STATEMENT OF SIGNIFICANCE

Overview

The Mount Tabor Park Reservoirs Historic District encompasses Reservoir 1 built in 1894 and Reservoirs 5 and 6 built in 1911. The resource is located on the west and south sides of Mount Tabor, a 640-foot volcanic butte parkland encompassing 196 acres located in a residential neighborhood in Southeast Portland, Multnomah County, Oregon. The reservoir undertaking was not only remarkable for its architecture and engineering but as a relatively early example of private-public partnership. The district meets Criterion A, for its association with significant historic events, in the areas of community planning and development, engineering, architecture/landscape architecture, and recreation. Along with Washington Park Reservoirs 3 and 4, located approximately 6 miles due west of Mount Tabor, Reservoirs 1, 5, and 6 serve as the main storage and distribution system for Portland's water supply. The layout of Portland's reservoirs, on the east and west side of the Willamette River, was one of the early connections to the two sides of Portland. The result of a government-business paradigm for public works, funding the creation of Portland's Bull Run water system, of which the reservoirs are an integral part, was a landmark process for Oregon's legislature that illustrated a commitment to public health and an adequate supply of high quality water using a cost effective delivery design. The reservoir construction embodied innovative engineering utilizing patented reinforced concrete and attractive finishing techniques that had not yet become widely accepted. The engineering involved the active channeling of water in a gravity-fed system to provide power for pumps (and eventually for the generation of electricity) making the system fiscally responsible. The breadth and depth of the water basins and the views afforded of the reservoirs and the surrounding landscape, harmonized with the site chosen for their construction. The Romanesque architectural style chosen for the gatehouses, weir buildings (screen houses), parapet walls and other features exhibited the quality of "beautility"[1] encompassing both highly attractive design with exceptional attention to detail and utilitarian function. This packaging of beauty with utility was a natural off shoot of the combined tenets of the Progressive Era and the City Beautiful movement. The turn of the century, when the reservoir districts were constructed, was a period of intense interest in improving growing urban areas, a reaction to the oppressive conditions found in American cities in the wake of the Industrial Revolution. Constructed in 1894, the same year as the National Municipal League was founded, and as the City Beautiful movement was rising throughout the country, the reservoirs' design reflects the mood of the period in which they were built. The lighted walkways and other amenities surrounding the deep open water provided a recreational destination and encouraged the remainder of the Mount Tabor butte to be developed as one of Portland's primary parks. The reservoirs provided a gift of more than tap water to the citizens for a very costly project for the time.

The district also meets Criterion C for its embodiment of distinctive characteristics of a type, period, or method of construction using masterful techniques, as an early example of concrete construction and romantic eclectic architectural and landscape design. Designed and constructed during the Progressive Era, and in the wake of the City Beautiful Movement, the reservoirs, with their careful attention to aesthetics and innovative engineering technology, serve as intact physical representation of this period in Portland's history. The concrete techniques were innovative, utilizing patented methods of Ernest Ransome, one of the earliest American pioneers in various aspects of concrete construction. The historic structures and buildings of Reservoir 1 are built of reinforced concrete, using the patented "Ransome System" and may be categorized as Late Victorian – Romanesque Revival style of architecture. Collectively, the reservoir complex represents the largest, earliest application of the Ransome construction type in Portland, and one of the earliest in the country. The decorative wrought iron fence and lampposts were designed by prominent local architects Whidden and Lewis who went on to design Portland City Hall, now on the National Historic Register. The wrought iron work was manufactured by Old World trained and locally celebrated craftsman, Johan Tuerck. Although Reservoirs 5 and 6 were constructed at a time when reinforced concrete construction was more common, their design followed the "beautility" theme advanced by the earlier reservoirs. The engineering showed creative solutions to water delivery using natural elevation differences with minimum reliance on other sources of power. Because of the care in planning and construction, Reservoirs 1, 5 and 6 are important pieces of living history providing service and beauty as they first did 109 and 94 years ago.

Criterion A: Community Planning and Development

Reservoirs 1 and 2 on Mount Tabor and Reservoirs 3 and 4 in City Park (now Washington Park) were built simultaneously with the Bull Run water system in 1894. Reservoirs 5 and 6 were built when the Bull Run watershed delivery capacity was expanded and Mount Tabor Park was formalized in 1911. Reservoir 2 is now demolished and the property privately owned. The Reservoir 2 gatehouse was preserved as a private residence and is listed in the National Register of Historic Places and has been documented in the Historic American Engineering Record. Reservoirs 3 and 4 have been nominated to the National Register of Historic Places.

The reservoir district is eligible for listing in the National Register under Criterion A in the category of Community Planning and Development. The reservoir complex is noteworthy for its association with the city building activities of Portland's business community. The result of a government-business paradigm for public works, funding the creation of Portland's Bull Run water system was a landmark process for Oregon's legislature that illustrated a commitment to public health and an adequate supply of high quality water using a cost effective, publicly owned delivery design. The legislation to create Portland's Water Committee designated fifteen prominent businessmen to develop a municipal water system. While the bonds to build the system were guaranteed and paid for by Portland's general fund, it was not until 1913 that the Bull Run Water system came under the direct control of the city government. Prior to that time, the Water Committee was solely responsible for providing water to the citizens of Portland. That system – by design, by innovative construction, by emphasis on water quality, and by financing – far exceeded the water needs of the Portland community of the day. The Mount Tabor Park Reservoirs 1, 5, 6 featured aesthetic design, construction and detailing that transformed the water-holding utility of the reservoirs into a dramatic and defining community asset that would carry the city through a century of rapid growth.

The dedication of the Water Committee to create a private-public initiative to build a first-class water system for the city of Portland was successful. From this early initiative, these and other business leaders led a series of efforts that are highlighted by Whidden & Lewis's City Hall in 1895, the Portland Park Association of 1898, the 1905 Lewis & Clark Exposition, the Greater Portland Plan of Edward H. Bennett in 1912 (Bennett was the associate of Daniel Burnham of the "White City" fame) and the installation of handsome public drinking fountains known as the Benson Bubblers in 1912. The sum total of these city-building activities served as the catalyst that launched Portland's great growth spurts in the 1910s and 1920s and have contributed to the ongoing "livability" of the city of Portland.[2]

Trend toward Municipal Water Works in the Progressive Era

The Progressive Era, spurred on by the growing middle class and the suffrage movement, dominated the political landscape from approximately the late 1880's until the U.S.A. entered World War I in 1917. It was characterized by a call for reform in all aspects of American life – labor, politics, engineering, recreation, and public health. As a reaction to the domination of industrialization with laissez faire capitalism and ballooning populations, public interests moved toward civic organizations like The National Municipal League in 1894, formed the same year as the completion of Reservoirs 1,2,3 and 4 and the Bull Run system. Cholera and other epidemics had finally been directly associated with water. In 1909, when Reservoirs 5 and 6 were being designed, the General Federation of Women's Clubs formed national committees to review waterways, connoting pure water with the health of the individual and the community. Citizens' lack of trust in private companies to be able to guarantee safe and abundant water for a good price mobilized a move toward municipalizing water sources. In addition, as the density of buildings grew in neighborhoods so did the risk of fire. Municipal water works were a good investment for the safety and health of the infrastructure as well as the citizens of a city. The trend toward public ownership of utilities expanded so that in 1896 less than half of U.S. cities owned their water works but by 1915 two thirds did. Portland's commitment to a municipally owned water system, including the reservoirs, followed this national trend. Although the same arguments regarding public ownership of the water supply held true for other utilities, such as trolley, gas, electricity, telegraph or telephone systems, water remained the sole municipally owned utility in the city of Portland until mass transit was acquired in the mid-20th century.

Historian Martin Melosi, in The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present helps to summarize the trend toward publicly owned water works in this statement:

By the late 19th century there was a strong feeling among municipal leaders that any respectable community needed a citywide waterworks. A healthy community was an essential ingredient in the process of growth. Many city leaders concluded that control of the sanitary quality of its water service would be difficult if the supp remained in private hands. The push for municipal ownership, therefore, had as much to do with the desire to influence the growth of the cities as to settle disputes with private companies over specific deficiencies.[3]

Situated on rivers, cities had easy access to water for drinking, transportation, industry, and sewage disposal and Portland, like most cities, paid the cost of a burgeoning population and industrial growth with the undermining of the quality of the water of the river and its tributaries. As settlements grew along the Willamette River, the water quality deteriorated until an early Portland water activist, P.F. Morey had this to say regarding drinking its water, "… the river Willamette is the sewer of nearly one-third of the state…Men should not drink such water, nor used it in their house either for culinary or lavatory purposes. They have been doing so in defiance of every sanitary principle; and as the state grows older and becomes more settled up, the (contamination) will only increase, and the danger of a greater epidemic overhang this entire community." [4]

Governor Pennoyer considered the Willamette a sufficient source of drinking water, as did business leader Simeon Reed. The Willamette River flows north, dividing the city into an East and West side. It was a readily accessible water source. It would have been much less expensive to develop a water source right in the city rather than to seek one over 50 miles to the East. Technology existed to filter impurities from water but no move was made by the Water Committee to institute filtration for the Willamette River water in the nine years it took to create the Bull Run system. The emphasis on a quality water source and the desire to find an alternative to the Willamette River was remarkably forward looking. Bull Run water is still a Portland hallmark and Portlanders and wholesale community customers continue to benefit from Bull Run's quality and inexpensive use of gravity as a delivery system even today.

The History and Development of Portland's Water System

Early Water: In the earliest days of settlement, Portland residents drew their water from wells located on or near their property. That pattern continued until the mid-1850s, when drainage from the growing population began to seep into the wells.

In 1856, Steven Coffin, Finice Caruthers and Jacob Cline founded the Portland Water Works and petitioned City Council to lay pipe. City Ordinance #54 granted the company a franchise for conducting water into the city. Their water supply was a creek on Caruther's Donation Land Claim in Marquam Gulch. It fed through a series of wood pipes to provide service from Southwest Fourth Street east to the Willamette River.

In 1859, Portland Water Works was sold to Robert Pentland. Pentland installed a steam pump at the foot of Southwest Mill Street to draw water from the Willamette River to supplement the Caruther Creek supply. He also hoped to pump water to supply water to the higher elevations from a reservoir at Southwest Fourth and Market Streets.

Three years later, faced with personal financial challenges, Pentland sold the water system to Herman C. Leonard and John Green for $5,400 (equivalent of $103,000 in 2001 dollars.) [5] Leonard and Green had already established themselves as utility entrepreneurs, starting the Portland Gas Light Company in 1859. The new enterprise was called the Portland Water Company. With a city population nearing 3,000, Leonard and Green began to upgrade the system immediately with cast iron pipes imported from the east coast and erecting a 300,000-gallon per day pumping station at the foot of Southwest Market Street. Leonard and Green also augmented the supply with water from Balch Creek northwest of town, piped to a reservoir at what are now Southwest 15th Avenue and Alder Street and providing gravity service to the higher elevations west of Fourth Street.

As Portland's population grew to 8,000 by 1870, so did the Portland Water Company's efforts to expand capacity. In 1868, it built an 800,000-gallon per day pumping station at the foot of Southwest Lincoln Street. Three years later, it installed a new steam powered pump to increase daily capacity from that location to 1.8 million gallons per day. The Portland Water Company also built a new reservoir at Southwest Sixth and Lincoln Street, and expanded the one at Fourth and Market Street.

Complaints of cost and quality prompted Mayor Philip Wasserman in 1871 to explore options for a new water service. He appointed a 5-member committee to consider the possibilities. The committee's report, issued in 1872, recommended municipally owned water service and identified the Willamette River or Stephens' Springs as possible sources. The projected cost for such a system was $1 million. Portland's Common Council approved the report, but the city's charter did not empower the city to finance such an enterprise. That power was reserved to the state legislature. For its part, the legislature was fearful of taking on such a large debt on behalf of Portland. (Such fear was not unfounded; as late as 1909, when Portland was four times larger, surrounding Multnomah county still only had a total capital investment of $22 million.)

At the same time, the privately owned Portland Water Company continued to expand. New pumps were installed in a new "Round-House Station" at the Southwest Lincoln Street pumping station, increasing capacity there to 4 million gallons per day. Ten years later, demand continued to surge as Portland continued to grow. By 1880, the city's population was 18,000 and would grow to 46,000 by the end of the decade. This growth prompted the Portland Water Company to build the Palatine Hill Pumping Station four miles upstream from the city, with new capacity of 10 million gallons per day. At this time, the Portland Water Company abandoned the Caruthers Creek source as it fell victim to development. Completed in 1884, Palatine Hill was inadequate within 8 years as Portland's population continued to nearly double.

Relying on the Willamette River as the water source, the Portland Water Company also faced increasing challenges in water quality. Waste matter from upstream mills posed problems. Sewer disposals posed problems. And occasional tidal shifts affected the flow of the Willamette also posing problems. As Portland headed into the 20th Century, a new water source would need to be found.

<u>The Portland Water Committee</u>: As the Portland Water Company struggled to keep up with demand and its degrading water source, the city government once again picked up the question of a city-owned water works. Of the 3,000 public water systems built in the United States between 1860 and 1896, half were municipally owned.[6] In the 1885 state legislature's special session, Republican Joseph Simon orchestrated legislation to create the Portland Water Committee, passed on November 25, 1885. Simon's bill appointed fifteen of the

city's most prominent business and civic leaders to serve as members: John Gates, C. H. Lewis, Henry Failing, Frank Dekum, L. Fleischner, H. W. Corbett, F. C. Smith, W. K. Smith, J. Loewenberg, S. G. Reed, R. B. Knapp, L. Therkelson, Thomas M. Richardson, A. H. Johnson, W. S. Ladd. The Committee was charged with the responsibility "to construct or purchase, keep, conduct and maintain water works . . . with an abundance of good, pure and wholesome water." The Committee was also authorized to issue up to $700,000 in tax-free bonds (equivalent to $13 million in 2001 dollars). Upon establishing a new water works, the Committee was to disband in favor of a permanent five-member Water Commission. [7]

The bonding authority in the legislation was significant in its size and in its structure – representing a sizable risk. Bonds were then, and remain, a common financial mechanism to fund government operations but particularly capital projects. They would be issued for a set period of time (typically 15-25 years) and paid back with interest from a city's general fund. At this time in Oregon, before a city could go into debt, it had to receive authorization from the state legislature. Typically, the legislature set a debt limit and authorized the governmental jurisdiction to issue bonds up to that limit. Portland's debt was limited to $100,000.[8] In this one piece of legislation creating the Water Committee, the state legislature established a debt limit seven times that of the state's largest city – and gave the authority not to the elected officials of the city required to pay back the bonds but to the fifteen member Water Committee created by the legislation.

This act was challenged almost immediately. The owners of private water works sued the Water Committee, challenging the constitutionality of the charter amendment. The decision was finally rendered by the Oregon Supreme Court. Justice William Thayer ruled, "It would be difficult we think, to find any class of cases in which the right of eminent domain is more justly or wisely exercised than in the provision to supply our crowded towns and cities with pure water . . ."[9]

At their first meeting on December 8, 1885, the Committee elected Henry Failing as President, a post he remained in for twelve years. Equally important was the influence of William S. Ladd until his death in 1893. The first step was the acquisition of the existing Portland Water Company. Following Thayer's decision, that sale was completed by the end of 1886 for $464,551. It subsequently also acquired the Crystal Springs Water Company for $150,000.

The second step was to locate a water source for the long-term. The committee initiated action in January, 1886, when it advertised to acquire water rights. One offer came from Charles Talbot and A. G. Cunningham who contacted the Water Committee regarding Bull Run. As early as 1883, Talbot, an engineer for the Northern Pacific Railroad, had conceived of supplying water from Bull Run Lake to Portland. He convinced Cunningham to join with him in acquiring land and riparian rights from the Oregon & California Railroad. Talbot and Cunningham offered the land and rights to the Water Committee for $130,000 ($2.5 million in 2001 dollars).

The Water Committee hired Colonel Isaac Smith as staff engineer to investigate possible sources. The Committee directed Smith that the Willamette River needed to be replaced as the source and that pumping was prohibitively expensive. With that direction, Smith focused on possible gravity supplies. As Smith explored options that included Oswego Lake, Eagle Creek and Clackamas River, he increasingly was attracted to the Bull Run Lake, River, and its tributaries in the forested mountains east of the city and west of Mount Hood.

The investigation of the Bull Run vicinity, with its steep hillsides was challenging. The watershed was "a rugged wilderness impassible for a horse and difficult for a man to penetrate."[10] Upon reaching Bull Run Lake, at an elevation of 3174 feet above sea level and approximately 50 miles east of Portland, Smith deemed the water as pure and clear as any they had ever seen. Although in the shadow of the western face of Mount Hood, the Bull Run Lake, River and the watershed were separate from the glacial waters of the 11,237-foot mountain. Delivering this water to the city of Portland, however, posed a formidable task. Smith faced several false starts in attempting to define a specific course, however, in 1886, after five months in the wilderness, Smith and his party reported to the Committee on Bull Run that a pipeline could and should be built.

The Water Committee then set about securing riparian rights and rights-of-way for the pipeline. They sent Smith back towards Bull Run to secure pipeline rights-of-way and riparian rights from individual settlers. Typically, given the imposing landscape, owners were selling their water rights for $1-5 ($18-$90 in 2001 dollars). The Committee also began negotiations with Talbot and Cunningham regarding their claims to water rights, eventually securing those rights for one sixth of Talbot and Cunningham's original asking price, or $21,000.

As much of watershed remained unsettled and subject to the Donation Land Act, the Water Committee also set about courting the federal government. Early in 1892, the state's congressional delegation urged President Benjamin Harrison to exclude Bull Run lands from future settlement or sale. The President had received authority for such set-asides the year earlier with the "Act to Repeal Timber Culture Laws". On June 17, Harrison signed a proclamation declaring Bull Run as the nation's fifth national forest reserve.

The Committee also continued to grapple with the existing supply. Demand was increasing by an average of 25 percent per year. Even though a new source had been located, the Committee realized that capacity from the old Portland Water Company would need to be expanded until Bull Run could be brought online. The pumps were running 24 hours a day and yet the reservoir levels continued to drop, forcing the Water Committee to shut off the water flow during some peak periods.

With $600,000 of the initial $700,000 in bond revenues already spent as early as 1887, the Committee sought legislative authority to issue another $500,000 in tax-free bonds. Though passed by the legislature, Democratic and populist governor Sylvester Pennoyer vetoed the authorization, objecting to the bond's tax-free provisions benefiting the wealthy and banking interests. In the following legislative session in 1889, the Water Committee sought $1.5 million in tax-free bonding capacity to pay for expanding existing capacity and for the Bull Run system. Again, it passed the legislature but was vetoed by Governor Pennoyer – ostensibly now because the water originated from Mount Hood glacier run-off and "would cause goiter to the fair sex of Portland."[11]

Given the challenges of getting authority through the Governor and Portland's population growth, the Water Committee reassessed their vision for the Bull Run system. The proposed system was projected to provide 15 million gallons per day at a construction cost of $1.4 million. The committee reassessed demand projections and re-engineered the Bull Run system to produce 24 million gallons per day. This enlarged system would cost $2 million. The Committee then went to the 1891 state legislature for bonding authority of $2.5 million. To undermine Pennoyer's possible veto, they demonstrated that the water source was not from glacier run-off and stipulated that the bonds would not be tax-free. The legislature passed the authority and Pennoyer approved the bill but an inadvertent discrepancy in the legislation's bonding authority and limits delayed the project another two years. In 1893, the discrepancy was corrected and the Bull Run challenge now transformed from money and politics to engineering.

The Bull Run System: While the Water Committee worked on securing the money, Isaac Smith worked on the engineering and eventually would oversee its construction. Smith was born in Fredericksburg, Virginia. A graduate of Virginia Military Institute, he devoted his entire career to civil engineering. He was a captain in the Engineer Corps of the Confederate Army, afterwards engaging in public land surveys of state of Washington. Settling in the Pacific Northwest, he built lighthouses at Shoalwater Bay and platted the gas and water works in Tacoma, Washington. As engineer for the Northern Pacific Railroad, he located the line from Portland to Kalama, Washington and from Kalama to Tacoma, Washington, as well as the line across the Cascade Mountains from Tacoma to the Yakima and Columbia Rivers. Smith also built the system of steamboat locks around Willamette Falls in Oregon City, Oregon.

Smith had been appointed Chief Engineer by the Water Committee on December 22, 1885. In 1886, after surveying a line from Bull Run, Smith presented to the Water Committee "Specifications of Works for the Water Supply of the City of Portland." In that document, he outlined the requirements for headworks, pipelines and reservoirs. He refined his design and in 1891, Smith presented another report to the Committee in which he stated: "A high and low service reservoir are needed for the economical operation of the works, and to compensate for the varying consumption of water at different portions of the day."[12] The high service reservoir was at a higher elevation and served customers whose home or business were at a greater elevation than those served by the low service basin. As design work progressed, he solicited bids for materials and construction costs, including the construction of roads along the pipeline. All this preliminary work would result in speedy construction.

Smith's overall gravity based design was both simple and sophisticated. He established a headworks 710 feet above the Willamette River on the Bull Run River and ran pipeline west 24 miles to Mount. Tabor. With a daily capacity of 24 million gallons, the 33-42" riveted steel pipes ran initially parallel to the Bull Run River to avoid rockslide areas. From roughly the confluence of the Sandy and Bull Run Rivers, the pipeline then ran in a westerly direction through Gresham. With standpipes at Lusted and Grant's Butte, the end point was Mount Tabor Reservoir Number 1 at 402 feet above the Willamette.[13]

Once at Reservoir 1, the system began to distribute the water. From Mount Tabor, 1 million gallons per day would flow directly to East Portland for "high" service; four million gallons per day would flow nearby to southeast to Reservoir 2 at 220 feet above the Willamette with distribution to East Portland; and nineteen million gallons per day cross under the Willamette and would flow west 6 miles to Reservoir 3 at City Park (now Washington Park) 290 feet above the Willamette River. At Reservoir 3, four million gallons per day would go to "high" service in West Portland and fifteen million gallons would go to nearby Reservoir 4, 70 feet below Reservoir 3 and 220 feet above the Willamette River. Thirteen point five million gallons of this would provide low service to Portland and 1.5 million gallons would be pumped hydraulically west to "extra high" service (this original hydraulic pump, known as Thumper, is housed in Pump House 1 and still operates.)[14]

Building the first pipeline from Bull Run in the pre-automobile steam and muscle era of the 1890s was a difficult and heroic physical feat. In 1891, Smith convinced Multnomah County to construct four miles of roads and bridges west from the Sandy River through a landscape "covered with dense growth of brush and small timbers."[15] The road six miles east from the Sandy River to the Bull Run headwaters was to be the work of the Water Committee, completed largely by Italian immigrants in 1893-94. The land was cleared by hand because the forest was too thick for horses. Specifications called for all trees, logs and brush to be cleared along 33' right of way with trees being cut to a maximum height of twelve feet. The entire conduit required the excavation and refilling of 270,000 cubic yards of dirt, moving 10,000 cubic yards of loose rock, and cutting through 2,000 cubic yards of solid rock. The pipeline itself was the work of Hoffman & Bates Construction Co., which used six-horse wagon teams to haul 17' five-ton pipe sections along dirt roads to be riveted in place; of particular challenge was laying 2,000 feet of pipe along the bed of the Willamette River.

Construction on the Reservoirs 1, 2, 3 and 4 and ancillary buildings occurred simultaneously with the pipeline. The goal was to complete the reservoirs by January, 1895 when the first Bull Run Water was to flow to Portland. Excavation began in 1893 and was completed in 1894. Laborers were readily available due to the "depression," and with good planning, the work moved along at a rapid pace.

The engineering team of Charles Oliver and James Dix Schuyler worked under Chief Engineer Isaac W. Smith in the construction of the reservoirs. Oliver was born in Iowa in 1856 and came to Oregon in 1864. He was educated in Portland primary and secondary schools, but apparently acquired his engineering skills on the job rather than in the classroom. Prior to his employment by Smith, Oliver had worked in the City Engineer's office as chainman and roadman. Following 1895 he continued to work for the Water Department, primarily at the Bull Run headworks. James Dix Schuyler of Los Angeles, California was hired as a consulting engineer.

His brother Phillip, was the first secretary of the Portland Water Committee. Schuyler designed and constructed the Sweetwater Dam near San Diego and engineered the Hemst Dam in Riverside County, California.

Of the construction, Oliver observed: "I was superintendent of construction on Reservoirs Nos. 1, 2, 3 and 4 during the great depression of 1893 and 1894. They did not call it a depression then, but used the more expressive term, 'hard times'. The Water Committee built all of the reservoirs by day labor, except the excavation that was let by contract. Lawyers, doctors, dentists, accountants, and all classes of men were employed on the work as day laborers at $1.50 per day for common labor, and they were glad to get it. Men with families were employed almost exclusively. At times we had as many as 1500 men on the payrolls for the four reservoirs."[16] In total, the reservoir system had 66 million gallons combined capacity, enough to supply the city for 4-5 days. The conduit and distribution system took nearly two years and $2.4 million to build. As the project neared completion, the Water Committee issued a report on its operations in October, 1894:

Millions of dollars have been spent, a great public work carried to completion; no scandal exists; no charges of mal-administration are made; not even a hint of speculation is suggestion . . . The work of the Committee is practically done. It must be judged by its works. The City of Portland will have a supply of water which for purity is probably unexcelled anywhere in the world.[17]

An in-depth Oregonian article featuring details of the Bull Run system and the reservoirs published on January 1, 1895 stated, *When this work is completed the brilliantly lighted walks surrounding the reservoirs will be the most popular promenades in the city during the evenings of the warmer months of the year …These walks afford a delightful promenade for visitors who are separated from the basin itself by a concrete wall surmounted by a neat fence. All the reservoirs have been constructed in the most substantial manner and the effect of harmony it was possible to obtain by a little attention to the adornment of the finished work has not been overlooked by the engineers in charge.*"[18]

Meeting their construction deadline, on January 2, 1895, Bull Run water flowed into the city for the first time. In an ironic twist, it was Governor Pennoyer, perhaps with a palette accustomed to the more complicated constituents of Willamette River water, who took the ceremonial first drink and announced its inferior quality: "No Body!"[19]

Despite the enormous expense and controversy, the Water Committee had been determined to provide quality water and plenty of it. The first investment at $700,000 in bonds, was seven times the city's debt limit and an approximate investment of $15 per capita. By the end, the Water Committee had spent $5,400,000 in bond revenue (the equivalent of $100 million today) costing approximately $31 per capita. At the time, water rates were roughly $12 per household. The bond obligation of property tax revenues to pay for the water system far exceeded anything the city had contemplated before. As late as 1907, the city had only seven outstanding bonds totaling just less than $9 million. Of these, the water system made up two-thirds. The next closest bond was bridges at $1.1 million.[20]

Mount Tabor Reservoir 1: The Water Committee purchased less than a 10-acre area on Mount Tabor to build Reservoir 1, also referred to as the Mount Tabor "high service" reservoir. The basin itself is 1.63 acres. It was designed to be the primary site to store and deliver water to the other reservoirs, including Reservoir 2, the "low service" reservoir to the immediate southwest at the base of the butte, as well as to Reservoirs 3 and 4 six miles to the west across the Willamette River. Situated on the south side of Mount Tabor at an elevation of 411.6 feet, the site was determined by geography and availability of land. Excavation of the hillside allowed for the east, north and west sides to use the natural embankment. Reservoir 1's elevation was considered optimal for storage since the elevation and site allowed for easy distribution using gravity to the growing population of the east and west sides of Portland. Because of the optimum elevation for Portland's water needs, seventeen years later Reservoir 5 was constructed on the west side of Mount Tabor at the same elevation as Reservoir 1 and the two were tied together via a tunnel so that they could work as one reservoir.

Reservoirs 1, 2, 3, and 4 shared basic design and construction techniques. All were both creatively engineered and aesthetically attractive. The Gatehouses were round or oval in shape complementing the rounded features of the basins. The method of reinforced concrete construction adopted for the water system was quite innovative at the time. Although unreinforced concrete was nothing new at the time, reinforcing methods were in the early experimental stages. The method of concrete construction used for the reservoirs had a patent, known as the "concrete and twisted iron patent." The concrete finish on the buildings was also patented, as were the circular lights cast in the concrete of the gatehouse floors and pump house roof, and even the concrete mixer itself. All these patents were held by Ernest Leslie Ransome, considered by historians as the leader in early reinforced concrete technology in the United States.[21]

The concrete work for the Gatehouse at Reservoir 1 is notable, not only because it was technically innovative, but also because of its aesthetic qualities. Wooden formwork was constructed to give the poured concrete the general outlines of stone blocks. Elaborate scaffolding allowed workers to climb up the outside of the structures after each pour of concrete. When the beveled formwork was removed, the concrete was hand tooled and bush hammered to simulate rusticated stone blocks. This construction technique differs from the more common "cast stone" block construction that was often used in residential construction at the time. The concrete itself was notable. Josson brand, imported through Antwerp, Belgium, was used until shipments were delayed in the middle of the project. Instead of holding up the project, North brand cement, available locally, was substituted.

Original contracts for all the basins seem to indicate that they were originally to be lined with brick and then coated for water proofing instead of being constructed with concrete panels. As the bricks were not available when construction began, concrete was utilized, with the exception of Reservoir 2. (Reservoir 2 was an afterthought whose construction was encouraged by the consultant to the project, James D. Schuyler. Because construction was begun later than the other 3 reservoirs, brick was utilized in the basin of Reservoir 2.) Reportedly all of the reservoir basins, with the exception of Reservoir 2, now demolished, were "lined with concrete strengthened with twisted iron placed at intervals of 10 feet in each direction, and anchored at intervals of 10 feet by means of anchors driven to a depth of from 3 to 20 feet into the slopes forming the sides of the reservoirs and imbedded in concrete."[22] The concrete basins were lined with asphalt, imported from a California firm, Alcatraz Asphalt refinery. "The asphalt used in the reservoirs is pure natural bitumen…."[23]

Contracts for the design of the ornamental wrought iron fence (and lamp posts of Resevoir 3 and 4) encircling the basins of the 1894 reservoirs were awarded to Whidden and Lewis, who also designed Portland City Hall built in 1895. On September 20, 1894, the Water Committee contracted with Johann H. Tuerck to manufacture the fences and lampposts from wrought iron. Tuerck, born in Germany in 1863, was trained in Bayreuth, Munich and Nuremberg before he came to America in 1888. Eighteen months after arriving in Portland in 1890 he established Portland Art Metal Works. The Oregon Chapter of the American Institute of Architects presented Tuerck with their premier award in June, 1928, in honor of his "exceptional ability."[24] He is credited with the work for major banks, clubhouses, churches and residences built in Portland from the 1890s. Some of his projects included the main entrance door of the Julius Meier home, the conservatory entrance of the Harry A. Green home, as well as work for the Congress Hotel and the Temple Beth Israel. The ornamental wrought iron fences and lampposts on the Reservoirs are prime examples of his work.

<u>Completing the Bull Run System</u>: In 1903, the city of Portland reorganized its government and the 15-member Water Committee was replaced by a 5-member Water Board. The shift in oversight did not appreciably change the operations or policies. One of the first actions of the Water Board was to endeavor to restrict public access to the approximately 120 square mile Bull Run watershed. In December, 1903, the Water Board officially requested limited entry, placing the site off limits to the public. President Theodore Roosevelt agreed that with the unique character of the land and on April 28, 1904 signed Public Law #206, popularly known as the Bull Run Trespass Act. Currently this watershed is still jointly managed by the city of Portland and the U.S. Forest Service. Public access is restricted.

While the Water Committee aggressively sought to create a long-term water system with capacity for 24,000,000 gallons per day, Portland's population continued to grow exponentially. Following the 1905 Lewis & Clark Exposition, Portland boasted 172,000 residents; nearly three times the number when construction on the Bull Run system began in 1893. Shortly after the Exposition, the Water Board decided to build Conduit #2, a $3 million project that included two additional reservoirs and additional capacity of 50 million gallons per day and storage capacity of 125 gallons. While this project would be funded by bonds, the process was considerably less rigorous than the first time. In 1902, Oregon voters had approved the Initiative and Referendum Amendment to the state constitution. This change allowed voters to create laws by direct ballot. In 1906, the voters approved an initiative that gave Oregon cities the right to amend their own charters. This change eliminated the need to go to the state legislature to raise debt. The City Council then referred the Water Board's request to the voters, who narrowly approved the measure. After some public debate, it was decided to build two additional reservoirs on Mount Tabor and, at the same time that land was being acquired for the reservoirs, to purchase additional land for creation of a public park. Both reservoirs were completed in 1911. Since that time no new open reservoirs have been constructed in Portland and the original reservoirs continue to supply water to Portland. By 1911, the physical structure of the Bull Run system was in place with headquarters, two conduits and six reservoirs.

Reservoirs 5 and 6

Early in 1909 sites for the reservoirs were secured and in October of that same year contracts were awarded to Robert Wakefield & Company for construction of Reservoirs 5 and 6. Isaac Smith, Chief Engineer of the Water Committee who had designed the Bull Run System, including the 1894 reservoirs, died in 1897 and was succeeded by David Dexter Clarke who had worked for the Water Committee since 1893. Clarke was responsible for the design of Reservoirs 5 and 6. Born in New England, Clarke moved to Portland in 1864. He and Smith had worked together, Clarke as Smith's principal assistant, on the construction of the Tacoma Water Works in the state of Washington. After 24 years of service, Clarke resigned his position of Chief Engineer of the Water Committee in 1917.

The long-term affiliation of Smith and Clarke probably helped to create the harmonious relationship between the 1894 site and the 1911 reservoirs. Though the designs of the buildings and other features differ, they are compatible. The Gatehouses at Reservoirs 5 and 6 are constructed of high quality reinforced poured in place concrete and in the years between 1894 and 1911, reinforced concrete had become more commonplace. The surface treatment of the concrete at Reservoirs 5 and 6 was made to look like blocks, and though specified to be bush hammered like Reservoir 1, it was left smooth. The wrought iron fences and lampposts of Reservoirs 5 and 6 have a similar design as those of the 1894 reservoirs, but are less detailed. Conspicuously missing are the forged hammered leaves and the intricate detailing of the lamppost scrolls. The 1911 ironwork, especially the lampposts are more hefty, less delicate than that of the 1894 work.

Additional Contributing Buildings and structures at Mount Tabor Reservoir Historic District

In 1923 a small rectangular Weir House (Screen House) was constructed to the west of the Gatehouse at Reservoir 1. It is constructed of poured concrete with essentially the same finish and detailing, though darker in color, than the Gatehouse.

In 1951 a poured concrete Weir Building (now known as the Hypochlorite Building) was constructed to the southeast of the Gatehouse at Reservoir 5. The construction style essentially matches the Reservoir 5 Gatehouse, except, like the Gatehouses at Reservoir 6, it is rectangular. This 1951 addition is the last time that the construction of buildings at any of the reservoir sites attempted to match the original romantic Romanesque designs.

A small circular concrete covered tank with a water holding capacity of 200,000 gallons was constructed on Mount Tabor at an elevation of 590 feet. Though Water Bureau sources have offered differing construction dates, in an accounting from a 1913 Department of Public Affairs report, an electric pump plant was being installed at this tank for delivering water to the attic tank in the residence on top of Mount Tabor, now demolished, which had been converted to a public comfort station for the park. The most recent accounting by Water Bureau personnel confirm construction in 1912 and suggest that this is a "reservoir" serving approximately 850 water customers at the highest elevation in the Mount Tabor neighborhood.

Associated with the utilitarian concrete covered tank is an original building that continues the romantic style theme of the other reservoir gatehouses with the arched doorway, original matching wood plank door, and the cut basalt block cornice.

Post-1911 Additions to the Bull Run Water System

In 1913, the city charter was revised and the Water Board transformed into a city bureau under the supervision of a city commissioner. With the Bull Run system in place, the Bureau continued to concentrate on expanding capacity and distribution to meet the growth of the city. Though changes were made to the delivery system and the headwaters, the Water Bureau made no significant modifications to the aesthetic design of the reservoir system. In 1952, the Bureau completed a fourth conduit, with capacity of 100 million gallons per day. In 1981, an underground reservoir at Powell Butte was added with capacity of 50 million gallons. In addition, the system has 69 smaller tanks and standpipes with a capacity of 68.2 million gallons located throughout the city.

Portland's East Side Development and Demand for Park Land

The Mount Tabor reservoirs also meet Criterion A as they helped to develop and bind Portland's east side with the central urban core area dominated by the west side and the property along the north-south axis of the Willamette River. After considering a variety of water sources, the Water Committee looked to the high mountains to the east of Portland and sited Reservoirs 1 and 2 on the south side of Mount Tabor in what was then, a rural area east of the city proper. The butte was a convenient high point along the route planned for the gravity water distribution system. The name Mount Tabor refers to the volcanic butte, the city park and the neighborhood that at one time was a much larger area of east Portland than makes up the "official" neighborhood presently. Mount Tabor Park is 3 miles east of the Willamette River. Downtown Portland is on the west side of the Willamette River. At the time Reservoir 1 was built, the neighborhood of Mount Tabor was not incorporated into the city of Portland. The reservoir construction project brought employment to the area during the depression of 1893 and 1894 when the area was still predominantly farms. New bridges constructed over the Willamette River beginning in the late 1880's and rail service in the 1890's, afforded easier accessibility and consequently the farmland in the Mount Tabor area was subdivided and the population of the area burgeoned and was incorporated into the city of Portland in 1905 adding more land to the earlier East Portland incorporation of 1901.

The 1911 reservoirs, like those of 1894, brought welcome employment during a national economic downturn.

Interest in building two more reservoirs to enlarge Bull Run water storage, also aided the movement already established to turn the Mount Tabor butte into an official city park. Residents were in the habit of using the land for recreation prior to its purchase by the city for park and Water Board land in 1909. In 1903, John Charles Olmsted was hired to visit Portland in preparation for the 1905 Lewis and Clark Exposition. For three weeks Olmsted toured existing and potential parklands. In his report, issued on December 31, 1903, he wrote, "There seems to be every reason why a portion, at least, of Mount Tabor should be taken as a public park. It is the only important landscape feature for miles around, and the population in its vicinity is destined to be fairly dense. It is already a good deal resorted to by people for their Sunday and holiday outings, and it will be better known to and more visited by the citizens as time goes on."[25] Reference is made to Mount Tabor Park in Park Board reports earlier than 1909. According to an Oregonian article in November, 1908, a "committee from the United East Side Push Clubs … was appointed mainly to have some action taken on the park question, for it has seemed to many citizens that little or no progress is being made toward securing a park at Mount Tabor, or anywhere else…It is said on good authority that the water committee contemplates locating two reservoirs on the west side of Mount Tabor for the second Bull Run pipeline, one for the low and one for the high service system and in that case the full 169 acres and perhaps more will be needed."[26]

Property prices soared with the population increase after the Exposition in 1905, and despite the recommendations of the esteemed Olmsted and public sentiment, the city did not act on purchasing land, other than that already controlled for Reservoirs 1 and 2 until 1909. As residential subdivisions burgeoned, pressure mounted to acquire parkland, and in 1907 a one million dollar bond issue passed narrowly but was then held up with legal entanglements. The Park Board went ahead and retained the Olmsted firm to prepare a land acquisition plan and they hired a former employee of the Olmsted's to prioritize and acquire parklands. In 1908, Emanuel T. Mische, a highly trained horticulturist in the employment of the Olmsted's Massachussets firm for eight years, was hired as superintendent of Portland parks. By 1909 four east side park lands were purchased including Mount Tabor, the most costly acquisition. Mount Tabor lands were acquired by the Water Board at the same time for the construction of Reservoirs 5 and 6 as reported by the Oregonian in March, 1909, "The property to be used for park purposes is some of the choicest in the city…From it may be had a magnificent view of the city and surrounding country and that it will become one of the principle attraction(s) in Portland is the belief of those who have studied it carefully. That portion which is to be purchased by the Water Board is to be used for a system of huge reservoirs, to be used in connection with the new pipe line…"[27] The area around Mount Tabor Park and its reservoirs helped to create a neighborhood which included some grand historic houses and two private colleges.

Criterion C: Architecture, Landscape and Engineering in the Progressive Era

"... beauty has always paid better than any other commodity and always will." Daniel Burnham, Designer of Chicago's "White City."[28]

The City Beautiful movement arose out of the Progressive Era. Some contend that the City Beautiful ideals were launched at the 1893 World's Columbian Exposition in Chicago. Designers such as architect Daniel Burnham and landscape architect Frederick Law Olmsted, of New York's Central Park fame, created the "White City" to illustrate how beautiful the built environment could be in a well-planned city. European styled-classical beauty coexisted with the most modern technological inventions. Moving sidewalks and modern lighting paired with buildings designed in a neoclassical style. Carefully implemented street plans included landscapes, outdoor sculpture, and grand water features.

The Exposition brought city planning to the forefront. Many architects and landscape designers were influenced by this Exposition and they brought their excitement back to their respective communities. Professional publications and promotional literature reached across the country. Completed in 1894, the reservoirs were designed and constructed at the start of the excitement about the Exposition. H.W. Corbett, business leader on the original Portland Water Committee when the first reservoirs were designed and built, went on to chair the 1905 Lewis and Clark Exposition commission in Portland.

The Columbian Exposition of 1893 show-cased water as a primary aesthetic feature in city planning. The exploitation of the waterfront as a space for beauty and public recreation was a major innovation. Before 1893 water frontage was primarily commercially exploited. Though the Olmsted firm preferred naturalistic water features, they appreciated the aesthetic character that open water brought to a landscape, even with the sterile banks and contrived shapes that water storage reservoirs usually exhibited. In The Relation of Reservoirs to Parks, written in 1899, Frederick Law Olmsted, Jr. discusses the virtues of reservoirs in parks and sums up his views as follows:

All reservoirs, have, in addition to their essential quality of storing water, an element of landscape effect; namely, that of an expanse of clear, sparkling water. This same element forms the chief feature of many landscapes in public parks, where it is created at large cost, and it is clearly a thing of great value to the public when it can be made available. In itself, regardless of its outline or setting, a body of water is beautiful and refreshing, and its value to the public is so well recognized that provision is very often made for giving the public access to the enclosure about a reservoir, whence it surface may be seen.[29]

Reservoir 1 clearly, both in the design of the gravity fed water system, still integral to water delivery in the city today, and in the architecture that graced the landscape. Although formal, the oval shape of the gatehouse enhanced the romantic character of the setting, complete with the planned Terrace Garden, it conjured images of "Old Europe." This romanticism was typical of the period.

Although Reservoir 1 predates the creation of Mount Tabor Park, like Reservoirs 3 and 4 in City Park (now Washington Park in the west hills) the reservoir benefited from thoughtful planning and was constructed with elegance befitting the striking location it occupied. Classical architectural style was adapted to utilitarian structures that featured innovative technology and inviting walkways and landscaping, including the Terrace Garden across the top of the dam in front of the Gatehouse. The design provided a destination for inspiration and rejuvenation and encouraged the development of the surrounding land into a public park.

Reservoirs 5 and 6 were planned in conjunction with the park in 1909 and continued the theme of "beautility." All of the reservoirs elevated the storage and distribution of water by enhancing water's highly prized characteristics in a recreational landscape . With their completion, the reservoirs provided fountains spouting from the center of the basins, aerating the water and entertaining at the same time. Walkways spanned the dams and encircled the basins and the use of gas lamps (to be replaced with electric lights powered by the generation of electricity from the fall between the two reservoirs) ensured evening use of the park. The light reflecting in the deep water created a romantic feeling. This character is preserved even today, though modern lights have replaced the period lamps. Reservoirs 5 and 6 were to be "formal features" in an otherwise primarily natural park setting. Instead of overflow water being routed to the sewer system, Emanuel T. Mische, former Olmsted associate and park superintendent from 1908 through 1915, saw "its high potential value in an ornamental scheme is the basis of the cascade feature. The water is to fall over a series of dams so contrived as to agitate and increase its seeming volume, be caught in a series of pools and supply several spray jets."[30] Reservoirs 1, 5 and 6 were a monument to the importance of water as a life-giving substance and as a beautiful visual resource for the benefit of the community.

Early Reinforced Concrete Work and the Patents of Ransome

Concrete was only beginning to be considered a serious building material when the reservoirs were constructed. Collectively, the Bull Run system as built in 1894 is perhaps the earliest large application of reinforced concrete in the state and one of the earliest major reinforced concrete projects in the country. The headwaters, now demolished, and reservoirs with associated buildings were all constructed using a reinforced concrete system call "the Ransome System," created in a series of patents by Ernest L. Ransome. The method of concrete construction used for the reservoirs had a patent, known as the "concrete and twisted iron patent." The concrete finish was also patented, as were the circular lights cast in the concrete of the gatehouse floors and pump house roof, and even the concrete mixer itself.

Reinforced concrete first developed as a construction technique in the 1850s. The earliest accepted use of reinforcing in concrete was by Frenchman Jean-Louis Lambot in the early 1850s. He reinforced his concrete boats with iron bars and wire mesh. He also had some plans for using this material in building construction because he applied for patents in France and Belgium in 1856. About the same time, in 1854, William Wilkinson of Newcastle-on-Tyne erected a small two-story servant's cottage reinforcing the concrete floor and roof with iron bars and wire rope. Wilkinson took out a patent on his technique and is generally credited with constructing the first reinforced concrete building. In the United States, the first building in reinforced concrete was by American mechanical engineer, William E. Ward, in Port Chester, New York, completed in 1875. Over the next quarter century, Ernest L. Ransome pioneered the development of reinforced concrete in the United

States, while Europeans G. A. Wayss of Germany and Francois Hennebique of France paralleled Ransome's innovations on the continent. Architectural critic Ada Louise Huxtable has described Ransome as the "Father of reinforced concrete" "As engineering and design, Ernest Ransome's work deserves a prominent place in the story of American architectural advance."[31]

Ernest Leslie Ransome (1844-1917) was born in Epswich, England. His family had engaged in the manufacture of agricultural machinery since the late eighteenth century and some of Ransome's ancestors had been inventors as well. Between 1844 and 1867 his father, Frederick Ransome, developed and manufactured a patented concrete stone. Following an apprenticeship in the family business, Ernest came to the United States to exploit his father's patent. He settled in San Francisco where he established a business to manufacture concrete blocks. His first notable innovation came in 1884 when he used twisted square bars as reinforcement, employing the technique in building the Arctic Oil Works completed that year. The round bars previously used had not established a good connection with the surrounding concrete. These twisted square bars, which came to be known as "Ransome bars," were used as reinforcement for Portland's reservoirs.

"Up to about 1888 my work in reinforced concrete was largely confined to what we now term small and unimportant structures," wrote Ernest Ransome in a contribution to the history of reinforced concrete.[32] His first major work was the 3-story Bourn & Wise wine cellar at St. Helena, California and the Academy of Sciences Building in San Francisco, both in 1888. The following year saw construction of the Alvord Lake Bridge in Golden Gate Park, the first reinforced concrete bridge in the United States. Besides the 1894 Portland Reservoirs, major works known using the Ransome system included the 1894 Stanford Museum in California and industrial buildings such as the 1897 Pacific Coast Borax Building in Bayonne, New Jersey, the 1903-04 Kelly and Jones Machine Shop in Greensburg, Pennsylvania. One of the largest projects using the Ransome system was the United Shoe Machinery complex in Beverly, Massachusetts, begun in 1902; that site was 74 acres and 3,340 linear feet. In 1904, the 16-story Ingalls Building (Cincinnati, Ohio) was the first reinforced concrete skyscraper. It remained the tallest reinforced concrete building until 1923 when the Medical Arts Building was constructed in Dallas, Texas. Other concrete achievements utilizing the Ransome system in the era include construction of the first concrete street in Bellefontaine, Ohio in 1891, and the construction of the reinforced concrete Harvard Stadium in Cambridge, Massachusetts in 1904.

Later Concrete Construction

By the time of the second phase of construction in 1911, reinforced concrete was a common method of construction. Reservoirs 5 and 6 were constructed to match Reservoir 1 stylistically, but were apparently not part of the Ransome patent. Cost cutting measures were undertaken with the finishing of the gatehouses at Reservoirs 5 and 6 as the original plans call for a hand chiseled finish. This work was never done. When the concrete Screen House was added to Reservoir 1 in 1923, it was again designed to match the 1894 gatehouse, and the Ransome finish was used. In 1951 a poured concrete Weir Building of a Romanesque style was added to Reservoir 5. Like the Gatehouses of Reservoir 5 and 6, it had the look of blocks but the finish was smooth.

The 1951 building was the last construction in the district that contributed to the aesthetics. Utilitarian design alone was used with the other two small non-descript, non-contributing concrete buildings added at Reservoir 5 (Outbuilding) and at Reservoir 6 (Hypochlorite Building.) Due to their modest style and size they do not detract from the earlier buildings.

Summary of Significance

Of the more than 5,000 properties included in the last Portland Historic Resource Inventory only 52 were considered Rank 1 and of the 52, the reservoirs of Mount Tabor and Washington Park accounted for 6 of them. Quotes from the city's recent evaluation of the reservoirs offer a good summary of this resource:

The great amount of historical documentation available on these properties indicates their historical importance to the City. The reservoirs are historically significant as examples of early engineering, and serve as monuments to the social history of the City's growth and development. They provide an early example of a planned landscape, including the views and vistas into and out of the landscape."[33]

Footnotes

[1] Lutino, Cielo. Merker, B., Green, R. "The City Beautiful Movement and Civic Planning in Portland, Oregon 1897 – 1921 National Register of Historic Places Multiple Property Nomination." 2001.

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[3] Melois, Martin V. The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present. (Baltimore: Johns Hopkins University Press, 2000).

[4] Proposed Amendment to Section 227 of the Charter of the City of Portland, November 19, 1908, p. liv-lv.

[5] Consumer Price Index, 2001 (All inflation estimates based on this reference).

[6] Melois, Martin V. The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present. (Baltimore: Johns Hopkins University Press, 2000).

[7] "Waterworks for the City of Portland, Oregon" (Portland, OR: R. H. Schwab & Bro., 1886).

[8] Ibid.

[9] John B. David, David P. Thompson and Jacob Kamm v. The City of Portland, et al, October 28, 1886.

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10 City of Portland, Oregon. Water: Portland's Precious Heritage. (Portland, OR: City of Portland, 1983).

11 Ibid.

12 Ibid.

13 Ibid.

14 Montgomery Watson Harza. Open Reservoir Study, Draft TM 5.7 Facilities Evaluation, City of Portland. August, 2001.

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23 Ibid.

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28 Kallus, Melvin. Frederick Law Olmsted: The Passion of a Public Artist. (NY: NY University Press: 1990).

29 Olmsted, Jr., Frederick Law. The Relation of Reservoirs to Parks. (Boston: Rockwell and Churchill Press, 1899).

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31 Quoted in www.cummings.com/arc.html.

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