1891.

NINTIETH ANNUAL REPORT

OF THE

BUREAU OF WATER,

For the year ending December 31, 1891,

AND

FIRST ANNUAL MESSAGE

OF

EDWIN S. STUART,

Mayor of the City of Philadelphia,

WITH

ANNUAL REPORT

OF

JAMES H. WINDRIM,

Director of the Department of Public Works,

ISSUED BY THE CITY OF PHILADELPHIA, 1892.

1892.

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APPENDIX I.

Proposed Plan for Supplying Philadelphia with Schuylkill Water from Norristown Dam.

Submitted by the Reading Railroad Company.

Starting at a point on Norristown Dam, where Barbadoes Island, nearly one mile long, divides the river into two channels, and effectually protects the west channel from contamination, it is proposed to build an aqueduct to the City Pumping Stations on Flat Rock and Fairmount Dams.

The proposed gate-house or inlet, with suitable regulating gates, would be located on the west bank about 600 feet above the dam, fronting on the main channel in deep water, free from the dam, fronting on the main channel in deep water, free from sedimentary deposit. From this point the water would be carried in two riveted steel pipes $8\frac{6}{10}$ feet diameter, with a grade of one in five thousand, and with a capacity when running full but not under pressure of 254,000,000 gallons in twenty-four hours, to the mouth of Arrowmink Creek, on the southern border of the village of West Conshohocken. Provision would be made at the inlet gate-house for putting the pipes under a head of two and a half feet at low water, and thus increasing their capacity if required. The pipes would end in a gate-house at Arrowmink Creek, in which provision is made for a waste-weir and blow-off, as well as for regulating gates for the next section of aqueduct.

It is not practicable, from Conshohocken to Philadelphia, a distance of about nine and a half miles, to follow the river with a conduit of large size. The existing railroads, manufacturing establishments and other improvements, would make such a location exceedingly costly. The preferable route is through the hills by an aqueduct line entirely in tunnel, from the gate-house at Arrowmink Creek to a similar one in the West Park, near Belmont Glen, a distance of 40,680 feet, or $7\frac{7}{10}$ miles. Modern science has provided means for tunneling in solid rock comparatively easy and cheap, so that this feature of the line should not be regarded as extraordinary. The Croton Aqueduct of the City of New York, lately completed, is mainly in tunnel, and the City of Baltimore also has an aqueduct in tunnel, seven miles long, carrying the Gunpowder river supply.

The section proposed as far as Mill Creek Valley would be twelve and a half ($12\frac{1}{2}$) feet diameter, horse-shoe shape, with a grade of one in six thousand, and a capacity when running full but not under pressure of 300,000,000 gallons per twenty-four hours. From Mill Creek Valley to Belmont, there would be another section of twelve and a quarter ($12\frac{25}{100}$) feet in diameter, horse-shoe shape, with the same grade and a capacity of 284,000,000 gallons per twenty-four hours. The excavation along the entire line of tunnel would be mostly in gneiss rock, of which it is estimated only thirty per cent. would require lining.

In Mill Creek Valley a gate-house would be provided, from which a branch line in tunnel is proposed to carry 40,000,000 gallons per 24 hours to Roxborough Pumping Station.

From the gate-house at Belmont provision would be made for the supply of Belmont Pumping Station by means of one or more 48-inch cast-iron pipes as required.

The crossing of the River Schuylkill at this place is proposed to be made by riveted steel pipes 50 inches in diameter, carried on a stone bridge of ten arches and one iron plate girder span, the latter over the East Park drive. This plan pro-

Based on cost of pumping in 1896, the table opposite should be

S.G.	31319	@ 1	31,319
Bel	5278	@ .89	4,697
Rox	3745	@ .24	899
			36,915

vides for a bridge 70 feet wide on top, with ample room for driveway and footwalks. The location would be in line with Diamond street, on the north side of the East Park reservoir, and this extension of Diamond street by means of the bridge would open up a much-needed and attractive avenue of communication between the east and west sections of Fairmount Park for the northwest section of the city.

On the east side of the river, south of the Edgley ravine, gate-house No. 5 would be located, forming the inlet with regulating gates to the tunnel section of aqueduct extending from Rockland to Spring Garden, a distance of 5,015 feet.

The cross-section proposed is eleven and a half ($11\frac{1}{2}$) feet in diameter, horseshoe shape, with a grade of one in six thousand, and a capacity when running full but not under pressure of 237,000,000 gallons in 24 hours. This section would cross both the Philadelphia and Reading Railroad and the New York Division of the Pennsylvania Railroad under grade, and deliver the water into a gate-house and distributing chamber located on the rock bluff adjoining the Spring Garden Pumping Station, this gate-house to be connected with the Fairmount Water Works by a 48-inch main.

The elevations at which water would be delivered to the pumps at the several pumping stations, and the saving in lift over the present system is as fol. lows

		million gals	@	¢
Roxborough,	42.00 feet above City Datum, saving 11.1 feet lift.	3745	@	33 1236
Belmont,	36.92 feet above City Datum, saving 31.8 feet lift.	5278	@	95 5014
Spring Garden,	37.16 feet above City Datum, saving 32.0 feet lift.	31319	@	96 30066
Fairmount,	35.07 feet above City Datum, saving 29.9 feet lift.	11381	@	90 10243
				46559

Based upon the present pumpage at the above works the saving to the City in cost of pumping should approximate fifty thousand (50,000) dollars per annum. *

The estimated cost of the main line of aqueduct complete from Norristown Dam to Fairmount, a distance of 74,150 feet or 14,004 miles, is in round numbers $6,500,000. This includes branches to Roxborough and Belmont Pumping Stations with necessary gate-houses and fixtures, and right of

* Average cost of raising 1 million gals. 100 ft = ¢2.99 (¢.92)
This assumes that the cost of pumping a million gals varies directly as the head, whereas labor &c &c would not be equally affected by the height & Fairmt should not be included

way, except over City property. The time required to build such a work would necessarily be lengthened by the amount of tunnel work to be performed. It is estimated at four years.

The proposed aqueduct described above is planned to meet the requirements of the existing pumping stations on the Schuylkill River. These locations, with the exception of the Roxborough Works on Flat Rock Dam, were chosen many years ago, when there was a comparatively small population north of Girard avenue. Considering the rapid extension of the City northward, and especially the growing movement in Philadelphia, and in fact in all cities, to locate private residences on higher ground than was the custom a quarter of a century ago, it certainly would be good engineering to place any future large reservoirs north of the City and at a higher elevation than has been proposed.

The low service distribution is controlled by the East Park Reservoir, at an elevation of 133 feet above City datum. This is within easy distance of the Spring Garden Pumping Station, and, under existing conditions, the location can scarcely be improved upon. The high service distribution is now controlled by the Roxborough Reservoir, at an elevation of 366 feet above City datum, but will in a short time be fed by the new Roxborough basin, of much larger capacity and at an elevation of 419 feet above City datum. Between the high service, 419, and the low service, 133, there exists a pressing necessity for an intermediate distributing reservoir, at an elevation, approximately, of 250 feet above City datum. Provision has, indeed, already been made for this by the Department of Public Works, in the proposed location of a large reservoir in the neighborhood of the Scheutzen Park, at Falls of Schuylkill, Twenty-eighth Ward. The distance from Spring Garden pumping station is three miles, and under existing arrangements the proposed basin can be supplied from that station only. It does not appear reasonable to convey water by expensive aqueduct lines to a point as far south as Spring

Garden, to be pumped back again through three miles of pipe to the point of distribution.

Looking, then, to the growth of the City northward, and especially in the event in the building of an aqueduct to bring in the Schuylkill or its tributaries from a point beyond the City limits, it would certainly be more economical to establish a new pumping station near Flat Rock Dam to pump by water or steam power into a reservoir for intermediate service. An excellent location may be found on ground owned by the City at the Roxborough Poor House, on Shawmont avenue, north of Crease's lane. Here it is possible to construct a large basin at an elevation, approximately, of 275 feet above City datum, and within easy reach of the City by way of Wissahickon avenue. The distance from Flat Rock to the proposed site, by way of either Domino lane or Cinnaminson avenue, depending upon the location of the pumps, is about 7,000 feet.

The saving to the pumps, in lift, in connection with the increased elevation afforded by the proposed aqueduct would be 36 feet, as compared with the elevation at the Spring Garden Station. The advantage of using water power at both Flat Rock and Fairmount is too manifest to need argument. As to the use of both steam and water power, under the most favorable circumstances, the average cost for 1888 and 1889 was for water power $1.34 per one million gallons raised 100 feet high; for steam power at Spring Garden, Belmont and Roxborough, $4.60 per one million gallons raised 100 feet high.

The effective power at Flat Rock, based upon the average of nine years, 1880–1888, neglecting the year 1889, which was one of exceptionally large stream flow, and also making proper deductions for the water diverted at Norristown to feed the aqueduct, is as follows:

Average minimum three months of the year	1,025 H. P.
Average ordinary flow three months of the year	2,000 H. P.
Maximum six months of the year	2,400 H. P.

At $20 per horse power per annum, this power is worth $39,125 per annum.

The location proposed for the new reservoir is also near enough to the Roxborough Pumping Station to use steam power at that station as an auxiliary during the summer season, should the water-power at Flat Rock be below the requirements.

In conclusion, the Schuylkill has been a gift to the City for many years. Nothing has been expended upon it except to build one dam (Fairmount) to create a pool to pump from. Other cities—New York, Boston, Brooklyn, Baltimore, and many more—have expended large sums of money to protect their sources of supply. Philadelphia has, until very recently, done nothing but pump and sell its Schuylkill water, taking it as it flows past its doors without hardly knowing where it comes from or what it contains.

When the Schuylkill Navigation Company was in full operation, with as many as fourteen hundred boats engaged in the coal trade, and the Company exerted itself to the utmost to store water in the mountain districts, and let it down daily during the summer season to move a large tonnage, the river was kept in the best possible condition, and the standard of purity was raised by the inflow of water from the up-river dams. With the decline of the boating interest the City will certainly lose the beneficial effect of the Navigation Company's care of the river.

Surely, when we consider the great wealth and population of the City, the cheapness of its water supply in the past, and especially the dosirability of retaining, with some modification, its present system of water works, it will be to the interest of the City to go beyond the suburban towns to take water from the river, and also to control the stream with its dams and improvements by ownership, or otherwise, to its headwaters.

This plan would insure good water to the City of Philadelphia for a century to come. Not the least of its advantages

would be the saving to the City of the present pumping stations, which are admirably adapted to their work, and are the result of many years of labor and a large expenditure of money. To go to any other source of supply will involve sacrificing this plant, the pride of Philadelphia in the past, which, if supplemented by the construction of the proposed aqueduct, may continue to be the pride and satisfaction of the City for another century.

ESTIMATE OF COST

Of a proposed aqueduct to convey the water of the Schuylkill river from Norristown dam to the several pumping stations of the City of Philadelphia on the Schuylkill side.

For two $8\frac{6}{10}$ feet diameter riveted steel pipe conduits from inlet and gate-house at Norristown dam and Arrowmink creek, near Conshohocken, length 22,000 feet, 17,600,000 pounds of steel $\frac{5}{16}$-inch thick, including excavating and filling trenches, pumping, bailing, and extra labor	$1,116,550 00	
For stream crossings on pipe line at Swedeland, Gulf creek and Matson's Ford, and crossing main line of Philadelphia and Reading Railroad at West Conshohocken	29,500 00	
For aqueduct in tunnel from Arrowmink creek to Mill creek valley, 16,520 feet lineal, $12\frac{1}{2}$ feet diameter, horseshoe shape. Thirty per cent. with brick lining and 70 without	963,942 00	
For branch conduit from shaft in Mill creek valley to Roxborough Pumping Station, 4,450 feet in tunnel, including river crossing, shafts, gate-houses and 350 feet of 48-inch cast-iron pipe connection between conduits and pumps	138,000 00	
For aqueduct in tunnel from Mill creek valley to west side of River street, Belmont, 24,300 feet lineal, $12\frac{1}{4}$ feet diameter, horseshoe shape. Thirty per cent. with brick lining and 70 per cent. without	1,402,110 00	
For ten vertical shafts on Conshohocken-Belmont tunnel line of aqueduct, 1,735 feet lineal	203,365 00	
For branch conduit to Belmont Pumping Station, 2,900 feet lineal of 48-inch cast-iron pipe	36,250 00	
For Schuylkill river crossing from Belmont to Edgley, stone bridge, ten arches, 70 feet span, and one iron plate girder span over Park drive. Bridge 70 feet wide out to out, including 50-inch riveted steel pipe conduits from gate-house at Belmont to gate-house at Edgley. Distance 1,700 feet	872,505 00	
For stone arch bridge 30 feet span over ravine at Edgley in East Park	26,246 00	
For aqueduct in tunnel from Edgley to Spring Garden, 5,015 feet lineal, $11\frac{1}{2}$ feet diameter, horseshoe shape, lined throughout, including three shafts and extra work at railroad crossings	419,200 00	
For conduit from Spring Garden gate-house to Fairmount works, one 48-inch cast-iron pipe under pressure, 4,700 feet lineal	61,100 00	
For inlet and gate-house at Norristown dam, and gate-house at Arrowmink creek, Belmont, Edgley and Spring Garden, with necessary regulating gates and valves, etc	322,215 00	
For land and water right damages, and engineering and superintendence	458,500 00	
		$6,049,483 00
For contingencies, $7\frac{1}{2}$ per cent		453,711 00
		$6,503,194 00