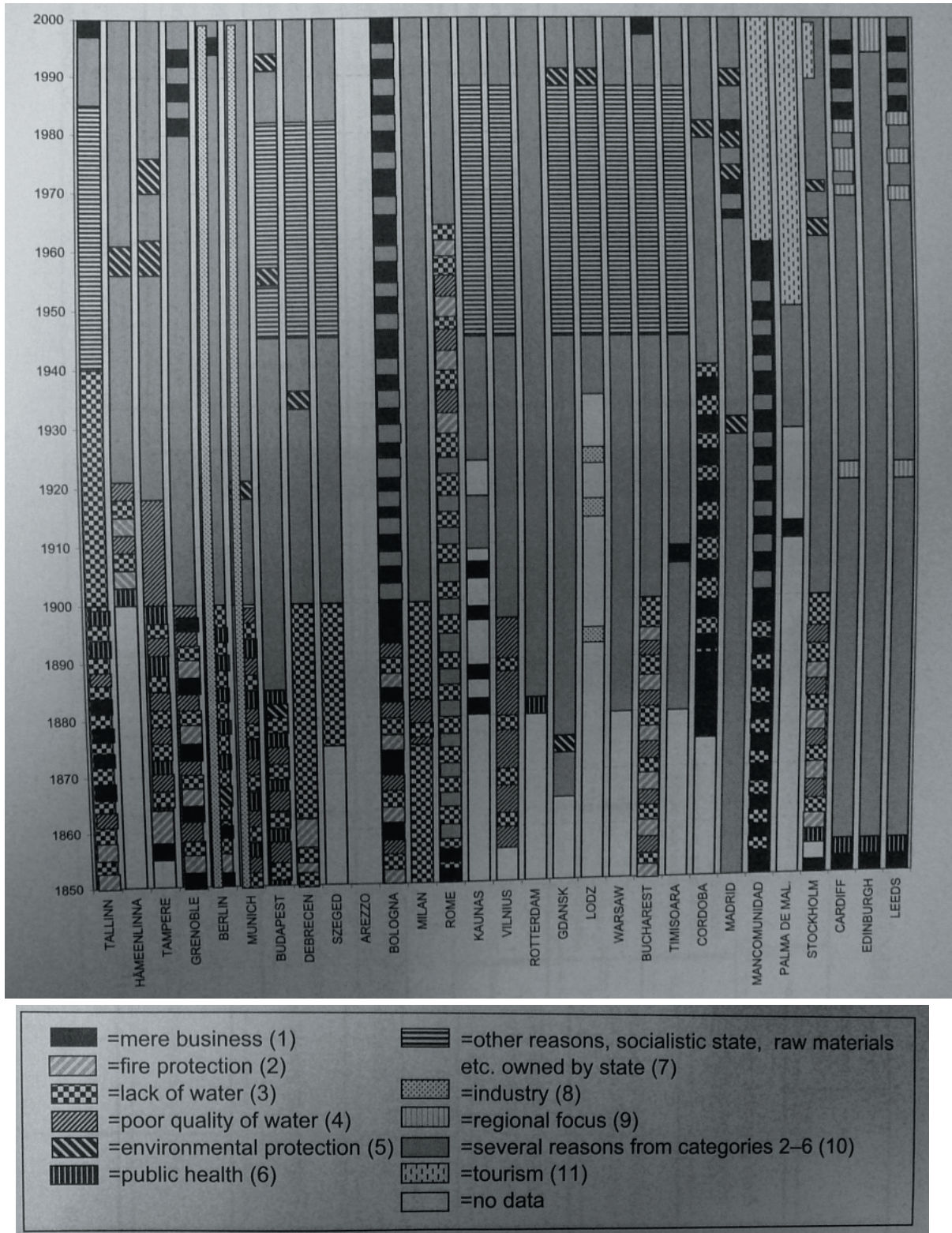


Figure 2. Factors creating demand for improved WSS services in the case cities over time.

The demand for improved water and sewerage services was created by several factors based on local conditions in all case countries. Figure 2 is a compilation of such factors: the WSS business itself, fire protection, lack of water, poor quality of water, environmental protection, public health, industrial use, regional focus, tourism, other reasons or various combinations of them. It is obvious that these demands were and also are of contradictory nature. In many cases the improvement of services was directly linked to WSS sector legislation as such, while in some cases societal changes in other sectors influenced also WSS services like regionalisation in the UK and later in the Netherlands.

The establishment of “modern” water supply, sewerage and wastewater treatment over time in the case cities is summarised in Figure 3. In many cases water supply was introduced first, followed, or in several cases combined with the establishment of sewerage systems. In some cases sewerage was introduced first, if deemed necessary. In a number of cases the first “modern” water supply systems had low-pressure or very simple systems for water treatment as in Tampere and Tallinn.

Alternatively, the coverage was remarkably low. Sewerage was often preceded by drainage, and in such instances the available data are only indicative. For instance, it is even possible that some form of sewerage or drainage has existed since the Renaissance period. In practice, introduction of separate systems for sewerage made it feasible to start wastewater treatment.

The various forms of public–private cooperation practiced over time in the case cities are shown in Figure 4. In one third of the case cities, particularly the first water systems, were implemented as private concessions. In several other cases concessions were proposed but municipal systems were selected instead. By 1900 most of the case cities had taken over the systems and started to develop utilities under local government. Yet, it is very important to note that in many cases these public utilities bought services, equipment and goods from the private sector already at this stage. Besides, these utilities took loans from private banks.

After WWII state water companies assumed the responsibility for WSS services in Eastern Europe. Obviously water pollution control was largely neglected in those days when low-priced or free services were provided and fuel was cheap — thus leading to inefficient use and high leakages of water systems. Some norms existed for water pollution control, but they were not properly enforced.

In the 1980s and 1990s, in connection with the so-called “Washington Consensus” and the introduction of neo-liberal ideologies, private concessions and operational contracts were introduced. The paradox of this so-called consensus was that it applied to a fairly small group of stakeholders or their representatives; no wider acceptance existed. The full privatisation in England and Wales in 1989 and partial privatisation in Tallinn in 2001 are the most dramatic changes of the period. However, the share of private companies and operation contracts is still small among the case cities. In addition to Tallinn, some private operation contacts



ESTABLISHING "MODERN" WATER WORKS AND SEWERAGE AND INTRODUCING WASTEWATER TREATMENT IN CASE CITIES

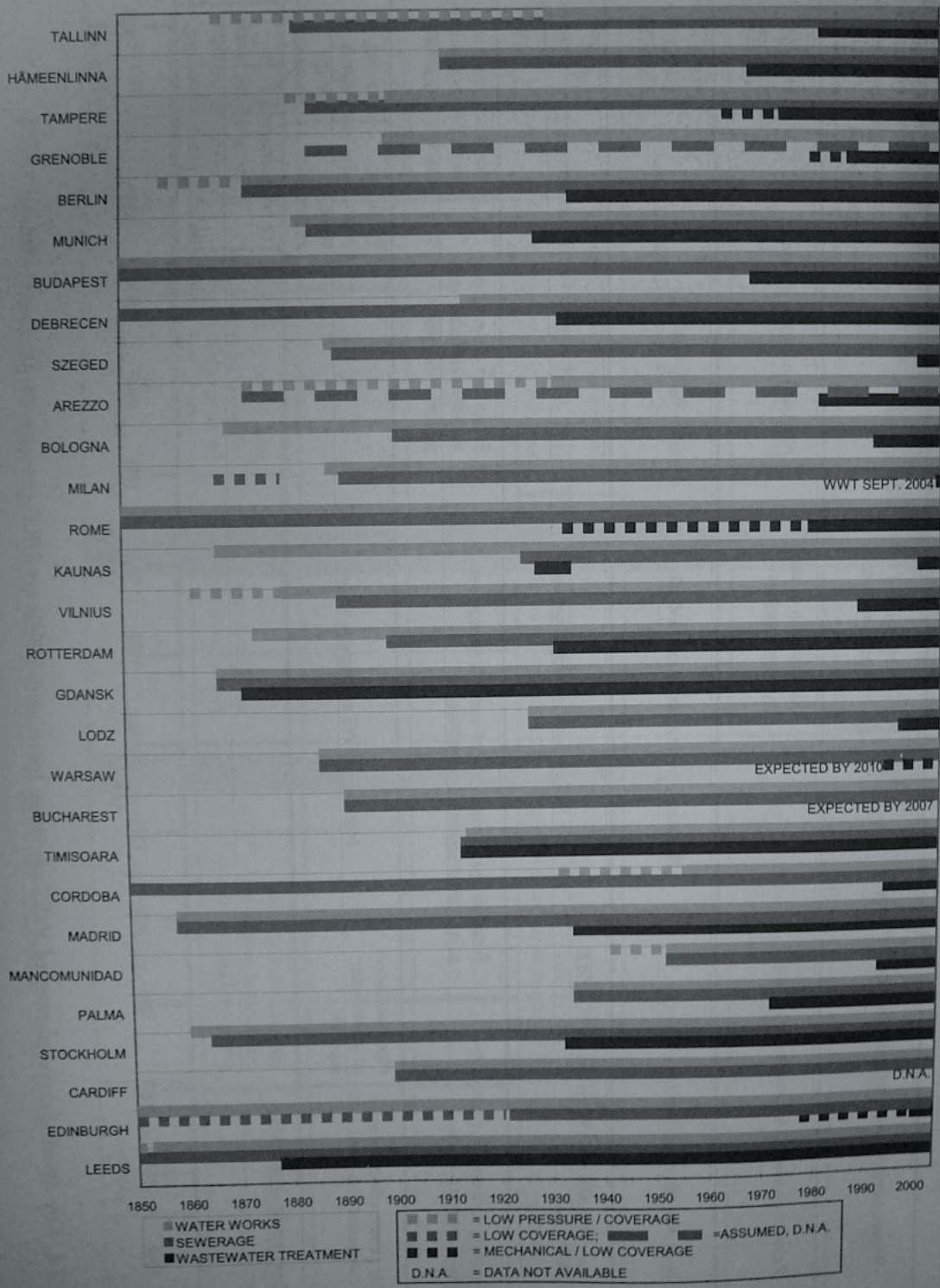
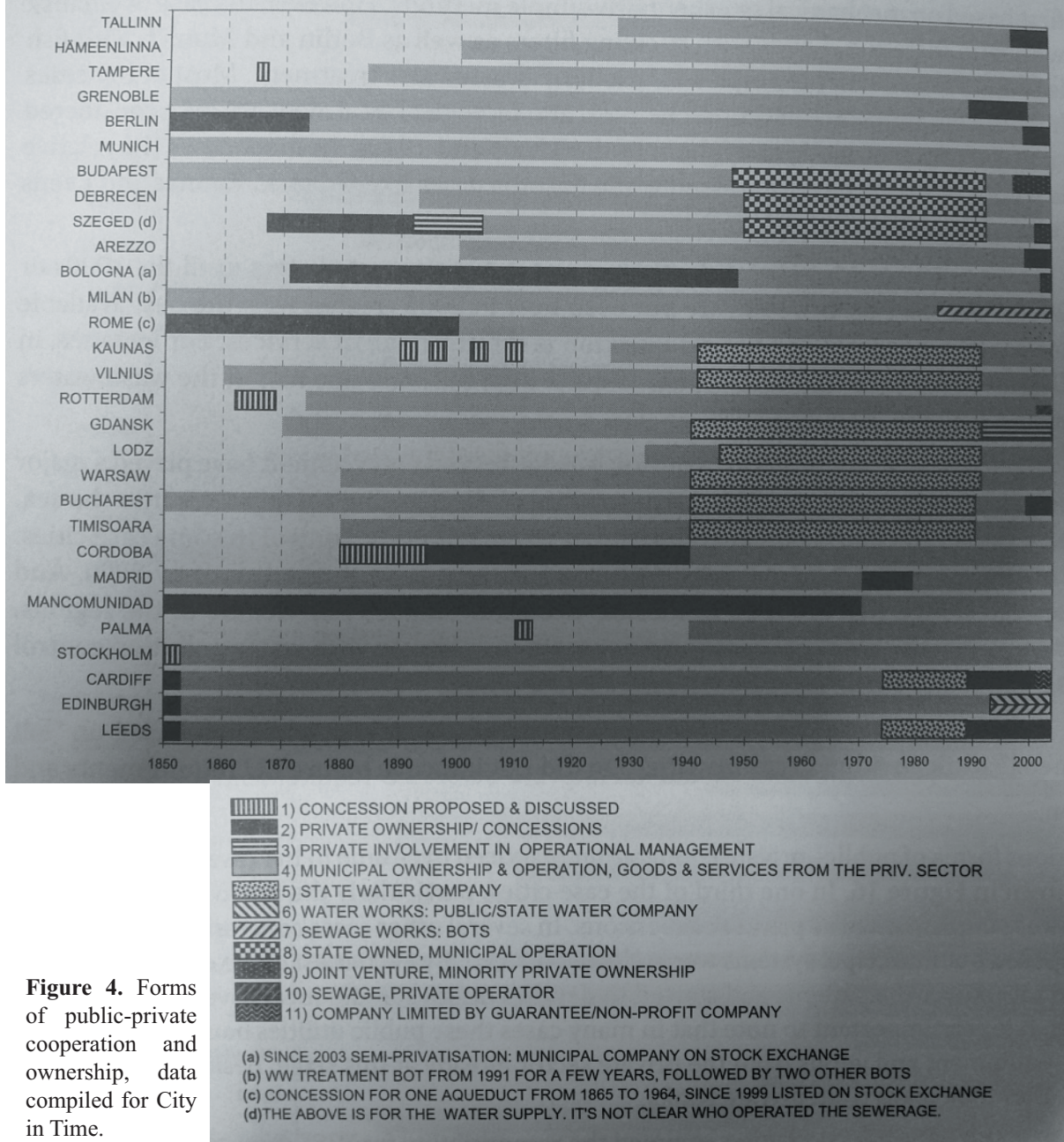


Figure 3. Establishment of modern WSS and introduction of wastewater treatment in the case cities.

FORMS OF PUBLIC-PRIVATE COOPERATION AND OWNERSHIP



**Figure 4.** Forms of public-private cooperation and ownership, data compiled for City in Time.

and concessions were awarded also in Eastern European cities, but many of them have started to develop autonomous city-owned companies that largely aim at operating on commercial principles. In some cases private companies have been awarded BOTs or minority shares.

Sustainability of the use of water as a natural resource can be estimated by the so-called specific water consumption, SWC. In principle, SWC is calculated as the total amount of water pumped to the network divided by the number of people connected. Fig. 5 shows the available SWC data for the case cities. Most figures

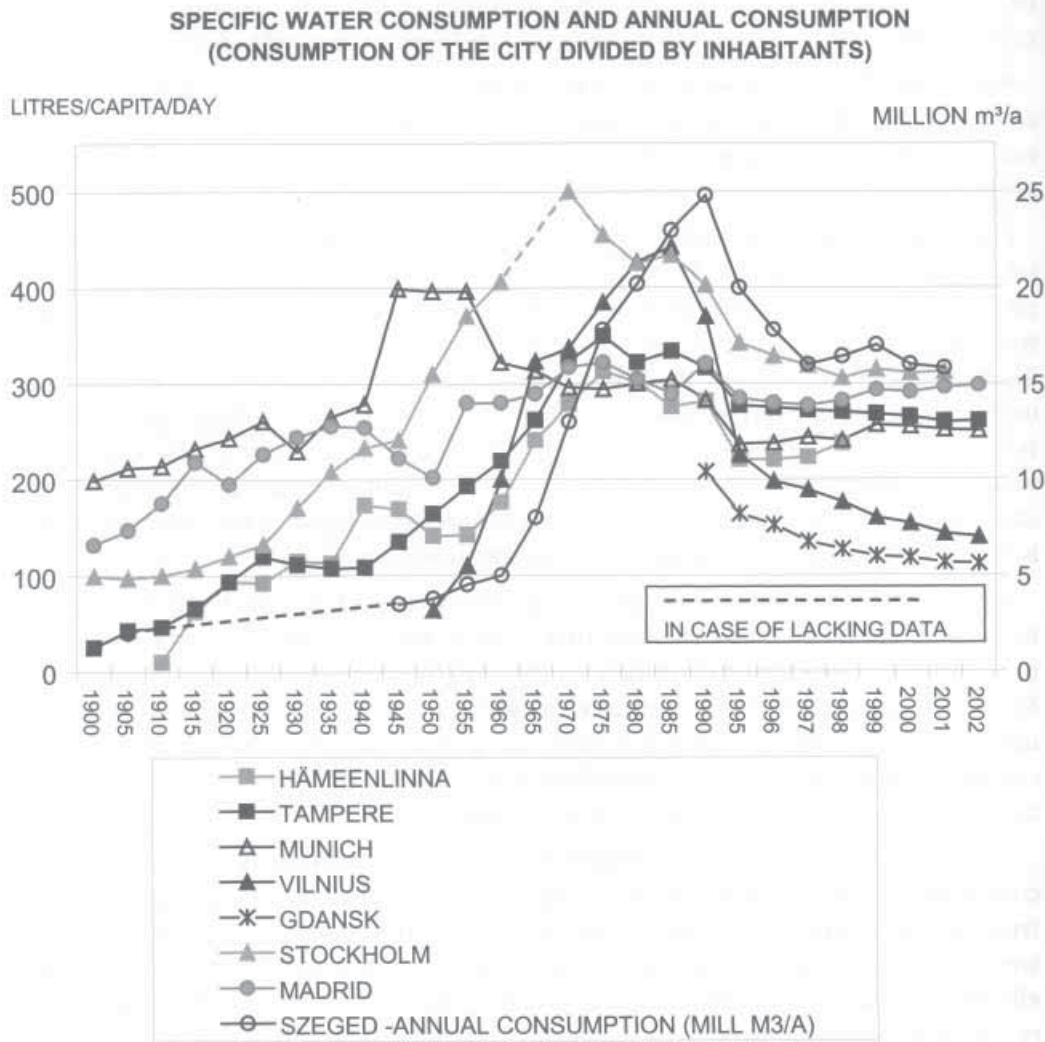
represent total consumption divided by the total number of people in the city and are thus probably smaller than the actual values. In some cases special water users, like industries, may be connected to the public systems, which explains the higher SWC rates. The figure also shows some data on total consumption. It is also possible that some utilities have lower average pressures which also means lower leakage rates. In addition to natural conditions, cultural and social factors and habits may also explain the variations.

Considering the cultures and traditions of urban planning, typologies of water resources management, legal and administrative families, cultures and organisations, and the variation in the roles of local governments in the European context, we obviously also face a diversity of options for water services management. Fig. 6 presents a rough classification for the WaterTime case countries as they were in 2004. It implies that there is probably even more variety in water services management than, for instance, in the traditions of urban planning. Once water services are managed at the local level, the role of local governments in each society also largely explains how water services are managed.

In the early 2000s water and sewerage services have been managed by a single utility in most of the case countries and cities (Baltic region, Hungary, Nordic countries, and Spain). Germany has a long tradition of multi-infrastructure companies, “Stadtwerke”, which manage water and gas and some other infrastructure services except for sewerage. Completely private water and wastewater companies exist in England, Wales and Tallinn, Estonia while a few concessions and private operators exist as well. Regionalisation has taken place in England, Wales and the Netherlands, while inter-municipal cooperation of utilities has taken place in many other countries and cities.

Based on the City in Time study, a typology of water services management paradigms over time is presented below:

1. Early trials in biggest urban centres with private concessions from the early 1800s to the late 1800s;
2. Municipalities assume responsibility between the mid-1800s and early 1900s. Somewhat later in France concessions were replaced by management contracts or affermage;
3. Technical expansion and development of the established systems, from the early 1900s to the 1980s (except for WWI and II) — from narrow to wide coverage and improved water and wastewater treatment technologies together with stricter requirements. Municipal or inter-municipal systems were the major option, while regionalisation and river basin became the basis for water services in UK. In France private operators have largely occupied the market;
4. The collapse of Soviet Union and the reconstruction of the water and sewerage system in many Central and Eastern European countries that followed.
5. Reinvention of privatisation and private operational contracts in the 1990s in some countries and cities while the vast majority of municipal-owned systems improve their performance and continue buying services, equipment and goods from the private sector;



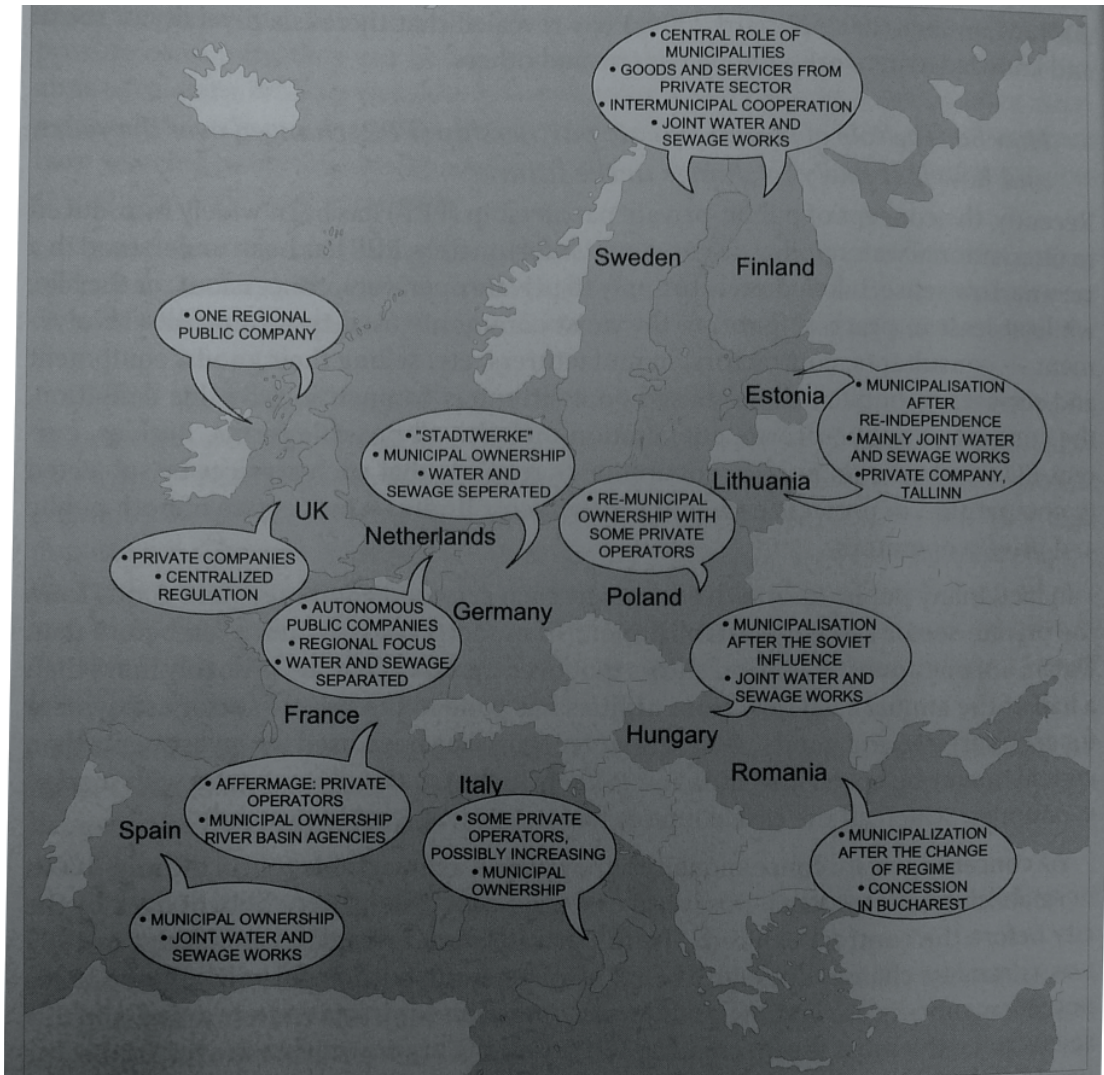
**Figure 5.** Specific water consumption in relation to time in the case cities.

6. New diverse culture of water management in the 21st century in terms of size, roles, technological solutions, alternative options within the wider EU framework while recognising the need of local traditions and conditions.

## CONCLUSIONS AND RECOMMENDATIONS

Some of the key findings of the study are as follows:

(i) In historical perspective water management, both services and resources, is substantially a local issue. In the development of water services provision and production the local government plays an important role in many countries, though not everywhere. This is in harmony with the subsidiarity principle.



**Figure 6.** Rough classification of water services families in the case countries of WaterTime around 2004 (Juuti and Katko, 2005).

(ii) Some of the strategic decisions have proved to have a long-term impact and thus strong path dependence. As for technology, selection or abandoning of metering, separate sewers, and abandoning of lead pipes have had very long-term impacts. As for institutional arrangements, private concessions have sometimes become very long.

(iii) Fundamental strategic changes have been decided upon often without real evidence of their potential superiority. In several cases decisions have been made in an ahistorical context or vacuum, while ignoring the past and even more recent experiences elsewhere.

(iv) It is possible that in the early phases of establishing the systems, options and alternative ways were discussed and considered relatively more than later on when the established systems were expanded;

(v) It is obvious that institutional changes are needed, but they should not be done for the mere sake of change — like the idea of reinventing private concessions or operators in a completely ahistorical context: not recognising the earlier models, let alone the experiences gained;

(vi) Some interesting and different traditions exist like the “Stadtwerke” in Germany, which operate both water and gas, but not sewerage systems. This diversity of options should be noticed and encouraged, if found feasible;

(vii) Integration of water supply and sewerage would be logical based on experiences from the Nordic and several other case countries. In any case, ensuring adequate cooperation between water and sewerage services could be a first natural step in terms of Integrated Water Resources Management;

(viii) Instead of assuming the business-as-usual scenario also for the futures, we should consider all possible means for more rational use of water, treating and managing wastewater as well as recycling water especially in areas with scarcity. Particularly, we should apply various types of demand-based management tools of whose performance we already have historical evidence;

(ix) In the historical context, we have evidence that water services cannot be considered merely managing an economic good. Instead, all the requirements of water based on political, economic, socio-cultural, technological, environmental and legislative dimensions have to be taken into account in a balanced way.

(x) History is full of warning examples of the so-called “opening up” of markets to international operators in the case of WSS services, or failed one-fits-all solutions;

(xi) Access to, and availability of, basic information and knowledge seem to be bottlenecks that should be removed. This could be argued, for instance, on the basis of the recent Århus convention on access to information, participation in decision-making and access to justice in environmental matters.

Finally, it is clear that for managing and producing water services we have a diversity of options bearing in mind all the political, economic, social, technological, ecological and legislative aspects. This is true among the old EU members, and particularly among the newer and future ones.

For further research proper indices on evaluating sustainability and operational efficiency and efficacy could be developed — if they cannot cover a century and a half perhaps at least a few decades. Although this study has concentrated on urban areas, it is good to remember that many European countries have a large rural population and free-time housing with their own piped or on-site systems. Another key question will probably be to what extent it is sensible to expand current water and sewerage systems considering all the political, economic, social, technological, environmental and legislative (PESTEL) dimensions and limitations.

## ACKNOWLEDGEMENTS

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# PART 3

## Global development

*“Water links us to our neighbor in a way more profound and complex than any other.”*

John Thorson



**Figure.** Water tower in Alexandria, Egypt. (Photo: P. Juuti 2003)





# Ontology of Water Services

Pekka E. Pietilä & Tapio S. Katko

Pietilä P.E. & Katko T.S.

Ontology of water services.

Modified from: Pietilä P.E. 2006. Role of  
Municipalities in Water services. Doctoral thesis.  
Tampere University of Technology.

## ABSTRACT

Water services<sup>1</sup> have several special features compared with other commodities. Water is a satisfier of a basic need and cannot be replaced with any other product, functioning water services are a prerequisite for all economic activity, water supply is and will remain a natural monopoly, water services are areally limited and highly susceptible to local natural conditions, and there are competing uses of water which may be mutually exclusive. This paper (a) discusses the nature, or ontology, of water services in a holistic way and provides some examples of the dissimilarities between water and other basic services and (b) analyses the multifaceted nature of water services using the PESTEL (political, economic, socio-cultural, technical, environmental/ecological, and legal) dimensions assessed by a group of experts in Finnish circumstances.

## INTRODUCTION

During the last decade the ultimate nature of water services has been the subject of discussion. On the one hand, water is a basic necessity for sustaining life and should thus be treated as a public resource or common good to ensure that everyone has access to at least a basic supply. On the other hand, as more than one billion people still lack even basic water services, opinions are voiced that water should be treated as a private commodity allowing the markets find ways to fill the gaps.

It is, however, frequently falsely argued that water and sanitation services and infrastructure would be similar to any other infrastructure and services – such as energy, electricity, telecommunications, and transport – and could thus be reformed and restructured along the same lines. Yet, water supply and sanitation have their special features that should be addressed in any water sector reform process.

## OBJECTIVES AND METHODS

The aim of this paper is to highlight the many dimensions of water and water services. It is argued that during recent years the discussion has been dominated unnecessarily often by the economic aspects of organising water services. We do not wish to undermine the importance of sound financing as a basis for sustainable water services, but one should not forget the special character of water and water services which are in many respects different from other basic infrastructure services.

The first part of the paper is built on literature and the writers' findings during the thirty years they have carried out both in domestic and international assignments in the water sector. It summarises the critical factors to be considered when developing and organising water services.

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<sup>1</sup>In this paper the term 'water services' is understood to cover both water supply and sanitation services

Ontology: the branch of metaphysics dealing with the nature of being.  
(The Oxford English Reference Dictionary)

Based on this general overview, the various factors connected with water services were grouped under six main dimensions: political, economic, socio-cultural, technical, environmental/ecological, and legal (PESTEL). The latter part of the paper summarises how a selected group of Finnish water sector professionals evaluated the importance of various factors in the Finnish setting.

## UNIQUENESS OF WATER SERVICES

### **Water as a basic need and a human right**

There is no life without water. All human activity depends on it. According to WHO (2003), everyone is entitled to sufficient water for drinking, sanitation, cooking and personal hygiene. But a huge proportion of the world's population can only dream of even these modest volumes. Over 1.1 billion people lack safe drinking water and over 2.4 billion do not enjoy the benefits of safe sanitation. Water scarcity – both qualitative and quantitative – is emerging as a major development challenge for many countries. This situation has prompted the emergence of an increasing number of social and political conflicts worldwide (Saleth & Dinar, 2004; European Declaration, 2005).

Based on the undisputed fact that we humans cannot survive without water, the concept of 'water as a human right' has emerged. In November 2002, the United Nations Committee on Economic, Social and Cultural Rights adopted a General Comment on the Right to Water (UN, 2002). It provides an authoritative, but not legally binding, interpretation of the right to water under the International Covenant on Economic, Social and Cultural Rights. The Covenant has been ratified already by 151 countries<sup>2</sup>. Langford (2005) presents a comprehensive summary of the development and the real meaning of the United Nation's concept of the right to water. The Committee did not state that water should be free, but stated that it should be affordable (Langford, 2005).

### **Water as an economic good<sup>3</sup>**

Water is used by a wide variety of users for very different purposes, and the market for water is not homogenous. Mehta (2003) points out that market forces do not operate in vacuum: they are influenced by social practices, cultural norms, and local institutional settings. Willingness and ability to pay varies enormously between user groups. Industry needs water as one of the basic resources for

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<sup>2</sup> As of 13 December 2005. Office of the United Nations High Commissioner for Human Rights (available at: <http://www.ohchr.org/english/countries/ratification/3.htm>)

<sup>3</sup> In this paper goods refers to both goods and services

production, and thus paying for water is not different from paying for any other raw material or means of production. Domestic users need a certain volume of water for basic needs even though the volume used depends highly on the ability to pay. Unfortunately many people are so poor that their ability to pay for water is very limited. Farmers often use large volumes of water for irrigation, and in many countries they receive highly subsidized water and are extremely unwilling to pay full costs. Nature also needs water in addition to human activities, but how can it pay? There is no single formula for setting a fair price on water – it is a highly political question that requires setting policies (Savenije, 2001).

The role of water as a basic need, a merit good, and a social, economic, financial, and environmental resource makes its pricing exceptionally controversial because the flow of water through a basin is a complex issue involving many externalities, possible market failure, and high transaction costs. Rodriguez (2004) softened the debate by suggesting that the management of water as an economic good does not imply the total commodification of water.

### **Water as a public good**

Economic textbooks define public goods as goods being non-rival in consumption and having non-excludable benefits (Kaul & Mendoza, 2003). By definition, once a public good has been produced everyone can benefit from it without diminishing others' enjoyment, and it is very difficult, if not impossible, to prevent access to it. It can be argued that water does not satisfy these criteria, but, on the other hand, there is an understanding that water supply and sanitation are public goods the provision of which the state has to ensure (Tipping et al. 2005). Kaul & Mendoza (2003) would like to stress that defining a good public or private is not just a technical, but also a political and policy matter, and that the definition may change in time. Hutton & Haller (2004) have analysed the value of future benefits of water and sanitation improvements. They concluded that water and sanitation improvements were cost-beneficial in all regions of the world, and that in developing regions an investment of \$1 would provide a net economic benefit of a minimum of \$5, often even more.

### **Water is non-substitutable**

Water is a special economic good in that it cannot be substituted. We need food, but if we run out of one kind of food we can replace it with another. For cooking and heating there are alternative energy sources, even if in certain conditions the choices may be very limited. Our daily drinking water need can be satisfied to a certain extent with juicy fruit, but we cannot wash our clothes or take a shower with fruit juice.

### **Water is a local resource**

Theoretically as well as in practice water can be transported even to other continents, but we need such large volumes of water that trade across long distances is not financially viable. Thus water is clearly a local resource to be mined, processed and distributed locally, but water services are often mistakenly taken to be similar

to energy services. Fuels (oil, coal and gas) can be transported over long distances on an economically sustainable basis. Even electricity can be distributed over thousands of kilometres at affordable costs unlike water.

*The problems caused by wastewaters have also to be solved locally.*

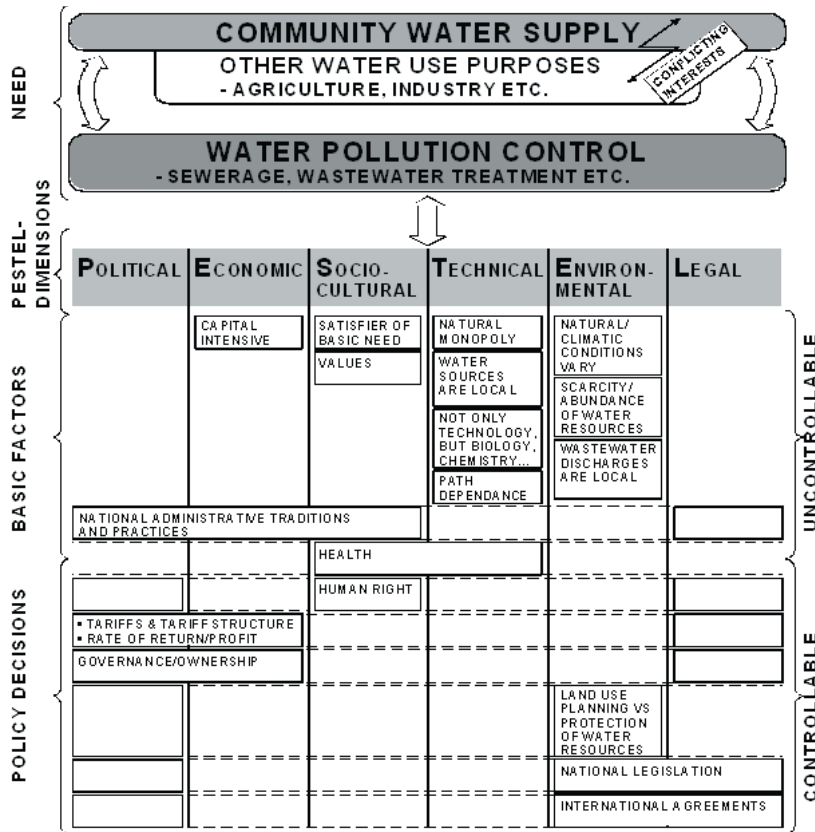
The problems caused by wastewaters have also to be solved locally. Wastewaters can be transported tens of kilometres, sometimes maybe even one hundred kilometres. In Finland there has been a gradual development towards larger units for wastewater treatment, especially in Helsinki metropolitan area. In the 1970s the City of Helsinki, with a population of about half a million, had 11 wastewater treatment plants. Since 1994 all the wastewaters of the city have been treated in a single treatment plant which also purifies the wastewaters from five neighbouring municipalities, thus serving a total population of 750 000 people. The longest transportation distances to the treatment plant are in the region of 50 kilometres which seems to be the maximum viable distance in Finnish circumstances (Helsinki Water, 2005).

## **EVALUATION OF WATER AND WASTEWATER SERVICES BY PESTEL ANALYSIS**

The PESTE framework has been widely used in analysing, for instance, business environments and process clusters. PESTE is an acronym for political, economic, socio-cultural, technical and environmental/ecological dimensions, under which information is systematically collected and analysed according to their nature. PESTE has been used in futures studies because it provides a framework for thinking about trends both now and in the future. There are a number of modifications of the basic PESTE framework. This research used PESTEL, which includes a legal or legislative dimension under a separate heading. For the analysis of water and wastewater services, the addition of the legal dimension is well justified due to the importance of legislation at various stages of these services.

In the first stage of the research we asked about thirty Finnish water and environmental sector professionals to list factors they consider important or relevant for water and wastewater services. Based on their answers we compiled a summary of indicating some key factors as seen in Figure 1 (Pietilä et al., 2004). Each dimension includes factors which we human beings cannot control such as natural and climatic conditions as well as ones which depend on the decisions we make. The importance of the various factors and decisions of each dimension depends on a wide range of circumstances which may be geographical, climatic, financial, cultural, religious, etc.

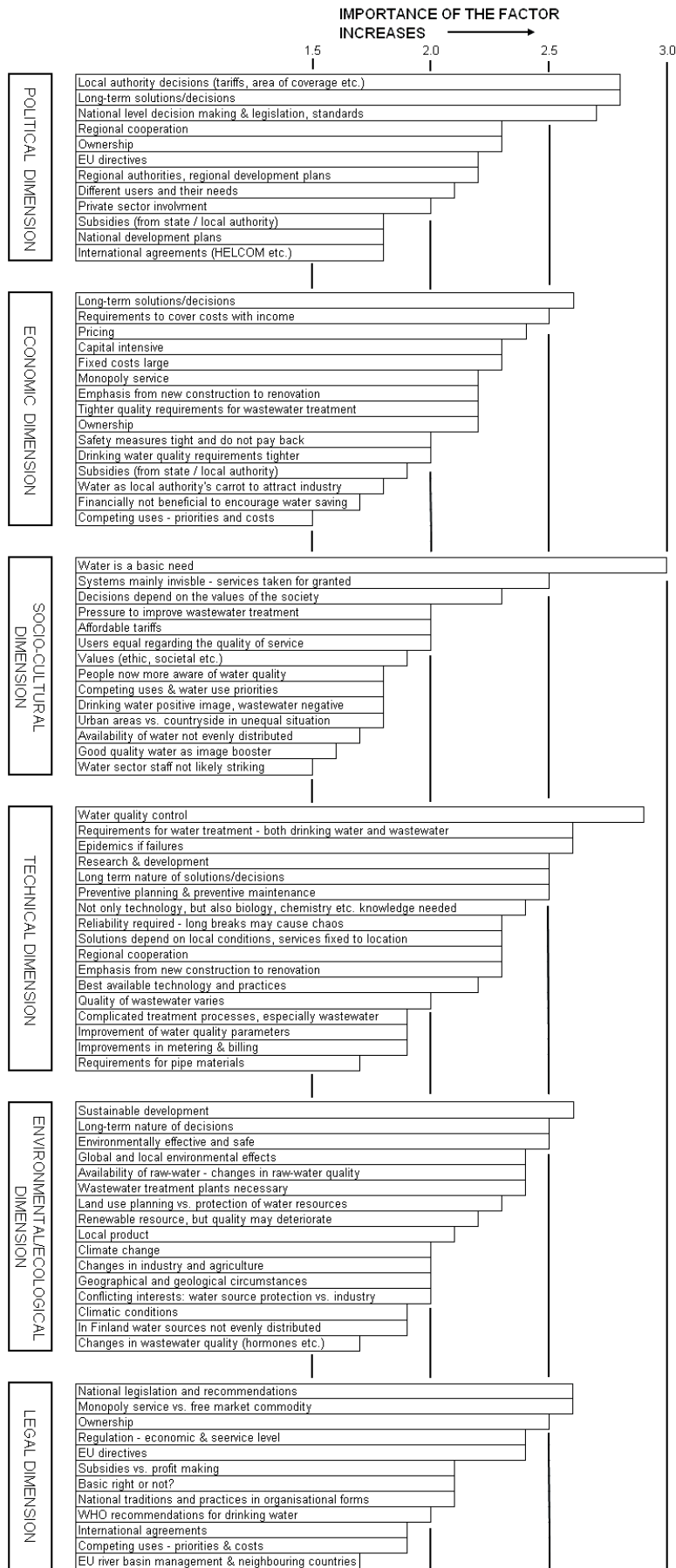
In the second stage, we compiled a set of factors related to water and wastewater services, based on the previous expert group's answers, discussions and feedback during and after the Marrakech Conference as well as consultations with some



**Figure 1.** Ontology of water services and PESTEL dimensions, a poster presentation at 4<sup>th</sup> IWA World Water Conference in Marrakech, Morocco, 19-24 September 2004.

additional sector professionals. The factors were grouped under the six PESTEL dimensions: political, economic, socio-cultural, technical, environmental/ecological, and legal. We came up with a total of 86 factors.

In the third stage, we invited 16 Finnish water and environment sector professionals to assess the importance of each of the 86 factors on a 1 to 3 scale (1 = not important; 3 = very important). Figure 2 shows the average grade received by each factor within each PESTEL dimension. The group consisted of a variety of professionals including utility managers, municipal council members, consultants, water sector researchers, water and environmental historians, and futures researchers. Several of the factors are so strictly country-specific that we asked the group to rate the factors in Finnish circumstances which is why some of the presented findings are not necessarily applicable to other countries as will be discussed later. Some key findings on each of the six PESTEL dimensions are presented in the following.



**Figure 2.** PESTEL dimensions and rating of factors in Finnish circumstances



### **Political dimension**

The most important factors under the political dimension were the long-term solutions or path dependence typical to many decisions on water services as well as local authority decisions on issues such as tariffs, area of coverage, etc. This is an interesting finding considering that in Finland the responsibility for water services lies clearly with municipalities while political decision makers at the municipal level are also often blamed for only seeking short-term political gains and lacking long-term thinking. National level decision making such as legislation and standards were also seen as quite important.

### **Economic dimension**

No economic factors proved as important as the political factors mentioned above, but the long-term nature of many decisions was considered quite important also economically. The relatively low valuation of economic factors can also be explained by the quite stable and good financial state of water services in Finland. There is a long tradition of people paying for water services, and, on average, tariffs cover costs including investments.

### **Socio-cultural dimension**

The factor the group unanimously considered very important was that water is a basic need. This most likely applies throughout the world. Otherwise the factors under socio-cultural dimensions were not regarded all that important in the Finnish setting. The relatively low valuation can probably be explained to a great extent by the fact that the coverage of water services in Finland is practically 100%, the level of the services is good, and affordability is not a problem. Thanks to the good coverage, the respondents did not find rural areas to be in an unequal situation compared with urban areas. Interestingly, Finland's good water quality was not seen as an important factor in enhancing the competitiveness or image of Finland and Finnish products.

### **Technical dimension**

Clearly the most important technical factors were water quality control, followed by the requirements for water treatment (both drinking water and wastewater), and the reliability of the hygienic quality of the systems in preventing epidemics caused by failures. These factors are clearly interconnected, and they all stress the importance of safeguarding the hygienic quality of drinking water. Most likely these factors received high scores partly due to a couple of recent cases of limited pollution of drinking water due to severe flooding. These rare cases were widely publicised because availability of good quality drinking water 24 hours per day is taken for granted in Finland – anything less is not acceptable. Preventive planning and the importance of long-term decisions and path dependency were also regarded rather important.

**Environmental/ecological dimension**

In the environmental/ecological sphere the most valued factor was sustainability, followed by environmentally effective and safe practices and, once again, decisions of long-term nature. Finland is blessed with plentiful good quality water resources and, thus, understandably conflicting interests or competing water use purposes were not a major issue.

**Legal dimension**

Of the legal factors national legislation and recommendations, and the nature of water as a monopoly service vs. a freely marketable commodity, were regarded as most important. The ownership of water services was also seen as rather important – the general opinion in Finland is that water services should remain in municipal ownership. Thanks to the abundance of water, no reason was seen to prioritise water use purposes by stronger legislation or pricing. The EU's river basin management principle was not regarded as important and, surprisingly, neither were the WHO's recommendations for drinking water quality. The low importance placed on WHO's recommendations should not be interpreted as meaning that the Finns would not be interested in drinking water quality, or would not appreciate good quality drinking water, but it rather indicates their confidence in national legislation and recommendations.

**DISCUSSION AND POLICY IMPLICATIONS**

Many decisions related to water services have long-term, if not irreversible, consequences. The importance of this came out clearly in the analysis of the political, economic, technical and environmental/ecological factors. What is decided today will affect us still after twenty, fifty or even one hundred years. Water services are exceptionally capital intensive – the great majority, often up to 80%, of the assets of water and sewerage undertakings lie invisible underground in networks which may provide service for one hundred years (Vehmaskoski et al., 2002). Technically it is, of course, possible to rebuild and reroute existing networks, but due to the high costs involved it may prove financially difficult if not impossible. Thus we are bound to use structures possibly laid by earlier generations.

The selection of a water source may also be a decision for generations. Helsinki metropolitan area draws water from a large lake via a 120-kilometre rock tunnel (Hukka & Seppälä, 2004). Until 1982 its water source was a river flowing through the metropolitan area. Local availability of raw water was not a problem then or now, but the quality was so poor that it was decided to build a long tunnel to bring water from such a long distance.

The long-term perspective of the decisions should be carefully acknowledged in economic analysis of water and wastewater services. Economic analysts can demonstrate that the future has no value in monetary terms. The discount rate makes any future benefits or costs further than, say, 20 years ahead valueless

and thus irrelevant (Savenije & van der Zaag, 2002). But, on the other hand, if we consider environmental effects, 20 years is an extremely short period. There are examples from Finland where it will take generations for lake water quality to improve significantly after the discharge of wastewater has been completely stopped. Thus mere relying on economic calculations may present formidable challenges in the future. Clearly, a much broader approach taking into account various PESTEL dimensions should be the basis of decision making.

In Finland local authorities have traditionally made the important decisions concerning water services. Current legislation also states that local authorities are responsible for the provision of water services. In recent years the financial burden of local authorities has increased as they have been burdened with more responsibilities for the social and welfare services of the residents, without corresponding support from the state budget. Municipal water undertakings are, therefore, now increasingly used as 'money makers' whose profits are used to cover the costs of other municipal services. There are already signs of such short-sighted financial thinking compromising the long-term needs of water infrastructure management, maintenance and rehabilitation. Bearing in mind the long-term nature of water infrastructure, such myopic political thinking may have serious consequences for the futures. This may require stricter regulation mechanisms to be introduced, which – on the other hand – is against the decentralised administration tradition of Finland.

The quality of water and the level of water services are generally very high in Finland. In many international water sector evaluations Finland is one of the leading countries. This success can be partially explained by the high trust in and obedience towards authorities. The legislation on water quality and water services is also an important contributing factor, but the success of the implementation of legislation depends largely on the administrative tradition of the country, as well as on the attitudes of the public. Thus, legislation as such does not guarantee high level services.

The nature and severity of water problems are different from country to country due to several reasons: availability and quality of water resources, water pollution, population density, industrial and agricultural development and practices, etc. On the world scale, agriculture is the largest user of water with 69% of the total withdrawal of fresh water used in agriculture (mostly in irrigation), industry accounts for 23% and domestic use accounts for about 8% (World Bank, 2003). But the situation varies immensely by countries. Even within Europe the countries are highly different. In Spain agriculture's share of water use is about 70% while in Finland agricultural use is only 3%. On the other hand, Finland has a large pulp and paper industry, and industry as a whole accounts for 85% of freshwater use while in Spain industrial water use is only 5% (Hukka & Seppälä, 2004; Watertime, 2004). In Finland less than 3% of total renewable water resources are in use and thus the large industrial water use does not cause any significant problems (FAO, 2004). But Spain's water resources are not that plentiful, and a controversial water

transfer scheme pursued a couple of years back created massive opposition which, at the peak of the demonstrations, brought up to half a million people to the streets of Zaragoza, Madrid and Barcelona (Torrecilla & Martinez-Gil, 2005).

## CONCLUSIONS

Water has many faces, and arrangement of water services requires a wide range of approaches. It is universally accepted that water is a basic need and a necessity for all human activity. The lack of safe drinking water and proper sanitation facilities are commonly understood to be among the greatest challenges for the future, but the views on how this challenge should be tackled differ clearly.

It is clear that there is no simple answer to the problem of inadequate water services. During the evaluation process it became obvious that the relevance of several factors is country specific which supports our view that there is no panacea for the problem of arranging water services and that, for instance, the special conditions and circumstances of the country in question have to be taken into account. It is relatively easy to understand and take into account differences in natural conditions, such as the availability and quality of water and seasonal variations, but understanding and taking into account social, cultural, religious, legislative, etc. traditions and practices, which often are of vital importance to the success of any societal action, is more complicated.

What makes the task very challenging is that values and priorities vary enormously from country to country, and even within a single country. During recent years the discussion on ownership and operational modes and financing, which are certainly vital components, has unfortunately overshadowed other important dimensions of water services. Water has been considered an economic as well as a public good but is not exclusively one or the other – it is a mixture of these two and many other features. This mixture is not constant but varies by time and place.

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# Many Ps needed for sustainable water services – expansion of the scope of public-private partnerships

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This research note discusses the commonly used concept of public-private partnerships (PPPs) promoted particularly by international financial bodies in water and sanitation services during the past few years. The article argues that the scope of PPPs, which now includes only private operators, should be expanded. The article proposes a related list of policies, principles, and practices with selected priorities for viable and sustainable water and sanitation services. They must be assessed in a long-term perspective rather than in a historical vacuum.

### **Keywords**

Water policy; principles; priorities; practices

This research note discusses the commonly used concept of public-private partnerships (PPPs) promoted particularly by international financial bodies in water supply and sanitation services during the past few years. While the world is facing the huge challenges of the Millennium Goals and the Water Decade 2005-15, we should promote the development of the basic water and sanitation services in all ways possible, particularly to those currently without access or, as defined in the goals, to reduce the amount of those without access by half by 2015. First, we would like to point out that we by no means mean to ignore or underestimate the importance of any feasible cooperation of various stakeholders including PPPs. Unfortunately, the scope of PPPs has been until recently limited, at least by some external support agencies, too much in favor of private multinational companies or operators instead of accepting all possible forms of private sector participation that exist or that need to be developed. Therefore, Hukka and Katko (2003) suggested that we should rather speak about public-private cooperation covering all the possible options for such cooperation. One of them is the traditional and vastly used form where the public utility buys services, goods, and works from the private sector based on continuous competition rather than long-term contracts with vertically integrated multinational companies.

During the 3rd International Congress of IWHA (International Water History Association) held in Alexandria, Egypt, December 11 to 14, 2003, the second and third authors of this article had a good opportunity to listen to the presentation by Ismael Serageldin (2003). In his paper, Serageldin stated that instead of the three Ps of PPPs, we should expand the concept by the introduction of people, and should have four Ps—people, public, private, partnerships. This presentation inspired the authors, English being not their mother tongue, to explore how many key elements and issues starting with the letter P there are, or may in fact

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be needed, to describe the whole context of viable and sustainable management of water and sanitation services. This is by no means meant to detract from the merit of the mentioned excellent and thought-provoking paper of Serageldin. Our article also aims at assessing the priorities for the various key elements as Ps that are needed for managing water and sanitation services.

## THE PROPOSED MULTI-P APPROACH

### Justification and provision of services

We can start with people, who are the primary beneficiaries of these services. It is this primary purpose and justification of water and sanitation that should be kept in mind before the promotion of any superior ideas—through policies, principles,

*It is this primary purpose and justification of water and sanitation that should be kept in mind before the promotion of any superior ideas—through policies, principles, and practices.*

and practices. In the global scale, one of the biggest questions is how to provide and produce water supply and sanitation services for the ever-growing cities and the peri-urban population and for the rural poor. In this context, provision refers to decisions made through collective-choice mechanisms regarding the kind, quality, and quantity of goods and services to be provided, arranged, regulated, financed, and monitored. Production, on the other hand, refers to “the more technical process of transforming inputs to outputs—making a product” (Ostrom, Schroeder, & Wynne, 1993, p. 75). One of the cornerstones of the millennium goals is to reduce poverty. In practice it can be reduced particularly by providing such essential basic services as education, health, water supply, and sanitation.

A recent study of 11 countries (Katko & Rajala, 2005) shows that even in countries where an overwhelming share of water is used for irrigation or other production purposes, community water supply has always been the first priority. The issue of water-use purposes and priorities is also recognized in the water legislation and measures taken in many countries where preference is given to the most important water uses.

All in all, we should find the best policies in each country, region, municipality, and community to promote the expansion of these services, keeping in mind that, in fact, water is largely a local issue. The possibilities of providing these services vary according to places. Thus, water management is very closely connected to the doctrine of subsidiary—management at the lowest appropriate level—which is one of the basic EU principles. Local government (municipalities) is essential in achieving the Millennium Development Goals because without local government, there can be no sustainability. Thus, they must be empowered to play their proper role in the provision of water services (Global WASH Forum, 2004).



*Even in countries where an overwhelming share of water is used for irrigation or other production purposes, community water supply has always been the first priority.*

### **Planning of systems**

When planning and organizing water and sanitation services in developing countries, one of the basic criteria is the need for privacy, especially in relation to sanitation. Although safe community water supply is particularly meant to secure protection against waterborne and water-related diseases, purity and even pleasure can also be achieved through potable water. In a wider context, water can be also used for productive purposes, both in rural and urban areas, which may even be one of the major water-use purposes for creating “felt” demand.

In terms of water availability the planet earth is mostly covered with water, although most of it is salty and thus not usable as such. Its use may become feasible in the future if the cost of desalination technologies decreases at the rate of recent years. On the other hand, the cost of desalinated water seems to be decreasing, and, therefore, particularly in areas with water scarcity, it may well be a viable option. But for developing economies, it will probably remain too expensive for a long time. Unfortunately, water availability varies a lot, largely because of precipitation patterns and seasonal fluctuations, and very often the human population or other water demand creators are less favorably situated in relation to water resources—or water quality.

In a developed society, any larger scale water extraction is normally subject to a permit application required by environmental or other authorities. We may have different procedures for granting such permits, but the key principle is that water extraction should not be higher than safe yield. There have been problems in terms of overextracting of ground water in cities such as Mexico City and Bangkok, whereas overuse of surface water has occurred in Lake Aral.

Water has many quality-related parameters describing the physical, chemical, and biological properties of water. This plentitude of water parameters may seem excessive, whereas the criteria, quality parameters, and even the possibilities of meeting these criteria may differ case by case. When raw water does not meet the quality requirements, it has to be treated by various types of processes. However, it is too often, even among the professionals, let alone the public, forgotten that clearly the biggest portion of the investment is required for constructing and renovating the networks—water, storm water, and sewerage—and the whole infrastructure. The same applies to sewerage and water pollution control. But certainly the quality requirements for drinking water and wastewater treatment have to be met. History shows how polluted water may cause epidemics and even pandemics. In developed societies, we have proper penalties and punishment that may be applied if requirements are not satisfied. The introduction of proper

pollution control requires social pressure that is strong enough to persuade politicians and other policy makers to adopt viable and sustainable principles. “Technical” pressure is the key requirement when pumping water into a network or a water tower or when collecting sewage from wider areas that cannot be managed by gravity sewers alone.

As for wastewater treatment, it is fair to state that there are currently perhaps a dozen countries that treat their wastewater properly, providing secondary and/or tertiary treatment, often through a combination of physical, chemical, and biological methods, whereas the vast majority still have a long way to go toward proper wastewater treatment and overall water pollution control.

### **Management and policy options**

Historian researchers have recently started to use the concept of path-dependence, more commonly used by economists, in connection with water and sanitation services. It is obvious that the pasts, presents, and future prospects are interrelated. The plurality of these terms refers purposefully to the fact that we do not have only one past, present, or future but instead several alternative interpretations depending on the point of view.

*The pasts, presents, and future prospects are interrelated. The plurality of these terms refers purposefully to the fact that we do not have only one past, present, or future but instead several alternative interpretations depending on the point of view.*

As Kaivo-oja, Katko, and Seppälä (2004) suggest, more convergence among historical and futures research is needed. Besides, water sector professionals and particularly those dealing with strategic decisions should take the resulting experiences and predictions seriously. Although we do not actually need prophets, we should in professional terms explore the potential, plausible, and preferable future development paths and act proactively toward the agreed vision. Another somewhat paradoxical historical lesson is that described by the Greek philosopher Plato (427-347 B.C.) concerning pollution. Plato stated, for instance, that he who pollutes the water should also clean it. If this principle of Plato had been followed, the problem of water pollution would have never emerged (Biswas, 1970, p. 61). Because of historical loadings—past pollution of water bodies—we have to use various ways for renovating our water bodies and protect them also

against nonpoint and other dispersed loadings from paved surfaces, forests, and agricultural fields. For futures, the protection of water sources is particularly important.

Although water as a natural source should probably be available to all, the costs of the services—water and sanitation—have to be covered in one way or another. Thus, proper pricing of these services is a must. In principle, everyone should pay, but not necessarily in the same way, at the same time, or in the same amount.

In the 1990s, the World Bank and other financial bodies started to promote the idea of privatization or private operation. In practice, this PPP has been largely limited to awarding various types of operational contracts to private companies. Yet the overwhelmingly most common form of private sector involvement in water and sanitation services is the outsourcing of construction activities, services, equipment, and goods that publicly owned utilities buy from the private sector based on continuous competitive bidding. As Hukka and Katko (2003) argue, and the Prinwass Project (<http://users.ox.ac.uk/~prinwass/index.shtml>) and evaluations of the World Bank (Kessides, 2004) and Anonymous (2003) confirm, privatization is really not a panacea—a “miracle medicine”—though it is not a pancake—a complete failure—either. Instead of merely understanding PPPs as operations of multinationals, as has been the case even at leading international conferences such as in Stockholm in August 2003, we certainly need wider perspectives. The concept of PPP can also be understood to mean public-public partnerships (e.g., twinning between municipalities and utilities) or private-private partnerships (e.g., international operators cooperating with and developing the capacity of local operators). Therefore, we certainly have a plurality of alternatives and options for PPPs. One of the challenges of water and wastewater undertakings is to get more positive publicity—to manage public relations and reputation in a proactive way.

*Less haughtiness, better professional competence, better knowledge sharing, more pragmatism, and higher willingness to learn from past lessons is now required instead of the earlier enthusiastic and naive promotion of the paradigm of privatization.*

## DISCUSSION ON PRIORITIES AND CONCLUSIONS

Table 1 summarizes the various key policies, principles, and practices, described as Ps, that are needed for managing water and sanitation services from the water cycle point of view. Although the multi-P classification is simplified and does not necessarily cover all the necessary issues and dimensions, it in any case supports the idea that sustainable services will require a broader set of requirements.

The proposed multi-P list was furthermore tested by 20 BSc (Eng) students and 10 research team members (DSc or MSc) who were requested to select the 10 most important issues, yet without ranking them. The results are shown in Table 1 for both of the categories and as seen by both of the groups (in bold). Shortly, the issues of purpose and priorities of water use, people as water users, and purity and potable related to water quality were raised. Protection of water bodies and pollution control

**Table 1.** The Proposed Broad Multi-P Criteria for Assessing Viable and Sustainable Water Supply and Sanitation Services and Their Priorities

<i>Sequence on Water Cycle</i>	<i>Policies, Principles, and Practices</i>
Justification	Primary beneficiaries, <sup>a</sup> poor, poverty <sup>b</sup>
Water resources and use	<b>Purpose</b> , <sup>a,b</sup> peri-urban, population, <sup>b</sup> <b>priority</b> , <sup>a,b</sup> preference, possibility, place, productive, planet, <sup>b</sup> precipitation, patterns
Water demand	<b>People</b> , <sup>a,b</sup> planning, <sup>b</sup> privacy, population, <sup>b</sup> prognosis
Water sources and abstraction	<b>Protection</b> , <sup>a,b</sup> permit, procedure, pumping
Water quality requirements	<b>Purity</b> , <sup>a,b</sup> pleasure, parameter, <sup>b</sup> property, plentitude
Water treatment	Process, <b>potable</b> <sup>a,b</sup>
Water distribution	Pressure (technical), pumping
Wastewater management	<b>Pollution control</b> , <sup>a,b</sup> proper
Renovation of water bodies	<b>Protection</b> <sup>a,b</sup>
Undertaking	<b>Public</b> , <sup>a,b</sup> private, partnership, <sup>a</sup> produce, privatization
Operations and maintenance	Practice, procurement
Finance and economics	Portion, price, <sup>a,b</sup> pay <sup>a</sup>
Management	Paradigm, pragmatism
Mismanagement	Pandemic, penalty, punishment, pancake, pitfall
Competence	<b>Professional</b> <sup>a,b</sup>
Reputation management	Promotion, publicity, <sup>a</sup> public relation, participatory <sup>a</sup>
Strategic management	Pragmatism, paradigm
Local government	Provision
Enforcement	Pressure (social), persuade, politician, policy maker, <sup>a</sup> <b>politics</b> <sup>a,b</sup>
Strategic planning	Path dependence, <sup>a</sup> pasts, presents, prospects, <sup>a</sup> plurality
Futures	Prediction, <sup>a</sup> prophet, potential, plausible, preferable, <sup>a</sup> proactive, <sup>a</sup> progress <sup>b</sup>
Controversy	Paradox
Out of reach	Panacea
Philosophy	Plato

NOTE: Bold indicates priorities noted by both groups.

a. Priorities seen by 10 DSc or MSc researchers (minimum of 2).

b. Priorities seen by 20 BSc students (minimum of 4).

were those with the highest ranking. The public role of water, the necessity for pricing, and the need for professionals were further stressed. Obviously, other types of experts would have different priorities.

In connection with the Workshop on PPPs at the Stockholm Water Symposium in August 2004 and at the Global Water and Sanitation Forum in Dakar in December 2004, an economist argued that water utilities should involve themselves in politics as little as possible and that politics should have nothing to do with water services. Because water supply and sanitation are of necessity public services, we propose that utility managers instead keep politicians and decision makers well informed, whereas the latter should concentrate on strategic decision making and give operational autonomy to utilities.

## CONCLUSIONS

Less haughtiness, better professional competence, better knowledge sharing, more pragmatism, and higher willingness to learn from past lessons is now required instead of the earlier enthusiastic and naive promotion of the paradigm of privatization.

*We need institutional changes and development, but they should be managed in a balanced, holistic, and participatory way rather than reinventing “new” ideas in a historical vacuum.*

It should be rethought particularly as we now have several recent examples of its pitfalls. In fact, the recent findings show that even the private multinational companies are not interested in investing in water supply and sanitation in developing countries but rather in relatively short management or operational contracts to avoid excessive risks. The impacts of water policy implementation are usually difficult to assess at an early stage because of the complexity and uncertainty of the institutional environment especially in developing and transition economies. However, a prospective view to policy impacts is extremely important. Futures research approaches and methodologies can effectively be utilized in assessing the impacts of policy and institutional reforms.

Systems thinking, strategic and visionary management tools, and scenario processes can be successfully tailored to and used in long-term assessment of institutional change processes. Most plausible and preferable scenarios, as used by futures researchers, can be developed to assist decision making during the reform process (Seppälä, 2004).

Finally, it is obvious that “there is no short cut to progress,” to use the memorable phrase of Goran Hyden (1983) and that “technology is not enough,” as pointed out by Arnold Pacey (1977). Instead, we should remember that to reach the original objectives based on the justification of water supply and sanitation—health, safe drinking water, fire fighting, dignity, security, and so on—we have to consider the wider aspects. Particularly, we should be humble enough and more realistic when setting our goals and strategies. We need institutional changes and development,

but they should be managed in a balanced, holistic, and participatory way rather than reinventing “new” ideas in a historical vacuum. At the end of the day, sustainable water services will not be possible without educated and trained human resources.

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# Water and Health – From Ancient Civilizations to Modern Times

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## INTRODUCTION

Water is life – and life on earth is linked to water. Our existence is dependent on water – or the lack of it – in many ways, and one could say that our whole civilization is built on the use of water.

This paper summarizes the general outline and some of the main results of two academic, multi- and cross-disciplinary projects<sup>1</sup>. Special emphasis is given to the first urbanization of ancient civilizations focusing on ancient Greece and Rome (Vuorinen 2007).

## EARLY INNOVATIONS

Modern humans (*Homo sapiens*) have dwelled on this earth for some 200 000 years, most of that time as hunter-gatherers and gradually growing in number. Approximately 50 000 years ago modern man began to inhabit every corner of the world and people were constantly on the move. Occasionally people were troubled by pathogens transmitted by contaminated water, but general aversion for water that tasted revolting, stunk and looked disgusting must have developed quite early during the biological and cultural evolution of humankind. It has been postulated that the waterborne health risks of hunter-gatherers were small.

In reconstructing the history of water and sanitation of this hunter-gatherer phase, we have to rely on analogies with later societies. Modern anthropological studies and recorded mythologies of indigenous peoples play an important role in these analogies while observing primates and other more evolved mammals can also give us useful information. However, archaeological and written sources concerning water and sanitation can be found only on relatively recent times.

Humankind established permanent settlements about 10 000 years ago, when people adopted an agrarian way of life. This new type of livelihood spread everywhere and the population began to expand faster than ever before. Sedentary agricultural life made it possible to construct villages, cities and eventually states all of which were highly dependent on water. This created a brand new relation between humans and water. Pathogens transmitted by contaminated water became a very serious health risk for the sedentary agriculturists. This was a world in which guaranteeing pure water for people became a prerequisite for successful urbanization and state formation.

The earliest known permanent settlement, which can be classified as urban, is Jericho from 8000–7000 B.C., located near springs and other bodies of water. In Egypt there are traces of wells, and in Mesopotamia of stone rainwater channels, from 3000 B.C. From the early Bronze Age city of Mohenjo-Daro, located in modern Pakistan, archaeologists have found hundreds of ancient wells, water pipes

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<sup>1</sup> This article summarizes some key findings of two projects, GOWLOP-project and *Environmental History of Water: Global Views of Community Water Supply and Sanitation* –project by Petri S. Juuti, Tapio S. Katko, and Heikki S. Vuorinen.



**Figure 1.** Roman aqueduct in Segovia, Spain (Photo: T. Katko).

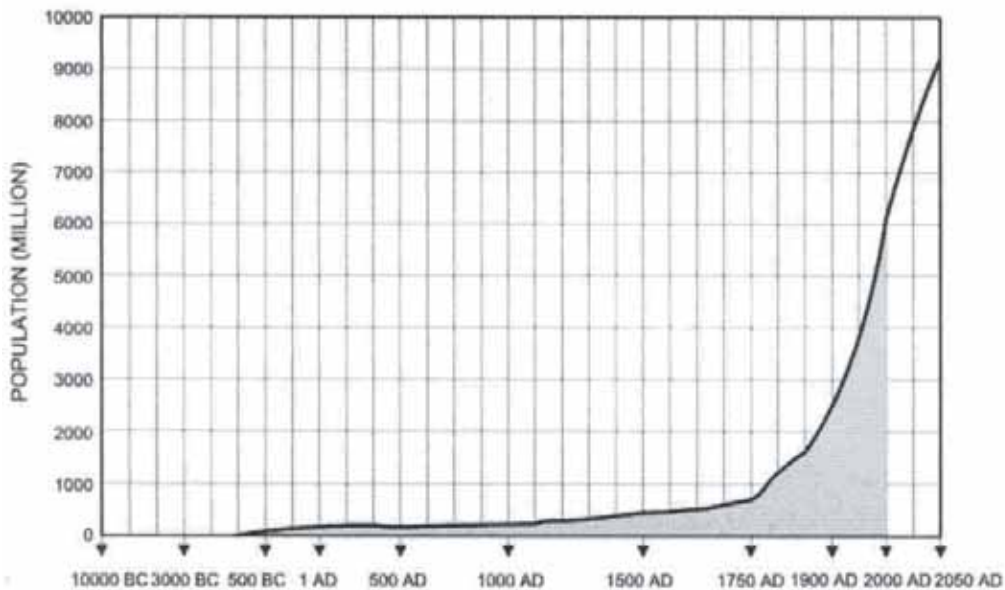
and toilets. The first evidence of the purposeful construction of the water supply, bathrooms, toilets and drainage in Europe comes from Bronze Age Minoan (and Mycenaean) Crete in the second millennium B.C.

The experience of humankind from the very beginning testifies to the importance and safety of groundwater as a water source, particularly springs and wells. The way in which water supply and sanitation was organized was essential for early agricultural societies. If wells and toilets were in good shape, health problems and environmental risks could be avoided.

The realization of the importance of pure water for people is evident already from the myths of ancient cultures. Religious cleanliness and water were important in various ancient cults. The first known Greek philosophical thinkers and medical writers also recognized the importance of water for the health of people.

#### **WATER AND HEALTH IN ANCIENT GREECE AND ROME**

The first urbanization in Europe occurred during antiquity (500 B.C. – 500 A.D.) around the Mediterranean region. By the birth of Christ the share of urban population reached some 10–20 % and the most urbanized areas were the Eastern Mediterranean, Egypt, North Africa (modern Tunisia), the Apennine Peninsula



**Figure 2.** Estimated human population growth from 10 000 B.C. until year 2050. Population grew from around 6 millions in 10 000 B.C. up to 200–300 millions by the birth of Christ. (Source: Juuti et al 2007, 13)

(modern Italy), and the southern part of the Iberian Peninsula, most of which were areas of quite modest rainfall. In this period the archaeological and written sources become richer, and consequently improve our possibilities to study the relationship between water and health of people (Vuorinen 2007).

Alcmaeon of Croton (floruit ca. 470 B.C.) was the first Greek doctor to state that the quality of water may influence the health of people. Hippocratic treatise *Airs, Waters, Places* (around 400 B.C.) deals with the different sources, qualities and health effects of water in length. Various other Hippocratic treatises (mostly written around 400 B.C.) contain short comments on the influence of water on the health of people.

The quality of the water was examined by the senses: taste, smell, appearance and temperature. Also the health of the people and animals using a water source was considered. Throughout antiquity tasty or tasteless, cool, odourless and colourless water was considered the best, and stagnant, marshy water was avoided. These ideas were held until the end of antiquity. The ancient Greeks and Romans were also quite aware of the dangers of water coming from hills and mountains where mining was practiced.

The ancient authors have thus made some comments about the influence of different kinds of water on the health of people, but had these comments any influence on the health of people is hard to infer. Because of the inadequacy of

sources, it is practically impossible to evaluate the health of ancient populations and the role of water in it. It is, however, quite safe to conclude that despite the impressive measures used to obtain pure potable water, urban centres had serious public health problems. The ancient Greek or Roman society did not have the interest or the means to deal adequately with matters of public health (Nutton 2005, 26).

The Greeks and Romans used different methods to improve the quality of the water if it did not satisfy their quality requirements. From written sources and archaeological excavations, we know that using settling tanks, sieves, filters and the boiling of water were methods used during antiquity. At least boiling of water, which was widely recommended by the medical authors during antiquity, would have diminished the biological risks of poor quality water. Although the boiling of water might have been feasible from a hygienic point of view, it was ecologically and economically not feasible in extensive use since firewood and other combustibles would sooner or later have become a scarce resource around the Mediterranean.

The poor level of waste management, including wastewater, most probably involved a major risk for public health during antiquity. For instance, toilet hygiene must have been quite poor. The abundance of water that was conducted to the bath could also be used to flush a public toilet. The Romans, however, lacked our toilet paper. They probably commonly used sponges or moss or something similar, which was moistened in the conduit in front of the seat and then used to rinse their bottoms. In public toilets facilities were common to all; they were cramped, without any privacy, and had no decent way to wash one's hands. The private toilets most likely usually lacked running water and they were commonly located near the kitchens. All this created an excellent opportunity for the spreading of intestinal pathogens.

Water-borne infections must have been among the main causes of death. Dysentery and different kinds of diarrhoeas must have played havoc with the populations. Although the ancient medical writers described different kinds of intestinal diseases, the retrospective diagnoses are difficult and the causative agents cannot be identified. Summer and early autumn, when water resources were meagre in the Mediterranean world, must have been a time when drinking water was easily contaminated, and intestinal diseases were rife as presented e.g. in several passages in the Hippocratic writings. The mortality of children, especially recently weaned, must have been high.

It should also be kept in mind that the salubrity of the water supply must have differed markedly in accordance with the social status of people in the Roman towns. The rich had running water in their homes; the poor had to fetch their water from public fountains. The rich had their own baths and toilets, while the poor had to use public toilets and baths. All this must have caused differences in the health of rich and poor people.

A lot of the water in a Roman town was consumed in bath(s) connected to the aqueduct(s) (Figure 1). Ideally shining marble walls and limpid water were considered a feature of a bath in Rome, the cleanliness of which was watched over by aediles. Baths were probably also beneficial for public health in towns where there was an abundance and rapid turnover of water. However, in towns where water was in short supply, cisterns had to be used and the turnover of water was slow, the role of baths was probably negative for public health.

Water supply and sanitation for military needs was a primary concern of the authorities of an imperial power like the Roman Empire needing a strong military machine. The Romans did know how to obtain adequate amounts of drinking water for their garrisons, cities and troops in the field and thus successfully planned their operations according to the availability of water. Army veterans were well accustomed to baths and to an ample water supply during their active service, and they may have been a quite important pressure group for building an aqueduct and bath in a town.

*The contamination of water by lead has been a topic in the discussions concerning the health of people in Roman times.*

The contamination of water by lead has been a topic in the discussions concerning the health of people in Roman times. Roman authors expressed doubts concerning the use of lead pipes and recommended the use of ceramic pipes. However, in practice it seems that although ceramic pipes were used, water was in many situations routinely distributed by lead pipes, as revealed by both written sources and archaeological remains. Yet, there are two reasons to believe that exposure to lead through water was quite minimal. Firstly, as a consequence of the quality of the water, a calcium carbonate coating separated the lead and the water in most cases. Secondly, because of the constant flow, the contact time of water in the pipe was too short for contamination by lead.

The indirect public health effects of water might have been greater than the direct effects during antiquity. Agriculture depended on the proper amount of available water. Droughts and floods led to food shortages and famines. Food, people and pathogens moved most easily by water during antiquity. Maritime trade was especially vigorous around the Mediterranean in the period 200 B.C. – 200 A.D. This meant that the Mediterranean world became more or less a common pool of infectious diseases. Two important diseases caused by parasites were intimately connected with water and the ways water was managed during antiquity: malaria and schistosomiasis.

The breeding of mosquitoes depended on water and mosquitoes spread malaria, which was a serious and widespread health problem around the Mediterranean during antiquity. Malaria was well documented by Greek and Roman medical authors from the Hippocratic writings onwards.



**Figure 3.** Bey privy attached to tower of Olavinlinna Castle, Finland. (Photo: P. juuti 2005)

Schistosomiasis (bilharzias) has been for millennia a scourge in Egypt. The parasite (blood-vessel inhabiting worms) has an intricate relationship between the human host and a snail intermediate host. The type of agriculture (irrigation, flooding of the Nile) must have spread the disease. Although the evidence from ancient Egyptian medical papyri remains hard to interpret, there is strong paleopathological evidence of schistosomiasis in human remains from ancient Egypt.

Romans knew well that a water system needed constant maintenance to function efficiently. For instance, calcium carbonate incrustation that formed inside the conduits needed constant removal, otherwise the flow of water would eventually stop. In Italy aqueducts and baths seem to have been maintained even after other monumental buildings in the towns, with the exception of town walls and palaces, fell into disuse in late antiquity (Ward-Perkins 1984, 31, 128). In Antioch and other Near Eastern towns, at least part of the ancient water system was maintained into the Byzantine period and possibly up to the Era of Islam (Kennedy 1992). Although there were continuities from antiquity to the Middle Ages, the water supply was more limited and the Christian water patronage replaced the classical one: it was a move from *luxuria* to *necessitas* (Ward-Perkins 1984, 152).

## **SECOND URBANIZATION: THE LONG 19<sup>TH</sup> CENTURY**

After the fall of the Roman Empire, water supply and sewage systems experienced fundamental changes in Europe. Medieval cities, castles (figure 2) and monasteries had their own wells, fountains or cisterns. Usually towns built a few modest latrines for the inhabitants, but these were mostly inadequate for the size of the population. The lack of proper sanitation increased the effects of epidemics in medieval towns in Europe.

Fundamental changes began to appear: science and knowledge were institutionalized for the first time when the development of modern universities started in the 13<sup>th</sup> century, and the agricultural world set out to industrialize from the 18<sup>th</sup> century onwards. Consequently, the growth of world population increased (Figure 2). All this profoundly affected water supply and sanitation.

Along with the industrialization and urbanization of the Western world, enlightened people were fascinated with the idea of progress. Ever since the 18<sup>th</sup> century, science and reason were considered to be able to lead humankind towards an ever-happier future. This was the period when the first actual water closet was developed. By 1900, the water closet became a generally accepted cultural necessity in the Western world –the same way aqueducts had been in the Roman Empire. The water closet was seen as a victory for public health without any consideration for where the human excreta went through sewer pipes.

The start of industrialization and the related growth of cities created a situation where public health and environmental problems overwhelmed city governments to a greater degree than before, and novel technology was often seen as the solution. In the 19<sup>th</sup> century, Great Britain was seen as the forerunner of modern water supply and sanitation systems, but the innovations soon spread to Germany, other parts of Europe, USA and later also elsewhere.

Sanitation in towns around Europe was one of the great achievements of the 19<sup>th</sup> century. During the century the role of water in the transmission of several important diseases – cholera, dysentery, typhoid fever and diarrhoeas – was realized. The final proof came when the microbes causing these diseases were discovered. Especially cholera served as a justification for the sanitary movement around the world in the 19<sup>th</sup> century.

Sensory evaluation of water quality was complemented with chemical and microbiological examination. During the 19<sup>th</sup> century, filtering of the entire water supply of a town was introduced and the systematic chlorination of drinking water started in the early 20<sup>th</sup> century. The discovery of microbes and the introduction of efficient ways of treating large amounts of water paved the way to an era in which the public health problems caused by polluted water seemed to belong to history.

## **URBAN INFRASTRUCTURE IN THE 1900S**

The 1900s was a period of extensive population growth –the global population about quadrupled while the urban population increased 13-fold (Figure 2). By 2000 A.D., in almost every country, over half of the population lived in urban areas. During the century industrial production increased 40-fold and the consumption of energy by a factor of tens. Water and sanitation services had a definite role in this rapid socio-economic change of the entire globe.

In the early 20<sup>th</sup> century the health problems associated with water pollution seemed to have been resolved in the industrialized countries when chlorination and other water treatment techniques were developed and widely taken into use.

Microbiological problems related to water were largely considered a problem of the developing world. However, in the late 20<sup>th</sup> century the biological hazards transmitted by water emerged again in the post-modern Western world. Anxiety about chemical and radioactive environmental hazards and their impacts on human health mounted in the 1960s. The overall amount of known biological and chemical health hazards transmitted by water increased manifold during the last half of the 20<sup>th</sup> century.

In today's world around 10 000 people die every day due to diseases like dysentery, cholera, and various diarrhoeal diseases, caused by a lack of safe water and adequate sanitation. Yet, since most of those who die are children and old people, whose death is considered "natural", or people who are more or less marginalized in their societies (e.g. refugees, the poor) or living outside areas that are important for the global economy, mortality due to these waterborne diseases is too often considered unavoidable.

### **FUTURE CHALLENGES**

In the historical context, the growth of urban centres has been a continuous and even an escalating trend. Many of these centres are today located in developing economies, while the ensuing problems are concentrated on the poorest people – as always. The most severe constraints include poor living conditions, a lack of democracy, poor hygiene, illiteracy, corruption and a lack of proper water and sanitation services. Especially women and children suffer from these constraints.

Today there is a global shortage of potable water. When making fundamental decisions concerning water supply and sewerage, it is also necessary to be ready to make big investments. Services that are now at a high operational level were not achieved easily and without massive inputs and efforts. This is something to keep in mind when assessing future options and considering required strategies.

The level of water supply and sanitation in a society is not necessarily bound with time and place as much as the capability of that society to take responsibility for developing the living environment of its citizens and proper policies. In some cases, the situation was even better earlier than nowadays. Decisions have been made concerning water and sanitation systems – e.g. the universal acceptance of the water closet as a cultural necessity – that through path dependence have limited future options. There have also been situations where the choice of a technology has been regarded as problematic from the first beginning but has been chosen anyway. For instance, lead pipes were considered hazardous for health already in antiquity but continued to be used in house connections until recently.

Water supply and sanitation systems have always required continuous maintenance and adequate rehabilitation. This was already evident with the Roman aqueducts: calcium carbonate incrustation forming within the conduits needed to be removed constantly or it would have stopped the flow of water. The same is true for modern systems: they must be maintained to function properly.



In the historical context, we can see both a continuation and a change in the perception of good quality drinking water and waterborne health hazards, which are both highly dependent on the scientific and technological level of a society. The importance of good quality drinking water for urban populations was realized already in antiquity. Yet, the importance of proper sanitation for the health of townspeople was not understood until the 19<sup>th</sup> century. The building of “modern” urban sewerage systems started in Britain and rapidly spread all over the globe.

The availability of water in large quantities has been considered an essential part of a civilized way of life in different periods: Roman baths needed a lot of water as does the current Western way of life with water closets and showers. Particularly high rates of water use occur when it is not properly charged for. Evidence indicates that as soon as water and wastewater are charged based on real costs, wastage diminishes remarkably.

There are numerous development paths that water supply and sanitation can take. From the point of view of the wellbeing of man and the environment, it is essential that water is good and safe – regardless of whether it is from piped systems or point sources like wells. The same applies to sanitation – it is a question of being connected either to the sewer or using proper on-site sanitation solutions. Local conditions, traditions and people have to be in the core of decision making when future solutions are considered. In the long historical perspective, it is evident that regardless of the political system, good local solutions can be found based on local conditions, needs and traditions. Although water – and particularly water services – is largely dependent on local conditions, it is useful to make comparative studies between various regions and cultures, and identify possibly applicable and replicable principles and practices.

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# EPILOGUE

*“Water is the one substance from which the earth can conceal nothing; it sucks out its innermost secrets and brings them to our very lips.”*

Jean Giraudoux



**Figure.** Alternative and appropriate solutions based on local conditions are to be explored to meet the challenges of developing economies. (Photo: T. Katko 1979)

# Water: a Matter of Life

Petri S. Juuti, Tapio S. Katko & Riikka P. Rajala

*Through laziness, the rafters sag; because of idle hands, the house leaks.<sup>1</sup>*

## FINDINGS ON RESEARCH QUESTIONS

Some of the key findings on the EFWAM research questions presented in the introductory chapter (p. 11-12) are discussed here. The key strategic decisions and choices affecting Finnish services [*ref. question i*], according to experts (7<sup>th</sup> paper by Katko, Juuti & Pietilä), were largely related to acts and decrees. However, legislation often merely confirms certain stages of development and principles that have become accepted rather than putting specific decisions into effect. On one hand, certain legislation made it possible and necessary to start establishing modern water and sewerage systems. On the other hand, in spite of early observations of polluted water, it took a long time before proper enforcement and legislation came into force. Yet, water pollution control by communities and even by industries started more or less at the same time as in other pioneering countries.

*Water utilities are bound to make strategic decisions whether they recognise their strategic nature or not.*

Water utilities are bound to make strategic decisions whether they recognise their strategic nature or not. Such decisions or selections are always influenced by local conditions and resources. As 9<sup>th</sup> paper by Katko, Juuti shows, organisational cultures and traditions may also affect the decision-making process – and may to a large extent also explain how water services are managed and operated.

Table 1 presents a collection of key strategic decisions – one example from each of the seven Finnish case studies on water utility histories. Six of the water utilities provide water and sewerage services mainly within their borders while The Tuusula Region Joint Municipal Authority for Water Supply (TSV) supplies bulk water to a total of four municipalities. Some of the mentioned decisions concern selection of technology, while others are connected to management and inter-municipal services. A more thorough analysis will be carried out at a later stage.

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<sup>1</sup> Ecclesiastes 10: 18 (Today's New International Version) <http://www.biblegateway.com/versions/>

**Table 1.** Selected strategic decisions in seven case water utilities.

CASE CITY	STRATEGIC DECISION
Espoo	Joined inter-municipal cooperation in the Helsinki metropolitan area: three-party agreement in the 1970s, the 120 km Päijänne tunnel
Hämeenlinna	Metering-based billing from the beginning (1910)
Porvoo	Ground water selected and used since the beginning
Tampere	New raw water source selected from neighbouring municipality since own source became heavily polluted
Tuusula	A federation of municipalities was established for a region where ground water occurred only in Tuusula, where severe constraints as to its protection existed. Joint political pressure through the federation solved the problem.
Vaasa	As groundwater was exhausted, started gradual protection of surface water intake area
Vantaa	Abandoned its own wastewater treatment plants: transfers wastewater to Helsinki and Espoo

Several strategic decisions had to be made especially in the early stages of development. Once we have selected a certain path or tree, as Levi (1997) prefers to call it, the costs of reversal are very high. Interestingly enough, some decisions like the selection between ground and surface water have been debated continuously – with varying emphases. Although the concept of path dependence appears binding, the related strategic decisions may be quite positive considering the overall long-term development. Such decisions include, for instance (7<sup>th</sup> paper by Katko, Juuti & Pietilä) metering-based billing and the introduction of separate instead of combined sewers.

Local conditions, like water scarcity, have forced or initiated certain solutions. Yet, some cases indicate how strategic thinking has been missing: the selection of lower capacity water treatment technology in Tampere (7<sup>th</sup> paper by Katko, Juuti & Pietilä) resulted in a severe epidemic that could have been avoided by the proposed technology.

Some strategic decisions have evolved into a chain of decisions or slowly accumulated long-term practices [*ref. question ii*], as in the case of ground water protection in Tuusula. Yet, the assumption of ever expanding systems both in water supply and sewerage is not self-evident.

In water pollution control the recent trend has been to consolidate smaller wastewater treatment plants. This approach is based on several good arguments accepted by most. However, hardly anybody – except perhaps for the authors – has questioned this paradigm. We suggest that this strategic issue now be seriously reconsidered. That requires considering the wider institutional framework that covers the overall political, economic, social, technological, environmental,

legislative (PESTEL) framework, while not forgetting the vulnerability and security aspects. Such systems need some feasibility limits, which should at least be explored and considered, although they are probably highly dependent on local conditions.

Although we have not been able to analyse very systemically the views of the various parties on the key strategic issues [*ref. question iii*], it is obvious that various emphases based on different interests exist. Water services provision and production involves many stakeholders with various roles and interests. Grigg (1996, 14-15) has classified these stakeholders into four major categories: service providers, regulators, planners and coordinators as well as support organisations. Castro (2007) reminds about the roles of citizens and citizenship – also to be taken into account in water services and governance.

It is understandable that local politicians, appointed typically just for four-year terms, tend to stress financial short-term needs more than long-term investments. It is obviously a real challenge for water utility managers to get sufficient attention from decision-makers to make their needs and views understood and seriously considered.

One contradictory issue is the cooperation between utilities and politically elected decision-makers who represent local governments and, ideally, also water users. Water utilities are presently also seeking wider autonomy especially in their daily operations. That can be considered a favourable trend, particularly if it means that decision-makers want to and are able to concentrate more on strategic ownership and policy issues.

However, as water utilities have gained more autonomy in their operations, the water services sector – at least in Finland – has not always been able to capture adequately the attention of decision-makers. At the local level, political decision-making tends to be for the short-term and based on self-interest, or it concentrates just on acute financial interests of the municipality. Yet, the case of Tuusula Region Joint Municipal Authority for Water Supply (4<sup>th</sup> paper by Katko) shows that it is possible to get political decision-makers actively involved and interested in water services for the long-term. Thereby decision-making becomes more professional and sound and public service provision replaces party politics. Similar practices should and can be developed also for utilities operating within one municipality.

As for the time frame, it is understandable that water utility managers tend to concentrate on short-term operative or “opportunistic” management of services – it allows them to cope with an environment of increasing pressures and conflicting interests. Since the life-span of these systems is very long – some parts serve more than a century – it is necessary to introduce also longer-term strategic and visionary thinking (Seppälä 2004). Historical decisions often have long-term impacts which should be accounted for in future strategic planning (Mattila 2005).

When the Finnish Water and Waste Water Association was being established (Herranen 2006, 109), the original proposal of having a board with representatives from various parties including members of parliament was rejected. One of the former associations had such a body which maintained active contacts between the sector and the parliament. To the editor's knowledge, such contacts no longer exist. One argument in favour of such contacts is that part of the legislation nowadays comes from the EU. However, the harmonisation of, for instance, wastewater treatment requirements concerning nitrogen removal is an alarming example of what may happen if proper information exchange or lobbying between professionals and decision-making does not exist. It appears that unnecessary investments in nitrogen removal now have to be made instead of using that money more wisely to, let's say, remove phosphorous which is a must with most of the Finnish water bodies.

*... institutional issues are the greatest impediment and success in these efforts is based on "70 percent politics, 20 percent engineering and 10 percent luck".*

As for decision-making regarding regional water systems, Grigg (1996, 442) notes that institutional issues are the greatest impediment and success in these efforts is based on "70 percent politics, 20 percent engineering and 10 percent luck".

Among the weak signals of the past [*ref. question iv*] we may recognise the early recognition of water pollution especially due to forest industries (9<sup>th</sup> paper by Katko & Juuti). It took some 80 years for the society to put in place proper water pollution control and enforcement. Another area, although not directly apparent from the selected papers, is the recent climate change and the challenge it poses to water and sewerage services.

Fifth paper by Juuti, Katko & Nygård shows that the strategic decisions and operating principles of Finnish and Swedish water supply and sewerage [*ref. question v*] are quite similar but differences also exist. Evolution of water services started earlier in Sweden, and Finland initially copied or applied their legislative principles to a large extent. One of the differences concerns small systems. While in Sweden and Norway (Takala 2007) municipalities are responsible for supplying all consumer groups, Finland and Denmark have a long tradition of consumer-managed water cooperatives.

One of the original objectives of the EFWAM project, exploring the experiences from so-called overall water resources planning of the 1970s and '80s and comparing them with those from the current Integrated Water Resources Management (IWRM), could not be fulfilled [*ref. question vi*]. Yet, it is interesting to note that the integration of water supply and sewerage utilities based on the hydrologic cycle is less common outside the Nordic countries (7<sup>th</sup> paper by Katko, Juuti & Pietilä). We think that in Finland such integration is justified in many cases.

However, for instance in the case of large inter-municipal systems, it may be more feasible to manage these services as separate units due to the location of water sources and recipient water bodies. Proper coordination must then be provided by other means. The same may also apply to some small systems.

The tentative findings on the evolution of water legislation [*ref. question vii*] show remarkable similarities between Finland, Sweden and even the USA. Economic water use, especially hydropower was emphasised in the early 1900s and acts on water pollution control were enacted in the 1960s in each country. This is not to ignore the obvious differences between the eastern and western tradition in the US, or the differences between various regions in Finland.

A survey of the major future challenges to water services in Finland, and the various means of meeting them [*ref. questions viii, ix, x*] is planned for later. Some of the challenges are: securing better quality of services, improving image, securing overall sectoral capacity, managing tacit knowledge, issues of aging infrastructure and vulnerability, climate change, energy, social and political effectiveness as well as research and development.

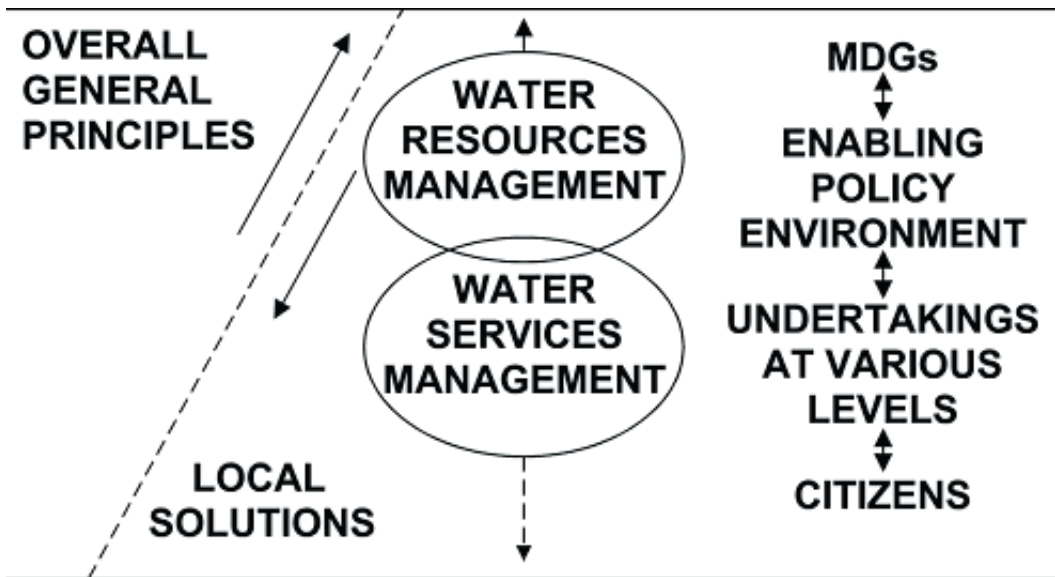
## GENERAL FINDINGS

One finding concerning several cases that raises serious concerns (7<sup>th</sup> paper by Katko, Juuti & Pietilä) is that, instead of identifying and assessing several options

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in the early phase of projects, too often only one option is considered by leaders, politicians or other related parties. Such phenomena have also been noticed by the authors in several other recent cases. Instead of investing adequate time and resources at the early phases of large scale projects, studies may be carried out with minimal resources. If these are then used as a basis of decisions, other options may easily be bypassed. Alternatively, such “saving at the wrong place” thinking may hinder the development of projects that otherwise could be feasible. We have also examples of inter-municipal projects where one option involving high risk is strongly promoted by semi-external bodies. When such top-down approach fails, it may hinder other options that could have developed through more bottom-up, voluntary cooperation.

We propose the framework presented in Figure 1 for synthesising the three sections of our book: *local, national and global solutions*. Water resources management tends to occupy a higher hierarchical level than water services management – the focus



**Figure 1.** The interconnections of overall principles and local solutions related to water resources and water services management at various levels.

of this book including sewerage or sanitation – that should be managed *at the lowest appropriate level*. At the global level we have the Millennium Development Goals where water plays an important role. The enabling policy environment exists at the national, and to some extent also on the international level, such as the EU while water undertakings provide services at the local level.

Finally and fundamentally we have the citizens who receive the services and may have various roles as payers, beneficiaries, consumers, customers and voters. None of them probably plays just one of the roles. Since the vast majority of the world's water utilities are publicly (local government) owned, we can say that the residents of communities are in most cases the actual owners of the systems. This should be kept in mind when exploring future challenges and the alternative means of meeting them.

*Plans fail for lack of counsel, but with many advisers they succeed.*<sup>2</sup>

<sup>2</sup> Proverbs 15: 22 (Today's New International Version) <http://www.biblegateway.com/versions/>



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