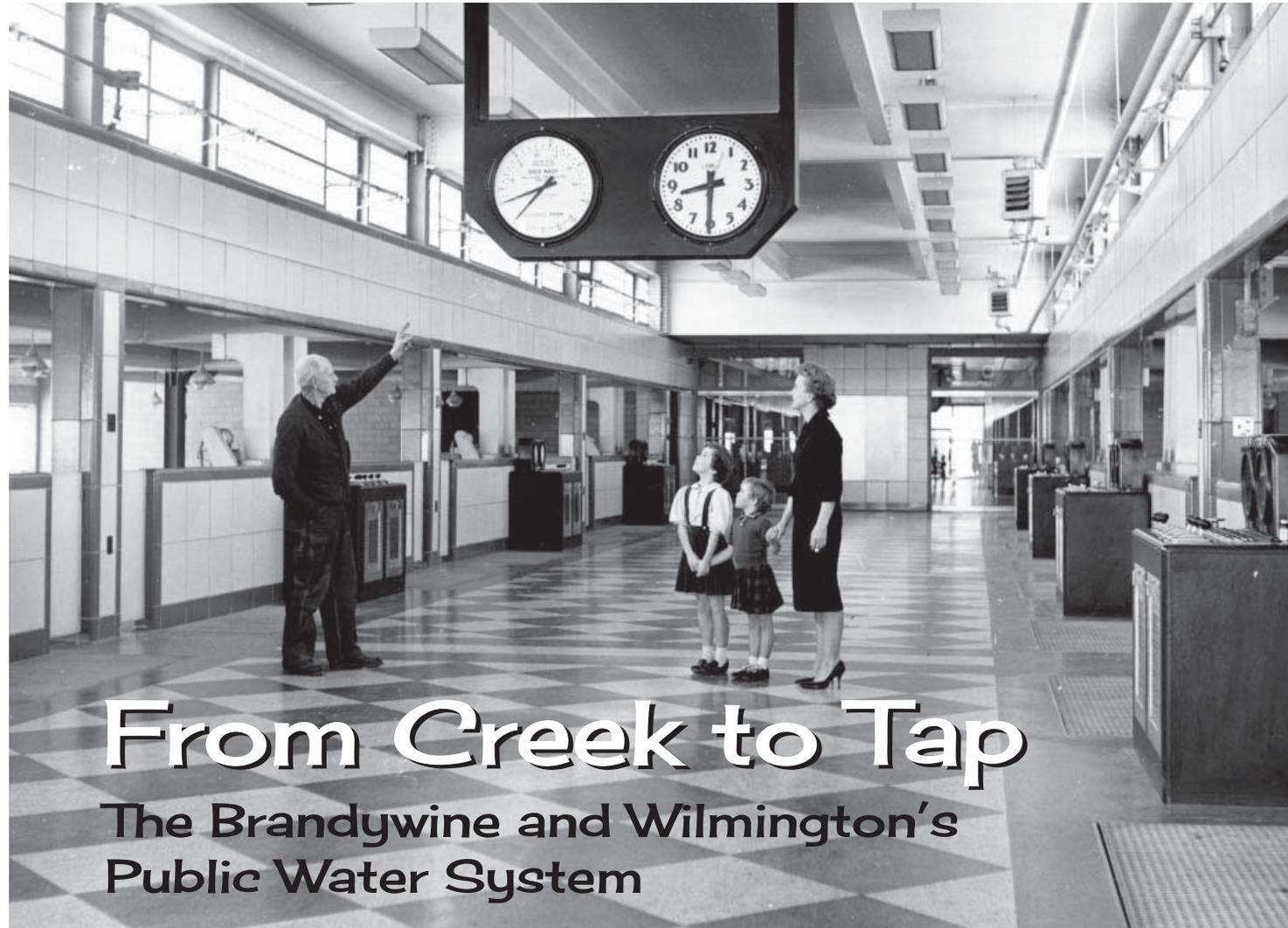


# From Creek to Tap

## The Brandywine and Wilmington's Public Water System

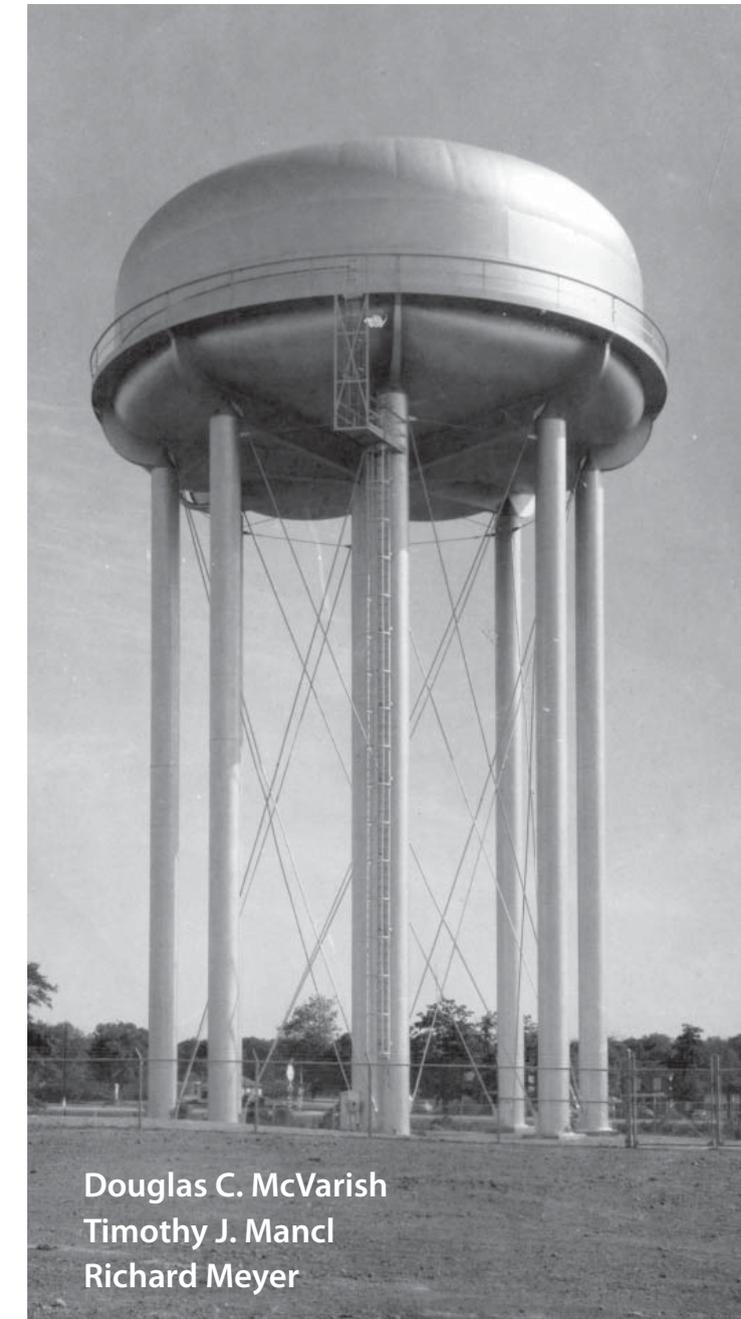
From Creek to Tap: The Brandywine and Wilmington's Public Water System

City of Wilmington

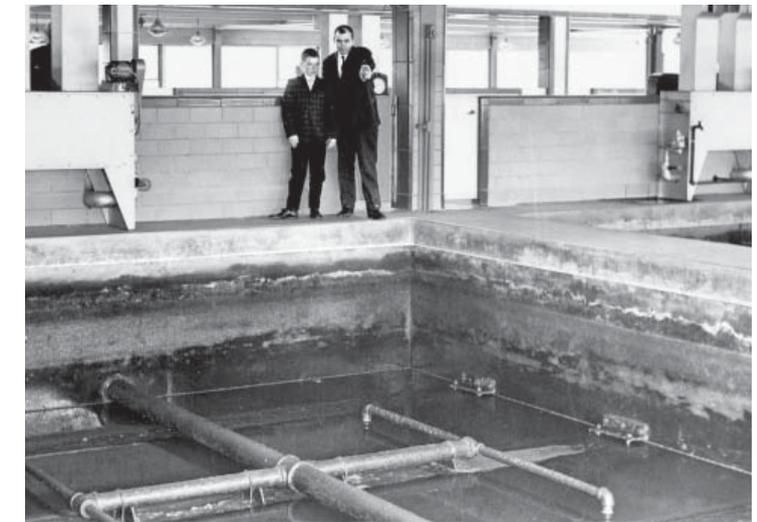


# From Creek to Tap

## The Brandywine and Wilmington's Public Water System



Douglas C. McVarish  
Timothy J. Mancl  
Richard Meyer



# From Creek to Tap

The Story of Wilmington's Public Water System



*Brandywine Plant from the air, 1929.*

# From Creek to Tap

The Story of Wilmington's Public Water System

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City of Wilmington, Delaware



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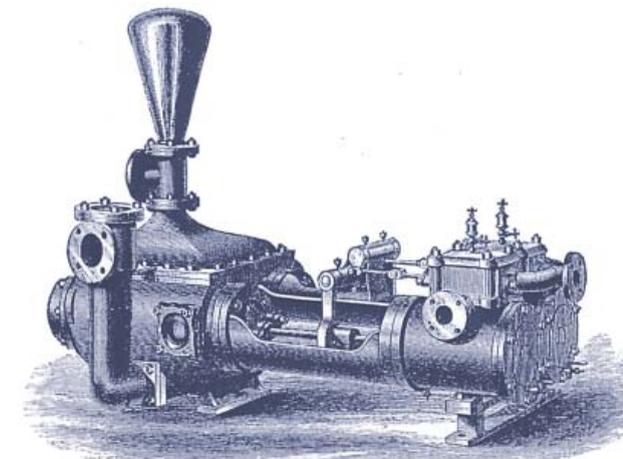
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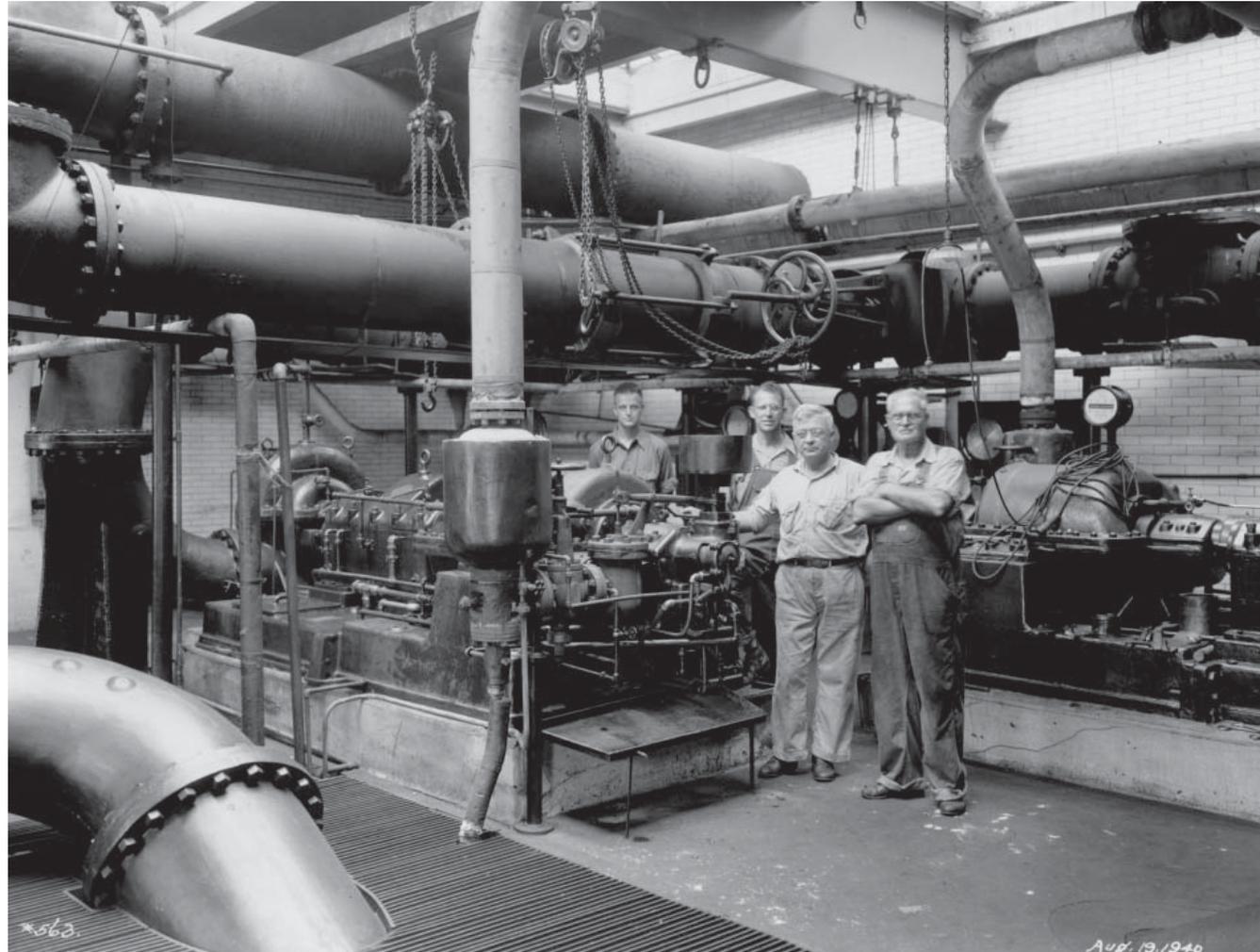
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*Fig. 1.—THE WORTHINGTON STEAM PUMP FOR GENERAL SERVICE.*



Completion of repairs on the No. 4 Centrifugal Pumping Unit, 1940.



## Introduction

The City of Wilmington could not exist, let alone grow and thrive, without an adequate and readily accessible source of fresh water. True enough, but you may not have given the subject all that much thought. The intent of this book is to give you pause—how did your public water system come about; how has it grown and changed over the years; and how does it continue to deliver this most vital commodity to every home, school, and business in the city?

We begin with a timeline that highlights some of the more important events in the history of the system, then move on to an illustrated historical sketch that provides background and context for these events. We present sidebars on related topics, and wrap things up with a schematic trip through the entire system—from creek to tap. Every reader should find something of interest here, but more than that, we hope you come away with a better understanding of your public water system and a greater appreciation of the efforts made to keep your water safe and running.

The idea for this book came about as a result of interagency coordination for a proposed service upgrade at the Brandywine Filter Plant. The headgate and raceway were to be refurbished, the rapid sand filter system was to be replaced by a membrane-type system, and existing filter consoles, filter beds, filter piping, and an exterior basin were to be removed. This work was to be funded through a capitalization grant from the U. S. Environmental Protection Agency through the Drinking Water State Revolving Fund, administered locally by the Delaware Division of Public Health. Since the raceway and filter plant were significant components of historic districts (Brandywine Park and Brandywine Village, respectively), the upgrade was subject to compliance with Section 106 of the National Historic Preservation Act. Section 106 requires that the possible effects of federally funded, licensed, or permitted action on historic properties be taken into consideration during project planning and that efforts be made to avoid, minimize, or mitigate adverse effects on such properties.

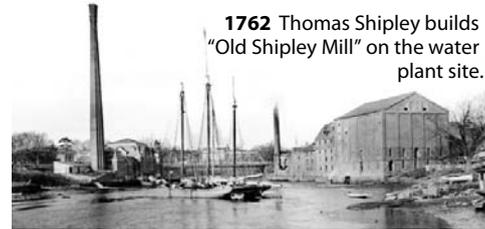
As a result of consultation under Section 106, the Delaware Department of Health and Social Services, the Division of Public Health, the Delaware Division of Historical and Cultural Affairs, and the City of Wilmington agreed that the planned upgrade would have adverse effects on both historic districts and that the effects would be mitigated through specified actions, including the review of new construction documents by the Wilmington Design Review and Preservation Commission and the preparation of historical documentation. This book is one of the agreed-upon mitigation products, and its preparation presented an exciting opportunity to introduce the fascinating story of Wilmington's public water system to a wide audience.

Many individuals and organizations contributed to the success of this effort. In particular we wish to recognize Debra Campagnari Martin of the Wilmington Department of Planning; Matthew Demo, Chau T. Le, Joseph Dellose, Francis Menton, and Sean Duffy of the Wilmington Department of Public Works; Craig Lukezic of the Delaware Division of Historical and Cultural Affairs; Constance J. Cooper and Ellen Rendell of the Delaware Historical Society; and staff of the Delaware Public Archives and the Hagley Museum and Library.



*Bird's-eye view of Wilmington, H. H. Bailey, 1874.*

# Milestones



**1762** Thomas Shipley builds "Old Shipley Mill" on the water plant site.

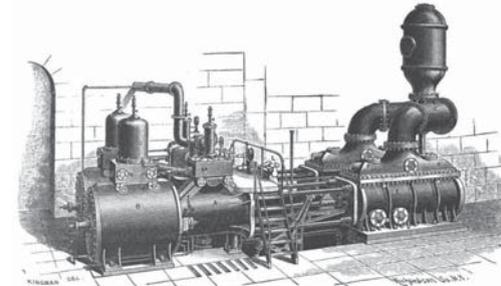
**1671** Tyman Stidham, a Swedish colonist, purchases the water plant site as part of a larger tract on the south side of Brandywine Creek.<sup>1</sup>

**1796** Isaac Hendrickson and William Poole build initial portions of a Wilmington waterworks.

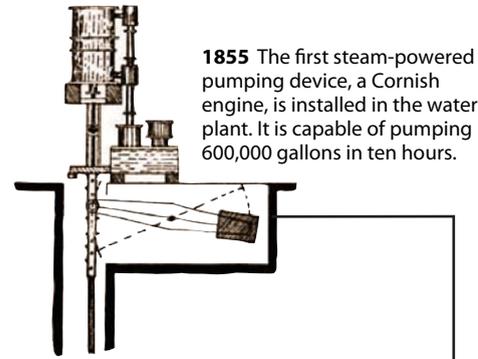
**1804** Wilmington Spring Water Company is established, marking the beginning of a dedicated water supply for the borough.

**1820** A borough committee submits a report recommending a water system similar to that in Philadelphia, but no action is taken.

**1827** The borough purchases a mill on the south side of Brandywine Creek as the site of a water plant. It uses an existing water wheel to power a double-acting pump.



**1874** The city replaces "Old Shipley Mill" with a fireproof pump house, equipped with a Worthington pump. The Cornish engine is placed in reserve.<sup>3</sup>



**1855** The first steam-powered pumping device, a Cornish engine, is installed in the water plant. It is capable of pumping 600,000 gallons in ten hours.



**1862** The site of Rodney Street Basin (Reservoir) is purchased.

**1863** Water is introduced to Rodney Street Basin (Reservoir).

**1877** Cool Spring Reservoir is dedicated.<sup>4</sup>

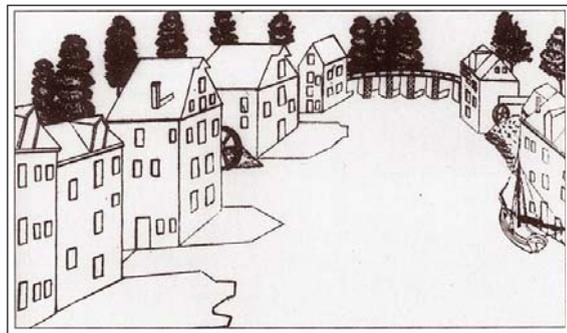
**1878** Cool Spring Reservoir is connected to new supply pipes.<sup>5</sup> Rodney Street Basin (Reservoir) is drained.<sup>6</sup>



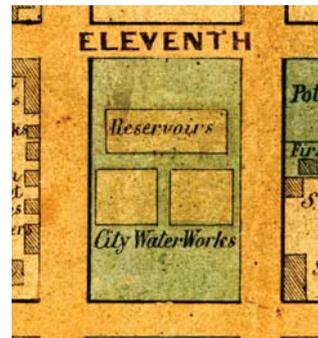
**1729** Samuel Kirk, a storekeeper, sells the water plant site, including two grist and two bolting mills, to John Richardson.

**1756** Thomas Shipley inherits and operates the gristmill after Oliver Canby's death.

**1742** Oliver Canby erects Delaware's first large gristmill on the water plant site.



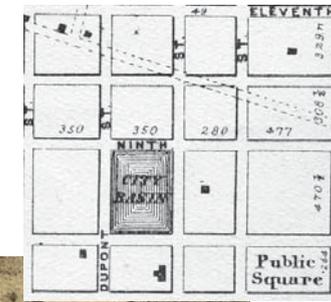
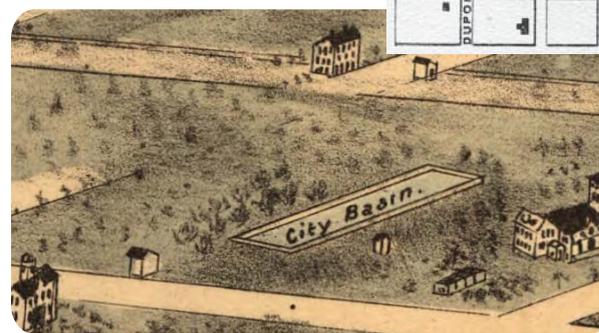
**1810** The borough assumes direct responsibility for water supply, acquiring Wilmington Spring Water Company for \$10,000.



**1825** A reservoir is constructed between Tenth and Eleventh and Market and King streets.

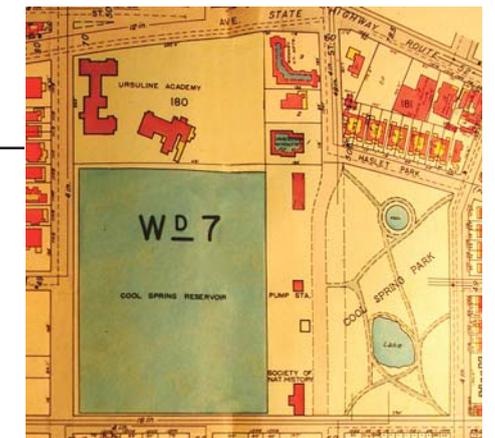
**1828** Five members of Borough Council are appointed to a Watering Committee.<sup>2</sup>

**1837** The water plant is improved by installation of a locally manufactured pump. It has twice the power of the original pump.

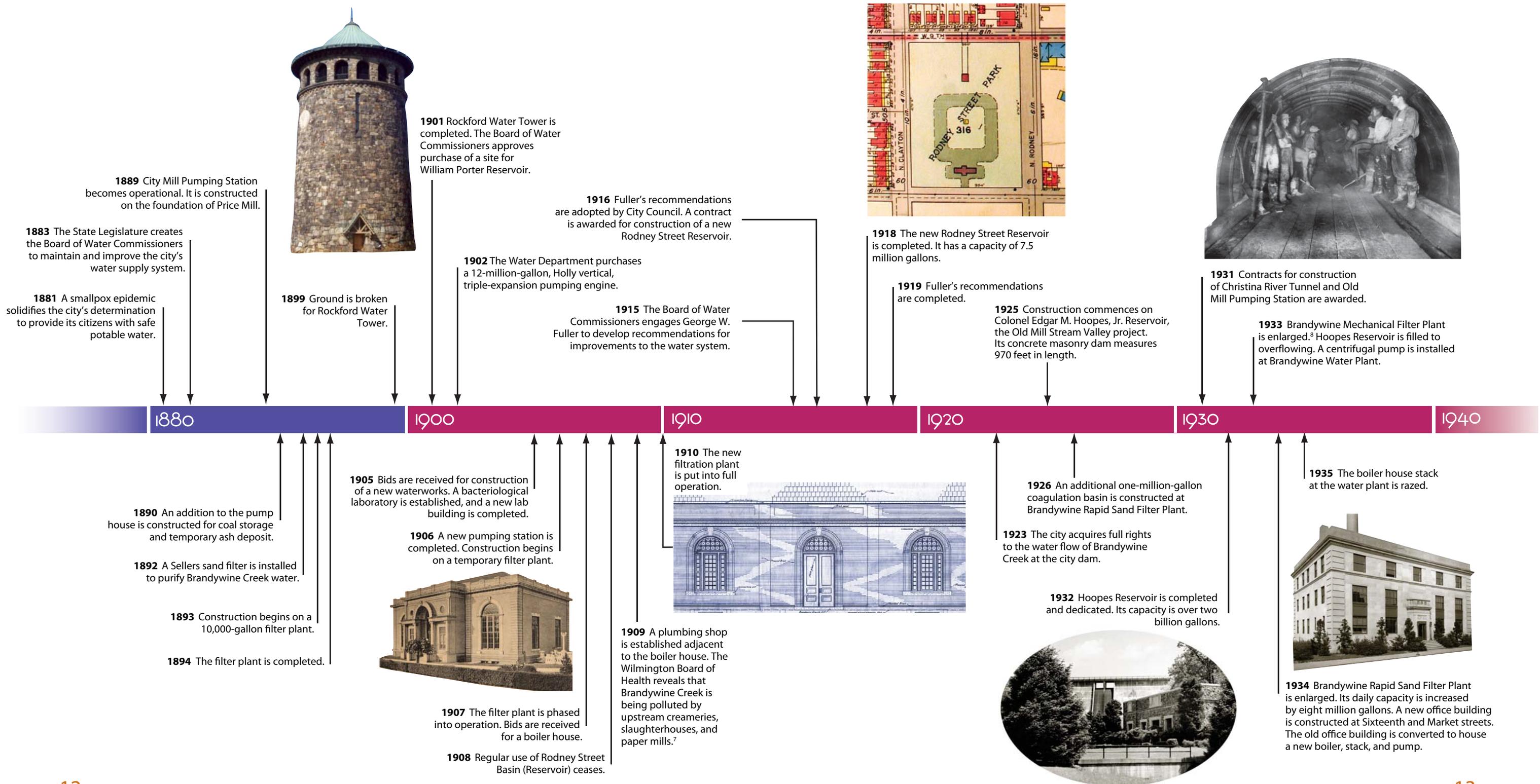


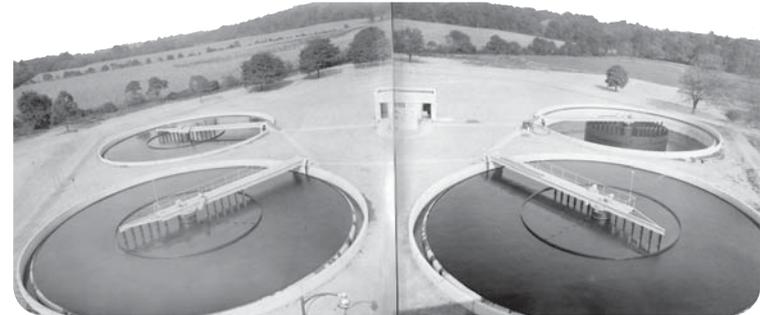
**1864** Rodney Street Basin (Reservoir) is completed. A new pump and boiler house is erected at Tenth and Market streets to supply it with water.

**1873** Construction of Cool Spring Reservoir is begun.



**1872** The site of Cool Spring Reservoir is purchased.





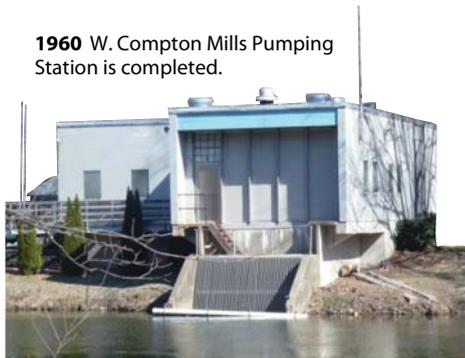
1953 Porter Filter Plant is opened.

1946 A contract is awarded for installation of two boilers at City Pumping Station.<sup>9</sup> The main control valve of the Holly triple-expansion engine at Brandywine Pumping Station explodes, tearing a hole in the roof.<sup>10</sup>

1949 The Society of Natural History vacates the Cool Spring Pumping Station to permit reuse by the Water Department.<sup>11</sup> The boiler and pump house stack is repaired.

1950 Construction begins on a new filter plant near Porter Reservoir. A major renovation to Brandywine Pumping Station is completed.

1951 Cool Spring Pumping Station is reopened.



1960 W. Compton Mills Pumping Station is completed.

1958 The Corps of Engineers begins to study the feasibility of constructing White Clay Creek Reservoir.

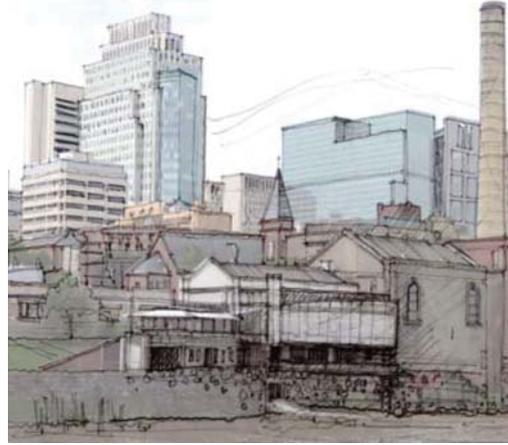
1955 The Water Department erects Beverly Place Water Tower. Its capacity is 100,000 gallons.<sup>12</sup>

1963 The roof of Rodney Street Reservoir is paved to accommodate a public ice-skating facility.<sup>13</sup>



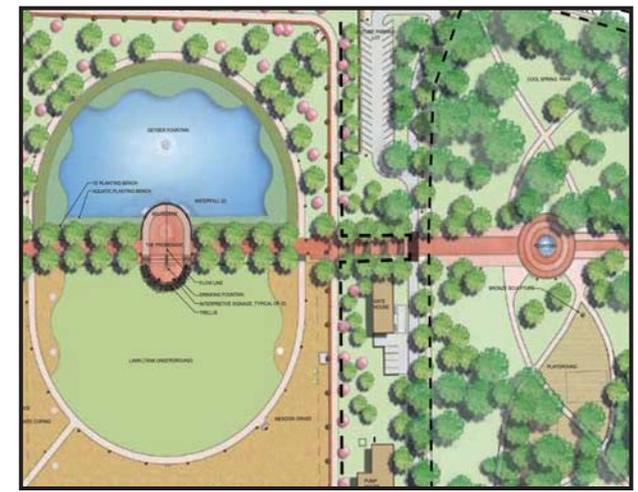
1966 The city taps Hoopes Reservoir for more than 11 days straight, the longest period of use since completion of the reservoir.<sup>14</sup>

1967 The city appropriates \$5.6 million to upgrade the water system, including construction of a standpipe on Foulk Road.



1993 Improvements are made to the heating system of Brandywine Filter Plant.

2003 Brandywine Pumping Station is completely restored.



2008 The former Waterworks Café Building is converted to a Water Quality Laboratory.



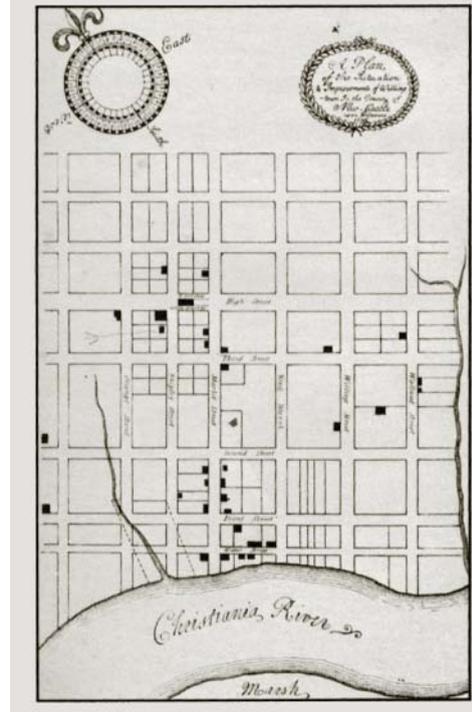
2009 Cool Spring Reservoir renovations are completed.

2010 Solar energy panels are installed at Porter Reservoir Filtration Plant. Filter controls are upgraded.<sup>15</sup>



Renewal of water main in Delaware Avenue, 1930s.

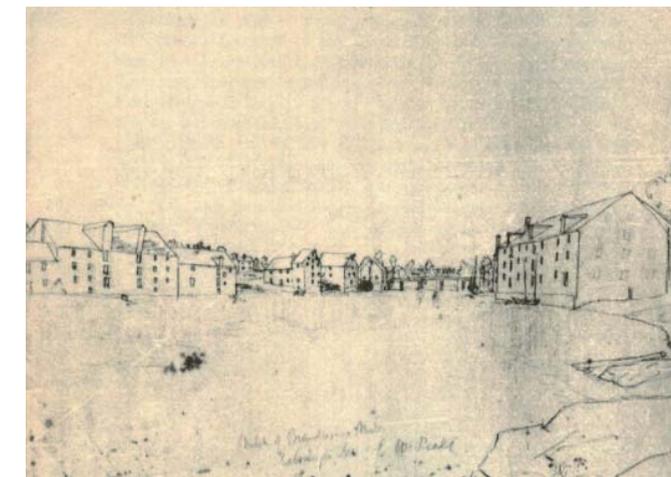
Plan of Wilmington,  
Benjamin Ferris, 1736.



## Historical Sketch

On the highways and in yards were draw-wells, often seventy or eighty feet deep. The limb of a tree was placed upright near them, a pole, balanced, being laid in a notch at the top, and a rope or chain at the end held the bucket, to be borne down till it filled with water, then carefully raised up. Those wells were not covered, and the water was excellent. Wells which had a windlass were more modern, and those enclosed were much safer. Two such were in front of Gov. Dickinson's house, in Kent Street, and thus supplied most of the neighborhood. In those days, half a square was near to get water for family use. Some had a hogshead in the yard to catch rain water for washing. Pumps were the next change; oftentimes it was hard labor to pump up water, owing to the well being deep.<sup>1</sup>

So was the early water system described by Elizabeth Montgomery in her "Reminiscences of Wilmington." Like many other cities in colonial America, early Wilmington relied upon a number of individual wells to supply fresh water to the community. It was not until the late eighteenth century that initial efforts were made to develop a general public water system. In 1796 Isaac Hendrickson and William Poole were appointed to a committee by the Borough Council to "inquire of the inhabitants of Wilmington who owned pumps which stand in the streets whether they would be willing to give them up to the Corporation," which would take care of them and keep them in order. The committee apparently fulfilled its mission for several years, providing the first municipal water to the citizenry.<sup>2</sup>



Drawing of Brandywine Mills, Charles Willson Peale, 1789.

The population and industrial growth of the borough soon demanded a better system for providing water. In 1800 the Borough Council appointed a committee comprised of John Way,

John Jones, and S. Nichols to examine the feasibility of bringing water from a spring on Quaker Hill at Third Street near Tatnall Street and conveying it down Market Street to supply the borough. The necessary infrastructure, which would have required digging and laying 835 feet of pump logs and construction of a 30-hogshead cistern, was estimated to cost about 112 pounds, nine shillings, and 11 pence (about \$7,500 today). Probably due to the cost, this project was abandoned.<sup>3</sup>

Four years later, Wilmington Spring Water Company was established to provide public water from its springs. Under the terms of its incorporation, the company was permitted to own the well or fountainhead it opened near the middle of High Street between Tatnall and West streets, as well as a reservoir constructed in Shipley Street above its intersection with Third Street, and associated pipes, conduits, hydrants, and pumps. The works supplied the portion of the borough lying south of Fourth Street. The company was authorized to dig, sink, make, and establish fountainheads, wells, and reservoirs through, under, or along all and any of the public streets, lanes, and alleys of the borough. The company was also given the power to levy fees on people who used water from its works.<sup>4</sup>

In 1805 the company expanded its works to furnish a larger supply of water and serve residents of the borough north of Fourth Street. To provide additional water storage the company acquired a parcel about a mile west of the borough, near Kennett Heights, as the location of a proposed basin. This parcel encompassed a portion of the future site of Cool Spring Reservoir.<sup>5</sup> After six years the plant of the company was purchased by the borough for \$10,000 (about \$171,000 today), and the Water Department was established, one of the earliest such departments in the country.<sup>6</sup>

The available supply of water proved inadequate, and several reasons were cited, including the diversion of water from the springs by private wells and the presence of Lombardy poplars and willow trees in the vicinity of the waterworks. The trees were believed to absorb much of the soil moisture. To eliminate this perceived threat, the Borough Council rashly ordered the removal of all street trees in the borough. Not only did this removal reduce shade and shelter along borough streets, it failed to solve the water shortage.<sup>7</sup>

An obvious source of additional water was Brandywine Creek. Originating in a spring located in the Welsh Hills near Honey Brook in Chester County, Pennsylvania, the creek has a drainage area of 320 square miles and flows 40 miles generally south and



*Brandywine Creek in Chester County, ca. 2011.*



Map of the Brandywine watershed, 2011.

east to its confluence with the Christina River near the latter's outflow into the Delaware River. The creek descends 300 feet in the final 25 miles of its course, making it a prime location for water-powered industry.<sup>8</sup> As it neared Wilmington, the creek was lined with the mills and factories that were the primary economic engine of the borough. But it also was polluted with sewage.<sup>9</sup>



DuPont powder mills, J. A. Dick, 1920s.



Henry Clay Village, 1920s.



Painting of Brandywine Mills, Bass Otis, ca. 1820.

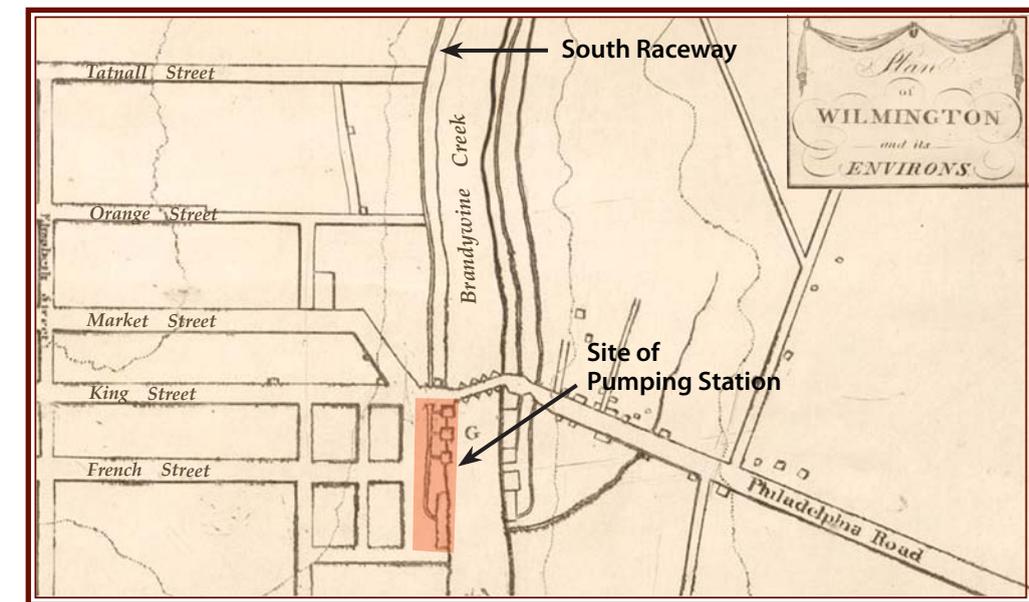
The Borough Council appointed Police Chief Burgess, Eli Hilles, and John Rumsey to “view the field and report on the probable expense of having water brought from the Brandywine.” The committee reported that for the sum of \$14,600 (about \$219,000 today) the borough could be supplied with water pumped from the Brandywine by means of iron forcing pumps to a tank or reservoir near the junction of Shipley and Chestnut (Tenth) streets where it could be furnished in iron pipes to all parts of the borough. The report was immediately acted upon, but the new and old works combined yielded only fourteen gallons of water per minute.

On August 2, 1824, yet another committee, this one comprised of Eli Mendenhall, Henry Hoopes, and John F. Gilpin, attributed the water shortage to defective log pipes and cisterns and proposed replacement of the log pipes with modern iron pipes. The following year permission was granted for all residents to introduce spring water to their yards and houses via iron pipes. A three-inch iron pipe was laid from the Wilmington borough line to

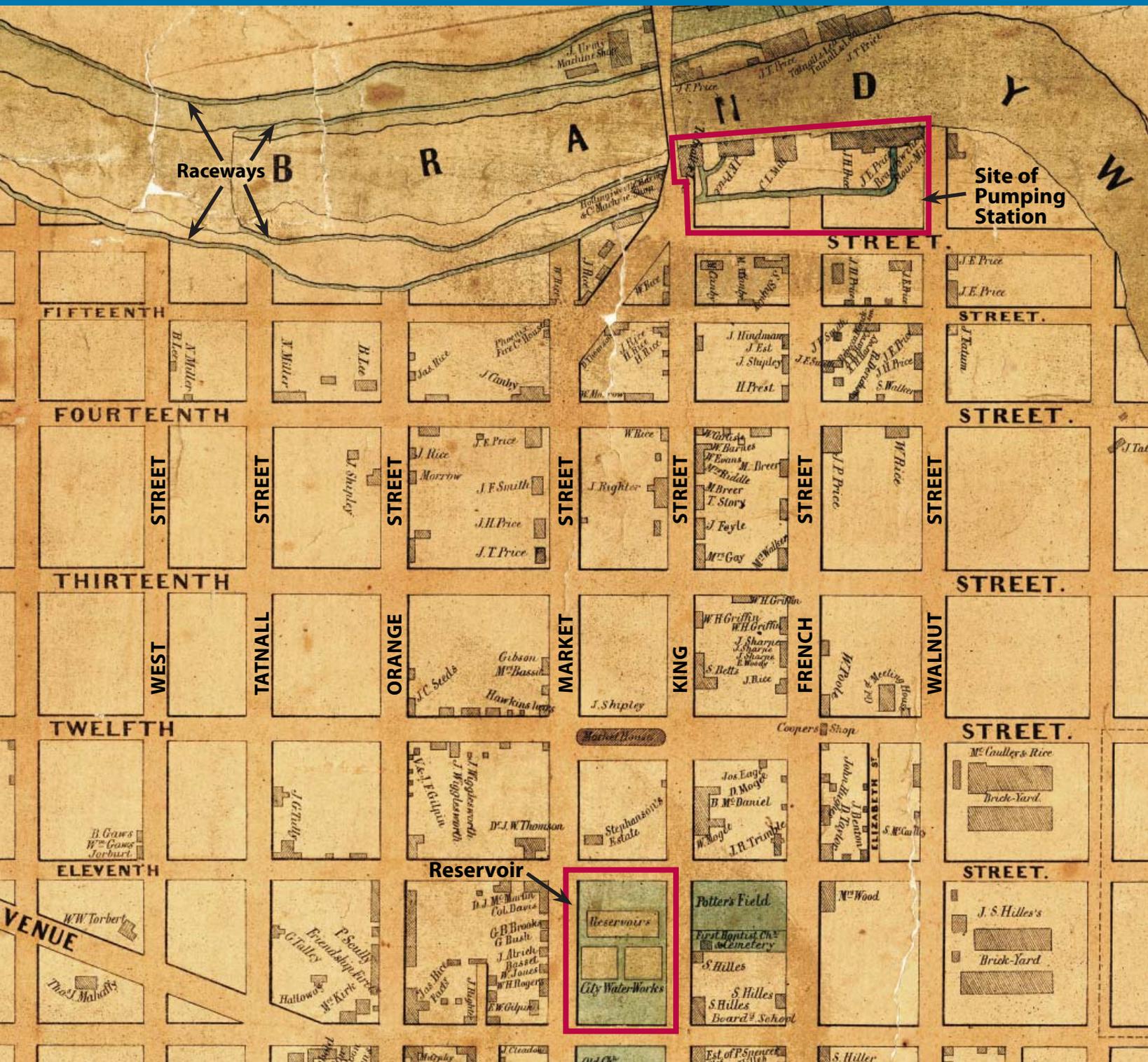
the block bounded by Tenth, Eleventh, Market, and King streets (today’s Rodney Square), where a reservoir was constructed. The project was overseen by William H. Naff.<sup>10</sup>

In 1826 a new committee was appointed to propose measures to “insure an ample supply of water for domestic and other purposes.” But the report again concluded that the only means of supplying adequate water for the borough’s use was to divert water from Brandywine Creek.<sup>11</sup> In June 1827 the borough purchased John Cummins Mill, located on the south side of Brandywine Creek, for \$28,000 (about \$631,000 today) as the site of a pumping station that would force creek water into the new reservoir.<sup>12</sup> The site of the pumping station had figured prominently in early Wilmington history. In the late seventeenth century, it was the location of a barley gristmill, established by a Swedish colonist named Tyman Stidham. It later was the site of the borough’s first large gristmill, built for Oliver Canby in 1746. Twenty years later it was the site of Thomas Shipley’s gristmill (“Old Shipley Mill”).

Water was conveyed to the pumping station by an existing race on the south side of the creek. A double-acting pump, manufactured by Prosper Martin of Philadelphia, was housed in a stone building that adjoined the overshot water wheel of the former mill. This wheel powered the pump. Put in operation in November 1827 under the direction of



Plan of Wilmington, Anonymous, 1804.

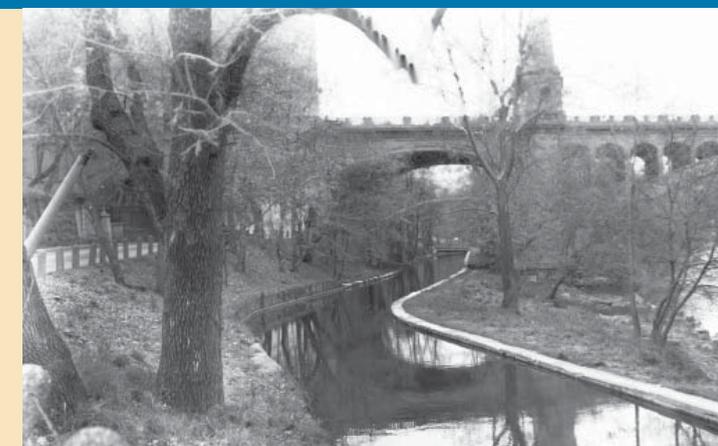


Plan of Wilmington, J. C. Sydney, 1850.

## The Brandywine Raceway

Water supplying the Brandywine Water Plant enters an open raceway at the city dam within Brandywine Park, from which it flows to a screen house near King Street. From the screen house the water flows underground to the pumping station and filter plant. The raceway has its origins in the development of large merchant gristmills that once lined both sides of the Brandywine. At the height of milling operations, each side of the Brandywine held two raceways—two that began at the dam near the south end of Brandywine Park at Tatnall Street and two that began further upstream. Of the upstream raceways, one began at a dam that once stood near Adams Street, the other at the dam near Broom Street.

In 1827 the borough bought the site of the first pumping station along with its water privileges from John Cummings. Water was drawn from the dam on the south side of the river near Broom Street and flowed through the raceway that had supplied the Cummings gristmill and adjacent Price mill to the east. This raceway, based on a petition of William Moore and Daniel Byrne, is said to have been completed by December 1762, about the same time that William Marshall erected a dam at the head of the race.<sup>1</sup> Recommendations made in 1870 to create a buffer to keep pollutants from entering the raceway (also known as the waterworks supply canal) led the city to purchase land that would later become Brandywine Park. Between North West and North Market streets the walls of the race were raised circa 1898 on the recommendation of the Board of Park Commissioners.<sup>2</sup> By the turn of the twentieth century the raceway fed by the dam near Tatnall Street was filled. Early in the twentieth century, the portion of the raceway east of King Street was covered. Today a pipe carries water within the buried section of the raceway to the water plant.



Raceway from West Street with Washington Memorial Bridge in background, 1976.



Park Drive over raceway with pumping station in background, 1976.

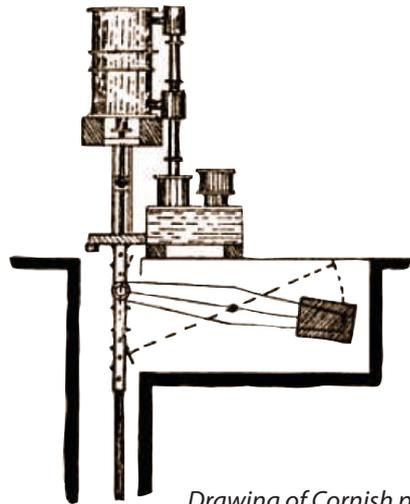


Buried portion of raceway, east of King Street, 2012.

engineer Jonas P. Fairlamb, it had a six-foot stroke and was able to raise the water to the basin in eighteen minutes.<sup>13</sup> Water flowed to the basin by 2,120 feet of eight-inch-diameter iron pipe that rose 99 feet. The reservoir, which consisted of two adjoining basins, had a total capacity of one million gallons. In 1837 a new forcing pump, manufactured by Betts, Pusey & Harlan of Wilmington, was purchased for \$1,200 (about \$23,500 today). On December 27, 1838, a petition was raised to increase the depth of the existing reservoir. An appointed committee rejected that proposal and instead recommended that Council construct an additional basin. In 1839 a new reservoir basin, measuring 158 feet by 80 feet by 14 feet in depth, was built at a cost of \$4,907 (about \$121,000 today).<sup>14</sup>

The water supply still proved inadequate for the growing city. In April 1855 a contract was executed with Betts, Pusey & Company to construct and install a direct-acting Cornish

pump, capable of forcing 600,000 gallons of water into the reservoir in ten hours. The work was completed by the end of the year. The installation was designed to use the steam pump only when the water wheel was unable to supply all of the needed water. Thus the pumping apparatus of the waterworks consisted of two double-acting force pumps of eight-inch diameter, driven by a water wheel, and a Cornish pumping engine with one 18-inch pump, all forcing water through a 16-inch main into the reservoir basin.<sup>15</sup>



*Drawing of Cornish pump.*

The City Council soon began to plan for the growing water needs of Wilmington. Realizing that the existing reservoir capacity would soon be inadequate, they considered the purchase of a site for a new basin. In January 1862 the Water Committee was instructed to purchase from James A. Bayard land lying between Eighth, Ninth, Rodney and Clayton streets, known as the "Gilpin Tract," as the site of a reservoir. Water was first introduced into the basin in November 1863.

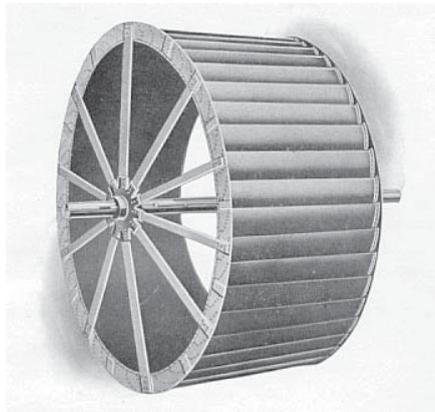
Work continued on the pumping machinery into the following year. Initially a small, temporary pump was used to fill the basin. A permanent Worthington pump entered service in 1864, pumping water from the original reservoir through two eight-inch pipes.<sup>16</sup>

## Power and Pumping

*Water-supply systems use gravity, pumps, or a combination of gravity and pumps to deliver water to the consumer. A gravity-fed distribution system can be the most reliable and inexpensive means of transporting water because mechanical equipment is not required. However, the water source must be at a higher elevation than the consumer. Where the supply is at an elevation below that of the consumer, pumping is required. There are three types of pumping distribution systems: direct, indirect, or a combination of the two. In a direct pumping system, pumps supply the pressure needed to deliver water to the consumer. In an indirect pumping system, pumps supply a reservoir, from which water is distributed to the consumer by gravity. A combined pumping system uses both means to deliver water to the consumer. For most of its history, the Wilmington waterworks used an indirect system, but today uses a combined system for delivering water.*

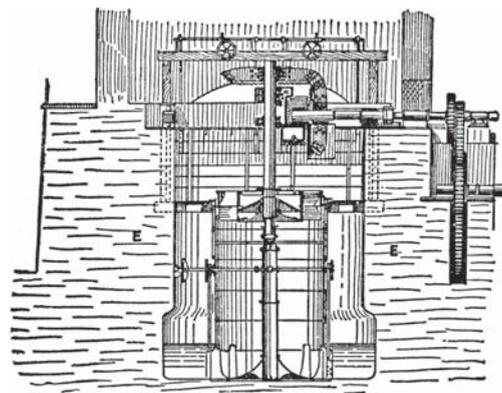
*A waterworks needs a source of energy to drive the pumps. Today electric motors are the most commonly used source of power in the United States. However, steam engines were the most common source of power historically. The earliest waterworks in the United States used a water wheel or turbine to power pumping equipment. The waterworks established in Wilmington in 1827 used an overshot water wheel to drive a double-acting pump. The water wheel measured 14.5 feet in diameter and was 45.25 inches wide. The pump had an eight-inch bore and a six-*





Overshot water wheel.

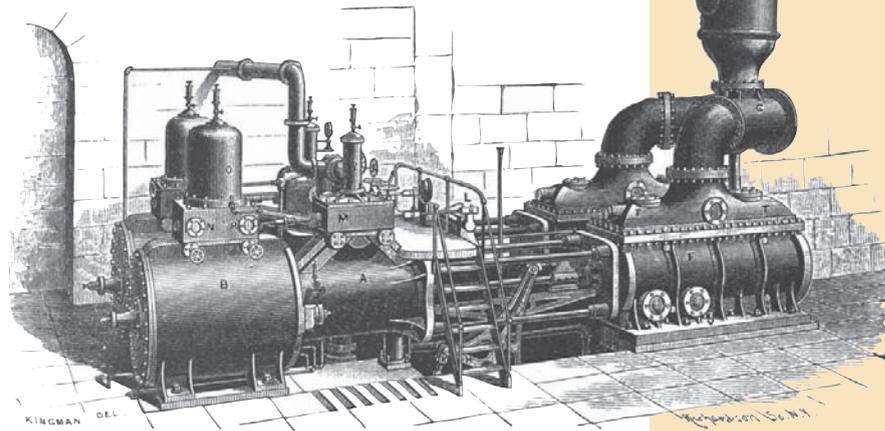
foot stroke. The pump was capable of delivering to the reservoir 590 gallons per minute, or nearly 850,000 gallons per day. For each five gallons of water needed to turn the wheel, one gallon of water was pumped to the reservoir. A Jonval turbine replaced the water wheel in 1881. Water turbines were more efficient than wheels, using less water to generate the needed power.<sup>1</sup>



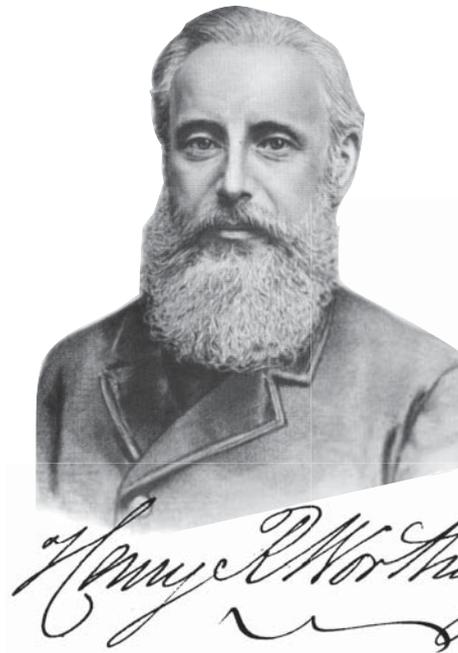
Jonval turbine.

Steam engines work by introducing steam under high pressure into a chamber containing a piston. The pressure of the steam moves the piston. Most frequently, steam pumping engines were used in waterworks, wherein the engine and the pump were combined in a single piece of machinery. In addition to housing a steam pumping engine, plants needed to expand to include room for coal storage and boilers to generate steam. Steam power came to the Wilmington waterworks in 1855 with the installation of a Cornish Bull engine, which was to be put into service when the water wheel failed.<sup>2</sup>

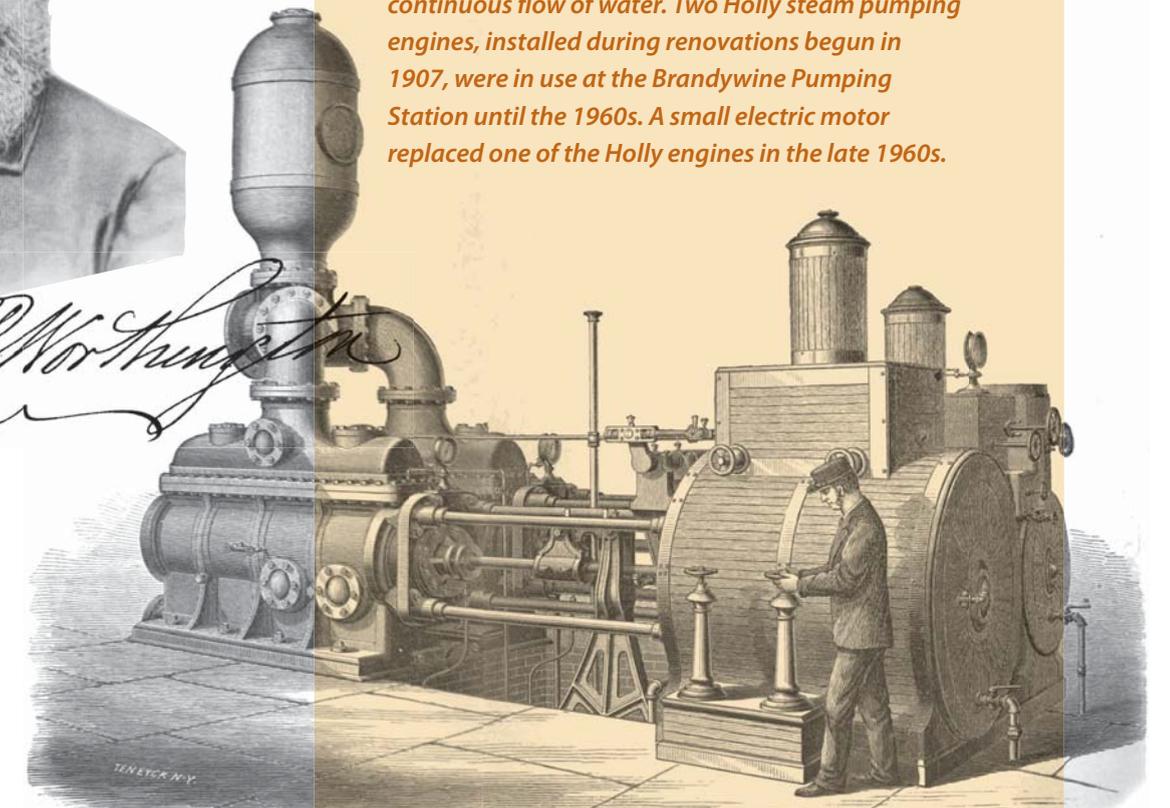
The double-acting pump and the Cornish Bull engine were both effective at moving water; however, they introduced shock to the system. In the case of the double-acting pump, a shock was introduced to the system each time the piston changed direction. The Worthington steam pumping engine, installed at the Brandywine Pumping Station in 1875, was designed to reduce the shock. Worthington accomplished this goal by designing his pumping



Worthington pumping engine.



*Henry D. Worthington*



Worthington tank engine.

engine so that the introduction and handling of steam, and the action of the pump, resulted in a gradual, uniform application of energy and a more continuous flow of water. Two Holly steam pumping engines, installed during renovations begun in 1907, were in use at the Brandywine Pumping Station until the 1960s. A small electric motor replaced one of the Holly engines in the late 1960s.

Another means of reducing shock and achieving a continuous flow was through the use of a centrifugal pump. However, such pumps operated at high speeds, and therefore were not well suited to being powered by the typical early steam engine used in most waterworks. The introduction of electric motors and turbine steam engines made use of a centrifugal pump more practical, and enabled waterworks to take advantage of its smaller size and greater reliability.<sup>3</sup>



Cornish Bull engine.

# Water Pump Valve Blasts Hole in Roof Truman Plans P Action When O Reaches White

### 3 City Workers Unhurt As Steam Pressure Blows Control Unit Into Air; Tile Scattered Over Area

Two engineers and an oiler escaped unscathed when the main steam control valve to the Holly triple expansion engine burst in the pumping station of the City Water Department at Sixteenth and King Streets, at 8:45 o'clock this morning.

Live steam, at 150 pounds pressure, blew the head and flange of the main valve, located 20 feet above the floor, through the roof of the building.

A large section of the roof, four by 12 feet, was torn out by the flange and valve parts. Broken tile fell to the concrete floor of the station and scattered over the semi-circular drive in front of the station and out onto Sixteenth Street.

#### Alarm Caused

So violent was the explosion that employes in other parts of the building and in the adjacent main office at the foot of French Street thought for a moment that a boiler had given way.

Half of the valve head flange, about 14 inches in diameter and weighing about 20 pounds in weight, shot through the ceiling of the building and is missing. It is believed to have been shattered or to have fallen into the Brandywine River.

James H. Matthews, engineer in charge when the valve gave way, was working on the main floor. With him were Engineer Fred Quinn and Oiler Walter Cummins. The three men fled through the main entrance of the station to escape the live steam.

#### Officials Arrive

Shortly after the explosion W. Compton Wills, chief engineer of the Water Department, arrived. The Board of Water Commissioners came to the pumping station after the explosion to inspect the damage.

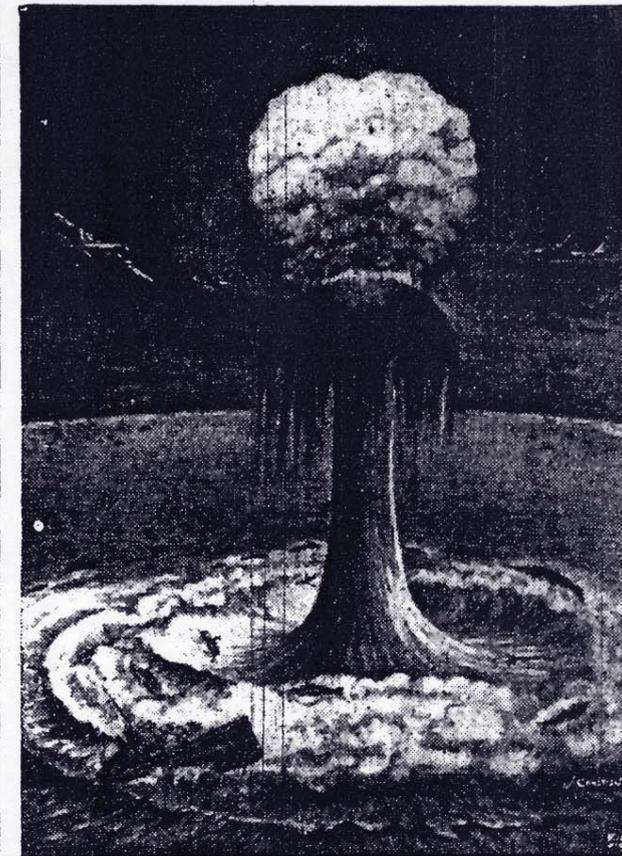
Herbert B. Mearns, president of the board, and Leroy W. Hickman, and Charles P. Maroney, other members, examined the building and interior of the pumping station. Damage was confined to the valve itself and to the section of the roof blown out.

Mr. Wills said the Holly vertical triple expansion steam engine was just being started to pump water. It had been closed down because of the turbid condition of the Brandywine River, following recent storms.

#### Duplicate Pump Used

As the department has a duplicate engine and pumps in the same building, they will be used until

### Artist's Conception of Blast



Based on Vice Admiral W. H. Blandy's advance description of likely results, this is an artist's conception of the column of water to be blown into the air from the underwater atomic bomb blast scheduled to occur at Bikini late this afternoon. Admiral Blandy predicted waves as high as 100 feet as a million tons of water rise in a huge column topped by a geyser-like spray. This drawing was made by AP Staff Artist John Carlton.

## Stage Set for World's First Undersea Atom Bomb Test

### Scientists, Admiral Board Barge to Cock Trigger Of Weapon After Blandy Decides to Go Ahead; Weather May Cause Postponement

While the Holly engines served well for 60 years, they did not run hazard-free. On July 24, 1946 the main stream control valve of one of the engines burst and blew a hole through the roof of the pumping station. Fortunately no one was injured. The Journal-Every Evening heralded a blast of a different order in the adjoining column.

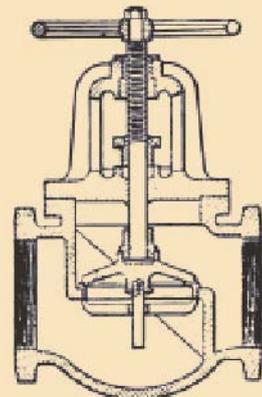
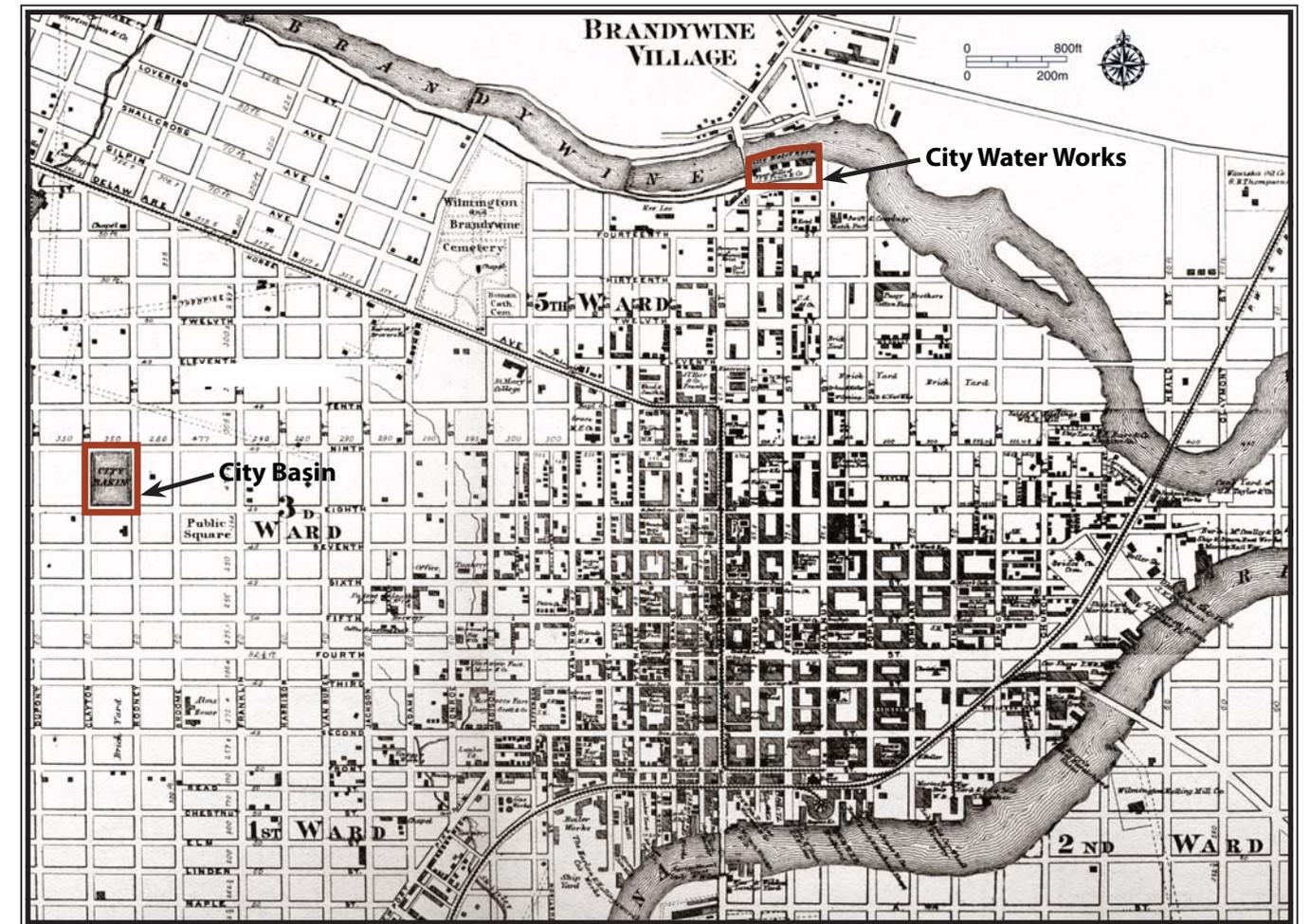
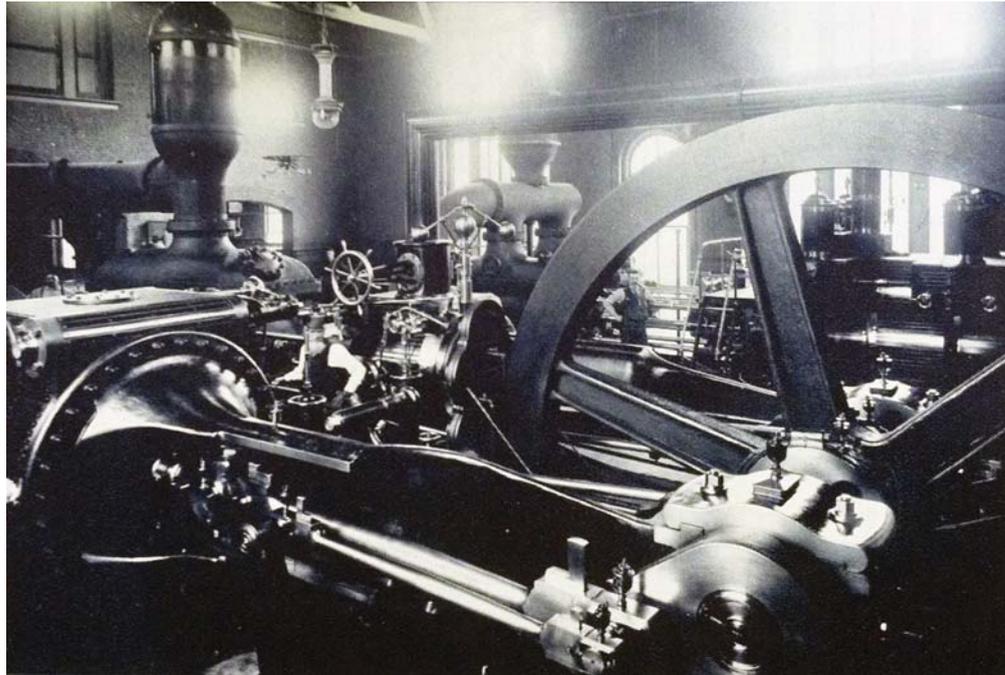


FIG. 333.—Globe Valve.



Map of Wilmington, D. G. Beers, 1868.

In 1872 the Water Committee considered the water supply of the city to be precarious and requested installation of a new steam pump with a capacity of three or four million gallons per day. In February the committee reported that a contract had been entered with Henry Q. Worthington of New York for a compound duplex pump, costing \$35,000 (about \$645,000 today) and having a capacity of five million gallons per day. This new pump enabled efficient service to an enlarged water system. To house the larger pump, J. D. Winslow constructed a new pump house, measuring 60 feet square, on the site of the old mill. It consisted of a main block that housed plungers, two Worthington five-million-gallon-per-day pumps, an old Cornish pump, and a lower west block that contained the



*Interior of Brandywine pump house, showing two Worthington pumps, ca. 1894*

turbine wheel. A single-story east block adjoined the main block and contained the boiler plant. The boiler plant was marked by a sixty-foot chimney. Water was conveyed from the plant to the city by means of two water mains: one 24 inches in diameter and the other 16 inches in diameter.<sup>17</sup>

With the continuing growth of the city, attention turned to protection of its water supply and increased water storage capacity. An 1867 report indicated that "Brandywine water unadulterated is a most desirable drinking water" and that the city should "use every possible exertion to get the Brandywine water purer than it now is." In addition, after evaluating the Red Clay Creek as an



*Brandywine pump house, ca. 1875.*

additional water source, the report instead recommended construction of a reservoir to increase the available water supply.<sup>18</sup> The city's entire storage capacity was approximately 3.5 million gallons, only slightly more than one-day's supply. Additional storage for the rapidly growing city was critical.<sup>19</sup>

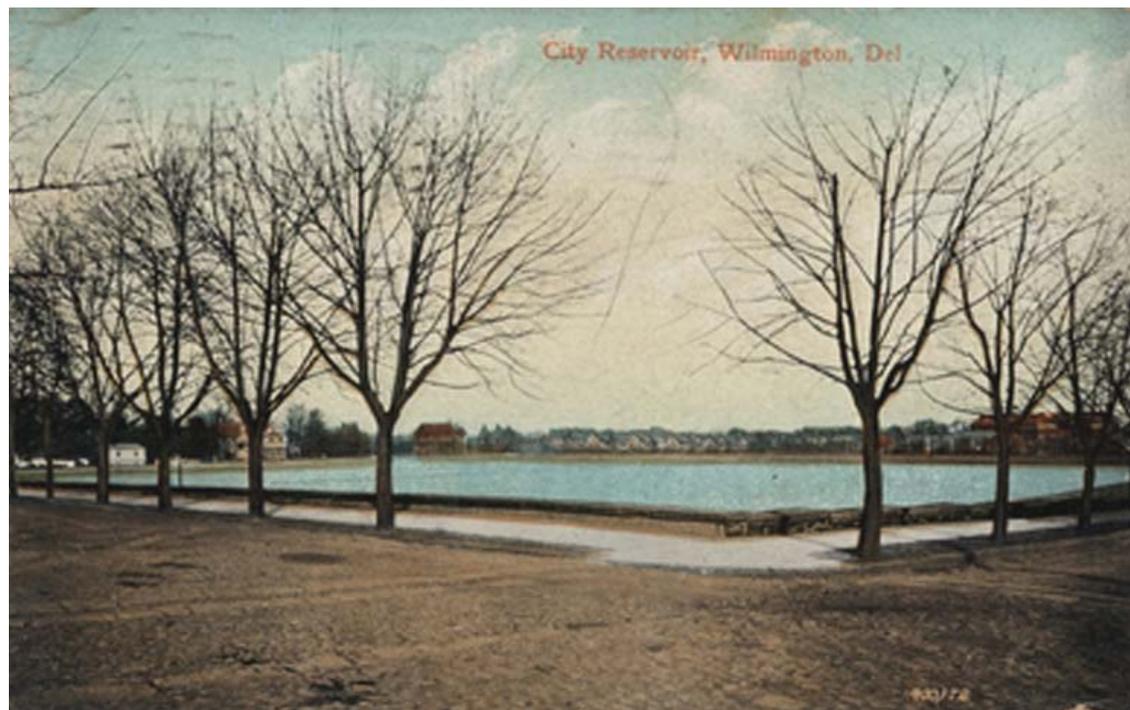
The subject of building a larger reservoir of sufficient size to hold two-weeks' worth of water was raised by the Water Committee, and in June 1871 the Committee was instructed by Council to find a reservoir site. In 1872 the city paid \$56,875 (about \$1,050,000 today) for 6.6 acres of land, currently bounded by Ursuline Academy and Park Place to the north, Jackson Street to the east, Tenth Street to the south, and Franklin Street to the west, as the site of a reservoir to be called "Cool Springs." Its name was derived from the name of Delaware Senator and U. S. Attorney General Caesar A. Rodney's nearby home.

Work began on Cool Spring Reservoir in August 1874 under the superintendence of Captain C. H. Gallagher, and the preparatory clearing of the lot was begun. Several months later Joseph C. Hyde succeeded Gallagher as superintendent, and the clearing was completed. In 1875 Allen Ruth became chief engineer, and work began on the excavation of two basins. Substantial progress was made, but due to the presence of underground springs, additional drains needed to be installed. In 1877 available funds were exhausted.

In April of that year the Delaware Legislature passed a supplemental act authorizing the Water Department to borrow \$200,000 (about \$4,300,000 today) and appoint a Board of Water Commissioners. In June 1877 the Board issued specifications for completion of the reservoir. Completion of the north basin was expected to require 8,400 cubic yards of puddling (a compressed mixture of loam, sand, and gravel intended to hold water), 1,200 cubic yards of gravel, 670 cubic yards of sand, 3,000 barrels of cement, 1.2 million bricks, and 81 linear feet of flagging. The south basin was expected to require 120 cubic yards of puddling, 1,400 cubic yards of gravel, 670 cubic yards of sand, 3,356 barrels of cement, 1,326 million bricks, and 81 linear feet of flagging. The contract was awarded to Peter T. Collins and James Kennedy of Philadelphia for the sum of \$69,000 (about \$1,480,000 today): \$33,000 for the north basin and \$36,000 for the south basin.

The reservoir was officially dedicated in an elaborate ceremony in December 1877, marking both its completion and the semicentennial of the Water Department. The depth



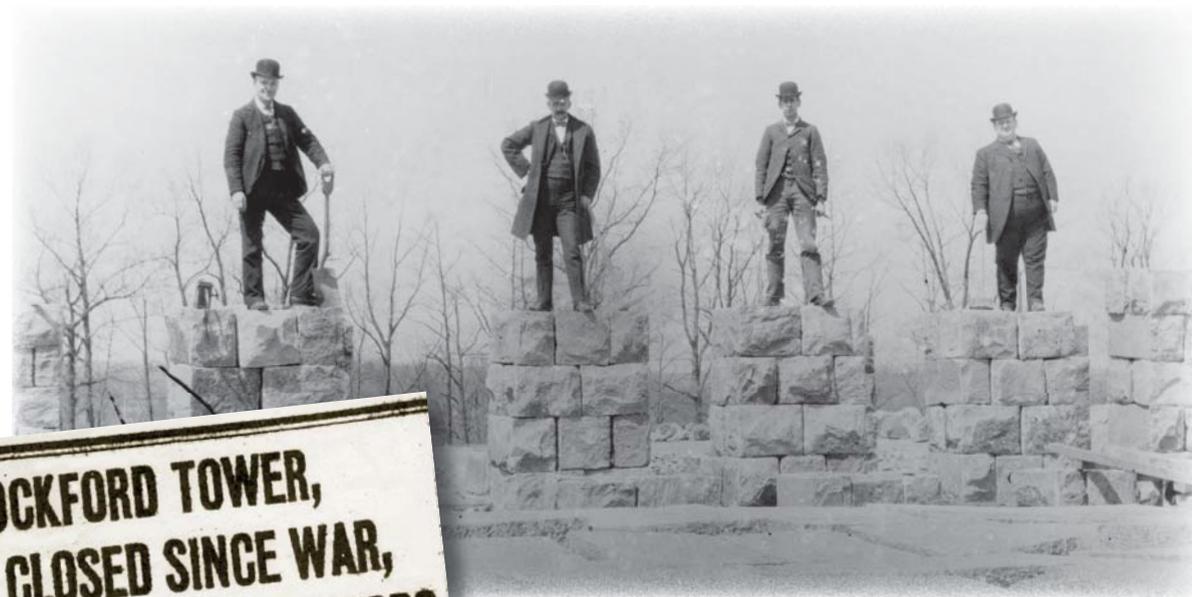


Cool Spring Reservoir, 1907.

of each basin was approximately 18 feet. The full capacity of the reservoir was estimated to be 28 million gallons.<sup>20</sup>

Shortly after Cool Spring Reservoir was completed, Wilmington industrialist William Poole Bancroft, acting on behalf of himself, his brother Samuel, and their mother Sarah Poole Bancroft, proposed a gift of 50 acres to the city for use as a park. Initially the city declined the gift, believing that the tract was too far removed from the city's residential neighborhoods. However, in 1889 the city reconsidered its decision and accepted a gift of 59 acres from the family. This tract became the core of Rockford Park.

To increase the capacity of the water system to serve the western portion of the city, the Boards of Park Commissioners and Water Commissioners agreed to construct a rustic, stone-clad water tower on the highest point in the park. It would also serve as an observation tower. Construction began in 1899, and the tower was completed in 1901.



Rockford Tower under construction, 1899.

**ROCKFORD TOWER,  
CLOSED SINCE WAR,  
OPEN TO VISITORS**

**Few So Far Seize Opportunity To Secure Splendid View of City**

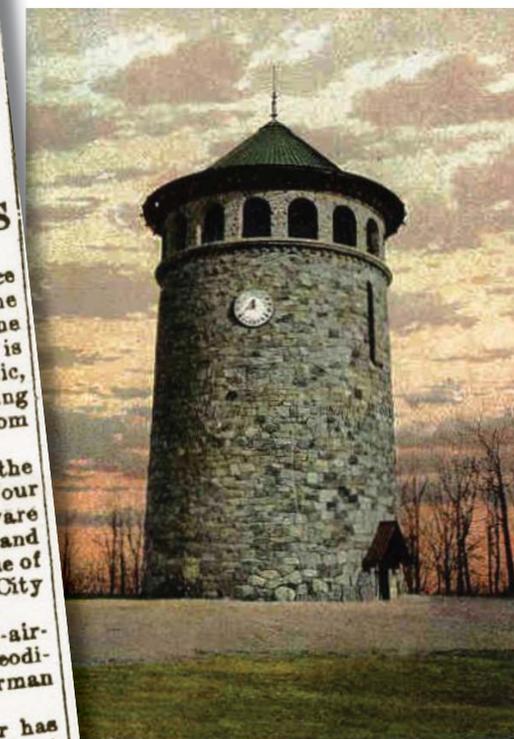
**FILL EXCAVATIONS FOR AIRCRAFT GUNS**

After being closed to the public since the first few days of war in 1917, the Rockford water tower is now open. The fact that the Tower has been opened is not generally known to the public, though occasional visitors are taking advantage of the wonderful view from the top of the structure.

The top of the tower is one of the highest points in Delaware, and four states may be easily seen. Delaware City may be seen on a bright day, and with a pair of field glasses the statue of William Penn on the Philadelphia City Hall may be discerned.

The excavations for the two anti-aircraft guns which had been dug in readiness for a possible attack by German Zeppelins have been filled up.

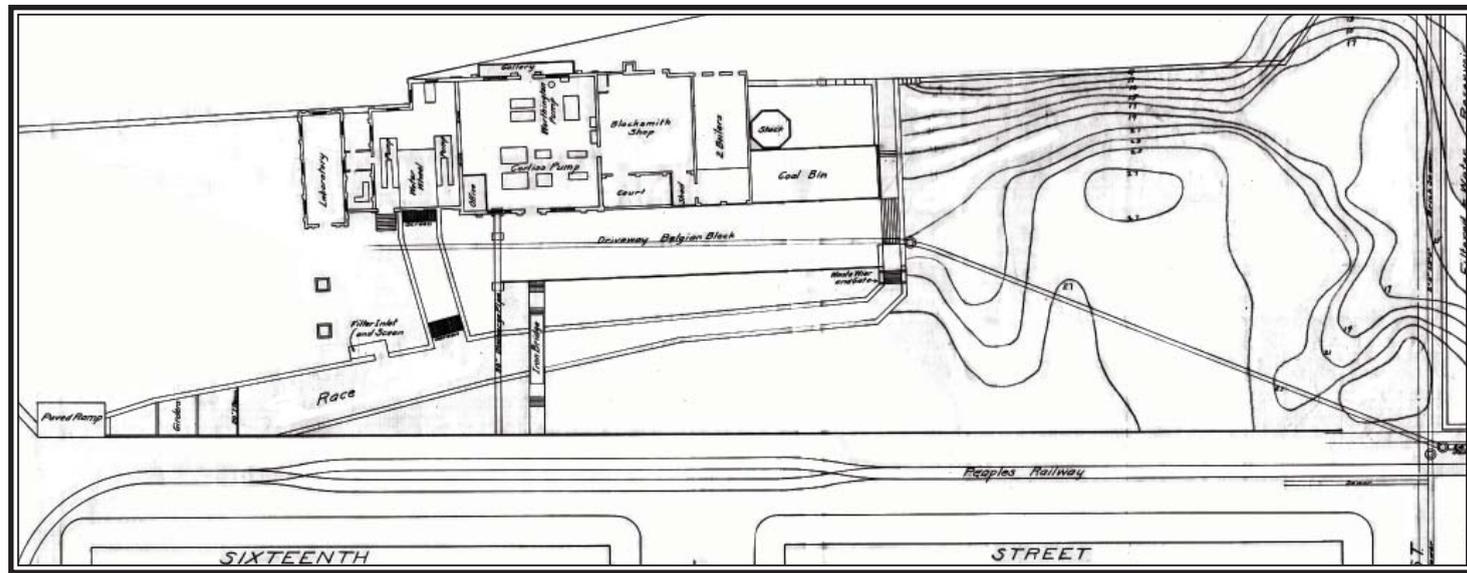
The Sward surrounding the tower has been trimmed and one of the prettiest spots of park land in the city is now ready for the spending of a lazy Sunday afternoon.



Rockford Tower, 1907.

Article from The Sunday Morning Star, July 6, 1919.

In 1900 Brandywine Pumping Station employed a Corliss pump of ten-million-gallons capacity, a Worthington pump of seven-million-gallons capacity, and a water-powered pump of three-million-gallons capacity. Water was pumped to Cool Spring Reservoir, located 144 feet above tide water. This reservoir, having a 38-million-gallon capacity, was the distribution and supply source for low service. A pumping station at Cool Spring, using two three-million-gallon pumping engines, raised the water to the high service reservoir at an elevation of 245 feet and the extreme high service of Rockford Tower at 310 feet maximum elevation.



Plan drawing of City Mill Pump Station, Theodore A. Leisen, 1905.

The final configuration of City Mill Pump Station is shown in a Water Department drawing. The main room contained a 10-million-gallon-per-day Corliss pump and a 10-million-gallon-per-day Worthington pump. To the west was a room containing a water wheel and two pumps. The water wheel was fed by a lateral with two sets of screens that extended off the south race. Further west was a room that housed a laboratory. A blacksmith shop adjoined the pump house on the east, while a boiler house with two boilers, a stack, and a coal bin marked the east end of the complex. Water supply into the city was conveyed by a 16-inch pipe that extended down Market Street and a pair of pipes, one 30-inch and the other 24-inch, that extended down French Street. Recognizing the increasing demand for water in a city growing in both population and industry, the Water Commission planned

an enlargement of the system that was to include: a pumping station with provisions for three vertical pumps, having a combined capacity of upwards of 40 million gallons; two 12-million-gallon vertical, triple-expansion pumping engines; two 300-horsepower Edgemoor water-tube boilers; a 43-inch forcing main to a new 35-million gallon storage or sedimentation reservoir (William T. Porter Reservoir), located on Weldin Farm; and a 48-inch distributing main from Porter Reservoir to Cool Spring Reservoir, connecting there with other distributing mains.



Brandywine Water Plant, 1908.

The main complex, known as Brandywine Water Plant, consisted of a series of neoclassical-style buildings that lined the north side of Sixteenth Street east of Market Street. Landscaping and street lighting enhanced their appearance from the street. At the west end of the complex stood a new pumping station, and a below-grade pump room adjoined the pumping station on the east. East of the pump room were three attached blocks: an office building, a boiler room, and a plumbing shop. The filtration plant stood at the east end of the complex. As described in the architectural drawings:

*The pumping station will be on Sixteenth Street where there will be handsome pillars and pilasters of Brandywine granite. The four columns will be 17 feet high and two feet in diameter while the pilasters will be nine feet, 10 inches high. The trimmings over the arches, windows and entrance will be of Brandywine granite. There will be considerable steel used in the building and the walls will be of pressed gray brick, the quoin bricks being darker, while the upper parts of the wall will be porcelain-faced brick.*

## The City Beautiful

*The Brandywine Water Plant (1906-1910) was a local expression of the City Beautiful movement. The movement began in the late nineteenth century as a reaction to the problems of urban growth. It was an effort on the part of progressive civic leaders and planners to reorient public thought and action toward urban beauty. Beauty it was thought led to moral and civic virtue, and beautification could promote a harmonious social order and enhance the quality of life. While much of its focus was on the creation of grand public buildings, sculptures, plazas, boulevards, and parkways, the movement also addressed functional concerns, such as improved streets, sewers, and water systems.*

*The ideals of the movement were embodied in buildings and public works, designed almost exclusively in the neoclassical style. Neoclassicism symbolized the historical heritage of the colonial and early national periods and expressed a romantic attachment to ancient Greece and Rome, and by extension, the Renaissance city-state. On a more pragmatic level, neoclassicism offered basic conceptions of proportion and arrangement that were readily adaptable to a variety of building types, and its design vocabulary could be replicated and easily employed by local practitioners.<sup>1</sup> While the most prominent expressions of the movement occurred in large cities, such as Washington, Chicago, Cleveland, and Detroit, smaller cities were by no means left behind. Besides the Brandywine Water Plant, Wilmington could take pride in its Public Building (1916), Washington Memorial Bridge (1921), Rodney Square (1921), and Public Library (1922), all heirs to the City Beautiful movement.*

Washington Memorial Bridge, 1926.



Rodney Square and Public Library, ca. 1925.



Public Building, ca. 1925.

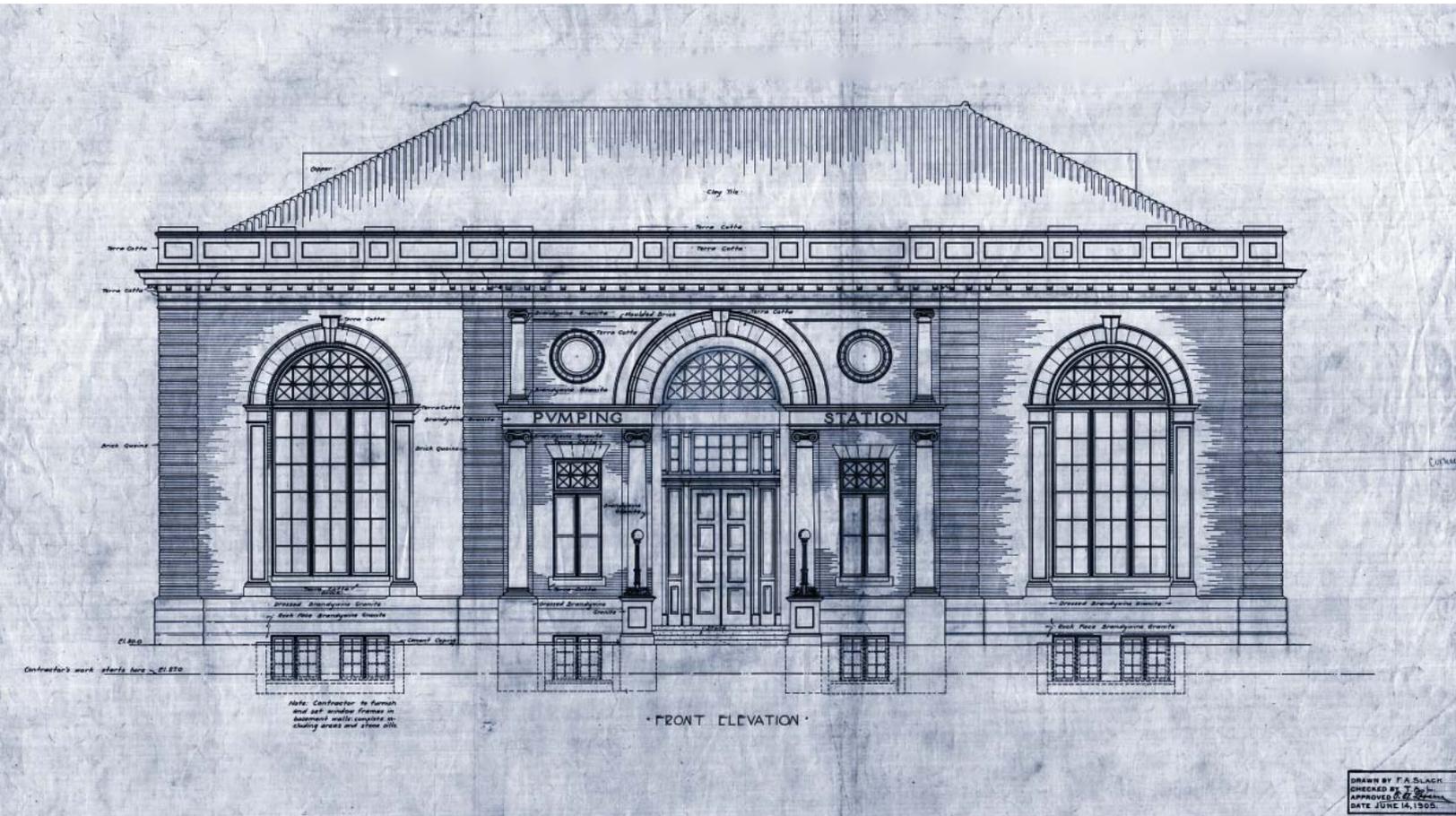


*All movements have their detractors, and the City Beautiful movement was no exception. Opponents succeeded in stigmatizing it as excessively concerned with monumentality, empty aesthetics, grand effects for the wealthy, and general impracticality.<sup>2</sup> Design professionals were among its severest critics. In 1909 noted architect Cass Gilbert declared in a meeting of the American Institute of Architects: "If I were disposed to delay, interrupt, or confuse the progress of city development I would publish the phrase 'city beautiful' in big head lines in every newspaper....Let us have the city useful, the city practical, the city livable, the city sensible, the city anything but the city beautiful."<sup>3</sup> Despite the criticism, public projects inspired by the movement continued to be approved and built well into the 1920s, although few large-scale, urban design schemes were fully realized.*

*World's Columbian Exposition, Chicago, 1893. The fair's "White City" is said to have inspired the City Beautiful movement.*



*Kittaning brick is to be used for the cellar walls. The floor will be concrete and the roof clay tile. The ventilators will be copper while much terra cotta will be used for the cornices and other places. The windows will be double hung and the transoms fixed. The building will have the best of electric and gas lighting.<sup>21</sup>*



Elevation drawing of Brandywine Pumping Station, Theodore A. Leisen, 1905.

Construction of the pumping station took place in 1906. At the same time, the Water Department erected an office building atop the foundation of the City Mill Pumping Station. The slow filter tunnels used by the earlier building were incorporated into the utility network of the new building.

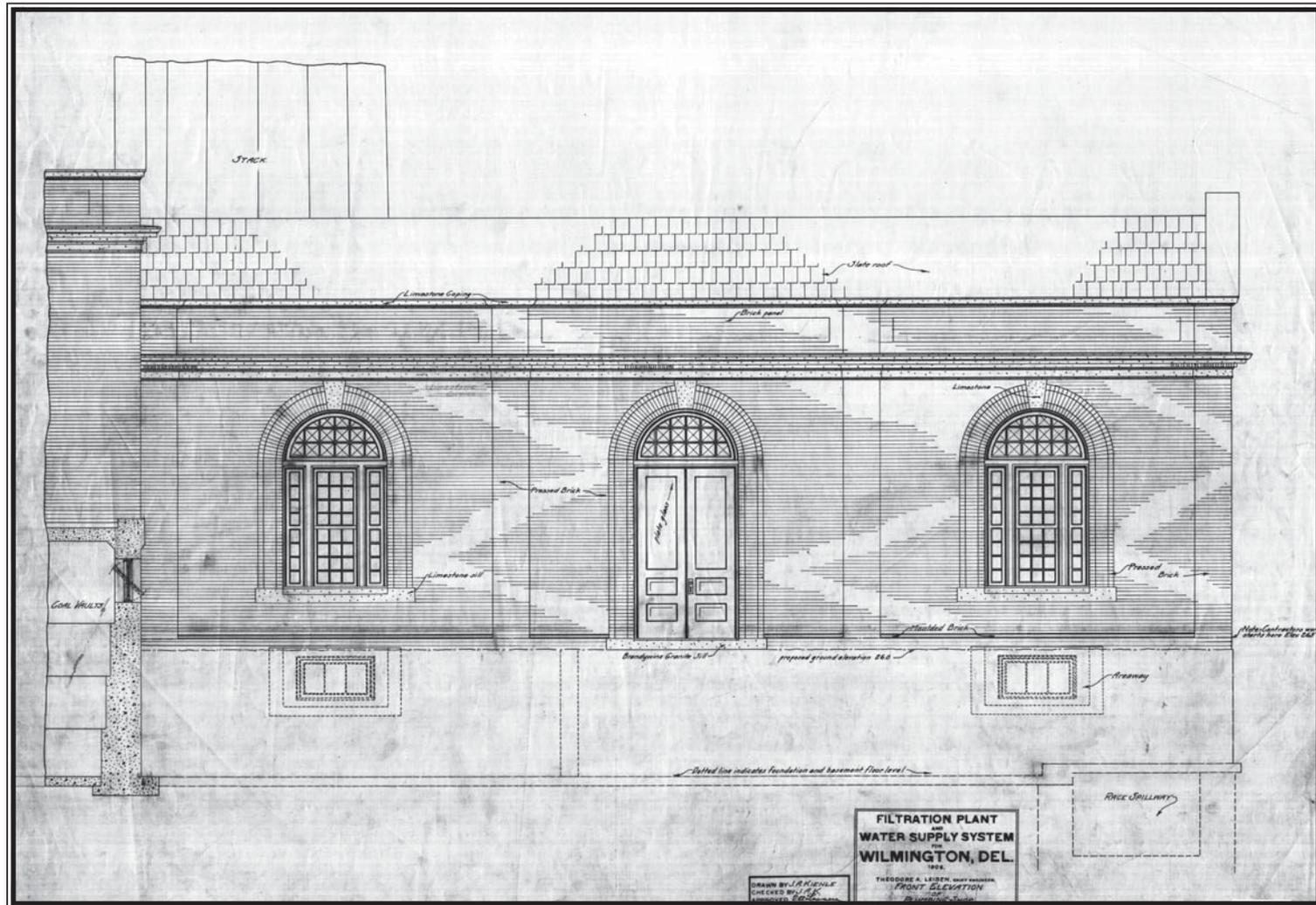
By the early twentieth century the Water Department recognized that the filtration system was a critical element of the water plant. Filtration consists of passing water through substances that retain or remove impurities. The filtering process is described in a 1914 issue of *Engineering and Contracting*:

*The partially clarified water then passes to the filter, which consists of a horizontal of rather fine sand supported by gravel and under drained, the whole being enclosed in a suitable basin or tank. The water, in passing through the sand, leaves behind upon the sand grains the extremely small particles which were too fine to settle out in the settling-basin and is quite clear as it goes from the gravel to the drains and the pumps, which forward it to the reservoir or city.<sup>22</sup>*



Pipe gallery at Porter Filter Plant, 1952.

*"It's pretty neat sometimes when we're doing improvements to look at how things were done originally, how well they were built. Sometimes you say to yourself 'how did they get that done?' We've got valves up at Porter that are over a hundred years old and still working."  
Joseph Dellose, maintenance supervisor*



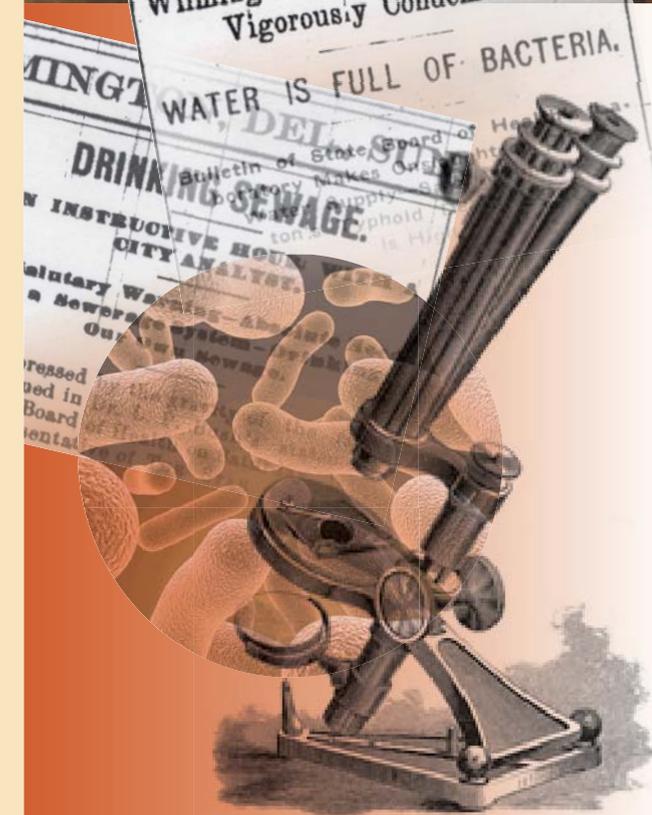
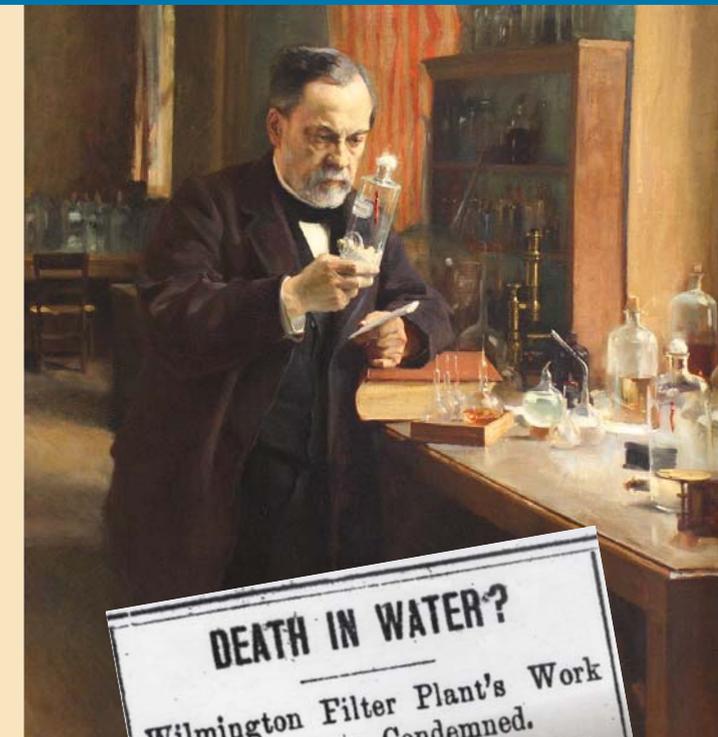
Elevation drawing of Brandywine Filtration Plant, Theodore A. Leisen, 1908.

In the Brandywine system, raw water was pumped from its source and allowed to settle in a basin to remove gross impurities. A preliminary filter with a daily capacity of 16 million gallons was to be located near a new pumping station through which water would pass before reaching the pumps. Slow sand filters would provide for the final purification.

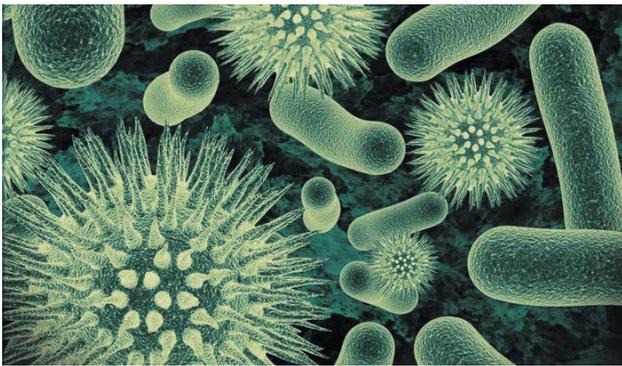
## Bacteriology

The development and gradual acceptance of the germ theory of disease causation in the latter part of the nineteenth century altered perceptions of water quality.<sup>1</sup> During the mid-nineteenth century the general belief was that disease came from the environment, but was not transmitted from person-to-person. In this scenario, filth and bad smells indicated the presence of a health problem. This perception of disease causation was evident in early Water Department reports on water quality, which reflected a concern over the organic content since such materials rotted. A report issued in 1864 contained an assessment of the organic content of water samples. The sample recommended for use as a supply contained the lowest percentage of organic matter.<sup>2</sup> A report issued in 1870 contained a section entitled "Protection of the Stream from Impurities." In the section it was recommended that a berm be built on the city side of the race that supplied the pumping stations from which drains could carry runoff underneath and into the Brandywine. This would accomplish the task of limiting organic wastes from entering the water supply. Brandywine Park had its origins in this recommendation.<sup>3</sup>

A concern over the presence of bacteria in drinking water gave rise to an increased use of filtration and chemical treatment of municipal water supplies. Before this, sedimentation and filtration served to increase the clarity of the water supply and reduce unpleasant odors. Chemical analysis focused on water hardness, a measure of the mineral content of



Articles from The Sunday Morning Star, August 10, 1902 (top) and February 19, 1882 (bottom).

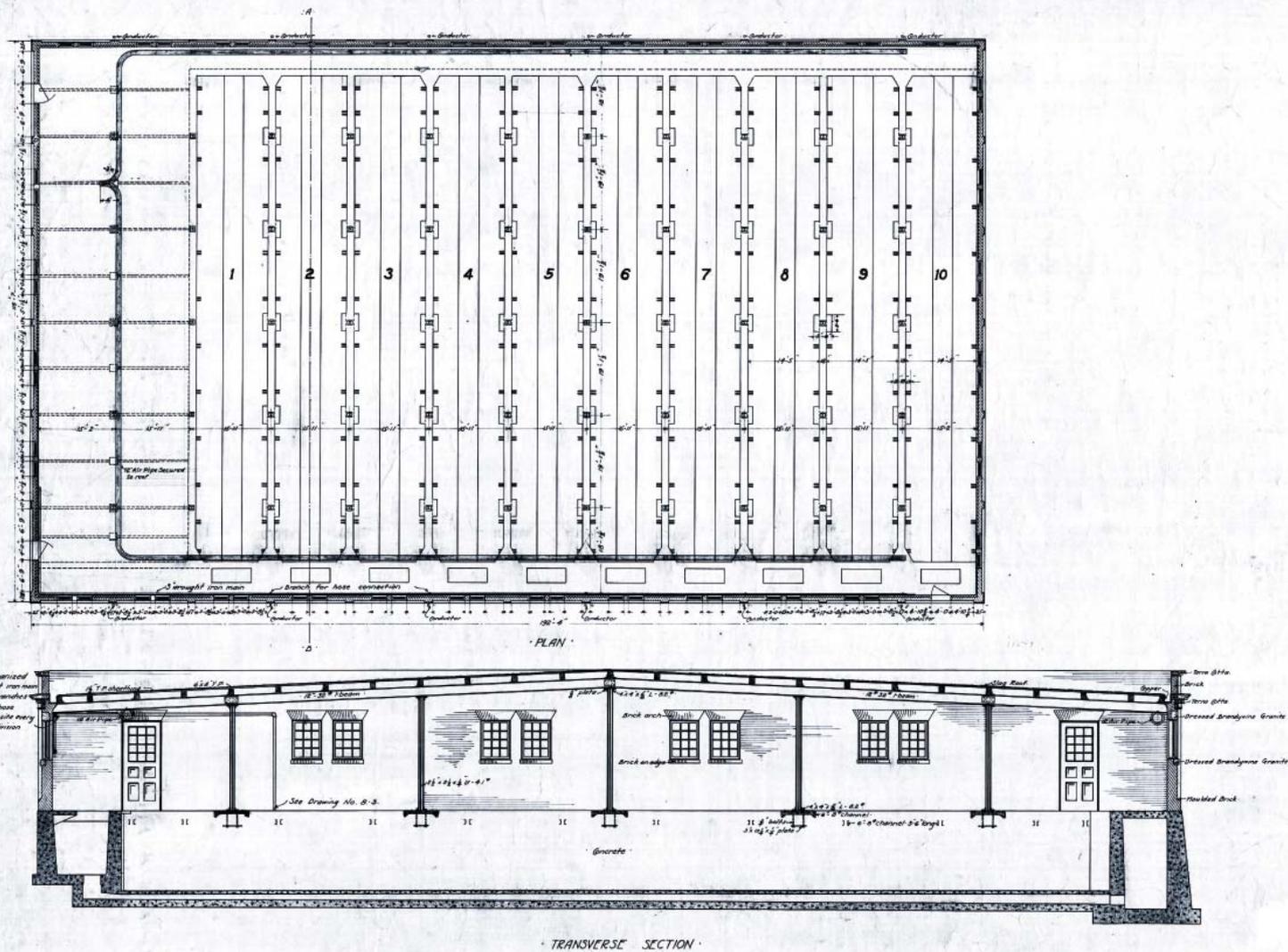


*the water supply. Clarification was conducted to make water more palatable, whereas hardness affected both taste and practicality of use. As the hardness of a water supply increased, the more soap was needed for cleaning. Hard waters also contributed to the build-up of scale in boilers, which reduced their efficiency.*

*Once it was understood, however, how the water supply could contribute to the spread of disease, the focus began to shift to the bacterial content of the supply as the primary concern. At first, water departments generally relied on filtering to remove bacteria. The Wilmington Water Department reported that from 1910 to 1913, slow sand filters removed 98.3 percent of bacteria present in the water as taken from the Brandywine. A typhoid epidemic upstream in Coatesville, Pennsylvania, in 1912 encouraged the introduction of chlorine to improve the sanitary condition of the water supply. Applied to the water after filtration, chlorine removed an additional 83.1 percent of bacteria.<sup>4</sup> In 1941 the Water Department reported that through sedimentation, filtration, and the addition of chlorine, 99.3 percent of bacteria were removed through slow sand filters, and 99.8 percent were removed through rapid sand filters.<sup>5</sup> Today the water supply is monitored for over 100 contaminants. Samples taken from city reservoirs, filtration plants, and the distribution system are analyzed for the presence of herbicides, pesticides, and microbes. In 2009 the city collected over 30,000 water samples and conducted over 70,000 analyses.<sup>6</sup>*

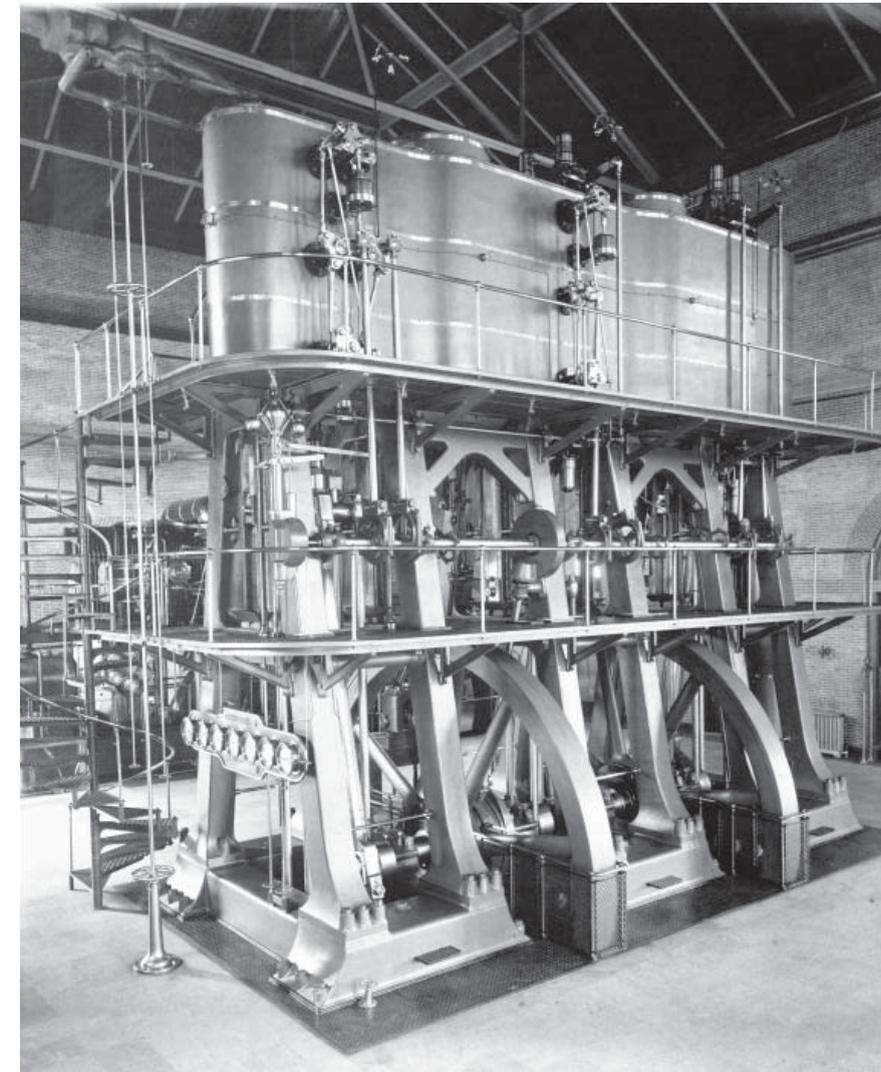


Monitoring water quality in the lab, 1952.



Plan and section drawings of Brandywine Filtration Plant, Theodore A. Leisen, 1906.

In 1906 the Water Department contracted with Holly Manufacturing Company of Buffalo, New York for the manufacture and erection of two 12-million-gallon pumping engines to be used in connection with the new filtration plant. Each engine had three steam cylinders (one high-pressure, one intermediate-pressure, and one low-pressure) and a total head of 275 to 285 feet. The initial filtration plant, of the coke and sponge type, was installed in 1906-1907 by Pittsburgh Filter Manufacturing Company. Known as a "scrubber," it removed about 50 to 75 percent of the foreign matter in the water supply and reduced the incidence of typhoid fever by 50 percent.



Holly pumping engine, ca. 1907.

115 feet in width, the facility housed 10 filter beds, arranged transversely to the building axis. The million-dollar plant had a capacity of 15 million gallons per day and used slow-sand technology. The contract for the filters was awarded to Coleman Brothers of Boston on a bid of \$237,000 (about \$5,610,000 today).

As the demand for water and the knowledge of effective water treatment increased, a mechanical filter plant was constructed east of the filtration plant. Standing two stories

*Francis Menton, Production Supervisor for the Water Department, began working in the meter shop. At the time he would often take his lunch to the pumping building to watch the Holly engines run. "It was fabulous," he said, "watching those humongous flywheels and the steam releases and piston drives."*

*In the late 1960s an electric motor replaced one of the Holly engines. It was placed in the pit that once held the lower half of the steam pumping engine. "It looks like a toy," said Menton, when comparing the electric motor to the three-story-high Holly engine. The electric motor pumped the same amount of water.*

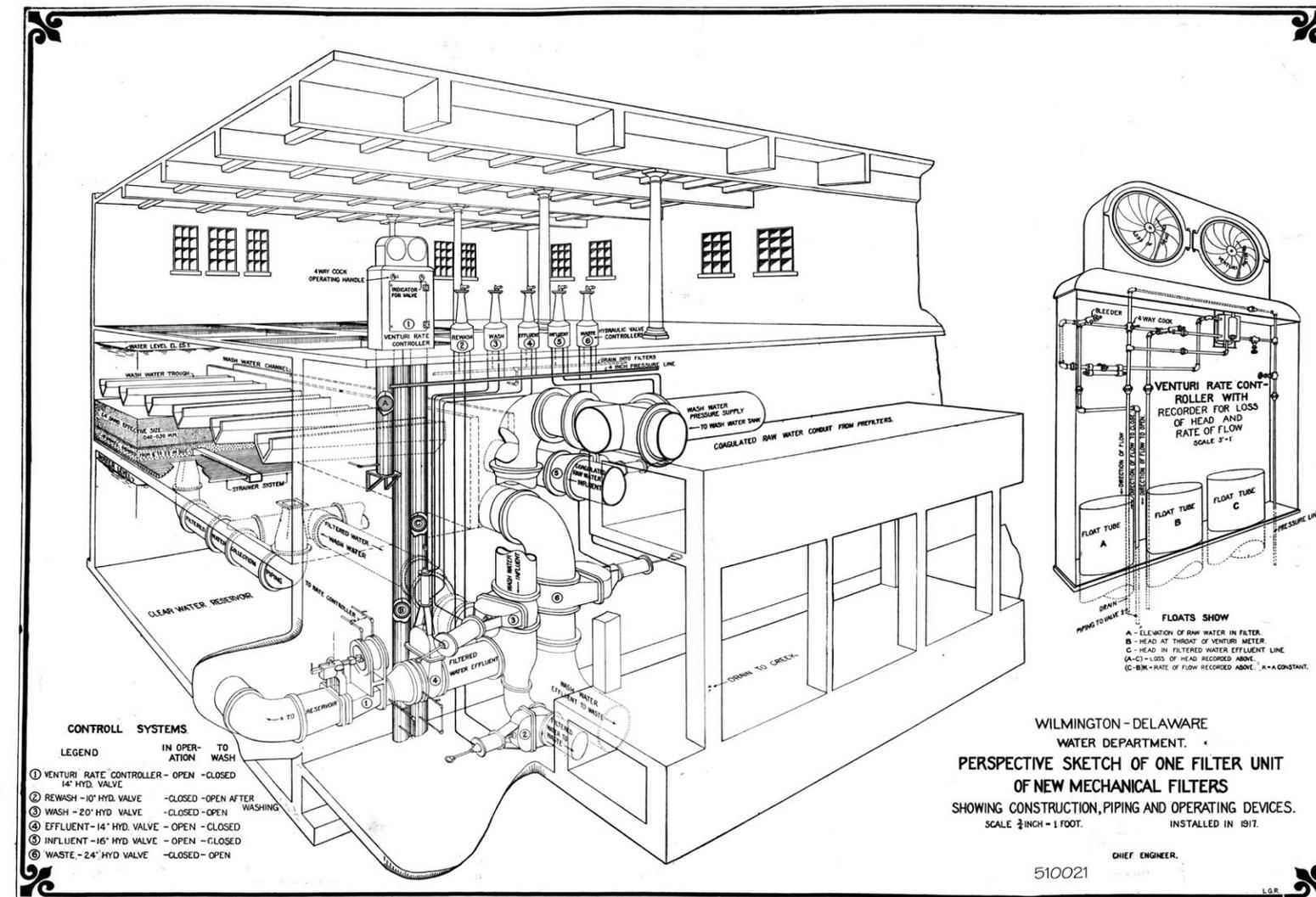
The new filtration plant, intended in part to nearly eliminate typhoid in the city, was completed early in 1910. Designed by F. A. Stack and approved by Theodore A. Leisen, Chief Engineer of the Water Department, it presented a utilitarian face to Sixteenth Street. Measuring 192 feet in length and

above grade, the neoclassical-style filter plant was three bays wide with flat-roofed wings to either side. In 1917 mechanical filters were installed.

In 1916, in recognition of the need to store more water for the city water supply, plans were made by the engineering firm Fuller and McClintock to rebuild Rodney Street Reservoir, which had been closed during the previous decade. The general contractor for construction was Williams & Kinnamon of Baltimore, while the project was superintended by Edgar M. Hoopes, chief engineer of the Water Department. The reservoir was of reinforced-concrete construction with a covered top supporting earthen fill. The dimensions of the reservoir were 249 by 268 by 15 feet. A reinforced-concrete division wall ran the length of the reservoir, dividing it into two equal compartments. The reservoir was completed in 1918.<sup>23</sup>



Elevation drawing of Brandywine Mechanical Filter Plant, George W. Fuller, 1916.



Drawing of filter unit, 1917.

By 1927 the Brandywine plant had evolved into a sizeable complex. At its west end stood the pumping station from which a 48-inch water main extended beneath the deck of Market Street Bridge. Immediately east of the pumping station was the concentration basin, located in a fireproof building with exposed metal roof trusses. A two-story office building adjoined this block on the east. It in turn adjoined the boiler room, coal bins, pipe shop, and storehouse. The east end of the property contained sedimentation basins and an aluminum-clad warehouse building.<sup>24</sup>



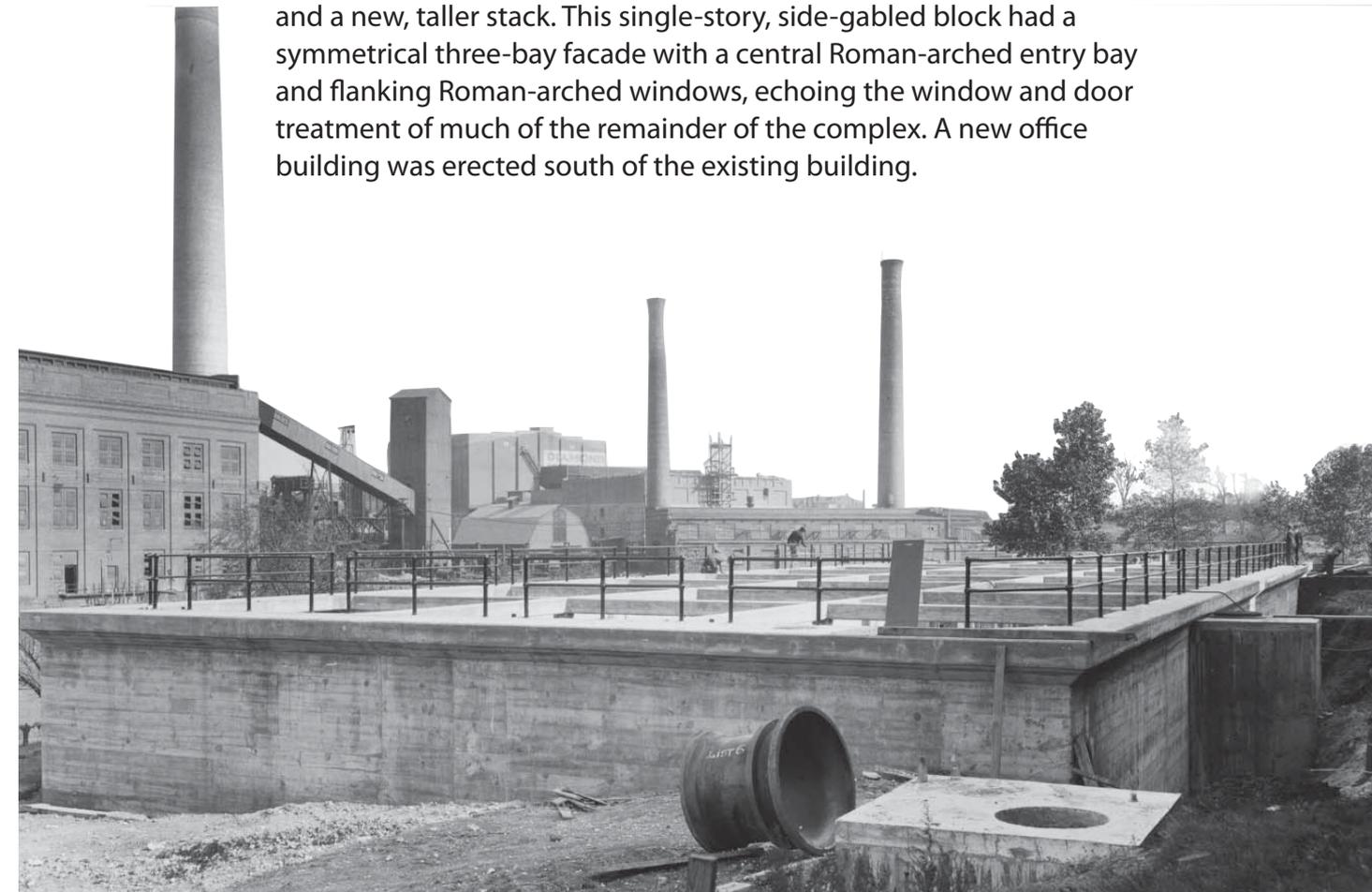
*Brandywine Water Plant, ca. 1950.*

In the late 1920s City Council and the Board of Water Commissioners discussed means to prevent or alleviate future city water shortages. Their solution was to construct a reservoir by damming a stream. The new reservoir's capacity would dwarf that of the city's existing water storage facilities.

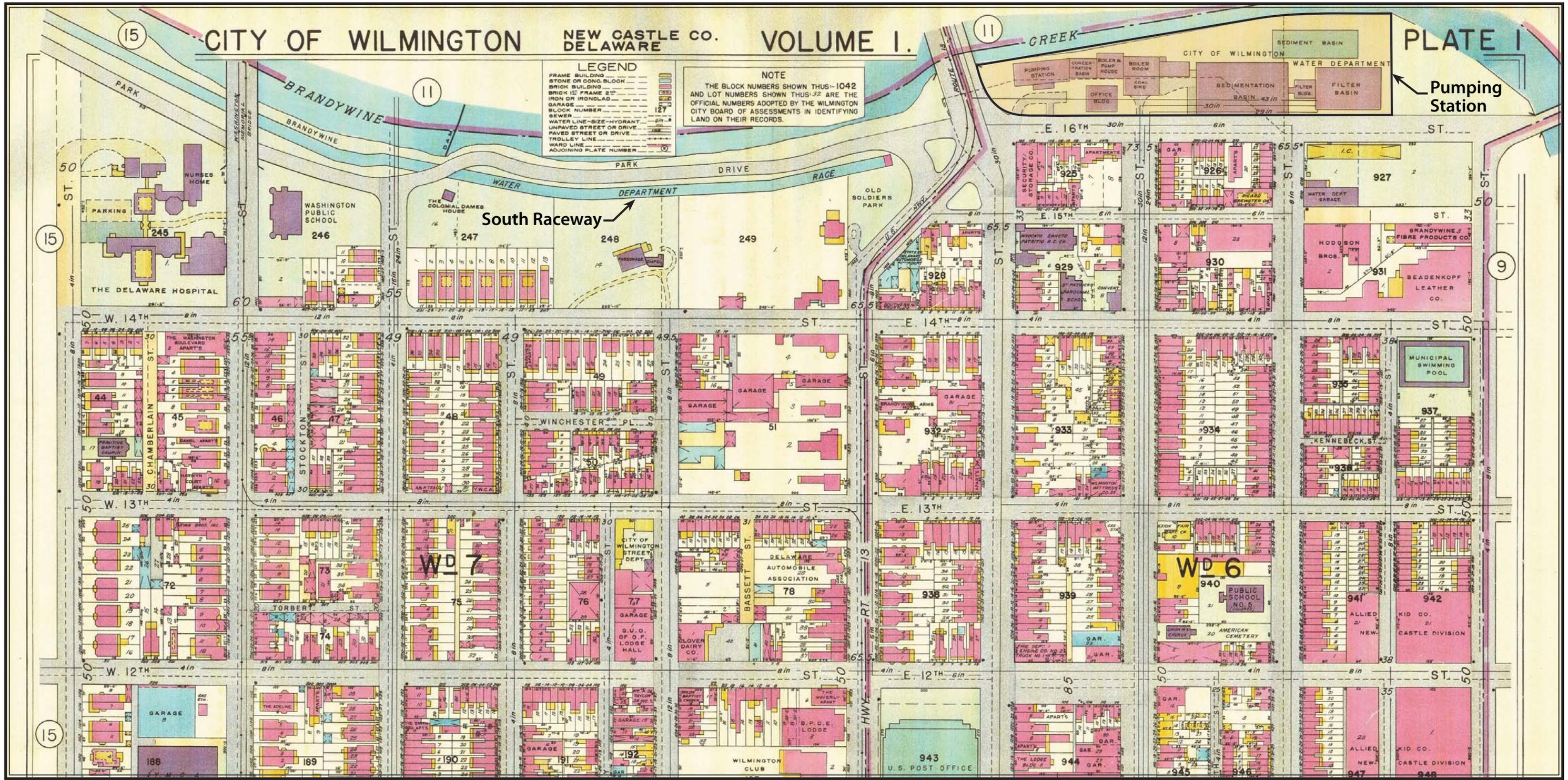
The chosen site, Mill Creek Valley, was north of Wilmington near the Pennsylvania border. The concrete dam would extend about 900 feet, and when the reservoir was at full pool, would impound about 2.2 billion gallons of water. The contract for construction of the dam was awarded to John L. Walsh of Northport, Long Island. The completed reservoir was dedicated in the name of former chief engineer Edgar M. Hoopes in June 1932.<sup>25</sup>

In the 1930s increased demand for water led to the reconfiguration of the existing space and construction of a new office building. The renovation and new construction was designed by the Wilmington firm of Brown and Whiteside. Among the firm's other commissions were the Wilmington YMCA, the Tower Hill School, the Security Trust Building, First Central Presbyterian Church, and the Wilmington Trust Center.<sup>26</sup>

The existing office building was remodeled to accommodate a new boiler room, a carpenter shop, a pump room, a machine shop, and a new, taller stack. This single-story, side-gabled block had a symmetrical three-bay facade with a central Roman-arched entry bay and flanking Roman-arched windows, echoing the window and door treatment of much of the remainder of the complex. A new office building was erected south of the existing building.



*Sedimentation basins, 1926.*





*Hoopes Reservoir under construction, 1931.*

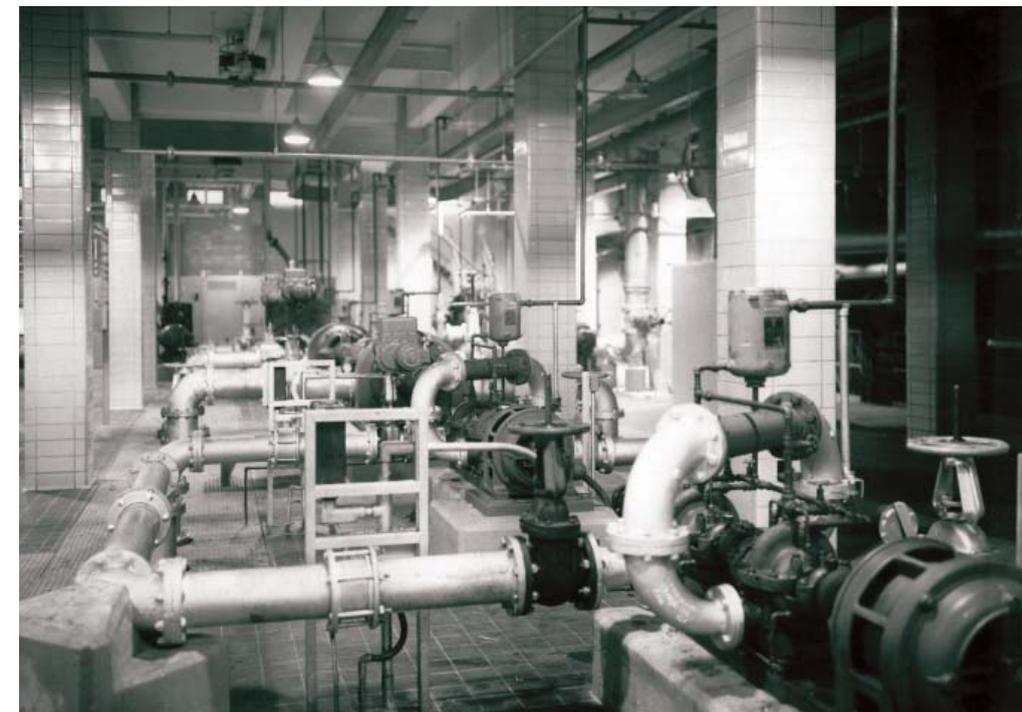
In 1933 the mechanical filter plant was extended to the east to accommodate an additional filter. The extension was designed by the Water Department's Chief Engineer, W. Compton Wills, and Fuller and McClintock, consulting engineers for the city.

During the 1940-1941 fiscal year the total metered water consumption amounted to slightly more than 604 million cubic feet (about 4.52 billion gallons). Approximately 42 percent of this consumption was for domestic purposes, while approximately 55 percent was for industrial purposes. The remainder was consumed by local governments and non-profits. Among industrial users, the leather-manufacturing industry was by far the largest. The 101 million cubic feet (about 755 million gallons) they used represented nearly 17 percent of the total metered water consumption for the year.<sup>27</sup>

After materials shortages eased following World War II, the Water Department, with guidance from consulting engineers Metcalf & Eddy, developed a strategy to update the water-supply system. Included in the plan were installation of oil-fired boilers for

pumping,<sup>28</sup> new pumping equipment for the Brandywine and Cool Spring pumping stations, and construction of a second filter plant at Porter Reservoir. The latter improvement, designed to provide improved sedimentation, had a capacity of 16 million gallons per day.<sup>29</sup> In 1949 plans were drawn up by Metcalf & Eddy to convert the former Cool Spring Pumping Station back to its original function.

A 1951 insurance map indicated additions and alterations in use that occurred between 1927 and 1951. It showed that by 1951 the pumping station building occupied the west end of the complex and the concentration basin adjoined the pumping station on the east. The former office building had been converted to a boiler and pump house, and the office had been relocated to a two- and three-story building south of the former office. The boiler room, coal bins, and pipe shop marked the east end of the attached buildings. The sedimentation basins were located at the east end of the complex, as was the filter basin building, initially erected in 1919 and reconfigured in 1934.<sup>30</sup>



*Porter Filter Plant pump room, 1952.*



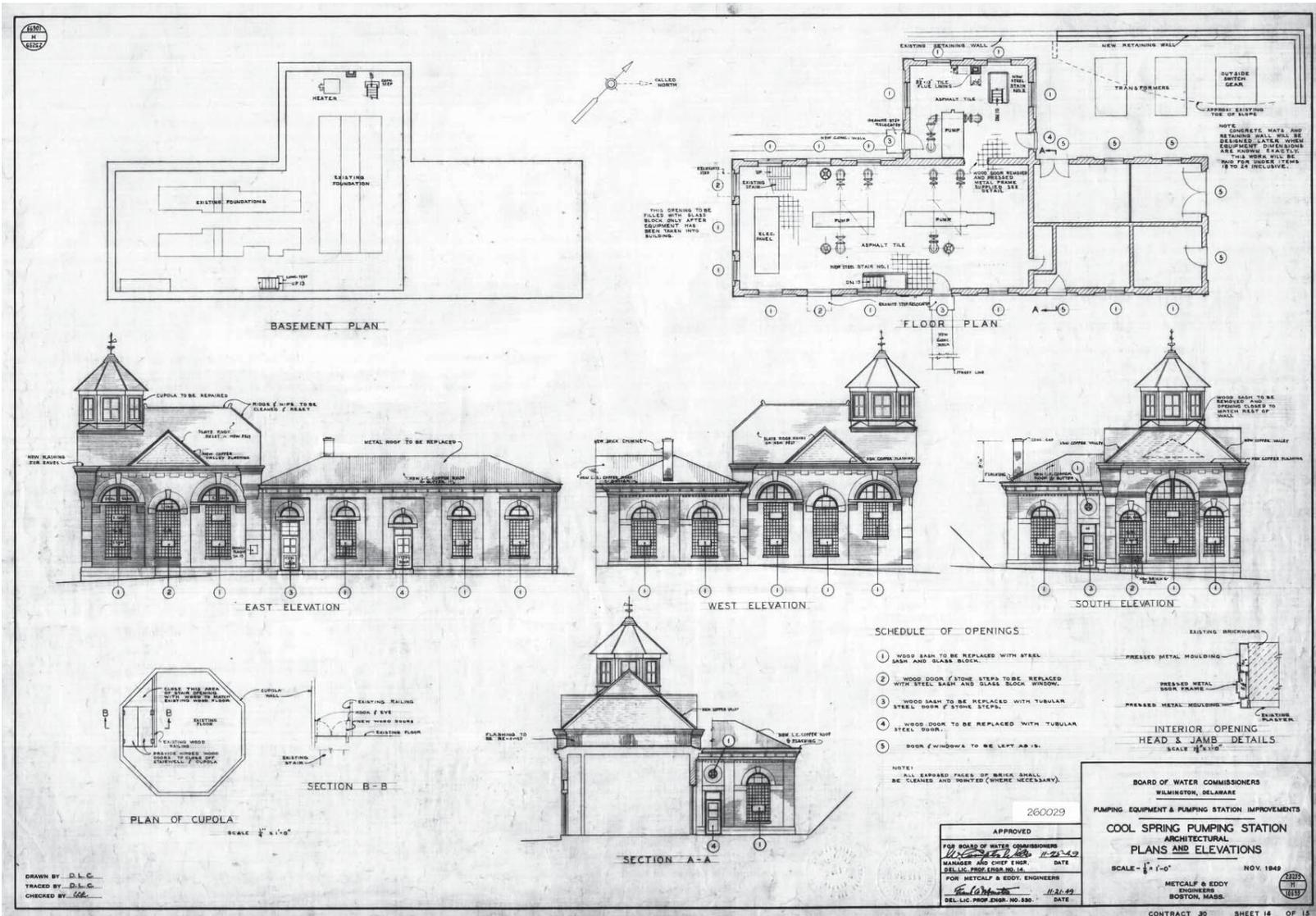
*Porter Filter Plant filter beds, 1952.*

In 1959, as part of the program of improvements, the water system's tie-in with Hoopes Reservoir was modernized. Part of this modernization included construction of a new pumping station between Augustine Bridge and new electric pumps at Hoopes Reservoir. The goal of these improvements was to add 8 million gallons per day to the water system's capacity and to make the emergency reserves at Hoopes more accessible. The purpose of the Augustine pumping station was to pump raw water from the Brandywine to either Hoopes or Porter reservoir.



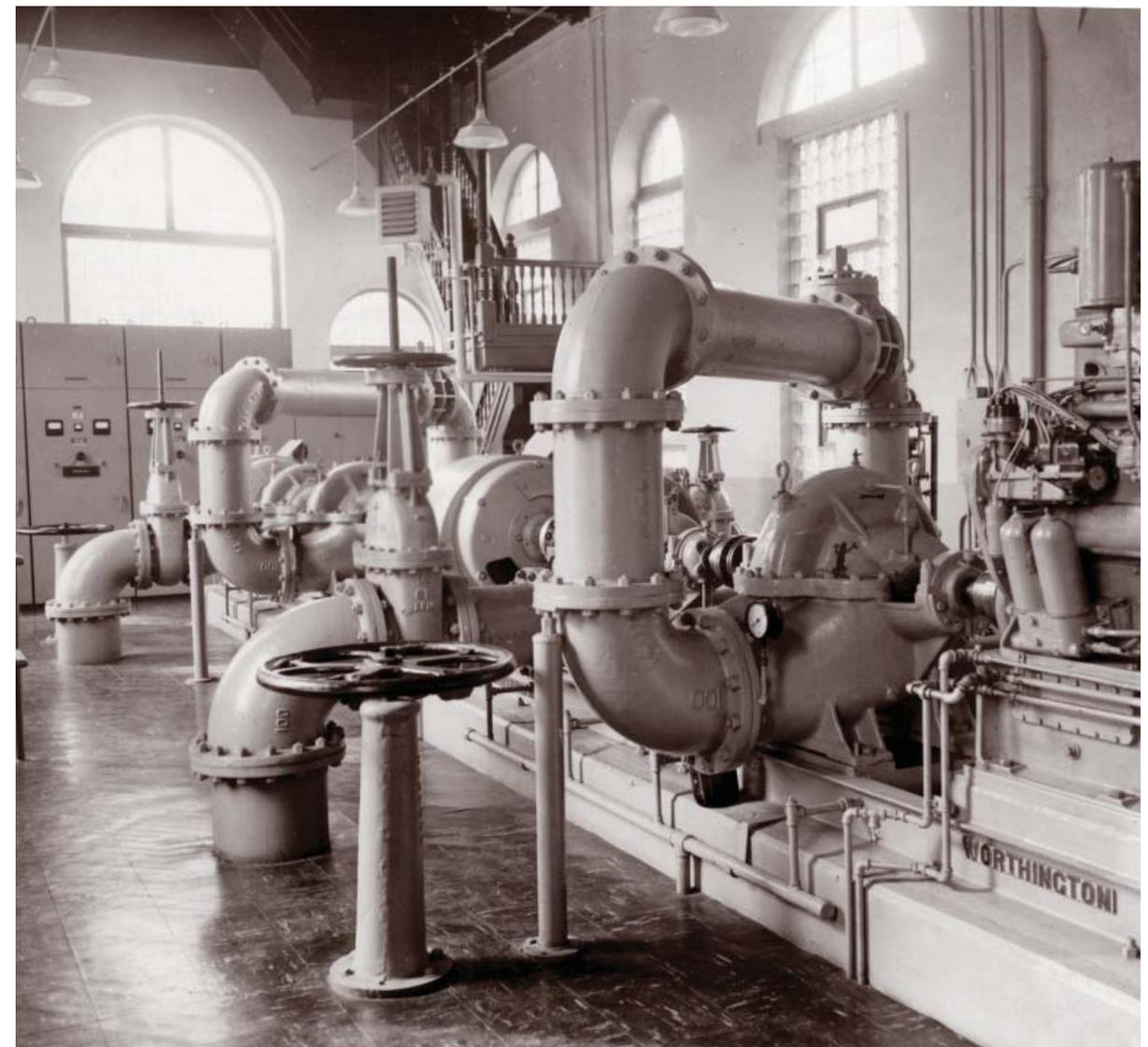
*Porter Filter Plant operating floor, 1952.*

The new pumping station, which took the name of former Water Department Chief Engineer W. Compton Wills, cost \$700,000 (about \$5,230,000 today). The consulting engineer for the project was Metcalf & Eddy, while the general contractor was C & T Affiliates. In addition to these improvements, Henckels & McCoy of Philadelphia was awarded a \$654,823 (about \$4,900,000 today) contract to construct a filter plant addition at Porter Reservoir. This addition was intended to boost the capacity of the filter plant from 16 million gallons per day to 24 million gallons.<sup>31</sup>



Drawing of Cool Spring Pumping Station renovations, Metcalf & Eddy, 1949.

In the late 1950s civic leaders and the management of DuPont became concerned about increasing population and industrialization leading to a future water shortage. In 1958 the Philadelphia District of the U. S. Army Corps of Engineers undertook a preliminary study of the need for an additional storage reservoir and indicated that the most feasible location would be on White Clay Creek north of Newark. The reservoir pool was to extend



Cool Spring Pumping Station Rockford Tower service, 1952.

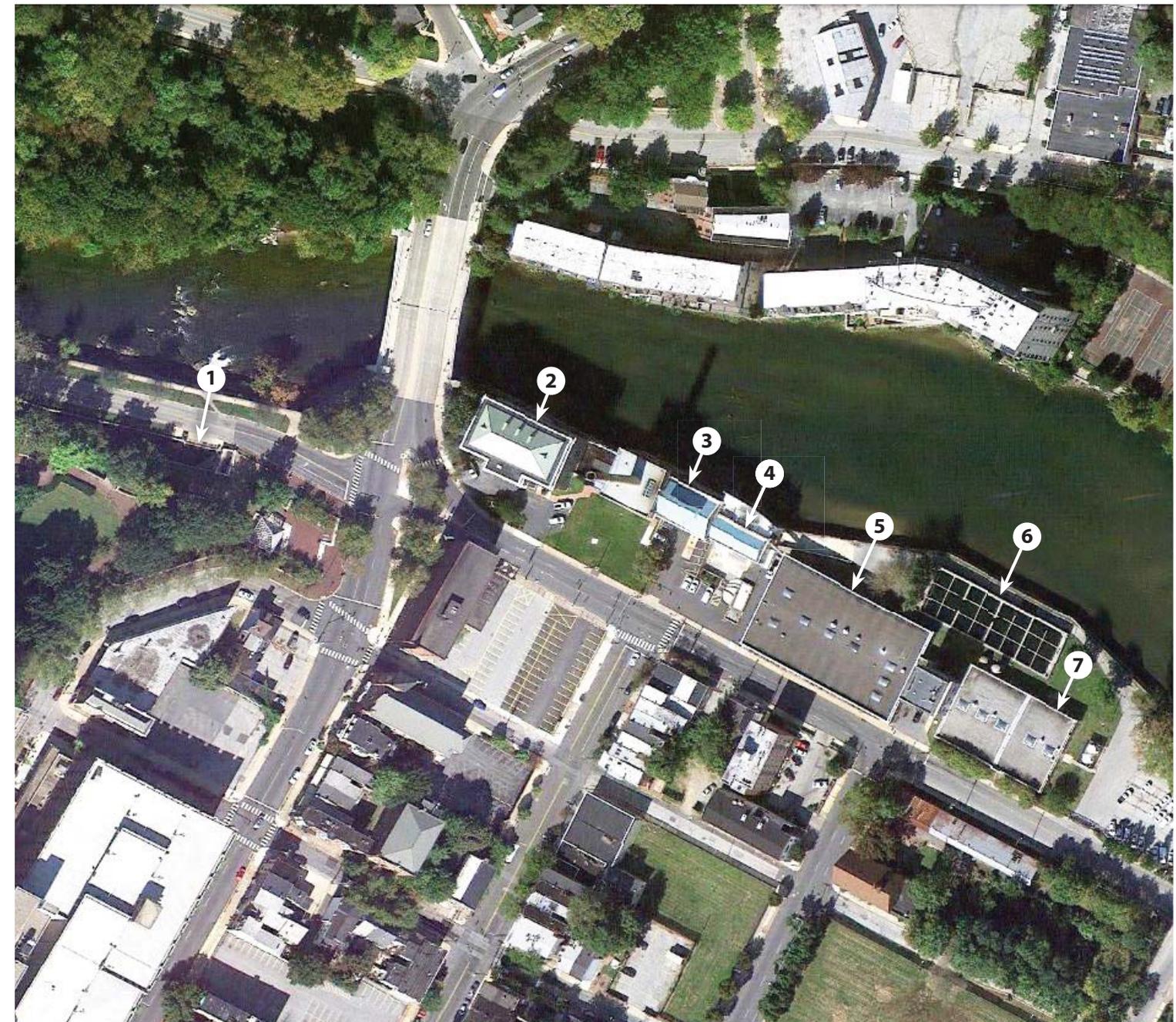
into Pennsylvania. To preclude development DuPont purchased much of the proposed reservoir site. From the start, the project generated controversy. Eventually, in the 1960s the project was officially canceled, and in 1968 DuPont donated the land it had acquired to the State of Delaware for White Clay Creek Preserve. In 1967 in response to a critical evaluation of the city's water supply system by the U. S. Public Health Service, the city

allocated \$5.4 million (about \$35,300,000 today) in its five-year capital improvement plan for water-system upgrades. Among the conditions that prompted this large expenditure were the poor condition of the sand and filter beds, with sand and gravel layers intermixed; leaking backwash valves in the filter plant; and the lack of adequate pumping and water-main capacity.<sup>32</sup>



*Brandywine Water Plant, 2011.*

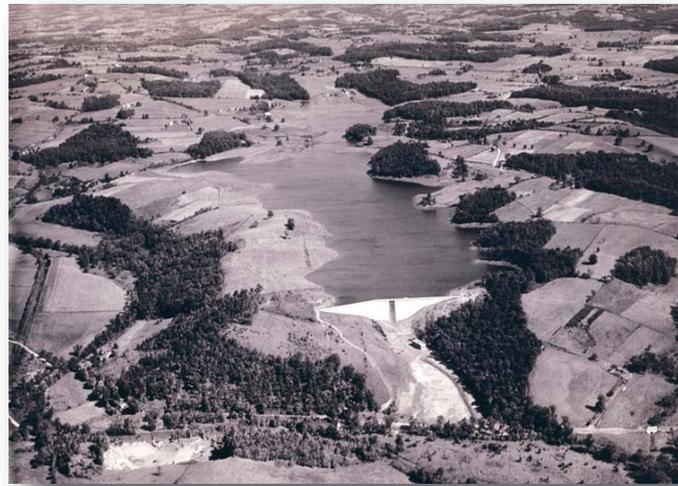
In 2003 Brandywine Pumping Station was completely restored. The complex currently consists of a raceway (1), a raw-water pumping station (2), a boiler room (3), a store room and service department (4), an interior coagulation basin (5), an outside coagulation basin (6), and a mechanical filter building (7).



*Aerial view of Brandywine Water Plant, 2011.*

# From Creek to Tap

We take it for granted. Turn on the faucet and out flows the water: cool to ice-cold as it arrives onsite, or warm to scalding-hot after it passes through the water heater. But where does the water come from in the first place and how does it get to you? Here's where and how.<sup>1</sup>



Hoopes Reservoir  
(see pages 72, 89-91)

Hoopes Dam  
Hoopes Pumping Station



Brandywine Creek



42" Raw Water Main

Kennett Pike Pumping Station



Rockford Tower

(see pages 72, 73)



City Dam  
(see pages 66, 71)

52



Cool Spring Reservoir  
(see pages 72, 74, 86)

Rodney Street Reservoir  
(see pages 72, 74, 89)

48

2

95



Wills Pumping Station  
(see page 91)



Brandywine Pumping Station  
(see pages 66, 74)

Brandywine Filter Plant  
(see pages 68, 74-83)

Raceway

City Dam  
(see pages 66, 71)

Cool Spring Reservoir  
(see pages 72, 74, 86)

Rodney Street Reservoir  
(see pages 72, 74, 89)

Cool Spring Pumping Station  
(see pages 86, 87)

9

202

95

48" Treated Water Main

43" Raw Water Main

Porter Substation  
Porter Reservoir  
(see pages 74, 85, 91)

Porter Filter Plant (see pages 74, 85, 86, 89, 91)  
Porter Filtered Water Reservoir  
(see page 89)

Porter Elevated Tank

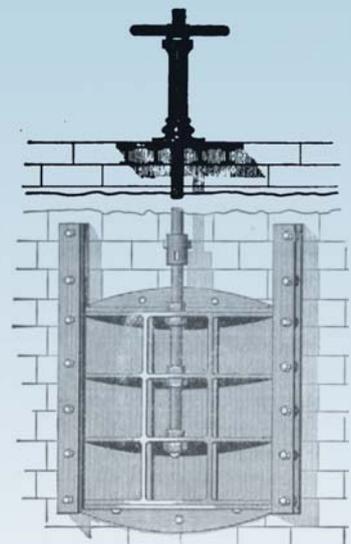


13R



Untreated river water enters a raceway on the south side of Brandywine Creek through a head gate just below the city dam and flows by gravity through a screen house, removing floating debris, to Brandywine Pumping Station. The city has the capacity to withdraw up to 56 million gallons per day from the Brandywine.<sup>2</sup>

*City dam on Brandywine Creek, 2011.*



*Sluice gate on Brandywine Creek, 2012.*



*South race on Brandywine Creek, 2011.*



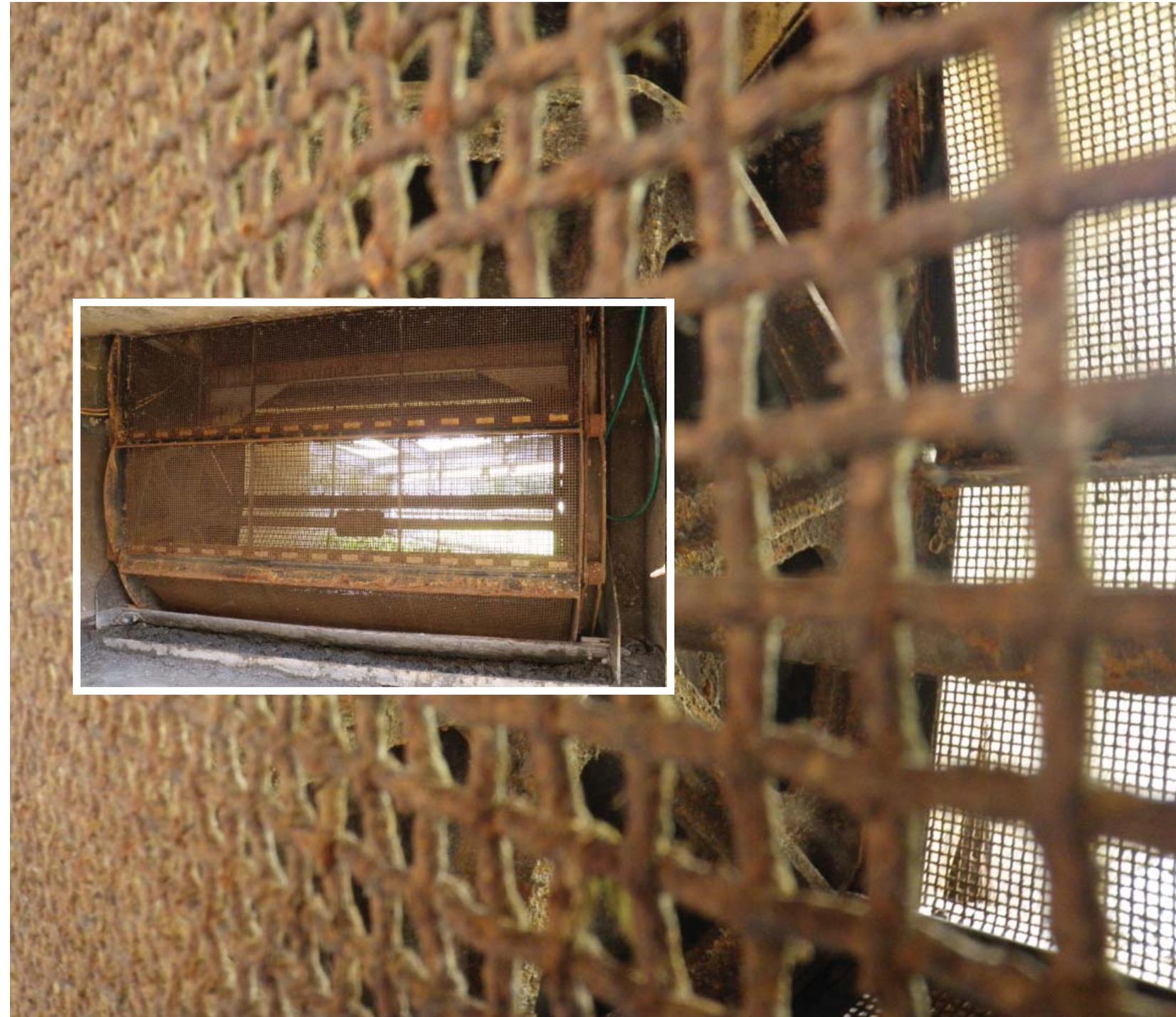
Newly installed Brandywine Filter Plant inlet pipe resting in the former mill race, 2012.



First room of the pump house forebay, 2012.



Manhole leading down into the pump house forebay, 2012.



Inside the screen house at the entrance to the buried section of the former mill race, 2012.



## The Water Supply

*Several sources of water are used for municipal water systems: underground springs; streams and rivers; and impounded streams and rivers. The Wilmington water system draws its water supply from Brandywine Creek.*

### Impounding Reservoirs

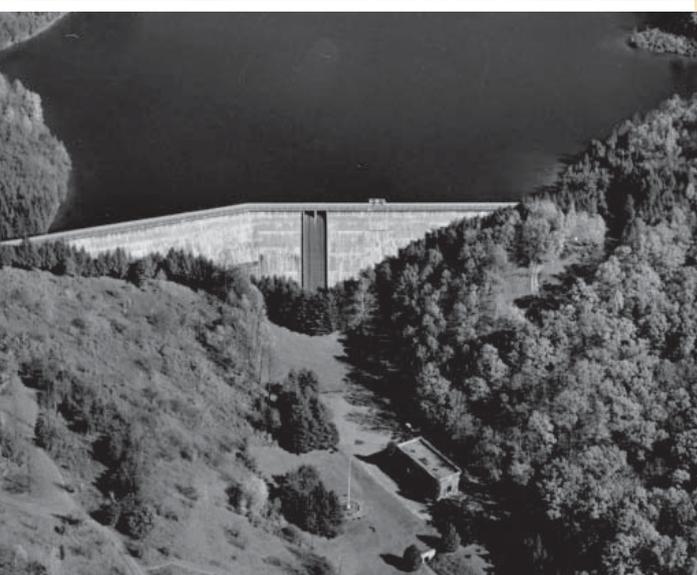
*Precipitation is neither predictable nor assured. Therefore, many water systems employ impounding reservoirs, often dammed streams, whose purpose is to provide a reserve supply of water for the system.*

### Filter Systems

*Very few public water systems are fortunate enough to have a supply of water that can be consumed without any treatment. To remove impurities from the water, such as industrial pollutants and sewage, the incoming water passes through a series of filters that improve its quality sufficiently to be potable.*

### Pumping Machinery

*Water-storage facilities are usually erected at an altitude that permits water to flow by gravity to the customers it serves. To reach this altitude the filtered water is pumped by high-capacity pumps. Additional pumping stations placed throughout the system ensure that the water flows to reservoirs and is lifted into towers for distribution.*

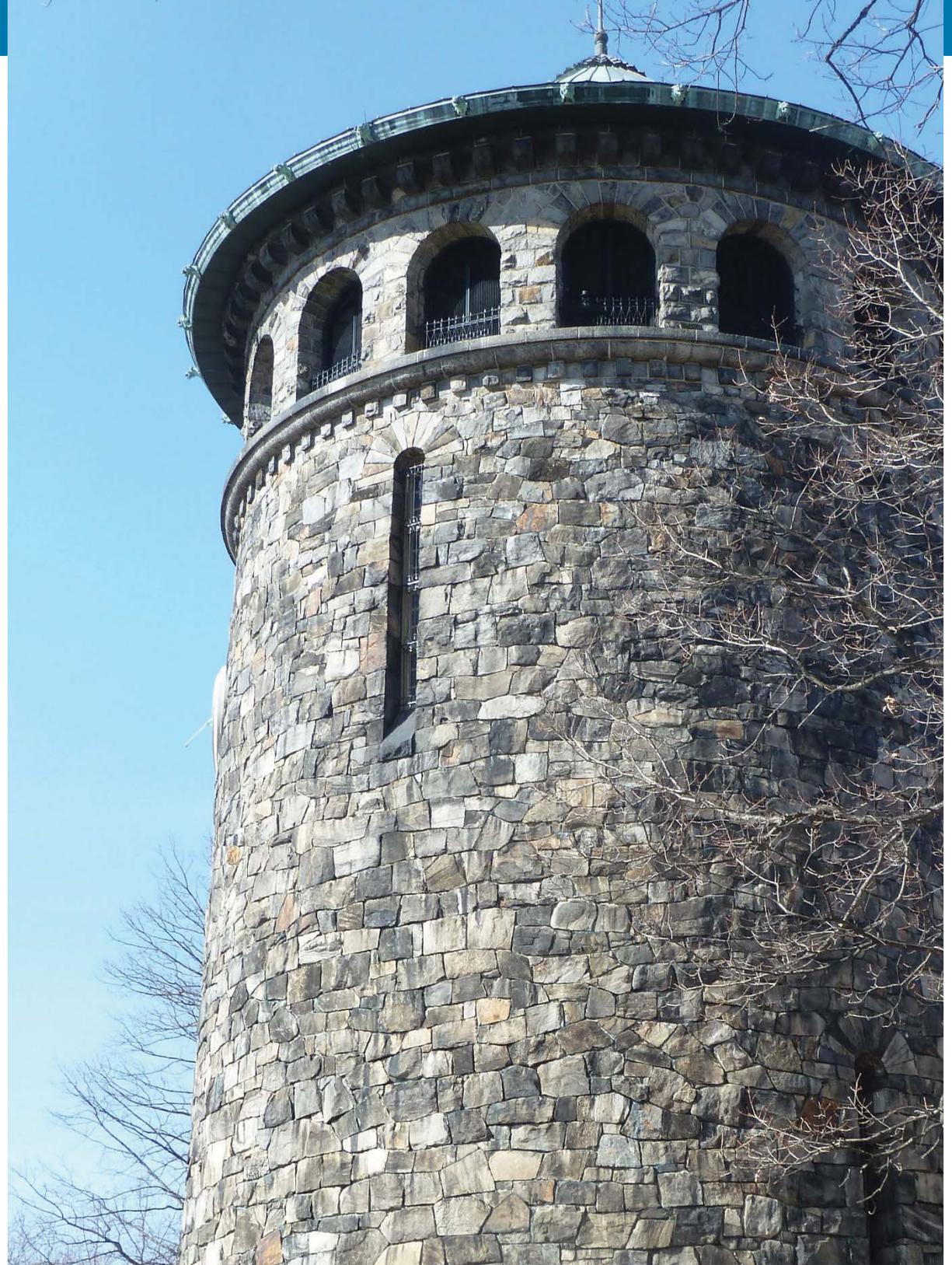


Brandywine Creek above city dam, 1940.



### ***Water Impoundments***

*A variety of types of impoundments are employed to store water prior to distribution. The type used depends, to a large extent, on the terrain served by the water system. In relatively flat areas or in areas in which the impoundment must serve a large geographic area, water towers or standpipes, such as Rockford Tower, are used. These structures raise the water above the level of the surrounding terrain so that customers may be supplied by gravity. Other types of distributing structures include purpose-built reservoirs, such as Cool Spring Reservoir and Rodney Street Reservoir, and dammed stream valleys, such as Hoopes Reservoir.*





*Brandywine Pumping Station, 2011.*

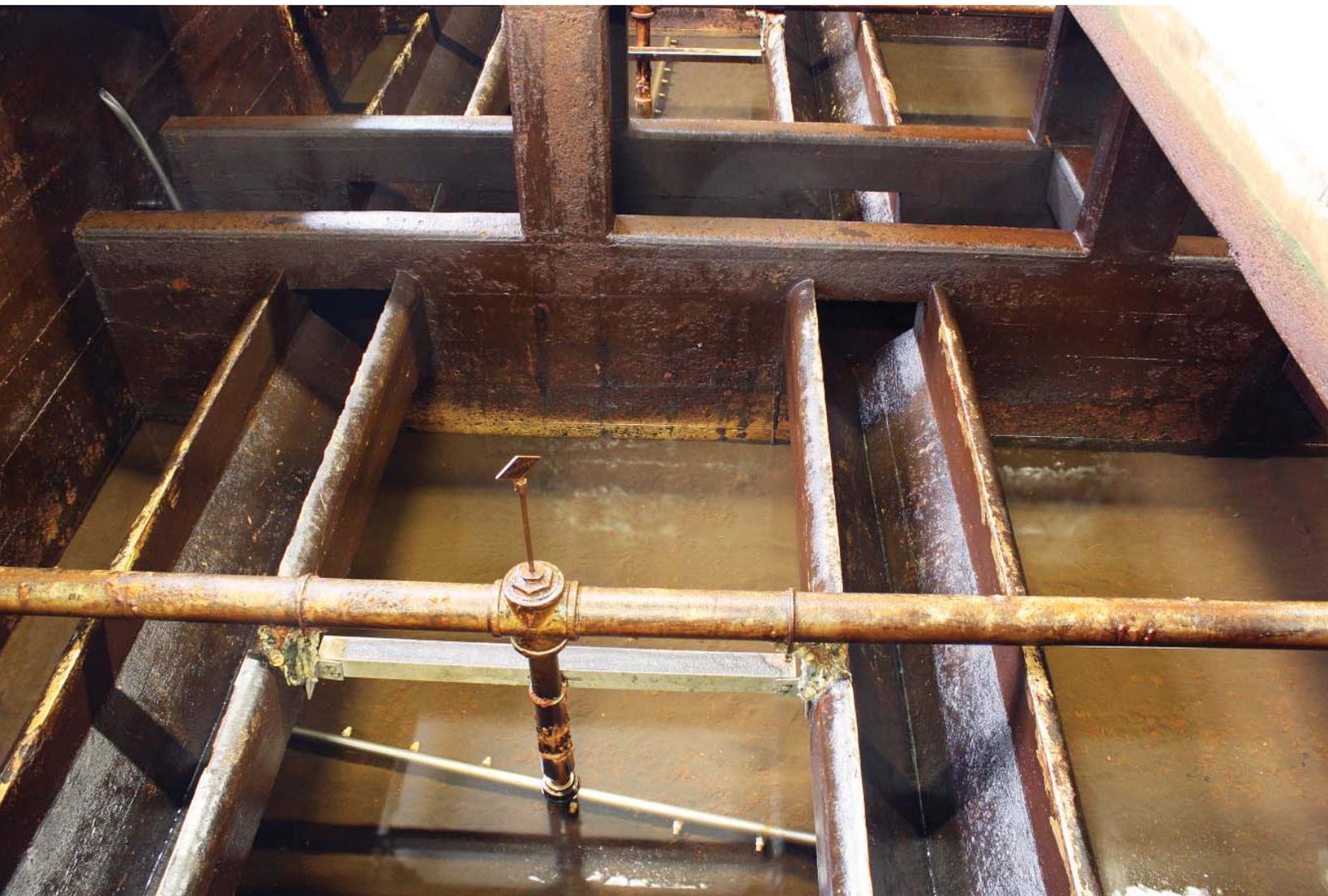
At Brandywine Pumping Station some of the water is transferred by electric-motor-driven, split-case pumps to Porter Reservoir. Other water enters a flume to the mixing chamber of Brandywine Filter Plant, then enters coagulation or settling basins and flows to the filter beds. Filtered water is stored in a clear well beneath the filter beds, and can then be pumped to Cool Spring Reservoir or directly into distribution mains. Water can also be pumped to the filtered water reservoir at Porter Filter Plant or to Rodney Street Reservoir.



*Brandywine Filter Plant water intake area, 2011.*



*Brandywine Filter Plant mechanical filter room, 2011.*



*Brandywine Filter Plant filter beds, 2011.*



*Brandywine Filter Plant ferric chloride pumps, 2011.*



*Brandywine Filter Plant coagulation basins, 2011.*



*Brandywine Filter Plant monitoring panel, 2011.*





Screen house for Brandywine Filter Plant and Pump House, 2011.



Surface wash system in filter bed at Brandywine Filter Plant, 2011.

## Filtration

*The clarity and purity of the water supply increasingly became a concern as water use increased, and population and industrial growth along the Brandywine upstream from the pumping station introduced contaminants. The introduction of filtration of the water supply began in 1892.*

### Screening

*Screening removes from the water source primarily large objects, such as leaves and trash, and prevents animal life, such as fish, from entering the water supply infrastructure.*

### Settling Reservoir

*A settling basin serves to remove all but the finest particles of suspended mineral and organic matter. When leaving a settling basin for filtration, what remains suspended in the water are clays and microorganisms.*

### Coagulant

*Fine particles quickly clog a filter bed, which must then be cleaned. To maintain the effectiveness of a filter over a greater period, a coagulant, most commonly aluminum or iron sulphate, is added to the water before it reaches the filter. When combined with slightly alkaline water, the sulphate*



Decorative tiles in clear well at Brandywine Filter Plant, 2011.

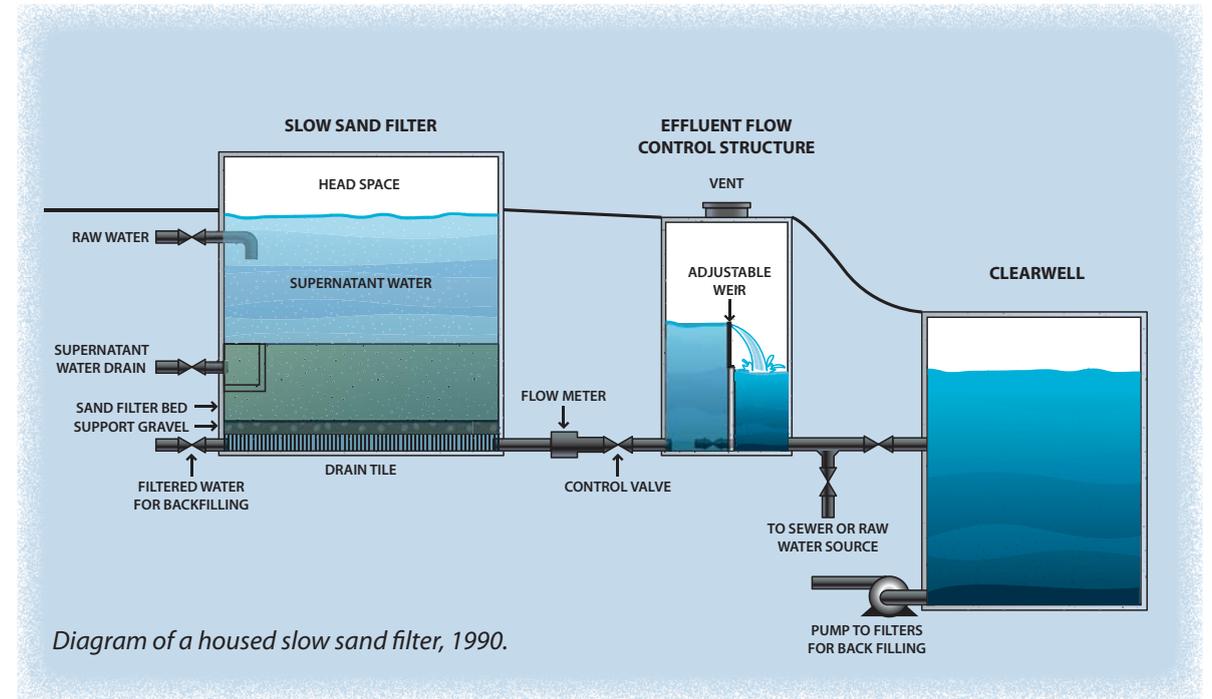


Pipe gallery at Brandywine Filter Plant, 2011.

partially converts to a gelatinous hydroxide. The hydroxide encourages the accumulation of suspended particles, which then can be removed through filtration.<sup>1</sup> In the 1970s Wilmington began using ferric chloride as a coagulant. Ferric chloride, a by-product of titanium oxide production, was developed by DuPont in 1974 for use as a coagulant.<sup>2</sup>

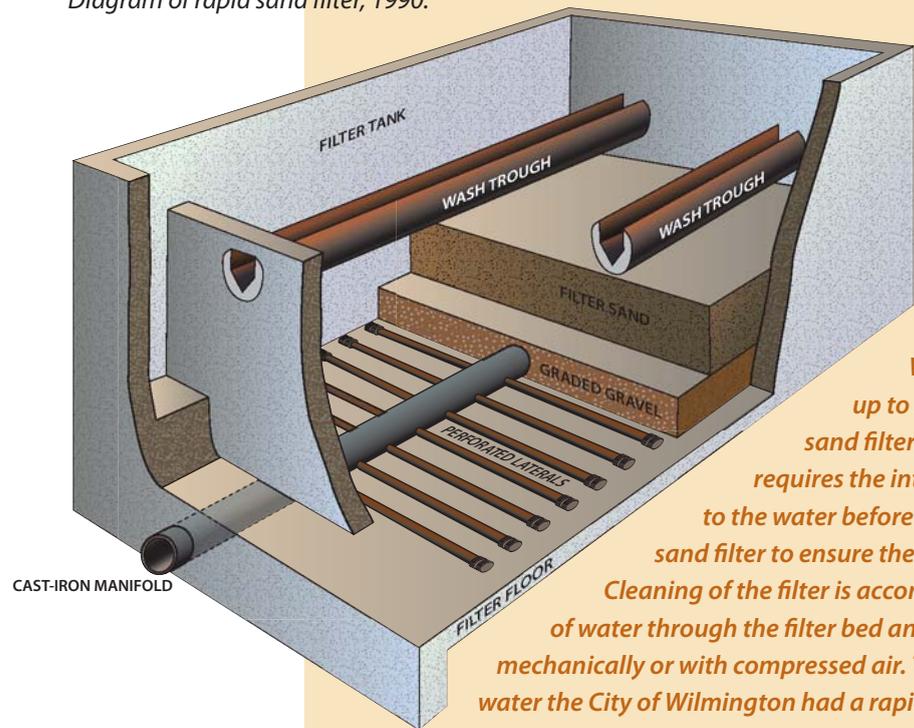
### Slow Sand Filter

A slow sand filter, also called an English-type filter, consists of a basin filled with gravel and uniformly sized sand. The base of the basin is fitted with drains. Water is introduced over the top of the bed of sand. As the water falls through the bed, sediments and bacteria are trapped in the sand. The water then passes through the layer of gravel into the drain pipes and to a holding reservoir. The filtered particles tend to settle in the upper part of the sand bed, which becomes clogged over time. When water no longer flows efficiently through the bed, a thin layer of sand is skimmed off the top. The removed sand can be washed and reused. The system of slow sand filtration in Wilmington in the early decades of the twentieth century began by taking water from the Brandywine and passing it through a preliminary filter to remove coarse sediments. Water flowed upward through the preliminary filter, which contained layers of coke, gravel, and sponge. Pumps raised the water to a sedimentation basin, from which it then flowed by gravity to the slow sand filters. The filtered water drained into a reservoir placed directly beneath the filters.<sup>3</sup>



Removal of superstructure of slow sand filter prior to covering, ca. 1934.

Diagram of rapid sand filter, 1990.



### Rapid Sand Filter

A rapid sand filter, also called an American-type filter or mechanical filter, consists of a bed filled with sand and gravel placed on top of a strainer. Beneath the strainer are pipes to collect the filtered water.

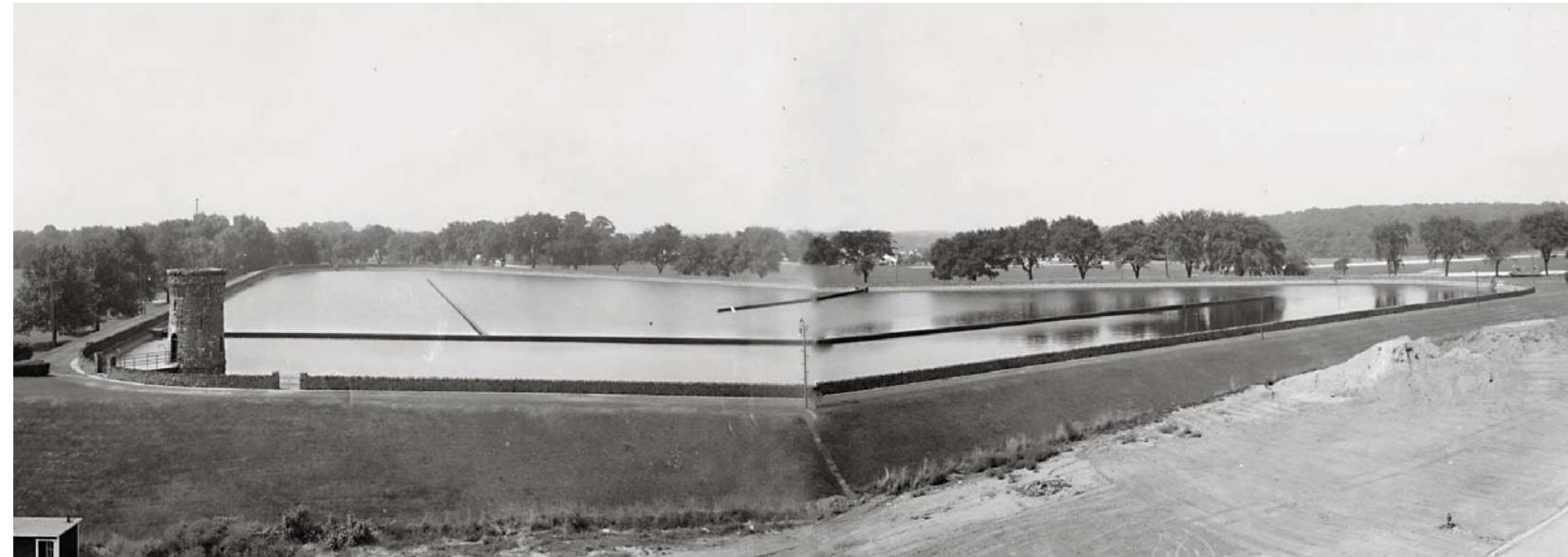
Water flows through the filter at up to 20 times the rate used in a slow sand filter. The increased rate of filtration requires the introduction of a coagulant to the water before it passes through a rapid sand filter to ensure the capture of fine particulates.

Cleaning of the filter is accomplished by reversing the flow of water through the filter bed and agitating the sand bed either mechanically or with compressed air. To increase the supply of filtered water the City of Wilmington had a rapid sand filter plant constructed at Brandywine Plant. Placed into operation in 1917, the plant consisted of six rapid sand filters. The early preliminary filters were replaced by coagulation basins, from which water was introduced to the new filters. The new plant increased the supply of water by 12 million gallons per day.<sup>4</sup> In the 1920s and again in the 1950s the city expanded the ability to filter water for consumption.

### Membrane Filtration

Membrane filtration employs pumps to either push or draw water through the pores of a synthetic fiber encased in a cylinder. A membrane process is categorized as micro-filtration, ultra-filtration, nano-filtration, or reverse osmosis, based on the size of materials that the filter can remove. Typical micro-filtration and ultra-filtration systems consist of a series of filters on a rack and equipment for cleaning the filters and handling the disposal of waste material.<sup>5</sup> Brandywine Plant is slated for modification to low-pressure membrane filtration.

Porter Reservoir is a sedimentation reservoir with a capacity of 35 million gallons and an elevation of 285 feet above mean low tide. The adjacent Porter Filter Plant consists of a chemical and filter building that encloses two 34-foot-diameter, steel wash water tanks; six 90-foot-diameter concrete coagulation and settling basins; and 12 two-million-gallon-per-day filtering units. In 2009 and 2010 the original filter controls of the plant were replaced with computerized automatic controls. In addition, 2,288 solar panels were installed to supply electricity to the plant.<sup>3</sup> The plant also contains electrically operated pumping



Porter Reservoir, ca. 1909.

units that serve the outlying Concord Pike and Foulk Road areas. Here the water moves to a flash mix chamber where chlorine and other chemicals are added to improve taste and clarity. Dirt and other particles settle to the bottom as the water moves through a series of paddles and into a clarification basin. The clarified water then flows over weirs and through collection pipes, which take it to filtration tanks for rapid sand filtration and final processing. The water is filtered through 30 inches of sand and gravel to remove any remaining solids and is then treated again with chlorine to disinfect and prevent bacterial growth. Purified water is stored in water tanks, standpipes, and water towers and is piped into homes and businesses, as needed.<sup>4</sup>



*Cool Spring Reservoir covered pool, 2011.*



*Cool Spring Reservoir open pool, 2011.*

A 48-inch distribution main extends from Porter Filter Plant to Cool Spring Pumping Station. This main is connected to feeder mains at various points along the way, supplying the high service. A rarely used connection permits water to enter Cool Spring Reservoir when required to supply the low service. Cool Spring Reservoir was constructed as an open, filtered-water reservoir with a capacity of 40 million gallons. Water flows by gravity from the reservoir to the low service district. Two 2-million-gallon-per-day, single-stage, electrical motor-driven pumps draw in water to fill the basins. In 2007 a new service building was erected below the east wall of the reservoir. During the following two years the reservoir complex was renovated. Two 5-million-gallon reservoirs are hidden beneath walkways and a grass covering at the southern end, while the northern portion remains open as a decorative landscape feature. The reservoir serves major downtown businesses, the Riverfront area, and 15,000 city residents.<sup>5</sup>



*Cool Spring Pumping Station, 2011.*



*Cool Spring Service Building, 2011.*



*Downtown Wilmington and Christina River, 2006.*



*Cool Spring Wading Pool, 1937.*



*Rodney Street Reservoir, 2011.*

Hoopes Reservoir was built in Old Mill Stream Valley, three miles northwest of Wilmington near the intersection of Routes 82 and 52. The valley measured 8,000 feet in length, 900 feet in width, and 135 feet in depth. Construction of the dam, erected at the neck of the valley, required excavation of 70,000 cubic feet of materials.<sup>7</sup> The reservoir was filled with a “cushion” of approximately 40 million gallons from Old Mill Stream. The cushion was necessary to prevent erosion of the banks of the reservoir as water was pumped in. Water Department engineers diverted the stream from its normal flow through the valley and into Red Clay Creek, backing the stream into the reservoir. An additional 700 million gallons were pumped into the reservoir from the Brandywine. The reservoir is capable of holding over 2 billion gallons of raw water and provides high-quality source water to Porter Filter Plant when heavy rainfall makes the Brandywine overly turbid and muddy.<sup>8</sup>



*Rodney Street Pumping Station, 2011.*

Rodney Street Reservoir is a 7.5-million-gallon covered reservoir for storing filtered water for delivery into the high service. Completed in 1918 on the site of the 1863 reservoir, it works in concert with the Porter Filtered Water Reservoir to ensure a sufficient supply of water at a steady pressure. Filtered water can also be delivered to the reservoir from Brandywine Plant. The top of the reservoir once held an observation tower, a skating rink, and a bandstand.



*Hoopes Reservoir, Dam, and Pumping Station from the air, ca. 1932.*

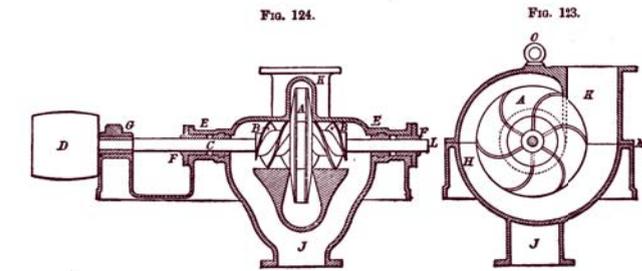
Dating from 1960, Wills Pumping Station was constructed in association with the expansion of Porter Filter Plant from 24 million-gallons-per day to 36 million-gallons-per-day maximum capacity. The pumping station was designed to draw water from Brandywine Creek and pump it to Porter Reservoir, Hoopes Reservoir, or both. When opened, it was equipped with two Baldwin pumps that could deliver 20 million gallons per day to Porter Reservoir or 24 million gallons per day to Hoopes Reservoir.<sup>6</sup>



*Wills Pumping Station, 2011.*



## Notes



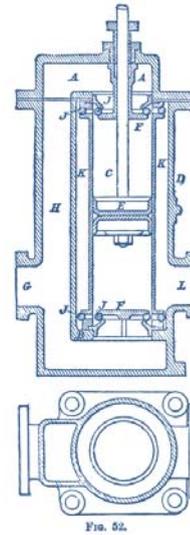
### Milestones

- <sup>1</sup> Peter Corbett Welsh, "The Brandywine Mills," M. A. thesis, University of Delaware, 1956, 7.
- <sup>2</sup> "An Ordinance," August 11, 1828.
- <sup>3</sup> Wilmington Water Department, *Annual Report of the Chief Engineer of the Water Department to the City Council of Wilmington for the Year 1877*, Glatts & Eckel, Wilmington, 1877, 6.
- <sup>4</sup> "Our Water Department," [Wilmington] *Every Evening and Commercial*, December 19, 1877.
- <sup>5</sup> Wilmington Water Department, 1877, 7.
- <sup>6</sup> Marjorie G. McNinch, *Wilmington in Vintage Postcards*, Arcadia, Charleston, South Carolina, 2000, 60.
- <sup>7</sup> "Keep Creek Water Pure," [Wilmington] *Evening Journal*, December 11, 1909.
- <sup>8</sup> Fuller and McClintock, "Wilmington, Delaware, Contract Drawings for Extension of Mechanical Filter Plant," Wilmington Department of Public Works Archives, 1933.
- <sup>9</sup> "2 Oil-Burning Boilers to Cost City \$217,000," *Wilmington Morning News*, July 20, 1946.
- <sup>10</sup> "Pumping Station Valve Explodes," *Wilmington Morning News*, July 25, 1946.
- <sup>11</sup> "Building Must be Evacuated: Society of Natural History Forced to Seek New Home," [Wilmington] *Journal-Every Evening*, June 14, 1949.
- <sup>12</sup> "Riser Pipe Goes Up," [Wilmington] *Journal-Every Evening*, February 4, 1955, 15.
- <sup>13</sup> "City Reservoir Roof Paved for Use as Ice Skating Rink," [Wilmington] *Evening Journal*, October 29, 1963.
- <sup>14</sup> "City is taking long drink from Hoopes," [Wilmington] *Evening Journal*, September 2, 1966, 1.
- <sup>15</sup> Wilmington Water Department, *City of Wilmington Water Works* 8, Summer 2010, 1-2.

### Historical Sketch

- <sup>1</sup> Elizabeth Montgomery, *Reminiscences of Wilmington in Familiar Village Tales*, T. K. Collins, Jr., Philadelphia, 1851, 270-271.
- <sup>2</sup> "Our Water Department," [Wilmington] *Every Evening and Commercial*, December 19, 1877.
- <sup>3</sup> J. Thomas Scharf, *History of Delaware, 1609-1888*, Volume II, L. J. Richards & Company, Philadelphia, 1888, 664.
- <sup>4</sup> *Laws of the State of Delaware*, Volume III, M. Bradford and R. Porter, Wilmington, 1816, 331-338; Carol Hoffecker, "Water and Sewage Works in Wilmington, Delaware, 1810-1910," Essay No. 12, *Essays in Public Works History*, Public Works Historical Society, Chicago, 1981, 3.
- <sup>5</sup> "Our Water Department."

- <sup>6</sup> Scharf, 665.
- <sup>7</sup> Scharf, 665.
- <sup>8</sup> H. Niles, "Wilmington, Delaware and its Vicinity," *Niles Weekly Register*, October 7, 1815, 92.
- <sup>9</sup> City of Wilmington, *Water Works* 6: 1, 2008, 1.
- <sup>10</sup> Scharf, 665.
- <sup>11</sup> Scharf, 665-666.
- <sup>12</sup> Hoffecker, 46.
- <sup>13</sup> C. H. Gallagher, *Annual Report of the Chief Engineer of the Water Department for 1872*, Glatts & Eckel, Wilmington, 1873, 22-23.
- <sup>14</sup> Hoffecker, 3-4.
- <sup>15</sup> "Our Water Department."
- <sup>16</sup> "Our Water Department."
- <sup>17</sup> Gallagher, 23-24.
- <sup>18</sup> City of Wilmington, *Report of the Joint Committee on the Subject of a Pure and Wholesome Water for the City: Also a Report of the Analysis of the Red Clay Creek Water*, Henry Eckel Printer, 1857, 4-5.
- <sup>19</sup> City of Wilmington, *Water Works* 2: 1, 2003, 1.
- <sup>20</sup> "Our Water Department."
- <sup>21</sup> As cited in Christopher Derganc, *Brandywine Pumping Station* (DE-19), Wilmington, New Castle County, Delaware, *Historic American Engineering Record* (HAER), 1976.
- <sup>22</sup> Edgar M. Hoopes, Jr. and James M. Caird, "Water Filtration and the Mechanical Washing of Filter Sand at Wilmington, Delaware," *Engineering and Contracting* XLII: 8, August 1914, 210.
- <sup>23</sup> "Rodney Street Reservoir Was Finished in 1918," *The [Wilmington] Sunday Morning Star*, July 21, 1940, F-22.
- <sup>24</sup> *Insurance Maps of Wilmington, Delaware*, Sanborn Map Company, 1927.
- <sup>25</sup> "Mill Stream Dam Engineering Feat," [Wilmington] *Every Evening*, July 21, 1931; "Hoopes Reservoir Dedicated Today with Ceremony," [Wilmington] *Every Evening*, June 4, 1932.
- <sup>26</sup> American Architects and Buildings, "Brown & Whiteside," [www.americanbuildings.org](http://www.americanbuildings.org), accessed March 8, 2011.
- <sup>27</sup> Wilmington Water Department, *Annual Report* (1940-1941 fiscal year), 24.
- <sup>28</sup> *Wilmington Morning News*, July 20, 1946.
- <sup>29</sup> "Public Invited to Inspect New Filtering Plant," *Wilmington Morning News*, December 9, 1953, 1, 34.
- <sup>30</sup> *Insurance Maps of Wilmington, Delaware*, 1951.
- <sup>31</sup> "New Pumping Station Updating the City's Drought Insurance Policy," *Wilmington Journal-Every Evening*, October 13, 1959.
- <sup>32</sup> "When you turn on tap, you're lucky if water comes out," and "Uncertainty clouds city's water," [Wilmington] *Evening Journal*, June 19-20, 1967.



### The Brandywine Raceway (sidebar)

- <sup>1</sup> Carol E. Hoffecker, *Brandywine Village: the story of a Milling Community*, Old Brandywine Village, Inc., Wilmington, 1974, 22-23.
- <sup>2</sup> *Annual Report of the Board of Park Commissioners of Wilmington, Delaware for the year 1898*, 7-8.

### Power and Pumping (sidebar)

- <sup>1</sup> *Report of the Committee Appointed by the City Council of Wilmington Relative to an Improvement of the City Water Works*, Wilmington City Council, Wilmington, 1849; M. N. Baker, editor, *The Manual of American Water Works*, The Engineering News Publishing Company, New York, 1888, 166-167.
- <sup>2</sup> Baker, 167.
- <sup>3</sup> J. F. Holloway, *Pumping Machinery: Ancient and Modern*, private printing, New York, 1892, 19.

### The City Beautiful (sidebar)

- <sup>1</sup> William H. Wilson, *The City Beautiful Movement*, The Johns Hopkins University Press, Baltimore, 1989, 88-89.
- <sup>2</sup> Wilson, 285.
- <sup>3</sup> Wilson, 287.

### Bacteriology (sidebar)

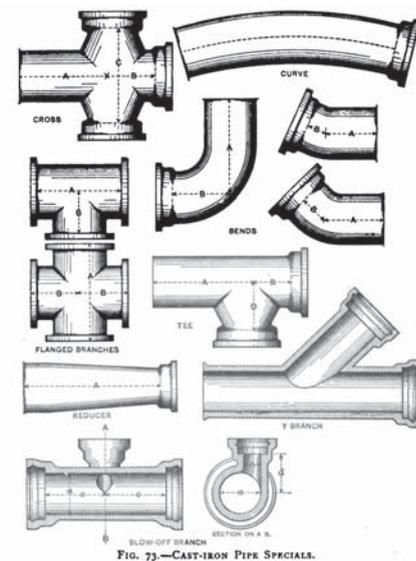
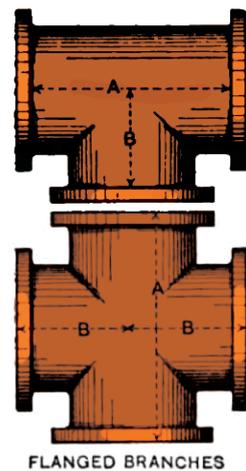
- <sup>1</sup> Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present*, Baltimore, Johns Hopkins University Press, 2000. This source contains an ample discussion on changing perceptions of sanitation and responses in relation to water supply.
- <sup>2</sup> *Report of the Watering Committee of the City Council of Wilmington upon the Analysis of the Brandywine Water*, Wilmington City Council, Wilmington, 1864.
- <sup>3</sup> William E. Morris, Engineer, et al., *Report on the Enlargement of the Water Works of the City of Wilmington*, Wilmington City Council, Wilmington, 1870.
- <sup>4</sup> Edgar M. Hoopes, Jr. and James M. Caird, "Water Filtration and the Mechanical Washing of Filter Sand at Wilmington, Del.," *Engineering and Contracting*, Volume XLII, July-December, 1914, 211.
- <sup>5</sup> Wilmington Water Department, *Seventy-Second Annual Report, Fiscal Year 1940-1941*, The Board of Water Commissioners, Wilmington, 1941.
- <sup>6</sup> City of Wilmington, *Water Works* 8: Summer 2010, 5.

## From Creek to Tap

- <sup>1</sup> "Water Supply of Wilmington, Delaware," Wilmington Water Department, 1963.
- <sup>2</sup> City of Wilmington, *Water Works* 2: 1, 2004, 4.
- <sup>3</sup> City of Wilmington, *Water Works* 8: Summer 2010, 1.
- <sup>4</sup> City of Wilmington, *Water Works* 1: 1, 2003, 3.
- <sup>5</sup> City of Wilmington, *Water Works* 2: 1, 2004, 2.
- <sup>6</sup> Wilmington Department of Public Works, *Water Works* 4: Summer 2006, 1.
- <sup>7</sup> City of Wilmington, *Water Works* 4: Summer, 2006, 2.
- <sup>8</sup> "Pumping Station Provides Flexible Link in Water System Components," *Public Works*, June 1962, 131.

## Filtration (sidebar)

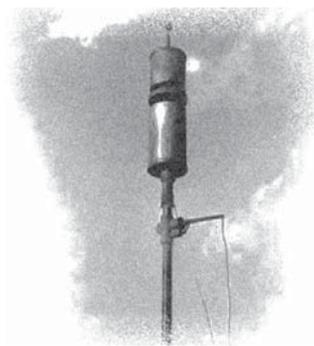
- <sup>1</sup> See for example, Frederick E. Turneure, Harry L. Russell, and Daniel W. Mead, *Public Water Supplies: Requirements, Resources, and the Construction of Works* (2<sup>nd</sup> Edition), John Wiley and Sons, New York, 1911; and John Goodell, *Water Works for Small Cities and Towns*, McGraw-Hill, New York, 1899. Coagulants are commonly discussed in writings on waterworks beginning in the latter part of the nineteenth century, although the level of detail varies across publications.
- <sup>2</sup> Francis Menton, personal communication, March 2011; *EPA Journal*, Volumes 8-9, 1982.
- <sup>3</sup> Edgar M. Hoopes, Jr., Recent Improvements in Wilmington's Water Supply, *Municipal Journal*, Volume XLIII, September 6, 1917, 215.
- <sup>4</sup> Hoopes, 217.
- <sup>5</sup> U. S. Environmental Protection Agency (EPA), *Low-Pressure Membrane Filtration for Pathogen Removal: Application, Implementation and Regulatory Issues*, EPA, Washington, D. C., 2001, 15-21.



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WPW	Wilmington Department of Public Works Archives, Wilmington, Delaware

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#3. CHRISTIANA RIVER TUNNEL  
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*Electric thawing machine, 1936.*

*"Thousands have lived without love, not one without water."*

W. H. Auden

