ROBERT B. MORSE WATER FILTRATION PLANT
(Washington Suburban Sanitary Commission, Burnt Mills Facility)
10700 and 10701 Columbia Pike
Silver Spring
Montgomery
Maryland

HAER MD-166
MD-166

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
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(Washington Suburban Sanitary Commission, Burnt Mills Facility)

HAER No. MD-166

Location: 10700 and 10701 Columbia Pike, Silver Spring, Montgomery County, Maryland

The Robert B. Morse Water Filtration Plant is located at UTM Zone 18, easting 326353.847m, northing 4321863.204m. The coordinate represents the approximate center of the High-Lift Pumping Station. This coordinate was obtained on April 15, 2009, by plotting its location on the Kensington, MD USGS Digital Raster Graphic in ESRI ArcGIS 9.2. The accuracy of the coordinates is +/- 12 meters. The coordinate datum is North American Datum 1927 CONUS.

Present Owner: Maryland-National Capital Park and Planning Commission

Present Use: Burnt Mills East and Burnt Mills West parks now encompass the site of the former Robert B. Morse Water Filtration Plant and contain trails and parking lots for visitors. The former pumping stations currently stand vacant.

Significance: Constructed by the Washington Suburban Sanitary Commission and opened in 1936, the Robert B. Morse Water Filtration Plant is significant for its unique filter assembly designed by Chief Engineer Robert B. Morse. Rather than locating the steps of the filtration process (sedimentation, flocculation, filtration and storage) in separate structures, Morse designed a filter assembly that incorporated nearly all the steps into one circular structure. Although the filter assemblies were removed after the plant was taken offline in 1962, elements of the filtration process remain. The site is also significant in the history of the development of municipal water systems, both in the Washington, D.C., metropolitan region and in the United States.

Historian: Justine Christianson, HAER Historian, 2008

Project Information: The Historic American Engineering Record (HAER) is a long-range program that documents and interprets historically significant engineering sites and structures throughout the United States. HAER is part of Heritage Documentation Programs (Richard O'Connor, Manager), a division of the National Park Service, United States Department of the Interior. The Robert B. Morse Water Filtration Plant recording project was undertaken in cooperation with the Maryland-National Capital Park and Planning Commission's (M-NCPPC) Cultural Resources Stewardship Section (CRSS), Park Planning & Stewardship Division, Elizabeth Jo Lampl, Manager. Christopher Marston, HAER Architect, served as project leader. Julianne Mueller (CRSS) oversaw the project and provided access to the site. Alden Watts (CRSS) provided research assistance. The HAER field team consisted of Will Dickinson, volunteer Laila Sharafi, and Anna Aranovich. Renee Bieretz and Jet Lowe, HAER, produced the large format photographs. Justine Christianson, HAER, served as the project historian.

Part I. Historical Information

A. Physical History of Buildings:

The Washington Suburban Sanitary Commission (WSSC) built the Robert B. Morse Water Filtration Plant and opened it for operation in 1936. Colesville Road (also known as Columbia Pike and U.S. Route 29) bisects the site on which the remains of the plant are located. The Northwest Branch of the Anacostia River, whose water the plant filtered, borders the site to the south and west. As originally constructed, the components of the plant included a dam, preliminary sedimentation basin, low-lift pumping station with two adjacent aerators, hydro pumping station, outbuilding, two filter assemblies, high-lift pumping station, two wash water tanks, and high tension substation. The plant had a 10 million gallon/day capacity (a common unit of water-use measurement, usually abbreviated as Mgd) and could serve 75,000 customers according to a 1935 article written by its designer, Robert B. Morse.[1] The filter assemblies consisted of concentric rings around a central well, which contained a pipe vault topped by a control house. The ring circling the central well was divided into four filters. The next ring served as the coagulating basin, and the outermost ring stored the filtered water. The WSSC dismantled and removed the filter assemblies and machinery after the closure of the plant in 1962. Currently, the site consists of the dam, high-lift and low-lift pumping stations, a parking lot on top of the former preliminary sedimentation basin, high tension substation, and a small brick outbuilding to the rear of the low-lift pumping station.[2]

The WSSC destroyed the original documents and drawings relating to the design, construction and operation of the plant, which has made describing the structures and the operation of the plant difficult. Robert B. Morse, Chief Engineer of the WSSC who designed this plant, published a few articles detailing its design and operation. These, coupled with several extant copies of drawings held by the Maryland-National Capital Park and Planning Commission, photographs, and WSSC publications, provide the basis for both the physical history of the plant's buildings and the description of its operation.[3] Both the extant and dismantled structures originally constructed as part of the plant are described in this section of the report while the later section detailing the current state of the site describes only the extant structures.

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[1] Robert B. Morse, "The New Water Purification Works at Burnt Mills, Maryland," *Journal of the American Water Works* 27, no. 6 (June 1935): p. 679. The low-lift pumping station is variously referred to as the head house and raw water pumping station, while the high-lift pumping station is also known as the high service pumping station.

[2] This description is based on site visits made in May-June 2008 by the field team.

[3] Morse acknowledged the aid of Assistant Engineer Charles O. Wherley "in developing many details for which no precedent appeared at hand" in his article, "Features of the New Water Purification Works at Burnt Mills, Maryland," *Water Works and Sewerage* LXXXI, no. 6 (June 1934): p. 182.

Dam (Extant):

1. **Date of Construction:**
The dam was constructed from 1929-30 at a cost of $94,000 and replaced an earlier dam at this site. It was completed in May 1930.[4]

2. **Architect/Engineer:**
The engineer who designed the dam is not known, but presumably it was someone employed by the WSSC, perhaps Morse himself.

3. **Builder/Contractor/Supplier:**
The builder of the dam is unknown, but it may have been built by the WSSC's day labor force since they were responsible for constructing the pumping stations.

4. **Original Plans:**
The original plans have not been discovered for the dam, but contemporary accounts do exist that include descriptions of its as-built condition. Located in a "narrow, shallow gorge characterized by comparatively steep sides and a flat rock bottom," the Ambursen-type, reinforced concrete dam measures 215' in total length with a 150' long spillway and has a 60' thick base. The downstream face is ogee-shaped (meaning it has a slightly S-shaped profile), while the upstream side is flat with a 1:1 slope.[5] The height of the spillway above the water level has been variously recorded as 20', 22', and 23'.[6] The height of the dam has been recorded as 30' and 32'.[7]

   As built, the dam created an approximately 1.5 mile-long reservoir covering 13.5 acres with a 30 million gallon capacity. The primary purpose of the dam, however, was not to create a reservoir but to raise the level of the Northwest Branch of the Anacostia River enough to allow water to flow by gravity from the dam to the filtration plant. The installation of 4' wood flashboards, which were put in place usually between April and October, increased capacity to 50 million gallons. The flashboards fell when the water level reached 3.3' above their tops. The dam's spillway had a discharge capability of 8,000 cubic

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[4] Washington Suburban Sanitary Commission (WSSC), "Burnt Mills Dam," Press Release, March 1966, unpaginated.
[5] Farrell F. Barnes and Carl B. Brown, "Advance Report on the Sedimentation Survey of Burnt Mills Reservoir, Silver Spring, Maryland, February 22-March 3, 1938," U.S. Department of Agriculture, Sedimentation Studies, Division of Research, in cooperation with the Maryland Agricultural Experiment Station, January 1939, p. 3.
[6] Washington Suburban Sanitary Commission, "A Brief Detailed Description of the Robert B. Morse Filter Plant and Appurtenant Works at Burnt Mills, Maryland," June 8, 1936, unpaginated, gives the spillway height as 20'. In an article entitled "The New Water Purification Works at Burnt Mills, Maryland," *Journal of the American Water Works* 27, no. 6 (June 1935): p. 680, Morse states the spillway measured 22' "above original water level in the stream." Barnes and Brown, "Advance Report on the Sedimentation Survey," p. 3, give the height as 23' above the lowest part of the channel.
[7] WSSC, "Burnt Mills Dam," unpaginated, gives the dam height as 30' above the stream bed; Barnes and Brown, "Advance Report on the Sedimentation Survey," p. 3, states it is 32'.

feet/second. Two screened intakes are located in the dam abutment where water from the reservoir passed into the pipes that led to the filtering operation.[8]

5. **Alterations and Additions:**
   The flashboards are no longer installed on the dam. Their abandonment probably dates to the 1962 closure of the plant.

Aerators (Removed):

1. **Date of Construction:**
   The two aerators were presumably installed with the construction of the low-lift pumping station in 1936.

2. **Supplier:**
   The aerators were the "Aer-O-Mix" brand.[9]

4. **Original Plans:**
   The aerators had a 6 million gallon/day (Mgd) rating and were located adjacent to the low-lift pumping station within extant concrete structures. Blowers also provided additional air to the aerator's U-tubes when necessary.[10]

5. **Alterations and Additions:**
   The aerators have been removed, probably as part of the 1962 closure of the plant.[11]

Preliminary Sedimentation Basin (also referred to as the Preliminary Sedimentation Reservoir) (Extant but altered):

1. **Date of Construction:**
   The preliminary sedimentation basin had been finished by spring 1934.[12]

2. **Architect/Engineer:**
   Robert B. Morse designed the plant, with assistance from Charles O. Wherley.

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[8] WSSC, "Burnt Mills Dam," unpaginated; WSSC, "A Brief Detailed Description," unpaginated; Barnes and Brown, "Advance Report on the Sedimentation Survey," p. 3.
[9] Morse, "Features of the New Water Purification Works," p. 179; Morse, "New Water Purification Works," p. 681.
[10] Morse, "New Water Purification Works," p. 681.
[11] The December 11, 1961 edition of *The Washington Post* contained information about WSSC Contract No. 3283, which involved dismantling and removing the site's steel filter units, steel standpipes, pumping equipment and piping (p. B9).
[12] Morse, "Features of the New Water Purification Works," p. 179.

3. **Builder/Contractor/Supplier:**
   Although the builder of the preliminary sedimentation basin is unknown, the WSSC's day labor force may have been responsible for its construction since they also built the pumping stations.

4. **Original Plans:**
   According to contemporary descriptions, the concrete preliminary sedimentation basin measured 110' wide x 200' long. The inlet end measured 8.5' deep, the center was 13' and the outlet end was shallowest at 6' deep. The capacity of the basin was 1.7 million gallons, which allowed for a sedimentation period of three-and-a-half to four hours.[13] An automatic valve on the inlet line controlled the basin's water level within 6" to prevent overflowing.[14]

5. **Alterations and Additions:**
   As part of the plant's 1962 closure, the WSSC filled in the basin and built a parking lot on top. The concrete wall surrounding the original basin is still extant and forms the perimeter of the parking lot. The wall contains traces of the pipe railing that was originally located on top of the wall. Light standards once circled the perimeter of the basin, but now only five light poles remain.

Outbuilding (Extant):

1. **Date of Construction:**
   The outbuilding was probably constructed at the same time as the rest of the plant since it is stylistically similar to the pumping stations.

2. **Architect/Engineer:**
   Robert B. Morse designed the plant, with assistance from Charles O. Wherley.

3. **Builder/Contractor/Supplier:**
   Although the builder of the outbuilding is unknown, the WSSC's day labor force may have been responsible for its construction since they also built the pumping stations.

4. **Original Plans:**
   The Colonial Revival style outbuilding, located at the east end of the preliminary sedimentation basin, is not described in contemporary accounts of the plant. Its location suggests that the building originally may have housed valves to control water flow to the preliminary sedimentation basin and/or the hydro pumping station. The only clue to the building's later use is a set of papers dating to November 1968 and distributed by the AT&T Company that are tacked to the back wall. The papers provide information about the N2

[13] Morse, "New Water Purification Works," p. 681. WSSC, "Brief Detailed Description," unpaginated, gives the depths of the basin as ranging from 6.9'-13.9'.
[14] WSSC, "Brief Detailed Description," unpaginated; Morse, "New Water Purification Works," p. 681.

Repeater, Repeated High-Frequency Line, N2 Repeater-To-N1 and –N1A Adapters.

Hydro Pumping Station (Removed):

1. **Date of Construction:**
   The foundation of the hydro pumping station had been completed by spring 1934, and the station began operating in November of that year.[15]

2. **Architect/Engineer:**
   Robert B. Morse designed the plant, with assistance from Charles O. Wherley.

3. **Builder/Contractor/Supplier:**
   Although the builder of the hydro pumping station is unknown, the WSSC's day labor force may have been responsible for its construction since they also built the pumping stations.

4. **Original Plans:**
   The hydro pumping station has been removed and no plans for it have been found, but contemporary descriptions of the plant provide some information. According to Morse, the WSSC built the hydro pumping station to take advantage of the abundant water supply provided by the Northwest Branch and augment the high-lift pumping station's capacity. The one-story brick structure measuring 30' long x 16' wide was originally located near the Northwest Branch behind and down-slope from the preliminary sedimentation basin. The building contained a high-lift pump with a 1.75 Mgd capacity against a 275' head (referring to the pressure exerted by a certain depth of water). One end of the pump shaft connected to a 100-horsepower (hp) electric motor while the other end connected via speed-increasing gears to a 137-hp hydraulic turbine. Water was delivered to the turbine via 42" and 36" cast-iron pipes from the dam. The turbine's rating was 105 hp at a 33' head or 120 hp at a 37' head. The station pumped filtered water from the filter assembly into the distribution system, thereby increasing the capacity of the high-lift pumping equipment housed in the high-lift pumping station to 21 Mgd.[16] Morse noted that the station "provides a valuable auxiliary or emergency source of pumping, keeping down the maximum demand charge during on-peak hours in the winter when stream-flow is ordinarily above normal, and reducing the required gasoline engine capacity, not to mention the incidental saving obtainable in a decrease of electrical energy used."[17]

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[15] Morse, "Features of the New Water Purification Works," p. 179; Morse, "New Water Purification Works," p. 680.
[16] WSSC, "Brief Detailed Description," unpaginated; Morse, "Features of the New Water Purification Works," p. 179; Morse, "New Water Purification Works," p. 684.
[17] Morse, "New Water Purification Works," p. 684.

5. **Alterations and Additions:**
The building was dismantled as part of the 1962 closure of the plant.[18]

Low-lift Pumping Station (also known as the Head House and the Raw Water Pumping Station) (Extant):

1. **Date of Construction:**
The foundation of the low-lift pumping station had been finished by spring 1934.[19]

2. **Architect/Engineer:**
Robert B. Morse designed the plant, with assistance from Charles O. Wherley.

3. **Builder/Contractor/Supplier:**
The WSSC's day labor force built both the high-lift and low-lift pumping stations.[20]

4. **Original Plans:**
Located in front of the preliminary sedimentation basin, the two-and-a-half story, Colonial Revival style, brick low-lift pumping station measures 48' long x 30' wide. Morse described the pumping stations as "steel-framed brick buildings with roof of nailing concrete and slate."[21] Thermostat-controlled electric heat was installed instead of a furnace. "Rock lumber" partitions (presumably Morse was referring to sheet rock) divided the interior space, which was finished with "Euboeolith" brand cement floors, while 1.5" thick Armstrong "Corkoustic" cork tiles clad the walls and ceilings, except in the chemical storage rooms. The Corkoustic helped insulate the buildings as well as absorb the noise and reverberations made by the pumps and other machinery. Morse noted the pleasing effect of the interior finishes: "buff-colored walls and ivory ceilings composed of this material [Corkoustic], in conjunction with the green floors and the pumping machinery painted in light gray, present a decidedly attractive appearance."[22]

All the machinery and equipment have been removed from the building, but contemporary descriptions provide information as to what it once contained. Six electric motor-driven centrifugal pumps with a total capacity of 20 Mgd against a 12' head pumped water to the filter assemblies located across Colesville Road. Two of the pumps (each with a 2 Mgd capacity) operated automatically and maintained the water level in the coagulating ring within a

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[18] The December 11, 1961 edition of *The Washington Post* contained information about WSSC Contract No. 3283, which involved dismantling and removing the site's steel filter units, steel standpipes, pumping equipment and piping (p. B9).
[19] Morse, "Features of the New Water Purification Works," p. 179.
[20] Morse, "New Water Purification Works," p. 691.
[21] Morse, "New Water Purification Works," p. 681.
[22] Morse, "New Water Purification Works," p. 683.

2" range. Two of the pumps (5 Mgd) were connected to gasoline engines so they could continue operation even in power outages. Various gauges monitored the amount and rate of water being pumped into the filters. The second floor contained four dry-feed chemical machines to add alum, soda ash, and activated carbon to the water as needed. The second and third floors contained chemical storage spaces, including a secured area with a metal gate and lock that effectively restricted access that is assumed to date to the original construction of the building.[23]

5. **Alterations and Additions:**
The original equipment and machinery used to operate the low-lift pumping station were removed as part of the 1962 closure of the plant.[24]

High-lift Pumping Station (also known as the High Service Pumping Station) (Extant):

1. **Date of Construction:**
The high-lift pumping station dates to 1936.

2. **Architect/Engineer:**
Robert B. Morse designed the plant, with assistance from Charles O. Wherley.

3. **Builder/Contractor/Supplier:**
The WSSC's day labor force built both the high-lift and low-lift pumping stations.[25]

4. **Original Plans:**
The two-and-a-half story, Colonial Revival style, brick high-lift pumping station with one-story wings at either end has a total length of 82' and a width of 30'.[26] A one-story half-circle projection is centered on the rear ground floor façade and contained the control room. Morse described the pumping stations as "steel-framed brick buildings with roof of nailing concrete and slate."[27] Thermostat-controlled electric heat was installed instead of a furnace. Rock lumber partitions divided the interior space into rooms, which were finished with Euboeolith brand cement floors and 1.5" thick Armstrong Corkoustic cork tiles on the walls and ceilings, except in the chemical storage rooms. The Corkoustic helped insulate the buildings as well as absorb the noise and reverberations made by the pumps and other machinery. Morse noted the pleasing effect of the interior finishes: "buff-colored walls and ivory

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[23] "WSSC, "Brief Detailed Description," unpaginated; Morse, "New Water Purification Works," pp. 681-82.
[24] The December 11, 1961 edition of *The Washington Post* contained information about WSSC Contract No. 3283, which involved dismantling and removing the site's steel filter units, steel standpipes, pumping equipment and piping (p. B9).
[25] Morse, "New Water Purification Works," p. 691.
[26] WSSC, "Brief Detailed Description," unpaginated.
[27] Morse, "New Water Purification Works," p. 681.

ceilings composed of this material [Corkoustic], in conjunction with the green floors and the pumping machinery painted in light gray, present a decidedly attractive appearance."[28]

All the machinery and equipment have been removed from the building, but contemporary descriptions provide information as to what it once contained. There were supposed to be seven electrically-operated high-lift pumps, although one had not yet been installed as of June 1935. It is not known if the seventh was installed as planned. The capacity of the six pumps was 17 Mgd, with the seventh planned as having a 19 Mgd capacity.[29] The two largest pumps were connected to auxiliary 240-hp gasoline engines. All the pumps connected to the filtered water reservoirs contained within the filter assemblies via a 24" header. A control panel and switchboard located in the center of a separate room at the rear of the first floor controlled the pumps. A steel plate trough ran behind the switchboard.[30] The second floor was divided into rooms by partitions clad in Corkoustic.[31] The chemical machine room located on the second floor held three dry feed chemical machines for applying lime, alum, and activated carbon, as necessary. Two chlorinators and an ammoniator were located in a separate compartment from the dry chemical machine room. A chemical and bacteriological laboratory and office were also located on the second floor. The attic had chemical storage space. A "Chlorine Room Partition" is depicted on an extant drawing. This partition was comprised of five full-length, fifteen light windows measuring 2'-8" wide and a door with a similar light pattern but measuring slightly wider at 3'. A 3' hatch in the floor of the third floor was adjacent to two 27" diameter pipes and one 21" diameter pipe.[32]

A drawing shows the pipe layout in the basement of the building. A 24" unlined pipe ran parallel to the pump foundations, with entry points on each end wall. There were connections from each pump to this pipe, which connected to the filter assemblies to the rear of the high-lift pumping station. At the front of the building were entry points for various sized pipes (ranging from 12", 14" and 18") branching off from a 20" discharge line that appears to

[28] Morse, "New Water Purification Works," p. 683.
[29] Morse, "New Water Purification Works," p. 682.
[30] Washington Suburban Sanitary District, "Four Corners District, High Lift Pumping Station Burnt Mills First Floor Plan," Approved December 3, 1934, A-10 34264Y, available from Montgomery County Department of Parks, Facilities Management Office.
[31] Washington Suburban Sanitary District, "Four Corners District, High Lift Pumping Station, Burnt Mills, Second Floor Plan & Reinforcing," Approved December 3, 1934; Revised February 14, 1935, available from Montgomery County Department of Parks, Facilities Management Office.
[32] Morse, "New Water Purification Works," p. 682; WSSC, "Brief Detailed Description," unpaginated; Washington Suburban Sanitary District, "Second Floor Plan & Reinforcing"; Washington Suburban Sanitary District, "Four Corners District, High Lift Pumping Station, Burnt Mills, Floor Reinforcing Plans & Sections," Approved December 3, 1934, A-10 34259Y, available from Montgomery County Department of Parks, Facilities Management Office.

have extended from that portion of the plant on the other side of Colesville Road. These pipes also connected to the pumps on the first floor.[33]

5. **Alterations and Additions:**
The original equipment and machinery used to operate the high-lift pumping station were removed as part of the 1962 closure of the plant.[34]

Filter Assemblies (Removed):

1. **Date of Construction:**
The two filter assemblies were completed in May 1934 and 1936.[35]

2. **Architect/Engineer:**
Robert B. Morse designed the plant, with assistance from Charles O. Wherley.

3. **Builder/Contractor/Supplier:**
The Chicago Bridge and Iron Works Company supplied the steel filter assemblies, which included the pipe vault, filter tanks, coagulating basin, filtered water reservoir, and control house, as well as the influent and effluent steel devices, filter bottom supports, walkways and railings. The company also built the filter control houses located in the center of the assembly. The control houses were outfitted with Euboeolith cement flooring and cork on the walls and ceiling for insulation (presumably Corkoustic). Windows and doors opened to the balcony encircling the control house.[36]

The "Tri-Lok" brand grating used in the filters cost approximately $400 per Mgd.[37]

4. **Original Plans:**
Despite the removal of the original filter assembly prior to the plant's closure in 1962, the basic design and operation of the filter can be determined from extant drawings and contemporary descriptions.[38] (See Appendix A, Figure 1.)

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[33] Washington Suburban Sanitary District, "Four Corners District, Pump Connections, High Lift Station Suction & Discharge Connections & Force Mains," Approved December 3, 1934, A-10 34285Y, available from Montgomery County Department of Parks, Facilities Management Office.
[34] The December 11, 1961 edition of *The Washington Post* contained information about WSSC Contract No. 3283, which involved dismantling and removing the site's steel filter units, steel standpipes, pumping equipment and piping (p. B9).
[35] WSSC, "Brief Detailed Description," unpaginated.
[36] Morse, "Features of the New Water Purification Works," p. 181.
[37] Morse, "Features of the New Water Purification Works," p. 181.
[38] Although the Washington Suburban Sanitary Commission destroyed the records relating the Morse plant sometime after 1994, M-NCPPC does have slides of drawings of the high-lift pumping station and filter assembly that were taken by William Bushong in 1994. The Montgomery County Department of Parks' Facilities Management Office holds paper copies of some drawings of the high-lift pumping station. Bushong researched the plant and completed a Maryland Historic Trust, State Historic Sites Inventory Form that year. See also Morse, "Features of the New Water Purification Works," for images and drawings of the filter assembly.

The circular filter assembly measured 100' in diameter and sat on a concrete slab. Operators accessed the filter assembly via a catwalk extending from the rear of the second floor of the high-lift pumping station. The filter assembly consisted of a central well with a filter control house on top. Three concentric rings in which the various steps of the filtering process took place surrounded the central well. Structural steel plates welded together made up the walls of the filter assembly, which Morse proudly noted achieved a "notable economy in both cost and space." Bitumastic enamel coated those portions of the steel walls in the filters covered by sand and gravel as well as the underground exterior wall sections.[39]

The central ring of the assembly, measuring 24'-6" in diameter, served as the control chamber with the control downtake and pipe vault in the center and the filter control house on top. Operators were able to observe the filtration process and sample the water from the 20' diameter circular filter control house twenty-four hours a day because of underwater lights in the filter assembly. Instruments located within the control house included four compact valve-control operating stands and rate-of-flow gauges. A pump raised water from the filtered water reservoir to the two wash water tanks located on the hill behind the filter assemblies. Twelve windows and four doors leading to the balcony encircling the control house gave the operators access to the assembly. From the interior of the control house, operators could access the central pipe vault via an open stairwell enclosed by a pipe railing and two 4' x 4' hatches.[40]

The filter ring, located adjacent to the central control ring, measured 54'-3" in diameter with 14'-6" high walls. The ring was divided into four sections, each of which contained an independently operating filter made up of an elevated floor of "Tri-Lok" grating resting on a structural steel frame. Morse stated that the grating was galvanized copper-bearing steel, and the "inner ends of the bars are slightly pinched so that the sections fit radially." On top of the grating was an 18"-thick layer of gravel followed by a 24"-thick layer of sand. Five wash water troughs were located at the top of each filter and extended from the outer ring wall to a trough circling the inner ring wall. A steel "slipless" walkway measuring 3' wide with a 31' high pipe railing was located around the exterior perimeter of the filter ring and connected to the balcony circling the control house as well as the catwalk extending from the high-lift pumping station.[41]

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[39] Morse, "Features of the New Water Purification Works," pp. 179-180.
[40] Morse, "Features of the New Water Purification Works," pp. 179-181; slide of WSSC drawing of filter assembly.
[41] Morse, "Features of the New Water Purification Works," pp. 179-180; Morse, "New Water Purification Works," p. 686; WSSC, "Brief Detailed Description," unpaginated; slide of WSSC drawing of filter assembly.

The next ring in the assembly held the coagulating basin and measured 72’ in diameter with 14’-6” high walls. Drains in the ring floor would have allowed the sludge produced during coagulation to descend into the sewer lines.[42]

The filter assembly’s outermost ring (measuring 100’ in diameter) stored the filtered water, up to 275,000 gallons. A steel roof supported by beams covered the filtered water reservoir to preserve the water’s purity. The exterior walls of this ring were shorter than those of the rest of the assembly at 10’ high. Two 4’ x 3’ hatches on the roof located opposite one another had ladders extending into the ring’s interior and provided access to WSSC personnel as well as ventilated the ring. Screens located on the hatches prevented material from entering the ring and polluting the filtered water.[43]

5. **Alterations and Additions:**
The WSSC dismantled and removed the filter assemblies as part of the 1962 closure of the plant.[44]

Wash Water Tanks (Removed):

1. **Date of Construction:**
The wash water tanks were in place in 1934.[45]

2. **Architect/Engineer:**
Robert B. Morse designed the plant, with assistance from Charles O. Wherley.

3. **Builder/Contractor/Supplier:**
The Chicago Bridge and Iron Works may have supplied the tanks since the WSSC also contracted with the company for the steelwork used in the filter assemblies.

4. **Original Plans:**
The two steel tanks measured 17.5’ high and 16’ in diameter and had a 25,000-gallon capacity. They were located on a hill above the filter assemblies and supplied the water needed for backwashing the filters. A 16” pipe connected the tanks to the piping system located in the filter assembly’s central pipe vault.[46]

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[42] Slide of WSSC drawing of filter assembly; Morse, “Features of the New Water Purification Works,” p. 179.
[43] Morse, “Features of the New Water Purification Works,” pp. 179-180; Morse, “New Water Purification Works,” pp. 686-687; slide of WSSC drawing of filter assembly.
[44] The December 11, 1961 edition of *The Washington Post* contained information about WSSC Contract No. 3283, which involved dismantling and removing the site’s steel filter units, steel standpipes, pumping equipment and piping (p. B9). During an April 2009 site visit, a long-time resident of the area stated that he remembered the filter assemblies still standing in 1963, but that they were removed shortly thereafter.
[45] William Bushong, “Robert B. Morse Water Filtration Plant,” Maryland Historical Trust, State Historic Sites Inventory Form, May 1994, Section 7.4.
[46] WSSC, “Brief Detailed Description,” unpaginated.

5. **Alterations and Additions:**
The tanks were dismantled as part of the plant's closure in 1962.[47]

B. Historical Context:

Burnt Mills

Prior to the construction of the Robert B. Morse Water Filtration Plant, a number of grist, saw and flour mills had been located in this area from the mid-eighteenth to the early twentieth century. One mill burned before 1788, after which the area became known as Burnt Mills. From ca. 1890-1903, Samuel Waters and William Mannakee owned the property on which the filtration plant would be constructed and operated a mill there. The flour and corn mill was located to the south of Colesville Road on the bank of the Northwest Branch, in the general vicinity of where the low-lift pumping station and preliminary sedimentation basin would later be built. Around World War I, the mill ceased operation, and in 1920, the land became part of the Boys Scouts' Camp Woodrow Wilson. The Boy Scouts used the mill as a dining hall.[48] The Washington Suburban Sanitary Commission had obtained a portion of the property from the Boy Scouts by the mid-1920s and razed the mill for the construction of the filter plant. The details surrounding this land acquisition are unknown as are the changes made by the WSSC to the site.[49] The WSSC built a dam and erected a temporary filtration plant soon after acquiring the property. From 1929-36, the WSSC built the permanent Robert B. Morse Water Filtration Plant (also called the Burnt Mills Facility) to serve residents within its district, which encompassed suburban Maryland, outside Washington, D.C.

Establishment of the Washington Suburban Sanitary Commission

Established on May 1, 1918 by the Maryland state legislature in Chapter 122, Acts of 1918, the Washington Suburban Sanitary Commission (WSSC) had the authority to construct water, sewage and storm drain systems, as well as issue bonds, levy taxes, and fix water and sewer charges. The newly established sanitary district encompassed the majority of Prince George's and Montgomery counties in Maryland.[50]

The establishment of the WSSC was the result of several years of planning. Public outcry about the unsanitary conditions of the waterways supplying drinking water to the Maryland suburbs of Washington, D.C., had begun as early as 1910 amid growing concern about potential typhoid outbreaks and other diseases. District officials were also

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[47] The December 11, 1961 edition of *The Washington Post* contained information about WSSC Contract No. 3283, which involved dismantling and removing the site's steel filter units, steel standpipes, pumping equipment and piping (p. B9).

[48] An article in the March 13, 1925 edition of *The Washington Post* reported that in the summer of 1924 more than 1,500 Boy Scouts representing forty-seven troops visited the reservation to practice their scout skills and hike. See "37 Acres of Land Given to Boy Scouts' Cause," *The Washington Post*, March 13, 1925, p. 9.

[49] See Bushong, "Robert B. Morse Water Filtration Plant," Section 8; "Searching for the Mill," *The Hillandaler*, January 2006, unpaginated; "37 Acres of Land," p. 9.

[50] Art Brigham, *History of the WSSC, 75th Anniversary, 1918-1993* (Laurel, MD: Washington Suburban Sanitary Commission, 1993), pp. 3, 10.

concerned about pollution because the newly created Rock Creek and Anacostia parks had as their focal points waterways that were being polluted in Maryland.[51] In the first decade of the twentieth century, only about one quarter of the Maryland population to be included in the new sanitary district had public water and sewer lines while the rest relied upon wells for drinking water (more than half of which were thought to supply unsafe water) and cesspools and outhouses for sewage disposal. Trash collection was only available to 6 percent of the population; the rest disposed of trash by burning or burying it on site, feeding it to animals, or throwing it into dumps deemed offensive.[52]

In 1912, state officials established a Bureau of Sanitary Engineering within the state's Department of Health with Robert B. Morse as its Chief and Harry R. Hall as Assistant Engineer. The state tasked the bureau with examining and recording any plans by municipalities to develop private or public water supply and sewerage systems, reporting on sanitation in public buildings as well as the waste and sewerage practices of businesses, and devising methods to improve sanitary conditions and the state's water supply.[53] Morse blamed the state's poor public works on the

> short-sighted policy of municipal officials, who think they are keeping down expenses on public works…with the resulting establishment of improperly protected or uneconomically operated water supplies, and poorly designed sewerage systems which are uneconomical in construction, unsatisfactory in maintenance and operation, and which create dangerous or offensive conditions in the bodies of water into which they discharge.[54]

A joint resolution of the Maryland General Assembly in 1912 authorized the governor to appoint a commission from Montgomery and Prince George's counties to report on the area's sanitary conditions. The Prince George's and Montgomery Counties Sewerage Commission, as it was called, relied upon the Bureau of Sanitary Engineering and Morse for assistance in its investigation. On February 4, 1914, the commission presented its findings on the state of sewerage to the governor, but the legislature failed to enact the proposed bill into law.[55] Two years later, in 1916, Morse and T. Howard Duckett (a member of the 1912 advisory commission) presented a revision of the 1914 recommendations that included a discussion of the water situation in the two counties to the Maryland General Assembly. This time, the act passed as Chapter 313 in the Acts of 1916 and established the Washington Suburban Sanitary District. The area encompassed

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[51] Washington Suburban Sanitary Commission, "Report on the Advisability of Creating a Sanitary District in Maryland, Contiguous to the District of Columbia, and Providing it with Water and Sewerage Service to the General Assembly of Maryland by the Washington Suburban Sanitary Commission," January 21, 1918, p. 2.
[52] WSSC, "Report on the Advisability of Creating a Sanitary District," p. 12.
[53] Brigham, *History of the WSSC*, pp. 7-8.
[54] Robert B. Morse, "State Control over Water Supply and Drainage Conditions in Maryland," *American Journal of Public Health* 4, no. 10 (October 1914): p. 848.
[55] Members of the Prince George's and Montgomery Counties Sewerage Commission included: William T. S. Curtis, T. Howard Duckett, Dr. J. Dudley Morgan, Dr. John L. Lewis, John I. Cassidy, J. Dawson Williams, Oliver S. Metzerott, Jackson Ralston, J. Enes Ray, Jr., Dr. Charles A. Fox, Louis L. Dent, Dr. William H. Welch, Dr. M. Langton Price. WSSC, "Report on the Advisability of Creating a Sanitary District," p. 2.

within the district included portions of the Rock Creek and Anacostia River drainage areas and all of the Oxon Run and Little Falls Branch drainage areas and totaled 95 square miles, 41 of which were located within Montgomery County and the remainder in Prince George's County.[56] The legislation also created a Sanitary Commission made up of three members and allocated $10,000 to finance its work, which consisted of investigating the water supply, developing a water supply and sewerage system plan, and identifying potential construction projects and distribution methods.[57] The State Department of Health (and Morse) was tasked with contributing to the report, and the commission's findings were slated for presentation to the 1918 General Assembly.[58] The establishment of the new district and commission would facilitate construction of a

> comprehensive water supply and sewerage system…affording pure water, excellent fire protection, and relieving insanitary conditions, at less cost to individuals than the majority of inhabitants not having access to public water and sewerage systems are paying for insufficient, impure, or unattractive water and lack of fire protection, or unhealthful and offensive methods of sewage disposal.[59]

As directed, the Sanitary Commission presented its findings to the Maryland General Assembly in 1918. The recommendations included permanently establishing the Washington Suburban Sanitary Commission. The creation of a sewer and water distribution system overseen by one agency would replace the patchwork of private systems serving incorporated towns and privately owned developments then contained within the boundaries of the proposed Washington Suburban Sanitary District.

As F. Howard Townsend, a WSSC employee for forty-seven years, remembered:

> Each town or incorporated settlement was trying to improve its condition but there was no concerted action toward advancing the interests of the Washington suburbs as a whole. Water supply and sewage disposal were two of the most vital and difficult problems facing the suburban area.[60]

The commission also recommended developing independent sources of water and establishing a separate distribution system rather than connecting the sanitary district's systems with those operated by the District of Columbia as earlier proposed. To that end, the commission asked the legislature to grant it the authority to acquire land as well as build, operate and maintain water supply, sewerage, storm drainage and trash disposal systems. Finally, it strongly urged the legislature to restrict private entities from

[56] WSSC, "Report on the Advisability of Creating a Sanitary District," p. 11.
[57] Commission members included J. William Bogley (appointed by the governor), William Curtis (representing Montgomery County), and T. Howard Duckett (representing the town of Bladensburg in Prince George's County). WSSC, "Report on the Advisability of Creating a Sanitary District," pp. 1, 3-4.
[58]Brigham, *History of the WSSC*, pp. 3, 9.
[59] WSSC, "Report on the Advisability of Creating a Sanitary District," p. 13.
[60] Quoted in Brigham, *History of the WSSC*, p. 5.

establishing rival systems without prior approval by the WSSC.[61] The Maryland General Assembly approved the plans, thereby permanently establishing the WSSC.

The WSSC initially focused on developing a water and sewerage system for the area under its jurisdiction. The rapid growth of the Maryland suburbs from post-World War I to post-World War II, resulting from the expansion of the federal government, pushed the capacities of the infrastructure to its limits. The WSSC, consequently, had to continually add to the system to keep pace with the rate of development. At the same time, the burgeoning infrastructure spurred the establishment of residential developments in Montgomery and Prince George's counties.

The WSSC's first undertaking was construction of a trunk line sewer in Riverdale, Prince George's County, Maryland, in 1919. Other early endeavors included purchasing various systems, including those in Takoma Park (1919), Chevy Chase and Edgemoor (1921), Mount Rainier and Kensington (1922), and Glen Echo (1926). The commission also began to look for new sources of water. A rapid sand filter plant drawing water from the Northwest Branch of the Anacostia River with a filtering capacity of 20 million gallons per day (Mgd) was built in 1920 in Hyattsville, Prince George's County.[62]

Temporary Burnt Mills Filtration Plant

The WSSC's first major building campaign was a temporary filter plant with a 2.5 Mgd capacity at Burnt Mills on Colesville Road in Silver Spring, Montgomery County, Maryland, that opened in 1924. Drawing from the Northwest Branch of the Anacostia River, the plant consisted of a "small stone intake dam, a steel coagulating basin, four wooden filters equipped with rakes for sand agitation and housed in a galvanized iron building, a steel filtered water reservoir and the required pumping facilities." In 1926, two open steel filters with wooden slat bottoms and a steel coagulating basin were added, increasing output by 1.3 Mgd. The WSSC advertised Contract No. 3411 in 1926, which called for the construction of 4,350 square yards of concrete surface that included curbs, sidewalks, and driveways, as well as necessary grading and siding.[63] All of the structures (except for the galvanized iron building and pumps) came from an industrial plant located in Hopewell, Virginia, that had been abandoned after World War I.[64]

By 1930, however, the newly completed dam and temporary Burnt Mills filtration plant could not supply a sufficient amount of water to the burgeoning suburban Maryland population. The WSSC made plans to build a new plant with at least a 10 Mgd capacity on the same site. The permanent plant was completed in 1936 and named in honor of its engineer, Robert B. Morse.[65]

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[61] Brigham, *History of the WSSC*, p. 10.
[62] Brigham, *History of the WSSC*, pp. 15-16.
[63] Classified Ad, *The Washington Post*, June 22, 1926, p. D4.
[64] Classified Ad, p. D4; Brigham, *History of the WSSC*, p. 16.
[65] Morse, "Features of the New Water Purification Works," p. 179.

Robert B. Morse

Robert B. Morse was born in Montpelier, Vermont, on September 13, 1880 to Harmon Northrop, a chemistry professor at The Johns Hopkins University in Baltimore, Maryland, and Caroline Augusta (Brooks) Morse. He attended Baltimore City College, The Johns Hopkins University (JHU), the University of Maine, and the Massachusetts Institute of Technology (MIT). He earned two Bachelor degrees in civil engineering, one from JHU in 1901 and the other from MIT in 1904. After completing his studies in 1904, Morse worked as a draftsman at the Bureau of Construction and Repairs of the U.S. Navy Department for one year before accepting a position as a draftsman with the Sewerage Commission of Baltimore City. For the next five years, from 1905-10, he held various positions within the commission before moving to New York, where he worked as an assistant sanitary engineer with the Metropolitan Sewerage Commission until 1912. During his tenure with the Metropolitan Sewerage Commission, he helped develop the plans to clean up the polluted New York Harbor. Morse returned to Maryland to work for the Maryland State Board of Health as its chief engineer from 1912-18, where, as previously noted, he also served as a consultant on the establishment of the Washington Suburban Sanitary District and Commission. Morse held the chief engineer position with the WSSC from its inception in 1918 until his death from septicemia (blood poisoning) following a minor operation in February 1936 at the age of 55.[66]

Obituaries published in various newspapers extolled Morse's engineering career. The *Portland Press Herald* of Portland, Maine, stated that he was "considered one of the outstanding sanitary engineers of the Country" and that he "pioneered a new field in his designing and constructing of concentric filters at the Burnt Mills water works in Maryland," a design that he replicated for a plant in Rumford, Maine.[67] Washington, D.C.'s *Evening Star* reported that Morse was "regarded as one of the outstanding sanitary engineers in the Eastern States," while *The New York Times* noted his work was well-known in the field of sanitary engineering.[68]

Robert B. Morse Water Filtration Plant Design and Construction

Morse designed the permanent filtration plant at the Burnt Mills site, consisting of two filter assemblies, two pumping stations, a dam, and various related structures. When Morse planned the layout of the site, he had to take into account the limited land

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[66] Biographical information about Morse obtained from "Robert Morse Funeral Is Set for Tomorrow," *The Washington Post*, February 2, 1936, p. X7, and "Robert Brooks Morse Family History," pamphlet prepared by Lawrence Trever Fadner, March 1992, available at Maryland Historical Society, Baltimore, Maryland. This pamphlet contains articles, primarily obituaries, about Morse and his family from various newspapers.

Morse also published a number of articles during his career. Examples found not directly related to the Burnt Mills plant include: "State Control Over Water Supply and Drainage Conditions in Maryland," *American Journal of Public Health* 4, no. 10 (October 1914): pp. 847-852, written while he was chief of the Bureau of Sanitary Engineering, Maryland State Department of Health, and "Water Service to Consumers in Areas Outside of Municipalities," *Journal of the American Water Works Association* 23, no. 5 (May 1931): pp. 733-735.

[67] "Rob't B. Morse Dies in Washington, DC," *Portland Press Herald* [Portland, Maine], February 9, 1936, located in "Robert Brooks Morse Family History."

[68] "R.B. Morse Dies; Noted Engineer," *The Evening Star* [Washington, D.C.], February 1, 1936, and "Robert B. Morse," *The New York Times*, February 2, 1936, both in "Robert Brooks Morse Family History."

available and the intrusion of Colesville Road, which bisects the site. In addition, the Northwest Branch of the Anacostia River borders the plant to the south and west, further restricting its layout. Morse himself noted that the "layout of the plant considered as a whole was not as compact as otherwise would have been possible."[69] (See Appendix A, Figure 2 for aerial photograph of plant.)

The challenges of the site particularly affected the placement of the preliminary sedimentation basin. Morse originally wanted to include it as a ring in the filter assembly (as specified in his patent for a "Liquid Purification Plant"), but he found the site could not accommodate a 10 Mgd filter assembly containing a preliminary sedimentation basin, coagulating basin, filters, and water storage. Instead Morse had to settle for putting the preliminary sedimentation basin behind the low-lift pumping station, which required excavating through rock and adding concrete fill to stabilize portions of the ground.[70] The two steel filter assemblies were unique, even if they did not follow Morse's ideal design. Rather than spreading the filtration process across several structures, one filter assembly accommodated the chemical mixing, coagulation, filtration and water storage in a 5 Mgd circular unit. Morse wrote in a 1934 article that the filter assembly design was an answer to the challenges of the Burnt Mills site and an attempt to save on construction costs. Morse went on to state:

> The writer had in mind the apparently unchallenged belief among engineers that the most compact and economical arrangement of filter-tank assemblies required rectangular units. Nevertheless, in checking up, he proved that cylindrical units permitted of at least equal compactness."[71]

Morse also chose to design the pumping stations in the Colonial Revival style, perhaps because of their prominent location on a major thoroughfare. Architectural historian William Bushong notes that the use of the Georgian and Colonial Revival styles was common in buildings throughout Montgomery County, Maryland. He notes the Georgian Revival style

> had strong associations with the early architecture and history of the state. As Montgomery County sought to establish a modern civic identity in the 1920s and 1930s, the tradition and conservatism represented by the Georgian Revival became a popular unifying theme in the county's public architecture.[72]

[69] Morse, "New Water Purification Works," p. 680.
[70] Morse, "New Water Purification Works," p. 682; Morse, "Features of the New Water Purification Works," pp. 179-180; Robert B. Morse and Carrie E. Morse, administratrix of said Robert B. Morse, deceased, "Liquid Purification Plant," Patent No. 2,129,181, filed April 11, 1934, granted September 6, 1938.
[71] Morse, "Features of the New Water Purification Works," p. 179. For more information on the design and operation of the filter assembly, see Part III, Operations and Process of this report.
[72] Bushong, "Robert B. Morse Water Filtration Plant," Section 8.3-8.4.

In addition, this time period saw a general trend in public works construction to creating more monumental structures.[73] The buildings were solidly constructed of steel frames and brick with roofs of concrete slabs and slate to accommodate the pumping machinery and equipment. The concrete slabs were numbered, which may have been for ease of construction since the WSSC's day labor force erected both pumping stations. The interiors of both featured green Euboeolith cement floors and 1.5" thick Corkoustic tiles on the walls and ceilings to insulate the rooms and deaden the sound and reverberations emanating from the pumps and machines.[74] Corkoustic was a sound insulating product manufactured by Armstrong and part of the development of sound proofing technology at the beginning of the twentieth century.[75] The tiles were easier to install and more uniform than earlier soundproofing materials like felt strips and plasters.[76]

Morse's concern for achieving efficiency and cost savings is repeated throughout his writings about the plant. In the filter assemblies, cost savings were realized in the use of steel as the primary construction material. Morse believed that steel was a superior material because

> the possibility alone of reproducing the original condition of the surface at any time by painting gives a great advantage over reinforced concrete for filter plant construction, as will be evident when one remembers the sad appearance and state of disrepair of many concrete structures connected with water works.[77]

Morse's decision to leave the coagulating basin and filters uncovered was another cost saving measure, based upon the operation of the temporary Burnt Mills plant for several winters. According to Morse, that experience revealed rapid sand filters could be left uncovered throughout the winter with minimal additional effort on the part of operators to keep them running, even when a layer of ice formed.[78] He attributed this to the "constant movement of the water during filtration, and especially violent agitation, at times of washing." In lower temperatures, he noted operators had found that opening the wash water valves for a time "gave good results." The only other problem he observed was that sand tended to freeze from the steel plating of the ring inward, but Morse thought the addition of the coagulating basin as the exterior ring would solve the problem.[79] In the pumping stations, Morse chose to have electric heat installed in all the

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[73] Paul Hansen, "Developments in Water Purification Practice," *Engineering News-Record* 104, no. 21 (May 22, 1930): p. 843.
[74] Morse, "New Water Purification Works," pp. 681, 683.
[75] By 1930, a wide range of companies were producing various types of acoustical products, including such specific brands as "Audiocoustone Plaster," "Acoustifibrobloc," "Insulite Acoustile," as well as Armstrong "Corkoustic." Various types of materials were used in manufacturing these products, like mineral wool, asbestos, pumice, gypsum, lime and volcanic silica.
[76] Emily Thompson, *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America, 1900-1933* (Cambridge: The MIT Press, 2002), see Chapter 5: "Acoustical Materials and Modern Architecture, 1900-1933."
[77] Morse, "New Water Purification Works," p. 690.
[78] Morse, "New Water Purification Works," p. 687.
[79] Morse, "Features of the New Water Purification Works," p. 181.

buildings, resulting in a savings in construction since a furnace room, chimneys, pipes and radiators were not required.[80]

How the WSSC financed the construction of the plant is not definitively known. *The Washington Post* reported in 1932 that the WSSC applied to the Reconstruction Finance Corporation (RFC) for a $250,000 loan to finance the construction of the plant and a 2-mile pipe from the Patuxent River to the Northwest Branch headwaters, noting it "would provide ample water for suburban Montgomery and Prince Georges counties under all normal conditions."[81] Morse stated the total construction cost of the filtration plant, was $350,000-375,000.[82] The cost of just one filter assembly, "ready to run, including excavation, foundations, 'Tri-Lok' grating, painting, all piping, valves, control stands, rate-of-flow gauges, lighting, heating and filter sand and gravel in place" was $50,000 (not including engineering and overhead costs).[83]

By spring 1934, one of the 5 Mgd filter assemblies was in operation. In addition, the preliminary sedimentation basin, foundations of the low-lift pumping station and hydro pumping station, and most of the pipes, sewers and drains had been installed. The WSSC completed the second filter assembly a year later, and the entire plant opened in 1936.[84]

The WSSC touted the completed Robert B. Morse Water Filtration Plant as the "first of its kind in the world" and lauded the innovative filter design in its press releases.[85] There were reports of delegations touring the site, such as a group of Soviet engineers and another delegation from India, but it cannot be determined if their visits were simply to see the WSSC operations as a whole or if there was specific interest in Morse's filter assemblies.[86] The WSSC also reported that similar plants were constructed at Bristol and New Britain, Connecticut; Shillington, New Bethelhem, and Irvin, Pennsylvania; and Lorton, Virginia, among other unspecified cities.[87] While Morse's idea of incorporating the filtration steps into one structure was novel, the practice of separating the filtering process into various structures continued to be the standard. Nevertheless, its completion signaled the consolidation of the WSSC's filtration operations into one plant.

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[80] Morse, "Features of the New Water Purification Works," p. 180.
[81] "R.F.C. Loan Asked for Water Project," *The Washington Post*, September 28, 1932, p. 8.
[82] Morse, "Features of the New Water Purification Works," p. 182, gives the cost as $350,000, including two pumping stations, hydro station, 1200 kva transformer, roadways, walks, and ground improvements (such as flood walls and fill). In "New Water Purification Works," p. 691, Morse gave the cost as $375,000 for the supply line, pumping stations, preliminary sedimentation basin, hydro plant, substation, second 5 Mgd steel filter assembly, retaining wall along stream, roads, walks, grading, planting and lighting (excluding engineering and overhead).
[83] Morse, "New Water Purification Works," pp. 690-91.
[84] Morse, "Features of the New Water Purification Works," p. 179.
[85] Brigham, *History of the WSSC*, p. 17.
[86] "Robert Morse Funeral is Set for Tomorrow," *The Washington Post*, February 2, 1936, p. X7; Arthur P. Brigham, "WSSC Water Supply Work-Horse Is Retiring," for immediate release from the Washington Suburban Sanitary Commission, January 19, 1962; "Historic Waterworks Done In By Progress," *The Washington* Post, January 22, 1962, p. A12.
[87] "WSSC Water Supply Work-Horse is Retiring," unpaginated. The veracity of this claim has not been verified. The HAER field team did visit extant Lorton, Virginia, plant. That plant used Aldrich filters, which are circular but operate differently than the Morse type. See Part III, Operations and Process of this report for more information.

Washington Suburban Sanitary Commission Expansion
Anticipating that the Northwest Branch and the new Morse filtration plant would supply adequate amounts of water to the Maryland suburbs until at least 1960, the WSSC ceased using other sources of water.[88] The projections were indeed overly optimistic and did not account for the region's growing population. By December 31, 1948, the WSSC had 744 miles of main, 385 of which were in Montgomery County while 359 were in Prince George's County. Months later in July 1949, that number had risen to 785 total miles of mains. By 1949, the district covered 200 square miles and served 230,000 people consuming 20 million gallons of water per day as compared to 1918 when the district encompassed a mere 95 square miles and served 32,000 people consuming 250,000 gallons of water a day. The population boom from 1940-48 in the district resulting from the expansion of the federal government during World War II contributed to the increasing use of the system.[89]

The WSSC had to start drawing water from the Patuxent River in addition to the Northwest Branch of the Anacostia River in the mid-twentieth century in order to adequately supply its customers. The Morse filtration plant only supplied that part of the district located within Montgomery County. Due to sedimentation problems at the dam serving the Morse plant, a pumping station had to be built in 1939. The Mink Hollow Pumping Station, located below Brighton Dam, pumped water from the Patuxent River into the Northwest Branch via a 30" line at a capacity of 12 Mgd. Meanwhile, the Willis School Plant, completed in 1944, served that portion of the district located in Prince George's County. Located between Burtonsville and Laurel, the Willis School Plant consisted of a 10 Mgd rapid sand Morse filter. The 13 Mgd capacity Rocky Gorge Pumping Station on the Patuxent River supplied the water for the Willis School Plant. Brighton Dam, which sat above the intakes of the Mink Hollow and Rock Gorge pumping stations, impounded 6 billion gallons of water in Triadelphia Lake as a reserve during dry periods. Both Brighton Dam and Triadelphia Lake had been completed in 1943 in response to the region's growth; combined they had a total capacity of 20 Mgd.

The residents of that portion of Prince George's County located southeast of the District of Columbia obtained their water from two 600' artesian wells with a 1.4 Mgd capacity. The WSSC's 1956 Annual Report noted that the water from those wells was chlorinated as a preventive measure but was of good quality.[90] In addition, eight connections to the

[88] Brigham, *History of the WSSC*, p. 17.
[89] *The Washington Suburban Sanitary District*, Annual Report, 1949, prepared by Wainwright Ramsey & Lancaster, New York, pp. 1-5, 16, available in Record Group 15: Commissions and Boards, Records of the Washington Suburban Sanitary Commission, 1918-1994, Montgomery County Archives, Rockville, Maryland.
[90] *The Washington Suburban Sanitary District, Maryland*, Annual Report, 1949, p. 10; Washington Suburban Sanitary Commission, "Your Sanitary Commission: What It Is and Does," pamphlet, January 1954, p. 3 and *The Washington Suburban Sanitary District, Maryland*, Annual Report, 1956, pp. 9, 13, all available in Record Group 15: Commissions and Boards, Records of the Washington Suburban Sanitary Commission, 1918-1994 in Montgomery County Archives, Rockville, Maryland; Bushong, "Robert B. Morse Water Filtration Plant," Section 8. 2. See also, "Patuxent Dam Would Provide Much Water," from *The Evening Star* [Washington, D.C.] reprinted in *Silver Spring Standard* [Silver Spring, Maryland], Thursday, January 15, 1940, p. 7.

District of Columbia's water system were maintained for emergency use only; this had been reduced by 1956 to six connections with a potential 8 Mgd capacity. Other structures maintained by the WSSC in the mid-twentieth century included sixteen standpipes and elevated tanks for storing filtered water. These tanks had a total capacity of 31,475,000 gallons, although they were rarely full.[91] (See Appendix A, Figure 3 for a 1949 map of the system.)

During the 1950s, the WSSC's infrastructure underwent additional expansion because of continued growth. By 1956, the district served 485,000 people and covered 302 square miles, the majority of which were in Prince George's County.[92] The WSSC enlarged the Patuxent Water Treatment Plant (formerly the Willis School Plant) in 1951 to a storage capacity of 45 million gallons in standpipes and elevated tanks. It underwent an additional expansion from 1953-56 to a 65 Mgd capacity, but an additional source of water was still needed. The WSSC built the Rocky Gorge Dam, located 10 miles below the Brighton Dam on the Patuxent River near Laurel from 1952-54. The dam had an impoundment capacity of 6 billion gallons of water. The Rocky Gorge Pumping Station was enlarged from 1953-54 with a resulting increase in pumping capacity from 28 Mgd to 94 Mgd. Another addition to the system was the 10 million gallon reservoir in Seat Pleasant in Prince George's County, in place in 1954.[93]

The expansion of the Patuxent Water Treatment Plant and the 1961 opening of the Potomac River Filtration Plant in western Montgomery County rendered the Morse plant obsolete. On December 11, 1961, the WSSC advertised Contract No. 3283, which called for dismantling and removing the steel filter units and standpipes, as well as the pumping equipment and piping at the facility.[94] The Morse plant closed in 1962, and the Patuxent River Filtration Plant with a 65 Mgd output became the sole supplier to Prince George's County. The 100 Mgd capacity Potomac plant, meanwhile, supplied the Montgomery County portion of the district.[95] The WSSC continued to use the former Morse plant as a storage facility for its vehicle fleet and conducted driver training for an unknown period of time.[96] The portion of the property east of Colesville Road became Burnt Mills East Park after the WSSC transferred it to the Maryland-National Capital Park and Planning

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[91] Annual Report, 1949, p. 16 and Annual Report, 1956, p. 9. The Brighton Dam reportedly cost $2,347,546 and measured 63' high x 1000' long, see Annual Report, 1956, p. 7.
[92] Of the 302 miles, 184 were in Prince George's County and 118 were in Montgomery County. See Annual Report, 1956, p. 1.
[93] "Your Sanitary Commission," p. 3; Annual Report, 1956, pp. 1, 7-9, 13. The Rocky Gorge Dam and Pumping Station cost a combined total of $3,209,322. The dam measured 129' high x 1110' long. See Annual Report, 1956, p. 7.
[94] Classified Ad, *The Washington Post*, December 11, 1961, p. B9.
[95] *The Washington Suburban Sanitary District Maryland*, Annual Report, 1962, pp. 7-8, available in Record Group 15: Commissions and Boards, Records of the Washington Suburban Sanitary Commission, 1918-1994, in Montgomery County Archives, Rockville, Maryland.
[96] This information provided by Tommy Marks, former chief plant operator of the Patuxent Plant beginning in the early 1970s in a telephone conversation with the author in summer 2008.

Commission (M-NCPPC).[97] In 2000, the WSSC transferred the portion of the property west of Colesville Road to M-NCPPC, and it became Burnt Mills West Park.[98] M-NCPPC currently maintains the parks for outdoor recreation, but the former pumping stations stand vacant.

Development of Municipal Water Systems
The establishment and development of the WSSC fit within the period of rapid urban growth and development and the subsequent need for utility systems in the first half of the twentieth century. The greatest period in growth in municipal systems in the United States occurred from the 1890s to the 1920s, with continued expansion into the 1930s due to the availability of federal funding from such programs as the Public Works Administration, Federal Emergency Relief Act, and Civil Works Administration.[99] Scientific study identifying the causes of disease along with ideological beliefs, particularly progressive ideas that "promoted the maintenance of a sound physical environment to meet social ends, that is, to impose a 'civilizing influence' on urbanites through the use of technical expertise in the development and management of city services," pushed the establishment of municipal water works.[100] More practically, the authority of city governments to tax and issue bonds to support establishment of utilities as well as increased regulatory powers made the large-scale construction of waterworks possible.[101] In 1924, there were 9,850 waterworks in the United States, and that number had grown to 10,789 in 1932. By 1939 there were 12,760, and just a year later, there were 14,500.[102] The Robert B. Morse Water Filtration Plant is an example of one of these early municipal water systems.

Part II. Site Information

A. General Description:
The structures extant as of summer 2008 are separately described below.

Dam:
The dam is located to the north of Colesville Road and behind the high-lift pumping station. Constructed of reinforced concrete, the Ambursen-type dam impounds the water

[97] Burnt Mills East Park covers 2.6 acres.
[98] Burnt Mills West Park covers 2.7 acres.
[99] Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present* (Baltimore: The Johns Hopkins University Press, 2000), p. 218.
[100] Melosi, *The Sanitary City*, p. 103.
[101] Werner Troesken argues that public water companies actually invested less than private companies in filtration systems in the period from 1880 to 1920, despite claims by Progressive-Era reformers. Through statistical analysis, he found little change in rates of typhoid when water systems shifted from private to public ownership. See Werner Troesken, "Typhoid Rates and the Public Acquisition of Private Waterworks, 1880-1920," *The Journal of Economic History* 59, no. 4 (December 1999): pp. 927-948.
[102] Melosi, *The Sanitary City*, p. 213.

of the Northwest Branch in a small reservoir.[103] On the east abutment of the dam is the non-overflow section, where a brick intake topped with a concrete parapet is located. Two doorways equipped with metal gates allow access to both the feed pipes that carried water to the pumping stations as well as the dam's interior. Single-walled buttresses measuring 1.2' thick divide the spillway portion of the dam into ten bays. Arched openings in the buttresses provide access to each bay.

Preliminary Sedimentation Basin:
To the rear of the low-lift pumping station is the former preliminary sedimentation basin, which has been filled in to create a parking lot measuring 113' x 203'. The original concrete wall that surrounded the basin is still intact, as is evidence of the supports for the railing that once ran along its top. Five light posts stand as remnants of the light standards that once circled the basin.

Outbuilding:
At the eastern end of the former preliminary sedimentation basin is a one-story, square brick building with a pyramidal hipped roof. The building's interior plan is 10'-4" x 11'-10". It is stylistically similar to the pumping stations and also incorporates the same building materials, including brick, slate roof shingles, and limestone lintels, sills and keystones.

Low-lift Pumping Station:
Exterior
The Colonial Revival style, low-lift pumping station (10701 Columbia Pike) is located to the east of Colesville Road. The low-lift and high-lift pumping stations are similar in appearance and construction, although the low-lift pumping station does not directly front the road like the high-lift pumping station. Instead, it sits at an angle. The two-and-one-half story brick low-lift pumping station measures 48' x 30' in plan and has a side-gabled roof clad in slate shingles. The front façade is divided into five bays. The main entrance, centered on the front façade, has a triangular pediment, fanlight, and engaged columns flanking the door. The fenestration of the front façade is symmetrical and consists of double-hung sash windows with eight-over-eight lights or six-over-six lights. Most of the windows have limestone sills and lintels with keystones. There are five eight-over-eight-light, double-hung sash windows on the second story, and two eight-over-eight-light, double-hung sash windows on each side of the main entrance. The rear façade has five eight-over-eight-light, double-hung sash windows on both the second and first floors and features a large light fixture at its center. Three dormers with six-over-six-light, double-hung sash windows punctuate the roof at both the front and the rear. The side elevations have three eight-over-eight-light, double-hung sash windows on the second story, none on the first floor, and an arched window with a brick surround at the attic.

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[103] Ambursen dams were named after patent holder Nils Ambursen who designed and built the first reinforced concrete, flat-slab buttress dam in 1903 at Theresa Falls in upstate New York. See Donald C. Jackson, *Building the Ultimate Dam: John S. Eastwood and the Control of Water in the West* (Lawrence, KS: University Press of Kansas, 1995), p. 31.

All the windows appear to be in-kind replacements. The windows have aluminum-clad exteriors, and the grilles are situated between the panes of glass.

Extending from both the side elevations are concrete boxes that once housed the aerators. The box immediately adjacent to the building measures 7' long x 12'-11" wide x 10'-11.5" tall and sits on another concrete box measuring only 2'-9.5" tall. The total length of the concrete structure is 19'. Double doors with granite lintels and keystones at each end of the building provide access from the interior of the building to these structures. The exterior of the low-lift pumping station is in good condition.

Interior

The first floor of the low-lift pumping station was originally open, aside from the main staircase located across from the front entrance. The staircase divides the room in half. Directly behind the main staircase is the stairway to the basement, with a closet located directly behind. Some alteration has been made to this original plan, as evidenced in the installation of a wall with a doorway to the south of the main staircase to more effectively close off the south half of the interior. Each of the two first floor rooms has a column at nearly the center point. The interior finish consists of glazed brick along the bottom of the walls and Corkoustic tile (painted yellow in the north room and white in the south) at the top. Vinyl composition tiles cover the floors. A drop ceiling was installed in the south room while the north room has tiles (probably Corkoustic) between the ceiling beams. A set of double paneled doors on each of the side elevations provide exterior access to the concrete structures that formerly held the aerators.

A utilitarian staircase with pipe railings and metal treads provides access to the basement from the south first floor room. The basement contains some remnants of the machinery formerly housed within the station, including pipes and valves, as well as two concrete foundations for the pumps originally located on the first floor, but is otherwise empty.

The second floor, accessed by the main staircase, has been divided into four rooms, two bathrooms, and a utility closet. Two rooms are located at the front of the building. The front, north room has exposed brick walls that have been painted white while the front, south room has Corkoustic tiles painted yellow cladding its walls. A metal gate running along a track on the ceiling blocks off the southern portion of the south room. This area was probably used to store chemicals or other materials whose access needed to be restricted. The rear half of the building contains two more rooms, the bathrooms and utility closet. The north, rear room has a large walk-in closet in the northwest corner. The closet is built of drywall while the room itself has Corkoustic tile painted yellow cladding its walls. The south, rear room has walls clad in Corkoustic tiles painted yellow as well. A hall extends from this room south and ends in a utility closet. A bathroom with a toilet and sink is located on either side of the hall. A drop ceiling has been installed on the second floor, and the flooring is vinyl composition tile.

The stairway to the attic is located in the north front room of the second floor. Like the basement staircase, it is utilitarian in character with pipe railings and metal treads. The attic of the low-lift pumping station has been finished with drywall and a drop ceiling, so the building structure is not readily apparent. Close inspection of the underlying structure reveals it is identical to that of the high-lift pumping station and consists of concrete roof panels, steel I-beams and tie rods. The interior of the low-lift pumping station is in fair condition, although the interior finishes have suffered from the building's extended vacancy.

High-lift Pumping Station:
Exterior
The Colonial Revival style, high-lift pumping station (10700 Columbia Pike) faces Colesville Road and is nearly surrounded by a parking lot. The main portion of the brick building stands two-and-one-half stories tall and is flanked by one-story wings. The main section is divided into five bays and measures 50' long while each wing is divided into two bays and measures 16' long. The main entrance is centered on the symmetrical front façade facing the road and features a triangular pedimented doorway with engaged columns and a semi-circular fanlight. Double doors are located on the building's end walls and have granite sills. Both the main building and the two wings have side gable roofs clad in slate shingles. The main roof is punctuated by three dormers with six-over-six-light, double-hung sash windows at both the front and rear. To the rear of the main building is a one-story brick projection in a half-circle shape with a flat roof. It measures 32' long. Originally, there were two doorways in the half-circle projection, one on the east side and the other on the west side, but the east one has been closed in with bricks. There are six window openings, although two have also been closed in with bricks. The remaining windows are six-over-six light, double-hung sash.

The fenestration of the high-lift pumping station primarily consists of eight-over-eight light or six-over-six light, double-hung windows. The windows have limestone sills and lintels with keystones. The main building's front façade has five windows on the second floor, with two on either side of the main entrance on the first floor. All of these are eight-over-eight-light, double-hung sash. The rear façade has five eight-over-eight-light, double-hung sash windows on the second story and none on the first. The side elevations of the center block feature an arched window in the attic with a brick surround and limestone keystones while the second-floor level has two six-over-six-light, double-hung sash windows. The wings have two six-over-six-light, double-hung sash windows on the front and rear façades with double doors on the ends flanked by six-over-six-light, double-hung sash windows on the first floor and one of the same type on the second floor. All the windows appear to be in-kind replacements (some are specifically Pella windows). They have aluminum-clad exteriors, and the grilles are situated between the panes of glass. The exterior of the high-lift pumping station appears to be in good condition.

Interior
The first floor of the high-lift pumping station originally housed the pumps, which have since been removed. The elegant staircase, located directly across from the main entrance, divides the first floor in half and serves as the focal point of the space. The

wide, straight flight of stairs has a railing comprised of square balusters that slightly flairs at the bottom step and ends in newel posts. Two clusters of four columns are located at the center of each half of the floor; these are constructed of steel I-beams clad in timber and then Corkoustic tiles. Beams extending the length and width of the ceiling provide additional support. The bottom third of the walls are clad in glazed brick, with the remainder covered in white Corkoustic tiles that appear to have been adhered to the walls with glue or some other sort of adhesive. Electric radiators installed in the walls provided heat. The floor is covered in vinyl composition tiles. A set of paneled double doors is located at the center of each side wall. The rear wall has a doorway leading to the semi-circular rear projection that housed the switchboard when the plant was in operation. Originally, this doorway appears to have been larger but was filled in at some point with concrete blocks. The switchboard room is centered on the rear façade of the main section of the building. Its interior walls are clad in dark wood paneling, while the ceiling is clad in Corkoustic tiles. A small raised platform is located on the center of the rear wall. Restrooms, each containing a toilet and sink, are located in the southwest and southeast corners of the switchboard room but are accessed from the main room by doors on either side of the opening to the switchboard room.

To the east of the main entrance on the first floor is a utilitarian staircase with metal treads and pipe railings leading from the first floor to the basement. Although the machinery housed in the high-lift pumping station has been removed, evidence of its placement remains in the basement in the form of brick foundations that once supported the pumps. Other evidence consists of bricked-in pipe openings in the exterior walls, a platform flanked by suction wells and capped-off pipes located underneath the switchboard room, and pipes with valves extending throughout the basement. A number of brick columns and riveted steel I-beam girders supported the first floor, necessary because of the pumps originally located on that floor. Horizontal I-beams extending the length and width of the ceiling provided additional reinforcement. Two trap doors whose use is unknown are located in the ceiling near the front of the building.

The second floor originally housed equipment related to the plant's operation. A variety of finishes reflects the multiple uses of the second floor. The west half is divided into three rooms. The larger room is located at the front of the building with a door opening to a closet containing a built-in cabinet with glass doors to the east. Two smaller rooms are located at the rear of the building. Wood paneling was installed over the original Corkoustic in all three rooms, even on the two support columns, perhaps reflecting the renovation of the rooms into offices after the plant closed. Electric baseboard heaters heated the rooms.[104] The attic space of the west wing has been left unfinished, with the brick end walls and ceiling structure (comprised of steel I-beams, tie rods, and concrete panels) left exposed.

[104] The baseboard heaters and wood paneling are probably modifications dating to post-1962 when the WSSC retained use of the site as a driving school for its employees.

Directly opposite the main staircase on the second floor is a doorway leading out to the roof of the switchboard room. A catwalk originally extended from this doorway to the two filter assemblies, which were located to the rear of this building.

The east half of the second floor is open, aside from two support columns and a restroom with a toilet and sink located in the northwest corner. The Corkoustic tiles remain uncovered and vinyl composition tiles comprise the flooring in this space. A vestibule leads to the attic space of the west wing, and there is a hatch in the vestibule floor. Unlike the west wing's attic, this space is more finished. The brick end walls have been painted white, as have the steel I-beams, tie rods, and concrete panels making up the roof structure. In addition, remnants of wood paneling remain on the east end walls.

The stairway leading from the second floor to the attic is located behind the main staircase at the front of the building. The staircase is more utilitarian in character than the main one, evidenced in the pipe railings and metal treads. The attic is open, aside from the railing surrounding the opening for the stairway at the center of the room and a wood panel located immediately adjacent, indicating it was probably used as a storage space. The exposed brickwork on the gable end walls has been painted white. An arched window punctuates each gable end wall. The visible roof structure consists of steel I-beams stamped "Phoenix US" with tie rods and concrete panels stamped with numbers, indicating that elements of the building were prefabricated and marked for easier erection onsite. Even the six dormers have I-beam frames and concrete panels. The concrete floor of the attic has been painted gray.

At the time of the writing of this report, the high-lift pumping station was vacant and in fair condition. Although structurally the building appears to be sound, the interior finishes have suffered from the extended vacancy period and a lack of maintenance. The Corkoustic tile has fallen away in areas, and the floor tiles are loose. The basement has been flooded multiple times, resulting in silt deposits covering the floor.

High Tension Substation:
A metal fence encloses the 1200 kilovolt-ampere (kva) high tension substation, which is located behind the high-lift pumping station. Vegetation currently obscures the substation.

B. Site Layout:
A portion of the Robert B. Morse Water Filtration Plant is located within the hundred year floodplain of the Northwest Branch of the Anacostia River, which runs to the south and west of the site. Colesville Road (U.S. 29) bisects the property, creating a major barrier between the two halves as it is now a heavily traveled route. To the south of Colesville Road is the low-lift pumping station, former preliminary sedimentation basin, and outbuilding. A stone retaining wall is located along the north bank of the Northwest Branch and discharge pipes are also apparent. To the north of Colesville Road is the high-lift pumping station, dam, and substation. Another stone retaining wall section is located along the north riverbank. Two parks (Burnt Mills East and Burnt Mills West)

now encompass the former filtration plant, which is surrounded by residential and commercial development.

Part III. Operations and Process

A. Operations:

The basic operation of the Robert B. Morse Water Filtration Plant involved taking water from the Northwest Branch and running it through the filtration and treatment process, with the end result being potable water for distribution to WSSC customers. Water traveled through the site via a network of cast-iron pipes equipped with valves to control the flow. Water passed through the structures in this order: dam, low-lift pumping station, aerators, preliminary sedimentation basin, filter assembly (where water passed through the coagulating basin ring, filter ring, and then was stored in the filtered water reservoir), high-lift pumping station, and finally into the water distribution lines.[105]

The dam on the Northwest Branch of the Anacostia River impounded the raw water to be filtered and treated at the plant. Gravity flow pipes moved the water from the dam to the low-lift pumping station where chemicals called coagulants (at this plant, primarily alum and activated carbon with the occasional use of soda ash) were added. A 30" inlet line equipped with a 16" Rotovalve extended from the suction wells of the low-lift pumps to the Aer-O-Mix aerators located at either end of the low-lift pumping station. The inlet line maintained a constant water level in the basin. The aerators thoroughly mixed the coagulants into the water prior to its entry into the preliminary sedimentation basin and moved the water, facilitating the collision of particles. When alum mixes with water, it creates aluminum hydroxide, resulting in a "gelatinous precipitate" that attracts particles in the water. The coagulating chemicals must have charges opposite those of the particles in the water, thereby effectively neutralizing the charges of the particles and allowing them to clump together. This process of the particles in the water clumping together is called flocculation, and the resulting particle clumps are referred to as floc.[106] At the Morse plant, the water flowed through the preliminary sedimentation basin (located behind the low-lift pumping station and aerators) for three to four hours, allowing the floc to settle down to the basin's bottom.

Six motor-driven centrifugal pumps then raised the water from the preliminary sedimentation basin via one of two 18" supply pipes to one of the filter assemblies

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[105] The following description of the water filtration process is based on: Robert B. Morse, "Features of the New Water Purification Works at Burnt Mills, Maryland," *Water Works and Sewerage* LXXXI, no. 6 (June 1934): pp. 179-182; Robert B. Morse, "The New Water Purification Works at Burnt Mills, Maryland," *Journal of the American Water Works* 27, no. 6 (June 1935): pp. 679-691; Washington Suburban Sanitary Commission, "A Brief Detailed Description of the Robert B. Morse Filter Plant and Appurtenant Works at Burnt Mills, Maryland," June 8, 1936; slide of WSSC drawing of filter assemblies.

[106] George D. Norcom and Kenneth W. Brown, "Water Purification for Plant Operators" (New York: McGraw-Hill Book Company, Inc., 1942), p. 19.

located across the road behind the high-lift pumping station.[107] Activated carbon and sometimes alum and soda ash were added to the water to encourage another round of coagulation before it entered the circular filter assembly. Morse noted that other plants used a mixing basin for this step, but none was provided at his plant. Instead, he designed baffles, which were located on either side of the supply line entering the coagulating basin ring, to help mix the coagulating chemicals into the water and promote particle collision. Since the raw water had already been treated in the preliminary sedimentation basin, the coagulation process only lasted about 55 minutes. Drains in the basin's floor allowed the resulting sludge to be removed into a sewer line. The water exited the coagulating basin ring via an influent pipe that led to the central pipe vault, located at the center of the assembly.

The next step in the process was filtration. Rapid sand filters, which the Morse plant used, rely upon sedimentation and flocculation/coagulation to remove the majority of particles, turbidity, and bacteria from the water prior to filtration. The actual filtering, therefore, removed any remaining particles in the water and tastes and odors not palatable to customers.[108] At the Morse plant, the filter ring of the assembly was divided into four 1.25 Mgd capacity filters that operated independently from one another. The influent pipe from the coagulating basin entered the central pipe vault, where it branched into four pipe extensions with valves at each end leading to one of the four filters. The filters consisted of a suspended floor of Tri-Lok grating sitting on a structural steel frame. The Tri-Lok grating was chosen for its even grate pattern, which would have facilitated backwashing by insuring an even upward thrust of water.[109] An 18" layer of graded gravel rested on the grating and on top of that lay a 24" layer of sand. Any remaining particles in the water stuck to the sand as it filtered through the layer.

After passing through one of the four rapid sand filters in the assembly, the filtered water entered an effluent pipe, which led to the central stack. Operators could then test the filtered water. Lime and ammonia were added to reduce the water's pH and remove unpalatable tastes and odors. The water then entered the filtered water reservoir ring, which had a 275,000-gallon capacity. It was covered to protect the filtered water, except for two hatches located at opposite ends of the assembly that provided ventilation and kept the walls of the ring from collapsing inward. Steel ladders extended down from the hatches into the ring.

Pipes led from the filtered water reservoir to the high-lift pumping station, which had a 24 Mgd capacity against an average 275' head (head being the pressure exerted by water at a certain depth). Chlorine was added to the filtered water at the high-lift pumping station before the water was finally pumped into the WSSC's distribution lines. The

[107] Centrifugal pumps were the most common type of pump used in filtration plants. Douglas McVarish, *American Industrial Archaeology: A Field Guide* (Walnut Creek, CA: Left Coast Press, 2008), p. 189.
[108] Harry N. Jenks, "Filter Design as Related to Operation," *Journal of the American Water Works Association* 28, no. 10 (October 1936): pp. 1541-1550.
[109] The Tri-Lok Company of Pittsburgh, Pennsylvania, received several patents for their products, including Patent 1,611,316 on December 21, 1926; Patent 1,657,446 on January 24, 1928; and Patent 1,674,479 on June 19, 1928.

hydro pumping station was put into operation pumping water from the filtered water reservoirs of the filter assemblies into the distribution lines when excess water from the Northwest Branch was available to power the turbine connected to the pump. This resulted in a savings in electricity usage and increased the capacity of the high-lift pumping station.

To keep the filters clean, a separate piping system with a feed pump delivered filtered water from one of two wash water tanks located on a hill above the filter assemblies for backwashing. The pipe from the wash water tanks entered the assembly at the central pipe vault and then branched into lines extending to each of the four filters. The wash water was sent down vertically to the bottom of the filter compartment via elbows in the pipes "in order to insure diffusion and prevent violent upward movement."[110] The force of the water being sent upward broke the particles of floc attached to the sand grains, cleaning the surface of the filter and promoting more effective filtration. During backwashing, the water would have risen as high as the five wash water troughs located at the top of the filter. The 15" wide troughs were equipped with a "wooden shoe" skimming edge that facilitated the removal of the displaced particles from the sand layer from the water and into the trough. These five troughs extended at a slight decline from the outer wall of the filter ring to the inner ring, where they connected to a steel trough and downtake.

B. Machines:

Contemporary accounts provide some information as to the types of machinery used in the operation, most of which were contained within the high-lift and low-lift pumping stations. The Aer-O-Mix aerators were located next to the low-lift pumping station. Inside the low-lift station were six motor-driven centrifugal pumps (manufacturer not specified) that had a total capacity of 20 Mgd against a 12' head. The two largest pumps (with a 5 Mgd capacity) had auxiliary gasoline engine drives, while the two smallest pumps (with a 2 Mgd capacity) were regulated by the water level of the coagulating basins. Rather than using gate and check valves, the two smallest pumps had Rotovalves at the discharge lines.[111] The second floor of the low-lift station contained the four, dry-feed chemical machines (manufacturer not specified).

The high-lift pumping station contained six or seven electrically-operated centrifugal pumps (manufacturer not specified) with a 19 Mgd capacity. The two largest pumps had auxiliary 240-hp gasoline engines. All the pumps had Rotovalves on the discharge lines, except the two smallest pumps. At the rear of the building was a 75 horsepower 8 x 6 unit flanked by a 210 horsepower 10 x 8 unit and a 200 horsepower 10 x 8 unit. Centered at the front of the building were two 150 horsepower 8x6 units flanked by a 75 horsepower 6 x 5 x 4 unit and a 200 horsepower 8 x 6 unit.[112] On the second floor of the high-lift pumping station were the ammoniator (for adding ammonia) and two chlorinators (for adding liquid chlorine). There were also three, dry-feed chemical

[110] Morse, "New Water Purification Works," p. 686.
[111] Morse, "New Water Purification Works," pp. 681-82.
[112] Washington Suburban Sanitary District, "High Lift Station Suction & Discharge & Force Mains."

machines that connected to the filter effluent pipe. One added lime, another alum, and the third activated carbon.[113] The manufacturers of these machines were not specified.

C. Technology:

Brief History of Water Filtration

Water filtration has been historically defined as removing

> the suspended matter by sedimentation, with or without the coagulation of the finer particles; the removal of color and pathogenic bacteria by filters, with or without the aid of coagulation; and the storage of the filtered water in sufficient quantities to permit the filters to operate at a nearly uniform speed.[114]

Advancements in scientific disease theory provided the impetus for developing public waterworks with filtration systems. The so-called "miasmatic theory of disease" or "filth theory of disease" attributed the cause of disease to filth in the 1850s, followed by the "germ" or "bacteriological theory" after 1880, in which the link between bacteria and disease was established. For example, originally typhoid was thought to be spread through miasmas, those "poisonous atmospheres thought to rise from swamps, decaying matter and filth." In the 1840s, English scientist William Budd proved that typhoid actually spread by drinking water contaminated by the waste of those infected with the disease, consuming tainted shellfish, or from contact with infected persons.[115]

With a scientific basis established for disease causation, technological improvements like the establishment of public works overseen by a central authority could ensure its prevention.[116] The need for municipal water filtration plants increased in the early twentieth century due to industrialization, growing urban populations, and greater pollution of the nation's waterways. A 1904 article on water filtration summed up the growing need for municipal water filtration plants,

> the more important features of health and cleanliness render it an imperative duty to prepare for the rapidly increasing population of our cities by taking judicious measures to secure to every community that system, which, having simplicity and durability to recommend it, will, while being economical, insure a sufficient supply of pure water for individual use as well as for the factories and mills.[117]

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[113] Morse, "New Water Purification Works," p. 682; WSSC, "Brief Detailed Description," unpaginated.
[114] James H. Fuertes, *Water Filtration Works* (New York: John Wiley & Sons, 1904), pp. 26-27.
[115] Typhoid symptoms include chills, nose bleed, cough, insomnia, tremors, nausea, diarrhea, temperatures of 105 degrees Fahrenheit, and sometimes spots on the torso. The only available treatment at the turn of the twentieth century was bed rest and a healthy diet, with a recovery time of as long as four months. It was not until the 1920s that a vaccine was widely available, although one had been created in 1900. Troesken, "Typhoid Rates," pp. 928-929.
[116] See Melosi, *The Sanitary City*, Chapters 2 and 3.
[117] "Water Filtration and Aeration," *Science* 13, no. 313 (February 1, 1889): p. 74.

Engineer M. N. Baker divided the history of water treatment in the United States into five eras.[118] The first ended in 1870 with the publication of James P. Kirkwood's 1869 *Report on the Filtration of River Waters*. Prior to 1870, there were some small filters in existence with sedimentation being the primary treatment option. Kirkwood, a waterworks engineer from Brooklyn, New York, had been hired by the city of St. Louis, Missouri, to improve the city's water supply. He traveled throughout Great Britain and Europe studying water filtration practices. The resulting publication was the first written in English dealing with filtration technology and introduced American engineers to various kinds of filters.[119] The second era lasted from 1870 to 1890 and encompassed the introduction of sand filters to the United States, although their effectiveness was limited because the science of bacteriology had not advanced enough for engineers to understand the potential benefits of filtration. During the third era (1891-1900), technological advancements were made in filter design, aided in part by the establishment of the Lawrence Experiment Station by the Massachusetts State Board of Health in 1887. Headed by chief chemist Allen Hazen, the center experimented with water filtration techniques, in the process becoming the "leading research center in water purification in the nation."[120] Other technological advancements included the use of steam pumps and standpipes rather than relying upon gravity to bring water to the plants, and the use of iron rather than wood in pipe construction.[121] The fourth era (1901-1910) is characterized by the continued debate over slow versus rapid sand filters and increased investigation into disinfection methods. Finally, the fifth era (1910-1930s) saw the widespread use of filter plants and chlorination. This era, in which Morse's filter falls, also saw experimentation with filtration technology.

Examples of early municipal water systems in the United States include the 1652 incorporation of a "Waterworks Company" by the Boston General Court, which consisted simply of a reservoir for household use and for firefighting with no water filtration or purification. Few residents used the reservoir, symptomatic of public skepticism about the cleanliness of municipal water supplies. Instead, people preferred to rely upon private wells and cisterns, which were perceived as cleaner.[122] Other early public water systems were established in the eastern half of the United States in the late eighteenth century in such towns and cities as Bethlehem and Philadelphia, Pennsylvania;

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[118] Baker's discussion of the eras of water treatment is outlined in Melosi, *The Sanitary City*, pp. 139-145.
[119] James H. Fuertes, *Water Filtration Works* (New York: John Wiley & Sons, 1904), p. v; M.N. Baker, *The Quest for Pure Water: The History of Water Purification from the Earliest Records to the Twentieth Century* (New York: The American Water Works Association, Inc. 1948), p. 133; Melosi, *The Sanitary City*, pp. 86-87.
[120] Melosi, *The Sanitary City*, p. 141. In addition, the establishment of the American Water Works Association in 1881 and the New England Water Works Association of 1882 created professional organizations for the newly developing field, see Baker, *Quest for Pure Water,* p. 141.
[121] Fuertes, *Water Filtration Works*, p. vi; Baker, *Quest for Pure Water*, pp. 139-140. Pipes were at first constructed of bored logs and then wood stave piping built of redwood or Douglas fir staves and bound with steel cable or bands. These continued to be the norm in the Pacific Northwest and West where low-pressure gravity systems abounded. The use of steam pumps required a pipe capable of withstanding higher pressures, so iron (after 1850), asbestos-cement (after 1913) and then plastics like PVA (after World War II) were commonly used. See J. Michael LaNier, "Historical Development of Municipal Water Systems in the United States 1776-1976," *Journal of the American Water Works Association* 68, no. 4 (April 1976): p. 178.
[122] LaNier, "Historical Development," p. 174.

Providence, Rhode Island; Salem, Massachusetts; Hartford, Connecticut; Geneva, New York; Worcester, Massachusetts; Portsmouth, New Hampshire; and Lynchburg, Virginia.[123]

The first waterworks with a filter was erected at Richmond, Virginia, in 1832, with other early nineteenth century waterworks built in Cincinnati, St. Louis, Boston, and New York City.[124] These early waterworks were really "protosystems—offering rudimentary distribution networks, pumping facilities, and new sources of supply" that led to the more fully-developed and centralized citywide water systems of the late nineteenth century.[125] At the end of 1860, there were only 136 waterworks in existence in the United States and Canada.[126] Construction of municipal systems increased as urban populations grew, rendering the previously relied upon system of private wells and cisterns inadequate. Most of these early waterworks simply provided a large public supply of water and offered minimal filtration, which generally consisted primarily of reducing the turbidity by allowing sediment to settle out in a basin. Despite scientific evidence indicating the need for filtration, in 1899, only 11 percent of water companies in the United States used a filtration system.[127] By 1930, there were more than 1,500 filter plants, which increased to 2,188 in 1939.[128] Although slow sand filtration plants were the norm in Europe, particularly England and Scotland, U.S. engineers instead focused on developing the rapid sand filter. The overwhelming preference for the rapid sand type in the United States can be seen in 1940 when 2,275 rapid sand filters were in operation in this country as compared to 100 slow sand filters.[129]

Slow Sand and Rapid Sand Filters

Both slow and rapid sand filters use sand as the filtering medium, with a 1904 publication recommending that it be free of clay and "calcareous materials" because of the tendency of these to "cement the sand grains together" and thus reduce the efficiency of the filter. Having a uniform size of sand grain also helped prevent compaction, but research had not proved a particular sand grain size was more effective at that time.[130] The filtration process itself is markedly different in the two filter types. In slow sand filters, also known as "English Filters" since that was where the type originated and was widely utilized, the water filters slowly through beds of sand without the use of chemicals. Most of the particles and bacteria are left on the sand's surface.[131] Albert Stein's 1832 filtration plant in Richmond, Virginia, used a slow sand filter but design flaws ultimately caused its failure. The first successful use of this filter type in the United States did not

[123] LaNier, "Historical Development," pp. 174-176. The first documented sedimentation basin was built in Lynchburg, Virginia (p. 178). Philadelphia's system was one of the first municipally owned waterworks and the first to use steam pumps in the United States (pp. 175-176).
[124] Baker, *Quest for Pure Water*, p. 127; Melosi, *The Sanitary City*, pp. 37-38, 86.
[125] Melosi, *The Sanitary City*, p. 39.
[126] Baker, *Quest for Pure Water*, p. 125.
[127] Troesken, "Typhoid Rates," p. 930.
[128] Melosi, *The Sanitary City*, p. 223.
[129] Baker, *The Quest for Pure Water*, p. 148.
[130] Fuertes, *Water Filtration Works*, p. 85.
[131] Fuertes, *Water Filtration Works*, p. 76.

occur for another forty years when a slow sand filter modeled after James P. Kirkwood's proposed plant for St. Louis was built in Poughkeepsie, New York, in 1872.[132]

U.S. engineers developed the rapid sand filter (also known as "American Filters" or "Mechanical Filters"), which became the standard in U.S. filtration plants. The Morse plant used this type of filter. The marked preference for rapid sand filters in this country was attributed to the turbidity of most of this country's water, which required chemical additives to successfully remove both the suspended clay particles as well as the bacteria adhered to those particles. Otherwise, the clay particles simply passed through the sand.[133] In addition, rapid sand filters were effective in filtering water that had been polluted by sewage and industrial waste.[134] The filter's job was to "polish up the water delivered to it by the pre-treatment works," the idea being that the pre-treatment of the water with coagulants in the sedimentation and coagulation steps would clean the majority of particles from the water prior to it even reaching the filter.[135] In rapid sand filters, the addition of coagulating chemicals like alum to the raw water resulted in the formation of a "sticky, gelatinous substance" to which particles and bacteria in the water adhered.[136] Rapid sand filters could take one of many shapes, including metal cylinders, open tanks, or filter beds that were similar to slow sand filter beds but smaller and deeper.[137]

Early experimenters and producers of rapid sand filters included Patrick Clark, John and Isaiah Hyatt, Col. L.H. Gardner and the Jewell family. By 1895, the Hyatts and Clark held over sixty patents for rapid sand filters. Companies building rapid sand filters between 1880 and 1900 included: Hyatt, Warren, National Filter Company, Blessing, Continental Filter Company, American Filters, and Jewell Filter Company. These were usually similar in design, consisting of a large steel cylinder or tank, layers of sand, and some type of draining and flushing system.[138] By 1900, the patents on rapid sand filters had been consolidated under the New York Continental Jewell Filter Company. The first use of the rapid sand filter in a municipal supply occurred in Somerville, New Jersey, in 1885.[139] The additional steps of chemical coagulation and sedimentation prior to filtration were introduced at the rapid sand filters constructed in Louisville by George W. Fuller in 1897, thus establishing the basic rapid sand filtration process.[140] A rapid sand

[132] LaNier, "Historical Development," p. 179; Baker, *Quest for Pure Water*, p. 148.
[133] LaNier, "Historical Development," p. 179.
[134] Norcom and Brown, "Water Purification for Plant Operators," p. 9.
[135] Harry N. Jenks, "Filter Design as Related to Operation," *Journal of the American Water Works Association* 28, no. 10 (October 1936): p. 1541.
[136] Fuertes, *Water Filtration Works*, pp. 75-76, 201-202.
[137] LaNier, "Historical Development," p. 179.
[138] LaNier, "Historical Development," p. 179.
[139] Melosi, *The Sanitary City*, pp. 140-41.
[140] "Water Purification Pre-Eminent," *Engineering News-Record* 104, no. 21 (May 22, 1930): p. 831. Other types of filtration included the Anderson process. Used in European cities like Antwerp, it was similar to rapid filtration in that a coagulant was added to the water, although ferric hydrate was often used rather than alum. Another was the Pasteur-Chamberland filter, an example of which was found in Darjeeling, India, that consisted of a hollow, unglazed tube of porcelain through which water was forced so that bacteria stuck to the surface of the tube. See Fuertes, *Water Filtration Works*, pp. 249-250.

filter built at Little Falls, New Jersey, by the East Jersey Water Company in 1902 had become the standard design by the 1930s. It was constructed of concrete and rectangular in form as compared to earlier round filters that were built of wood.

Filtration Process

The Robert B. Morse Water Filtration Plant operated from 1930 to 1960. During that time period, the typical filtration process using rapid sand filters can be generalized as the following. Low-lift pumps pumped water from the source to the sedimentation basin where coagulants like sulphate of alum (alum) or ferrous sulphate (copperas) and lime would be added. In the early filtration plants, large amounts of coagulants would be dissolved and stored in a tank that would then feed the mixture into the basin at a uniform rate via a small feed tank (known as the solution-feed method). Experiments in St. Louis in 1912 with adding dry chemicals via dry-feed machines proved successful. The practice quickly gained popularity as it was less messy and more compact than solution feeding. The coagulants were generally mixed into the raw water at either the suction point of the low-lift pumps, the inlet pipes to the sedimentation basin, or in the sedimentation basin itself with a variety of baffle types available for use. The mixing of the coagulants into the water was an important step in the filtration process as the movement of the water promoted the consolidation of particles, known as floc.[141]

Once the coagulating chemicals had been thoroughly mixed, the water sat in the sedimentation basin for a specified period of time to allow the resulting floc to settle down to the basin's bottom. Sedimentation basins were designed according to the desired capacity, rate of flow through the basin, and topography of the site. The standard layout at large filtration plants was to have a grouping of several sedimentation basins arranged with the inlets at one end and outlets at the other.[142] Few alterations were made to the basic form and function of the sedimentation basin, although by the 1930s, the trend was longer storage of water, with a preferable time period of about six hours although it could be as long as eighteen hours.[143]

Once the floc had settled out, the water was pumped via pipes to the rapid sand filter. Water passed by gravity through the sand and gravel filtering medium, with additional particles clinging to the sand. The final step was chlorination, in which chlorine was applied to the filtered water, generally at the suction of the high-lift pump. Omar Jewell designed the first system to deliver chlorine to water in 1888. This step was not part of the standard operating procedure until ca. 1924, although early filtration plants did include chlorine feeding systems (such as those at Louisville, Kentucky, in 1896; Adrian, Michigan, in 1899; and Philadelphia, Niagara Falls, and Wilmington, Delaware, in 1912).[144] From 1910-20, adding chlorine to the filtered water was not seen as necessary to insure water purity and eliminate bacterial diseases like cholera and typhoid.

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[141] Paul Hansen, "Developments in Water Purification Practice," *Engineering News-Record* 104, no. 21 (May 22, 1930): pp. 839-840.
[142] Fuertes, *Water Filtration Works*, pp. 45-46.
[143] Hansen, "Developments in Water Purification Practice," p. 840.
[144] LaNier, "Historical Development," p. 180.

However, the establishment of drinking water standards by the U.S. Treasury in 1915 and additional study by scientist H. W. Streeter in 1924 resulted in chlorination becoming an essential part of the filtration and purification process.[145]

Another important component of the filtration process was backwashing, which insured the continued effectiveness of the filters. Filters had to be periodically flushed with clean wash water since large accumulations of floc on the surface of the sand layer could cause clogs. Backwashing required a strong upward and diffuse flow of water (recommended in one publication to be 2' a minute) to adequately loosen the surface of the sand, thus allowing the sludge produced by flocculation to be disposed of via wash water troughs.[146]

Filter Plant Design

By the 1930s, the basic design of the filter plant had been established, with each step of the filtration process usually taking place in a separate structure. As noted in a 1936 article, "In effect, the filter structure of today differs little from what it was ten years ago, so far as physical arrangement, shape and dimensions are concerned. The most important changes in design and operation have occurred in relation to filter equipment."[147] Morse's idea of combining all the filtration steps into one filter assembly was a departure from the norm. He filed a patent for his "Liquid Purification Plant" in 1934 and was awarded the patent posthumously in 1938. His design harkened back to early circular filters while also looking forward by incorporating all the steps into one unit.

Morse's design is similar to the first filter ever built, which is attributed to John Gibb of Paisley, Scotland. Gibb constructed a circular filter to supply his bleachery as well as private residences because the source of the town's water, the River Cart, was often fouled by mud and industrial waste. In operation from ca. 1804 to ca. 1861, Gibb's filter consisted of a central well surrounded by concentric rings with walls of masonry. Water flowed from the river to a pump well, then through a "roughing filter" measuring 75' long. At the end of the filter was a well with a steam engine above to lift the water up to an "air chest" located 16' above the river. From the "air chest," the water flowed to a settling chamber and then through 200' of 3" diameter pipe built of Scots fir to the filter, which was made up concentric rings. The exterior ring contained a coarse gravel filtering medium, while the middle ring contained a filtering medium consisting of fine gravel and sand. The central well held the 23.5' diameter clear water basin. A pipe extended from the clear water basin 1/8 mile to a cask that could hold 480 wine gallons. A cart then delivered the filtered water throughout town.[148] This idea of creating a circular assembly with concentric rings containing the various processes may have informed Morse's later

[145] "Water Purification Pre-Eminent," p. 831; Matt Alvarez and Appiah Amirtharajah, "From Slow Sand to High-Rate Processes, Filtration Remains the Primary Protection," *American Water Works Association Journal* 96, no. 8 (August 2004): p. 57.
[146] George D. Norcom and Kenneth Brown, "Manual of Water Purification Procedures," prepared for Corps of Engineers, U.S. Army (Newark, NJ: Wallace and Tiernan Company, Inc., 1942), p 8.
[147] Jenks, "Filter Design as Related to Operation," p. 1543.
[148] Baker, *Quest for Pure Water*, pp. 77-79. Baker specifically notes that Morse used this design at Burnt Mills, Maryland, with the only difference being that Morse used steel for the filter walls while Gibb used masonry (p. 78).

patent. Morse was also responding to the challenges of the Burnt Mills site. As he stated in the patent application for his "Liquid Purification Plant":

> An important object of the invention is to provide a water purification plant of extremely flexible nature so as to lend itself to different topographic conditions; which economizes space and materials in its construction, and which, while a complete unit in itself, may be effectively utilized as one of a series of associated purification units of either similar or different construction. A further object is to provide apparatus of such character as to afford in a limited space a maximum amount of sedimentation, coagulation and filtration area.[149]

Responding to the challenges of the site chosen for the new filtration plant, Morse designed and eventually patented an innovative filter design that could be adapted to the topographic and spatial challenges of a multitude of sites.

The Morse filter design seems to have had some limited impact on later filters. The Aldrich Filter, developed by Elwood H. "Spike" Aldrich, chief engineer at American Water Works Company in 1960, is similar to that designed by Morse.[150] Aldrich filters had a central mixing well with a ring surrounding it where sedimentation occurred. Filtration occurred in the outermost ring as the water flowed down through a layer of sand and then gravel suspended on a grate resting on a structural frame. The Fairfax County Water Authority's treatment plant on the Occoquan River in Virginia dating to the mid-twentieth century used Aldrich filters, although the WSSC mistakenly reported that the facility used Morse's design.[151]

Constructed by the Washington Suburban Sanitary Commission and opened in 1936, the Robert B. Morse Water Filtration Plant is significant for its unique filter assembly designed by Chief Engineer Robert B. Morse. Rather than having the steps of the filtration process (sedimentation, flocculation, filtration and storage) taking place in separate structures, Morse designed a filter assembly that incorporated nearly all the steps into one circular structure. Although the filter assemblies were removed when the plant was taken offline in 1962, elements of the filtration process remain. The site is also significant in the history of the development of municipal water systems, both in the Washington, D.C. metropolitan region and in the United States.

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[149] "Liquid Purification Plant," Patent No. 2,129,181.

[150] Born in 1894, Aldrich earned a Bachelor's degree in Civil Engineering at the University of Illinois before joining American Water Works Company in 1933. He served as Vice President and Chief Engineer of the company from 1947-59. See Gilbert Cross, *A Dynasty of Water: The Story of American Water Works Company* (Voorhees, NJ: American Water Works Company, 1991).

[151] The author thanks the Fairfax Water Authority for its assistance with this project, particularly Mishelle R. Noble-Blair, Senior Plant Engineer, and John Hanchak, Manager, Water Production. They gave the HAER recording team tours of their facilities, supplied drawings of their plant, and provided invaluable information about water filtration and treatment in general and the Morse filter in particular. For more information about the Fairfax County Water Authority, see http://www.fcwa.org/about_us/history.htm, accessed December 2008.

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Inquiries were made to the Washington Suburban Sanitary Commission to see if drawings or documents relating to the design, construction and operation of the Burnt Mills filtration plant were available. Representatives from the WSSC stated that the documents relating to the site had been destroyed. Slides of three drawings were available from the Maryland-National Capital Park and Planning Commission due to the work done by William Bushong writing the Maryland Historical Trust Historic Sites Inventory Form. Paper copies of the some drawings of the high-lift pumping station were also available from the Montgomery County Department of Parks' Facilities Management Office.

Other potential sources of information that could be investigated include local newspapers, such as *The Evening Star* [Washington, D.C.] and the *Silver Spring Standard*, and post-1962 USGS maps.

Appendix A: Images

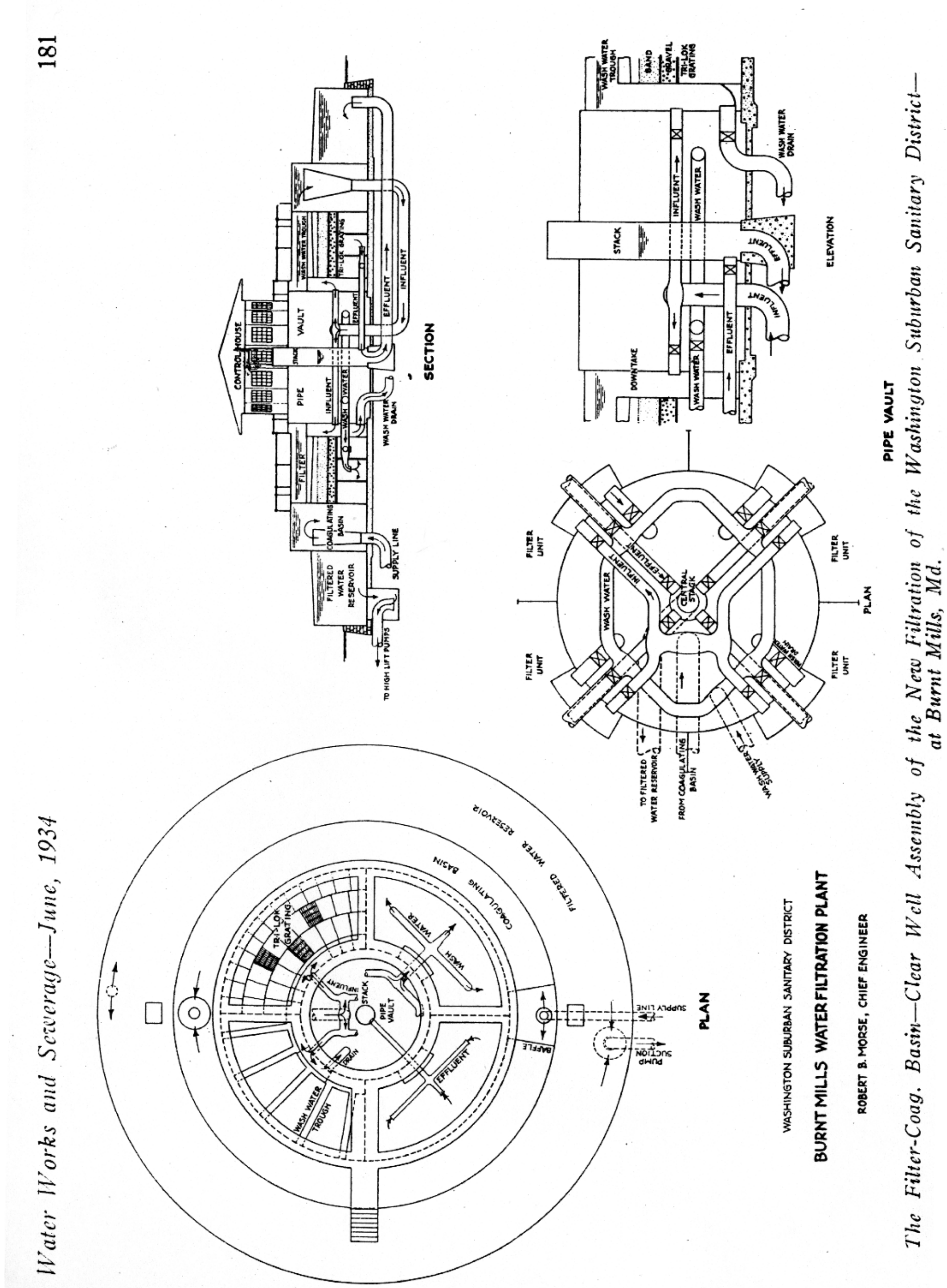

Figure 1: "The Filter-Coag. Basin-Clear Well Assembly of the New Filtration of the Washington Suburban Sanitary District-at Burnt Mills, Md." In Robert B. Morse, "Features of the New Water Purification Works at Burnt Mills, Maryland," *Water Works and Sewerage* LXXXI, no. 6 (June 1934): p. 181.

Figure 2: Robert B. Morse Water Filtration Plant aerial, 1949. From *The Washington Suburban Sanitary District*, Annual Report, 1949, prepared by Wainwright, Ramsey & Lancaster, New York, p. 14.

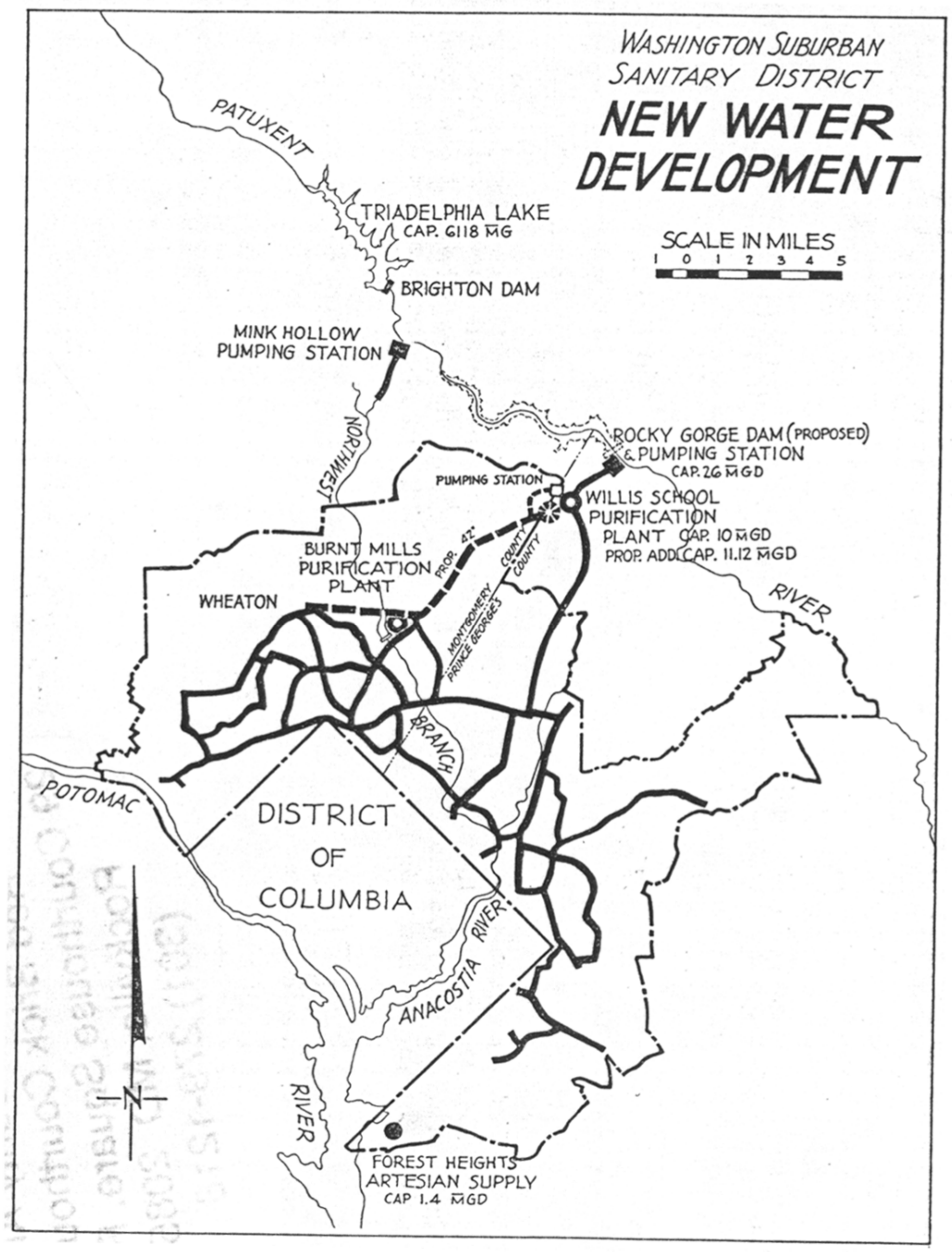

Figure 3: Washington Suburban Sanitary District, "New Water Development" map, 1949. From *The Washington Suburban Sanitary District*, Annual Report, 1949, prepared by Wainwright, Ramsey & Lancaster, New York, p. 58.