ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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A Partial History of Public Water Systems

This document identifies important historical elements in the development of public water supplies. This summary is written primarily for school children and those seeking a simplified overview of historic milestones in the public water supply profession.

INTRODUCTION

The development of public water systems, similar to those of today, has been in response to the needs of society and has been very dependent on many technical and manufacturing innovations in the last two hundred years. Important milestones effecting the profession included the growth of cities; advances in manufacturing technology such as the manufacture of water pipes, pumps, measuring and control devices; commercial generation of electricity, and the advent of government regulations in such areas as water quality standards and safety/fire codes.

EARLY HISTORY

Basic survival requires a safe water supply, food, shelter, and clothing. A safe water supply has always been a critical need of mankind. Villages were purposely located near good water supplies and ancient trails were often routed past natural springs. However, most early supplies were unimproved streams, ponds and springs that were frequently subject to droughts, contamination, and ownership struggles.

Water supply sources with high clarity, good taste, and reliable flows were prized by our ancestors. Where these sources were found, facilities were constructed to allow easier access. Investments in a water supply sources often consisted of simply digging a well or building a structure around a spring to make water collection easier. In a few cases, a much greater investment was made, such as in the Roman aqueducts in Europe. These aqueducts were open channels that used gravity flow to bring desirable water from distant locations to major cities. Closed piping, that allowed pressurized water, was extremely limited and consisted of clay, wood or hammered lead; all of small diameter.

History shows that the Greeks and Romans often practiced certain water purification methods, even though they did not know the scientific principles behind their actions. Purification techniques included settling of water, filtering water through sand, and storing water in copper pots. Today, we recognize the scientific basis for each of these purification techniques. From the Greek and Roman periods through the early 1800s, there was relatively little progress made relative to purification techniques, or the design or construction of water work facilities. Much of that period truly was the dark ages.

Modern water treatment science was spearheaded in England, Scotland, and France in the early and mid-1800s. Probably the most important single breakthrough was the understanding of how certain diseases were capable of being transmitted by drinking water. Notable health related developments included the recognition of the benefits associated with regular sand filtration and disinfection using chlorine. One of the most advanced water systems in the United States, in this period, was that of the city of Philadelphia's Schuylkill River supply, constructed between 1811-1819.

It was not until after the Civil War that U.S. scientists generally began to take an interest in water supply engineering, sanitation, and broader public health initiatives. Today, the U.S. water supply profession and government institutions lead the world in drinking water regulatory and technological developments.

EARLY HISTORY OF PUBLIC WATER SUPPLIES IN NEW HAMPSHIRE

In the 1600s and 1700s, New Hampshire residents made their living by farming, logging, trapping or seafaring. Life was hard. There was no electricity, and little, if any plumbing in homes. There were few areas that had population density sufficient to support a centralized water system.

Early Water Sources

Water systems were very localized and consisted generally of little more than just a supply source. Typical sources were neighborhood springs located very near where people worked or lived. Typically users came to central wells or ponds, filled buckets and carried the water home. This tiring work needed to be done every day or so even in the worst of winter weather.

Pipes were often made of wood and the connecting lines into buildings were made of solid lead. These pipes could only withstand minimal internal pressure, so only low elevation buildings could have running water. Buildings on even modest hills could not be served. See the attached article concerning New Hampshire's first water system in Portsmouth at Strawberry Banke.

MANUFACTURING TECHNOLOGY LEADS TO LARGER WATER SYSTEMS

Although there had been the need for larger water systems in the 1700s and early 1800s, their development was held back awaiting a number of important manufacturing breakthroughs that today we take for granted. These include:

Piping

There was a need for piping that was strong, had a long life expectancy once installed, and was interchangeable
, even with piping manufactured by others. Prior to the late 1800s, piping had been made of wood and other inferior materials. This piping was difficult to connect over long distances and to repair once in use. Since each piece was of a slightly different size, much hand work was needed to interconnect piping together. Without standardization of pipe dimensions, an extensive water service area was not feasible. It was not until new manufacturing techniques were developed after the Civil War that standardization of pipe dimensions allowed pipe to be readily interchangeable.

Pipe Installation

Water pipes in New Hampshire had to be installed approximately 5-7 feet below ground to prevent freezing during the winter. In the 1800s, a pipe trench was dug by hand, since there was

no excavation equipment available. Hand excavation for utility lines was the standard until after World War I, and is still common in many third world countries today. Such excavation is difficult in New Hampshire's rocky soils and nearly impossible where bedrock is near the surface.

Steam and Electrical Power

Water systems need power to pump water from wells and ponds and to move that water over hills and great distances. Until there was a convenient source of power, such as electricity, water systems were held back from servicing distant and high elevation areas. In 1800s steam power was a great advancement, however steam facilities still needed to be constantly staffed to maintain the fires that heated the boilers.

The old steam powered pumping stations are easily recognized by their large pump rooms, high, often square smokestacks, nearby coal bunkers, and rail siding for coal delivery. Some of these building are still in existence today but the pumping equipment has been converted to electrical power. Not until commercially available electricity and electric motors were developed were smaller pumping facilities in diverse locations feasible. See typical steam pump station in the appendix.

Pumps

Pumps are essential in the water supply field. Wooden pumps existed in the 1700s. These were used to empty the bilges of ships. They were made from bored logs with wooden pistons to create a suction. Metal piston type pumps, driven by steam, were developed in the early to mid-1800s but it was not until the advent of electrically driven pumps that water system expansion became feasible on a large scale. Layne Bowler developed the first vertical turbine water pumps in 1894 and Jacuzzi developed the first submersible pumps in the 1920s.

These manufacturing developments provided the hardware to allow the establishment of many New Hampshire public water systems in the very late 1800s. Please see the educational document time line "A Century and One half of Water Supply Improvements".

SOCIETAL FACTORS THAT LEAD TO THE FIRST LARGER SCALE SYSTEMS

Although technology and manufacturing made larger water systems possible, it was societal factors that made them necessary. Shown below are some of these critical societal needs that large central water systems addressed.

Population Density

During the 1800s, America fundamentally changed from an agrarian society to an urban industrial society. People migrated from rural areas to the cities in large numbers. Buildings grew higher to allow more people to live near their work. Central sewer and water piping systems became more important as population density increased.

Development of Disease Transmission Theory

Until the late 1800s the medical field did not know how diseases were spread through populations. Many thought that evil gases came up from the soil or that illness was caused by the alignments of the stars and moon. As disease origin and transmission became better understood, the importance of separating sewer disposal from water supply was recognized as critically important. Further, not only was pure water important for humans, but in the days when people

depended on horse drawn vehicles, providing safe potable water for horses was also important. Glanders was a common water transmitted disease that incapacitated horses.

Improved Fire Protection for Downtown Real Estate

Some New Hampshire public water systems were started as a direct result of one or more major fires that swept through a downtown urban area. Small fires often developed quickly into uncontrolled infernos due to a lack of high volume pressurized water. Some water systems were initially started to provide fire protection water. These systems were then converted to provide both pure drinking water and fire protection service, as knowledge of the science of disease transmission grew.

Business Opportunities

In some cases, town governments would not construct water systems because of voter resistance to the high construction costs. As a result, industry and business leaders in some cases, built community water systems to provide for improved health and to better protect their businesses and real estate investments from disastrous fires. In the early 1900s a number of major public water systems in New Hampshire were privately owned and operated for a profit.

Regulated Water Utilities

The government gave franchises to those businesses which invested in water utilities. Within these water service areas competition was prevented because it would have resulted in wasteful duplication of the pipe distribution systems and other facilities. On the other hand since competition was not allowed, the water system's rates were controlled by government. Although excessive business profits were restricted, there was a safe profit to be made as an efficient water utility.

Examples First Major New Hampshire Water Systems

New Hampshire's first public water system was the Portsmouth Aqueduct, incorporated in 1797. This system brought water some 2.5 miles to serve the compact part of Portsmouth through a system of wooden pipes. Some of these pipes were supplied by the Shakers at Canterbury, NH. The second oldest large system in NH was the Exeter Aqueduct, which gained permission to operate from New Hampshire Legislature in 1801.

Both the Portsmouth and Exeter water systems were engineered by Benjamin Clark Gilman, an Exeter clock maker who also designed similar water systems in Boston and Salem, Mass. and New London, Conn.

The Portsmouth system had low pressure and limited volume capacity. In 1802, a devastating fire in Portsmouth quickly brought newspaper editorials recommending that the town be supplied with large underground cisterns to be kept filled with water from the aqueduct and constructed to act as reservoirs for fire-fighting. In response several cisterns were built in public squares.

STOCKHOLDER WATER SYSTEMS

Although many of NH oldest water systems were started by the private sector in the 1880s, by the 1920s this private sector investment had significantly departed for greener rather than blue pastures. As a result city and town government were forced to take over these utilities. Larger stockholder-owned water systems in New Hampshire today include:

Hampstead Area Water Co., - Many locations
Hampton Water Co., (Affiliated with Am. Water Works Ser. Co.) - Hampton & coastal NH
Lakes Region Water Co., - Many locations

Pennichuck Water Co., - Nashua and many other locations
Integrated Water Co. - Barnstead and many other locations

REGULATION OF PUBLIC WATER SYSTEMS

Once disease transmission was scientifically understood, and given the rapid increase in the size of cities and towns it became clear that an entire community could be decimated if disease was present in a larger water system. As a result, water supply health oriented oversight programs were began at both the federal and state levels in the 1800's.

Federal Action

In 1916 the U.S. Public Health Service adopted the first water quality standards for water systems. These standards applied though to only those water systems servicing interstate commerce. This first water quality standard addressed only bacteria. In subsequent years more chemical contaminants were regulated. The critical weakness was that these standards only pertained to a very few water systems associated with interstate commerce.

State Action and Agencies

The New Hampshire Health Department was established in approximately 1880. A major part of their early program effort was drinking water oversight. In 1948 the Sanitary Engineering Division was established within the Health Department. In 1965 and 1967 the Water Supply and Pollution Control Commission was established. Finally in 1985 the Department of Environmental Services was established to coordinate most environmental issues. In NH the drinking water oversight program is part of the environmental hierarch.

SAFE DRINKING WATER ACT

As the 1970s began, there were a number of federal programs that had recently been enacted to address environmental pollution on a national level. None, however, dealt directly with the purity of public water systems. By 1974 the U.S. Congress had gathered substantial evidence, some of it supplied by special network TV "white papers," on the general inadequacy of the quality of water offered by the nation's public water systems and the limitations of state public water supply oversight programs.

Based on that evidence, the federal Safe Drinking Water Act was passed in late 1974. This legislation provided a uniform oversight program, a strong scientific basis for new rules, uniformity of program requirements to assure safe drinking water anywhere in the United States. The federal drinking water program is found in Code of Federal Regulations (40 CFR 141, 142, and 143.) New Hampshire's Legislation and Rules Governing Public Water Systems are found in RSA 485; the rules are in Chapter Env-Ws 300.

N. H. DRINKING WATER PROGRAM COVRAGE TODAY

A Public Water Supply in NH is defined as "a piped water system having its own source of supply, serving 15 or more services or 25 or more people, for 60 or more days per year." Public water systems can be divided into three categories. Typical examples include:

Community Systems (690 systems)	**Non-Community/ Non-Transient Systems (425 systems)**	**Transient Non-Community Systems (1100 systems)**

Municipal	Schools, Day cares	Restaurants, Motels, Hotels
Apartments/Condominiums	Year-round office buildings	Ski area, Beaches
Mobile Home Parks	Commercial or industrial business / permanent employees	Campgrounds
Single family home dev.		

Professional Associations

New England Water Works Assoc. Founded 1877 64 Dilla Street Milford, Ma 01757-1104 1-508-478-6996 **www.newwa.org**	American Water Works Assoc. Founded 1881 3333 W. Quincy Street Denver, CO 80235 1-303-794-7711 **www.awwa.org**	Water Quality Assoc. Founded 1960?? 4151 Naperville Road Leslie Il 60532-3696 1-630-505-0160 **www.wqa.org**

Non-Technical Water Works References

1. "The Water Supply of Rome," republished by the New England Water Works Association
2. AWWA Bicentennial Edition 1981, published by the American Water Works Association

FOR MORE INFORMATION

For more information or to offer comments, please call 271-3139. We would appreciate your contributions to improve this fact sheet. For a full list of water supply fact sheets please request WD-WSEB-15-2. Drinking water fact sheets are available through the DES web site at: **http://www.des.nh.gov/ws.htm** then select **fact sheets**.