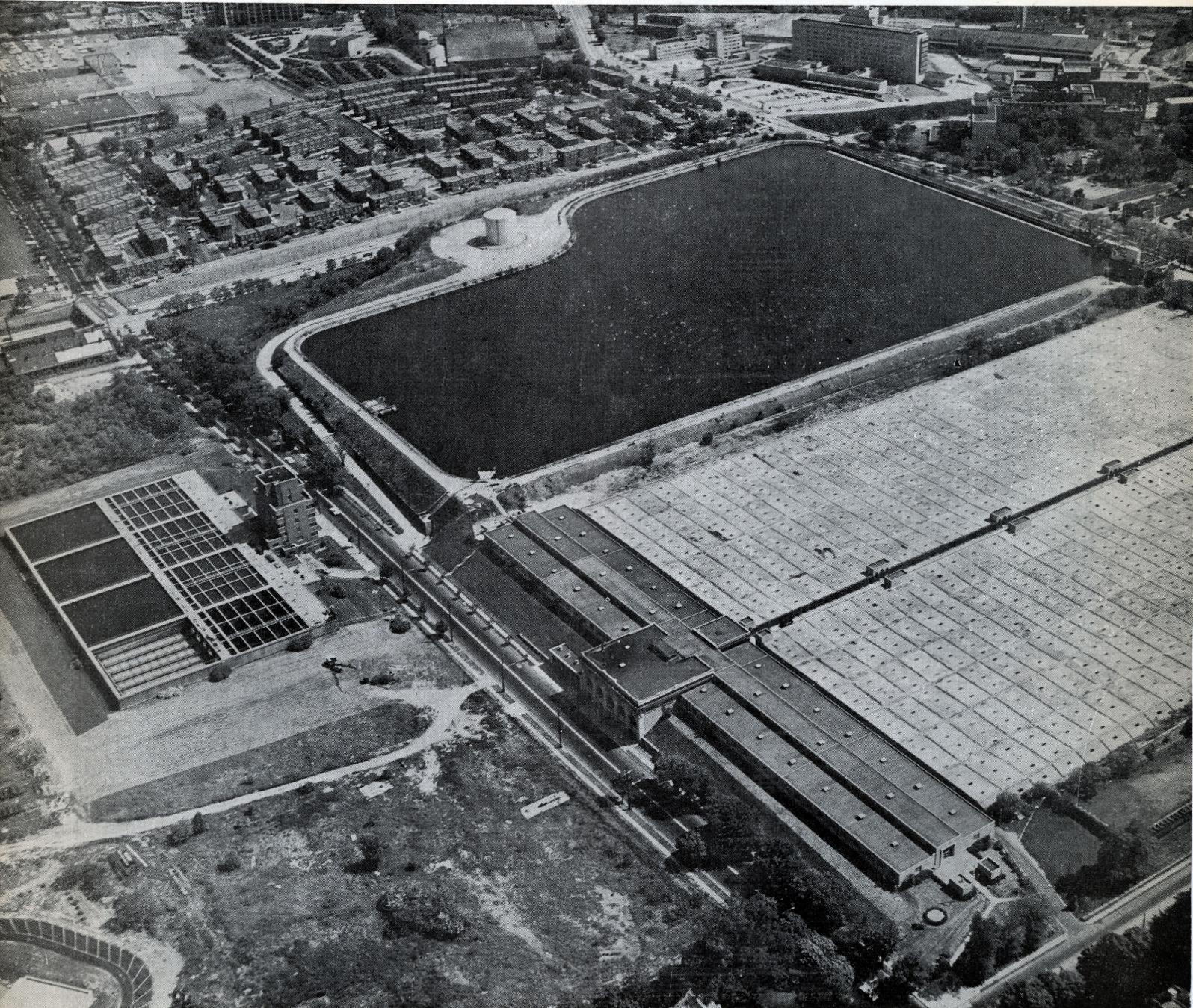


2019.004.0007 copy 2

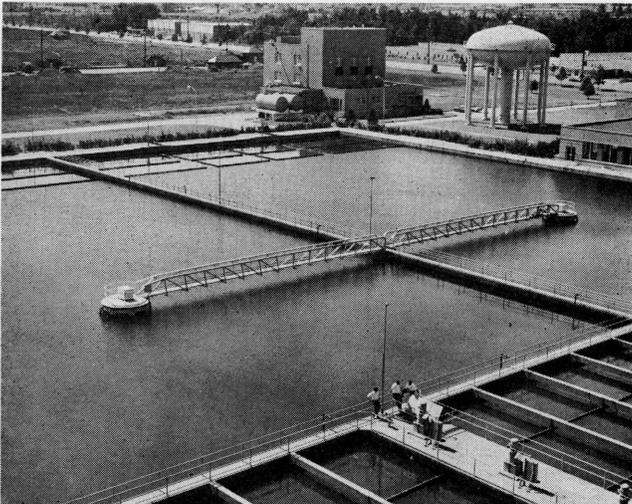


HOW WATER IN PHILADELPHIA IS TREATED AND DISTRIBUTED

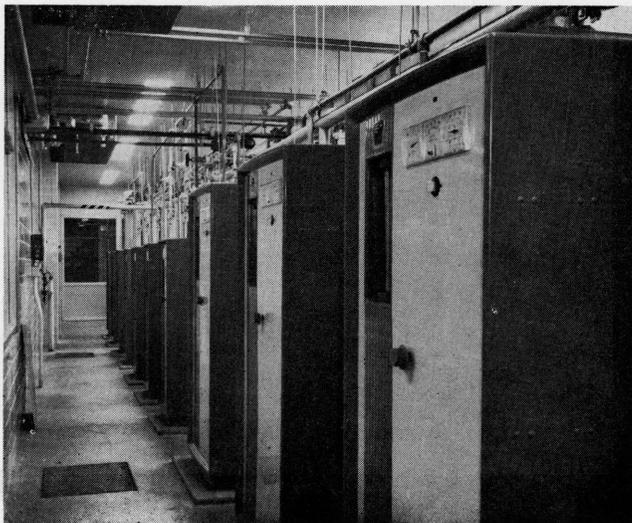
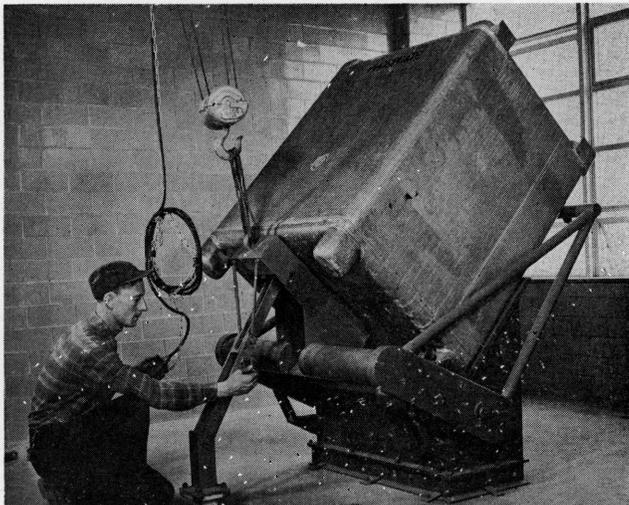


Queen Lane Water Plant

PHILADELPHIA WATER DEPARTMENT
1968



Torresdale Water Plant: The Delaware River water is settled (in basins above), filtered, and treated chemically. Tote bin below applies metaphosphates to water, while automatic equipment (bottom photo) applies chlorine.



SOURCES AND DISTRIBUTION

Where does Philadelphia get its water?

The city pumps one-half of its water from the Delaware River, just above the outlet of Pennypack Creek. The other half is pumped from the Schuylkill River at two different locations: the Belmont Pumping Station on the west side, just below Columbia Avenue Bridge, and the Queen Lane Pumping Station on the east side, just below City Line Bridge. The Belmont Station pumps from the pool formed by the Fairmount Dam, while the Queen Lane Station draws water from the head of the same pool.

All sources are located within the city and, with minor exceptions, all service is within the city limits.

After treatment and filtration, part of the effluent (or output) of the Belmont and Queen Lane Plants is delivered through the distribution system by gravity. This is possible because these plants have filtered water basins with water level elevations of 239 and 216 feet respectively.

The other effluents from Belmont and Queen Lane—and all the effluent from the Torresdale Plant—are pumped by stations located at, or not very far from the plants, and some effluents are repumped at six booster stations. Pumping helps to maintain the gradients required for satisfactory pressures and good service at all points in the distribution system.

Normally about one-third of plant output is delivered by gravity and two-thirds is pumped. Of the latter, about 15% is repumped at the booster stations.

Because of differences in elevation among city neighborhoods (a difference of 450 feet, for example, between homes in Roxborough and those in South Philadelphia), the city is divided into ten pressure districts. The fact that Philadelphia takes its water from three different river sources also makes some of these districts necessary.

Areas Where Delivered

Delaware water is delivered generally to those areas of the city east of Broad Street, while Schuylkill water reaches consumers west of Broad Street. There are some exceptions, however, to this pattern of distribution.

Thus Delaware water flows west of Broad Street to some neighborhoods south of Erie Avenue. It is also delivered to West Oak Lane and Chestnut Hill, and it may mix with Schuylkill water in the vicinity of East Park Reservoir before the latter water enters central city. Schuylkill water may also cross the Broad Street boundary: it serves the area bounded by Lehigh, Wyoming, and Kensington Avenue, and Roosevelt Boulevard.

Because of changes in consumer demands, and the need for occasional changes in plant operations, it is uncertain which of the river waters, or what combination of them, will be received in some areas along the north-south mid-axis of the city represented by Broad Street. West Philadelphia, however, receives only Schuylkill water.

The preceding is of particular interest to those who may be affected by changes in the mineral content of the water, since the Schuylkill water contains in solution about twice the amount present in Delaware water. In the 10-year period 1958-67, the annual hardness of water delivered to distribution from the Torresdale Plant on the Delaware averaged 89 parts per million; annual hardness of water from the plants on the Schuylkill averaged 154 parts per million.

The total population served is over two million. To these customers the Water Department distributed an average of 363.5 million gallons daily in 1968, compared with 339 M.G.D. in 1967. This was about 181 gallons per day for every person in Philadelphia.

The distribution system contains 3,200 miles of pipes of various sizes, from three inches to seven feet nine inches in diameter. About 103 miles of this pipe are three and one-half feet or larger in diameter. There are nearly 74,000 valves and over 25,000 fire hydrants.

Besides the regular distribution system, there is a high pressure fire system covering center city and that part of north central Philadelphia lying east of Broad Street and south of Lehigh Avenue. This is composed of 63 miles of mains, 1,900 valves, and 1,000 hydrants, together with two pumping stations that deliver water at pressures up to 300 lbs. per sq. in. One station is located at Delaware Avenue and Race Street; the other at 7th Street and Lehigh Avenue.

MODE OF TREATMENT

Daily output of the water treatment plants, in millions of gallons daily, averaged as follows:

	1967	1968
Belmont	61.3	63.1
Queen Lane	108.0	110.2
Torresdale	177.0	203.0

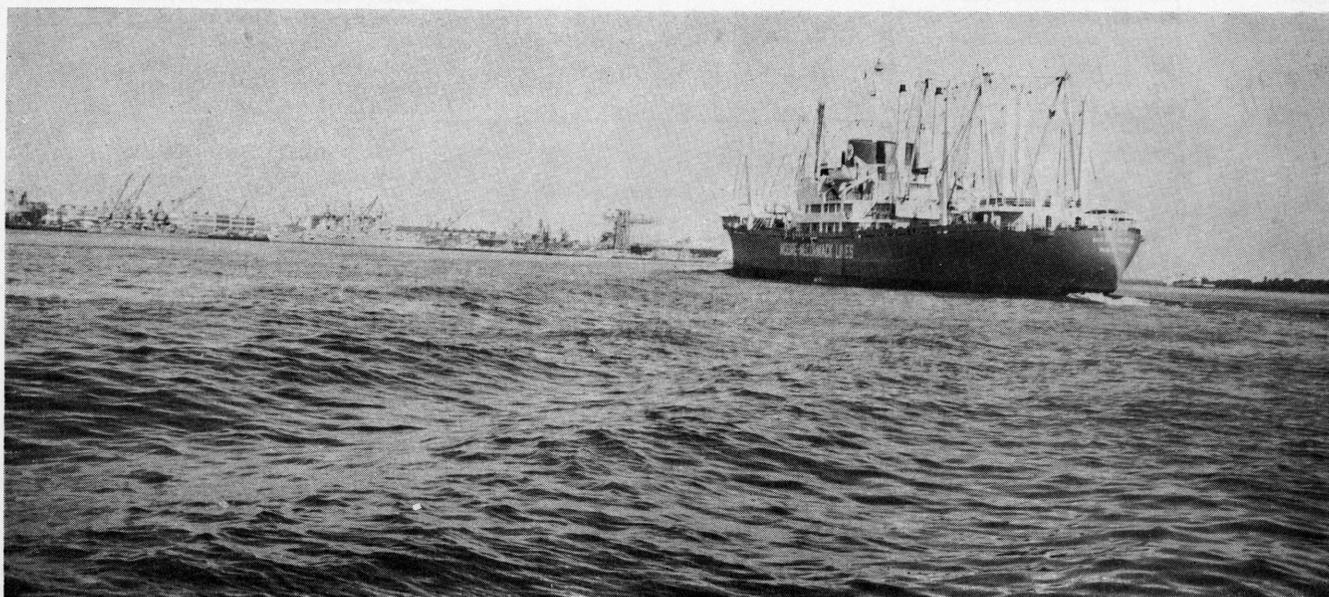
Successive steps in treatment at the plants in both years may be summarized as follows:

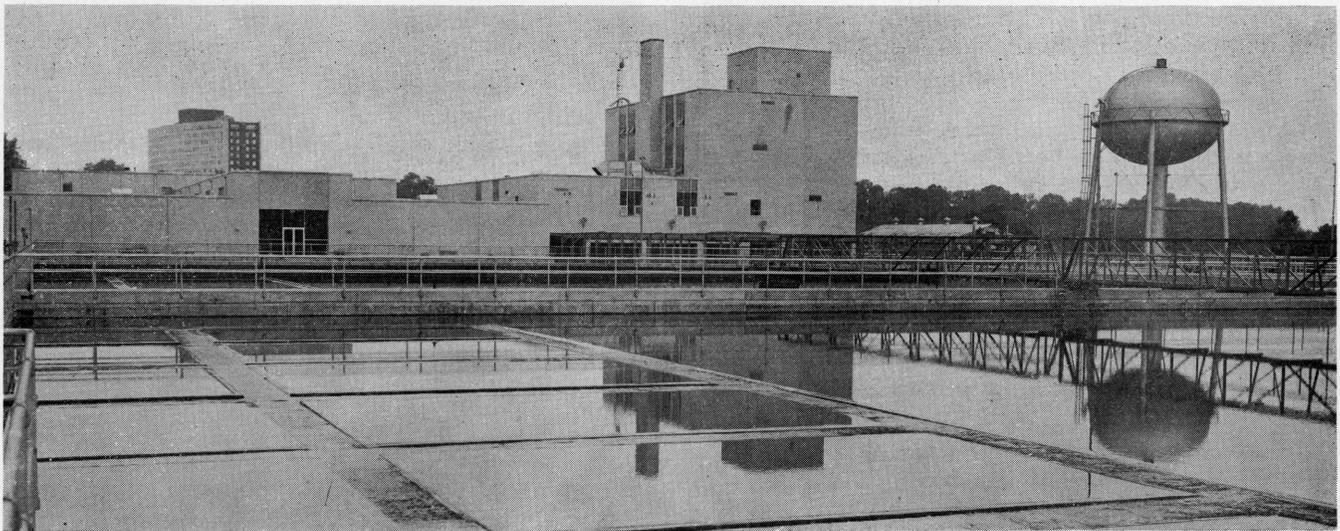
Belmont: (1) Pre-chlorination to free chlorine residual, (2) settling for 22 hours, (3) application of chemicals—chlorine or chlorine dioxide, alum with lime for pH adjustment, carbon, and ammonia, (4) rapid mixing of chemicals with water, (5) flocculation and settling, (6) rapid sand filtration, (7) post treatment, including chlorination, metaphosphate treatment, fluoridation, ammonia, and pH control with lime.

Queen Lane: (1) Pre-chlorination to free chlorine residual, (2) settling for 20 hours (3) carbon treatment, (4) chlorination, (5) application of alum with lime for pH adjustment, (6) rapid mixing of chemicals with water, (7) slow mixing of chemicals with water to form "floc," (8) settling, (9) chlorination if required, (10) rapid sand filtration, (11) post treatment, including chlorination, fluoridation, caustic soda for pH control, and (for high service and Roxborough express water only) metaphosphate treatment.

Torresdale: (1) Pre-chlorination to free chlorine residual, or application of chlorine dioxide, (2) pre-precipitation, (3) chlorination, (4) pre-treatment with alum in early 1967 and with ferric chloride from mid-1967 through 1968; use of lime for pH adjustment; use of activated carbon or chlorine dioxide when required, (5) rapid mixing of chemicals with water, (6) slow mixing of chemicals with water to form "floc," (7) settling, (8) rapid sand filtration, (9) post treatment, including chlorination, fluoridation and metaphosphate treatment, and pH adjustment by lime when required.

All water withdrawn from the East Park and Oak Lane Reservoirs is rechlorinated before entering the distribution system. Water at Oak Lane and East Park is treated with chlorine dioxide through the spring, summer and autumn to control algae.





Belmont Water Plant

WATER SYSTEM CAPACITIES — 1968

*PLANT TREATMENT CAPACITIES

(in millions of gallons daily)

	RATED	PEAK RATE
BELMONT PLANT	78	108
QUEEN LANE PLANT	120	150
TORRESDALE PLANT	282	423

PLANT RETENTION CAPACITIES

(in millions of gallons)

		TOTAL
BELMONT PLANT:	Two 36-MG pre-sedimentation basins	72
	Four sedimentation basins	14.2
	Filtered water basins	38.2
	Filtered water clear well	1.8
QUEEN LANE PLANT:	Pre-sedimentation basin	177
	Four 3-MG upper settling basins	12
	Four 3-MG lower settling basins	12
	Two 20-MG filtered water basins	40
	Future filtered water basins (ready in 1971)	50
TORRESDALE PLANT:	Pre-sedimentation basin	176
	Four 10-MG sedimentation basins	40
	Filtered water basins	193

**OTHER RETENTION CAPACITIES

(in millions of gallons)

		TOTAL
UPPER ROXBOROUGH:	Filtered water basins	25.6
LOWER ROXBOROUGH:	Filtered water basins	3
OPEN RESERVOIRS:	East Park (filtered water)	677
	Oak Lane (filtered water)	70
STANDPIPES:	Two 5-MG Somerton tanks	10
	Two 5.5-MG Roxborough tanks	11
	Fox Chase tank	1.5

§PUMPING STATION CAPACITIES

(in millions of gallons)

		TOTAL
RAW WATER:	Belmont Station (Schuylkill)	140
	Queen Lane Station (Schuylkill)	200
	Torresdale Station (Delaware)	360
FILTERED WATER:	1. Treated Schuylkill Water	
	Belmont High Service Station	42
	Chestnut Hill Booster Station	8.5
	East Park Booster Station	75
	Queen Lane High Service Station	77.5
	Roxborough High Service Station	45
	2. Treated Delaware Water	
	Fox Chase Booster Station	25.3
	Lardner's Point Station	210
	Oak Lane High Service Station	50
	Torresdale High and Low Service Station (200 MGD low, 42 MGD high)	242
	West Oak Lane Booster Station	27.5
	HIGH PRESSURE:	
	Fairhill Station	21.6
Race Street Station	21.6	

(Each high pressure station can pump 15,000 gallons per minute)

* Shut down permanently in 1962: Upper Roxborough Plant, 22 MGD rated, and Lower Roxborough Plant, 10 MGD rated.

** Shut down permanently in 1962: 147 MG pre-sedimentation basin at Upper Roxborough.

§ Shut down permanently in 1962: Shawmont Raw Water Station, 50 MGD, and Roxborough Booster Station (raw water), 73 MGD.

CHEMICALS USED BY THE PHILADELPHIA WATER SYSTEM — 1968

CHEMICAL	STORAGE	FEED	POINTS OF APPLICATION	PURPOSE	MAXIMUM DOSAGES
Aluminum: Commercial aluminum sulphate $Al_2(SO_4)_3 \cdot 18 H_2O$	Dry in bulk, liquid in lead-lined tanks	Belt-type dry feed and rotodip	Inlet to rapid mix or mixing basin	Clarification	2.5 gpg
Lime: Oxide and hydrate CaO and $Ca(OH)_2$	Dry and bulk	Belt - type dry feed (slakers for the oxide)	Inlet to rapid mixing basin or filter effluent	pH adjustment, also to increase alkalinity	1.0 gpg
Chlorine: Cl_2	150 - lb. cylinders, ton-cylinders, 55-ton R.R. tank cars	Commercial chlorinators with evaporators	Plant intake, rapid mix, or filter effluent	Taste and odor control (contact 16 to 20 hours), sterilization	16 ppm
Activated Carbon: C	Bags; also bulk R.R. car to slurry	With slurry feeder pump	Rapid mix or applied to filters	Taste and odor control	12 ppm
Hexametaphosphate: $(PO_3)_6$	Bags, 1 1/2 - ton unit hoppers	Solution tank and diaphragm feeder pump	Filter effluent	Reduce corrosion in distribution	1 ppm
Sodium Chlorite: $NaClO_2$	Dry in drums, liquid in stainless steel tanks	Solution tank and auxiliary tank to feeder pump	Plant intake, rapid mix, or filter effluent	Form chlorine dioxide for control of tastes, odors, or algae	1.5 ppm
Fluosilicic Acid: H_2SiF_6	Rubber - lined steel tanks	Measuring tank and diaphragm feeder pump	Filter effluent	Reduction of dental decay	1.0 ppm
Ferric Chloride: $FeCl_3$	Fiberglass - lined tanks	Rotodip liquid feed	Inlet to rapid mix or mixing basin	Clarification	1.0 gpg
Ammonium Hydroxide: $NH_4 OH$	Steel tanks	Diaphragm feeder pump	Inlet to rapid mix or mixing basin and filter effluent	Taste and odor control	1.0 ppm

NOTE: gpg—grains per gallon; ppm—parts per million. One grain per gallon adds up to approximately 143 lbs. of chemical per million gallons of water while one part per million would result in 8.34 lbs. per million gallons.

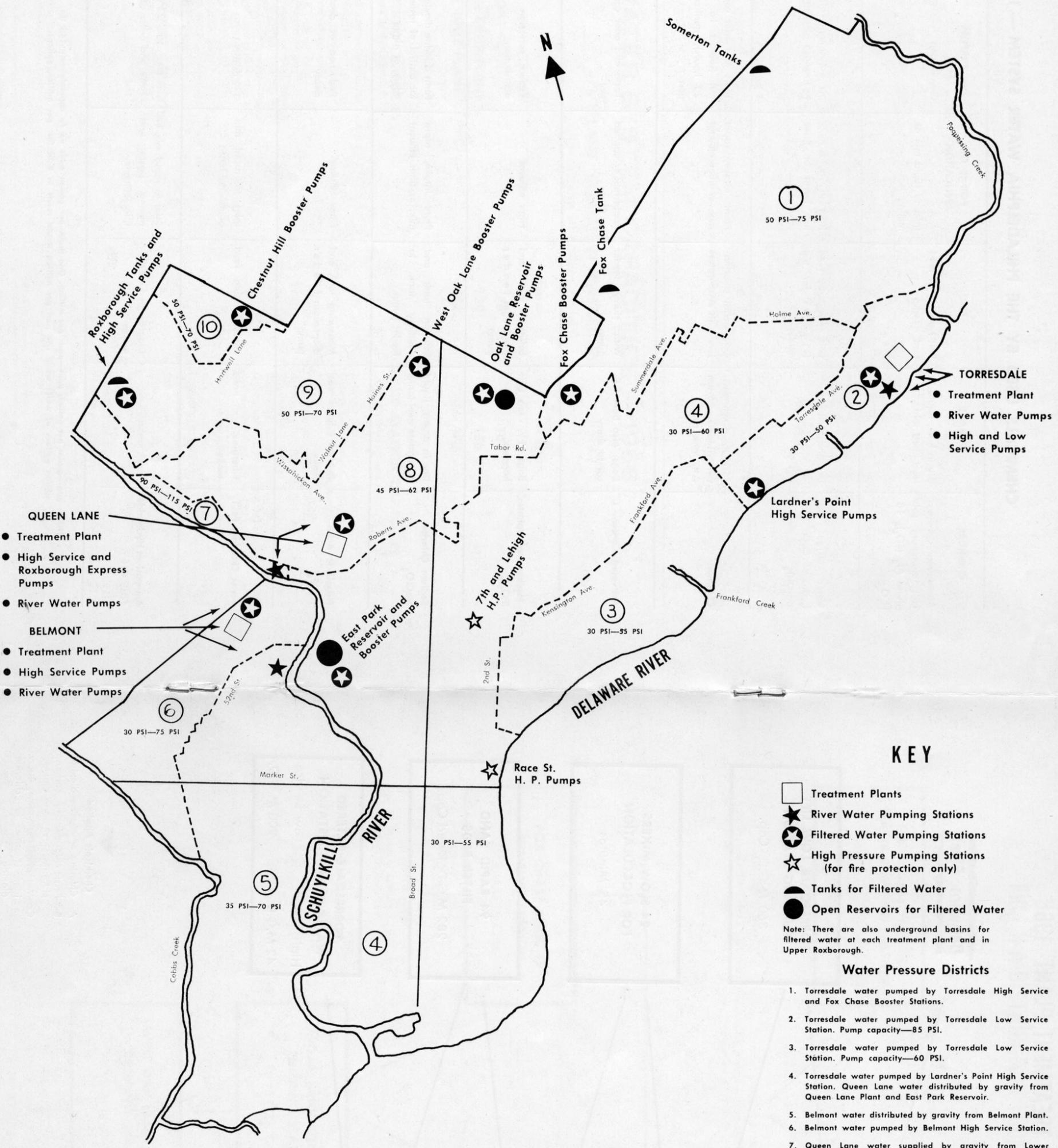
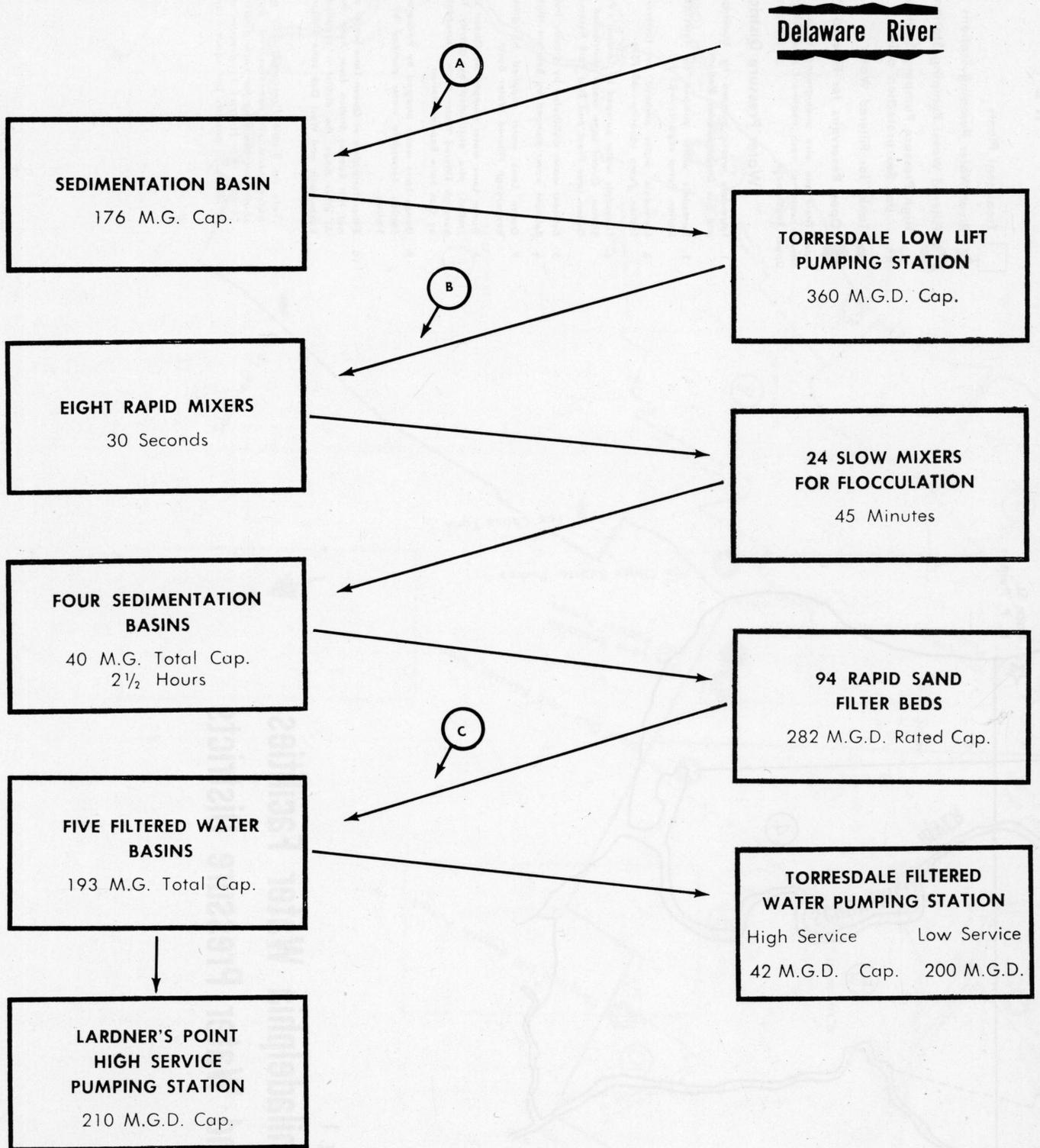


Fig. 1
**Philadelphia Water Facilities
 and Water Pressure Districts**

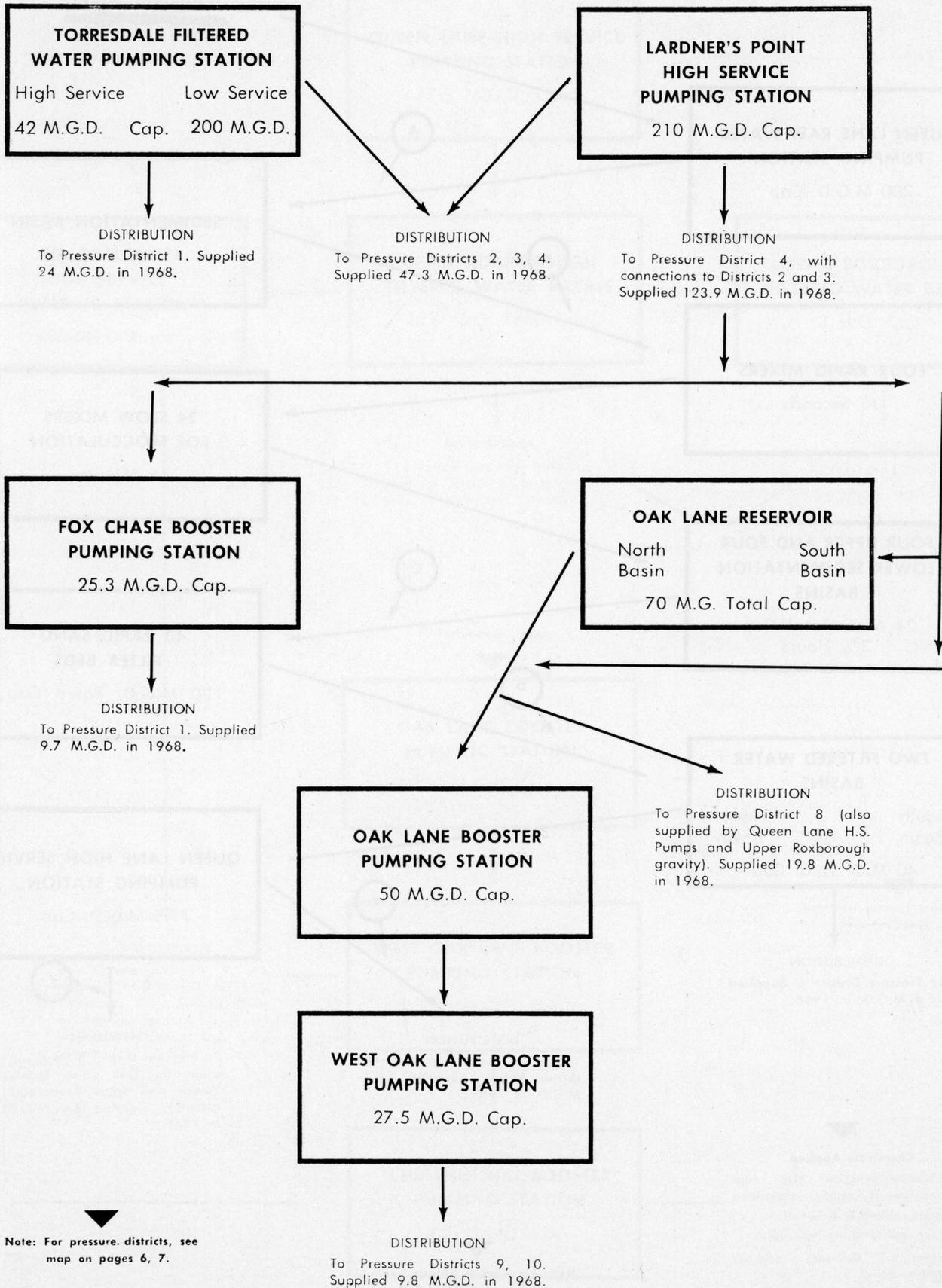
FIG. II-TORRESDALE WATER TREATMENT PLANT--1968



Chemicals Applied

- A—Chlorine or chlorine dioxide
- B—Ferric chloride, lime, carbon, chlorine or chlorine dioxide
- C—Metaphosphate, lime, fluoride, chlorine or chlorine dioxide

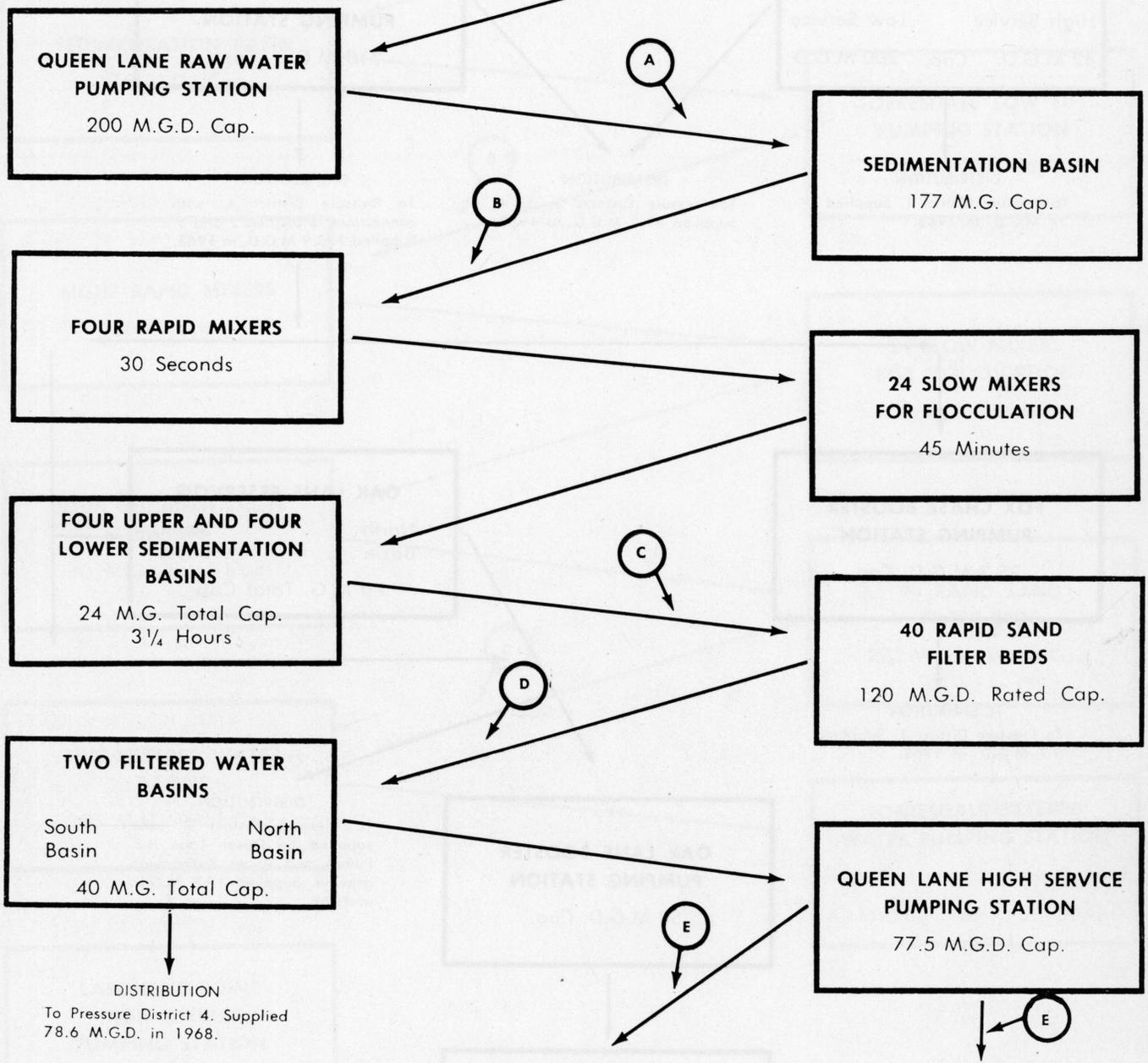
FIG. II-A-DISTRIBUTION FROM TORRESDALE--1968



Note: For pressure districts, see map on pages 6, 7.

FIG. III-QUEEN LANE WATER TREATMENT PLANT--1968

Schuylkill River



Chemicals Applied

- A—Chlorine, carbon; also alum and lime if turbidity is extreme
- B—Alum, chlorine, lime
- C—Chlorine or sulfur dioxide
- D—Chlorine, fluoride, sodium hydroxide
- E—Metaphosphate

Note: For pressure districts, see map on pages 6, 7.

FIG. IV-DISTRIBUTION FROM ROXBOROUGH--1968

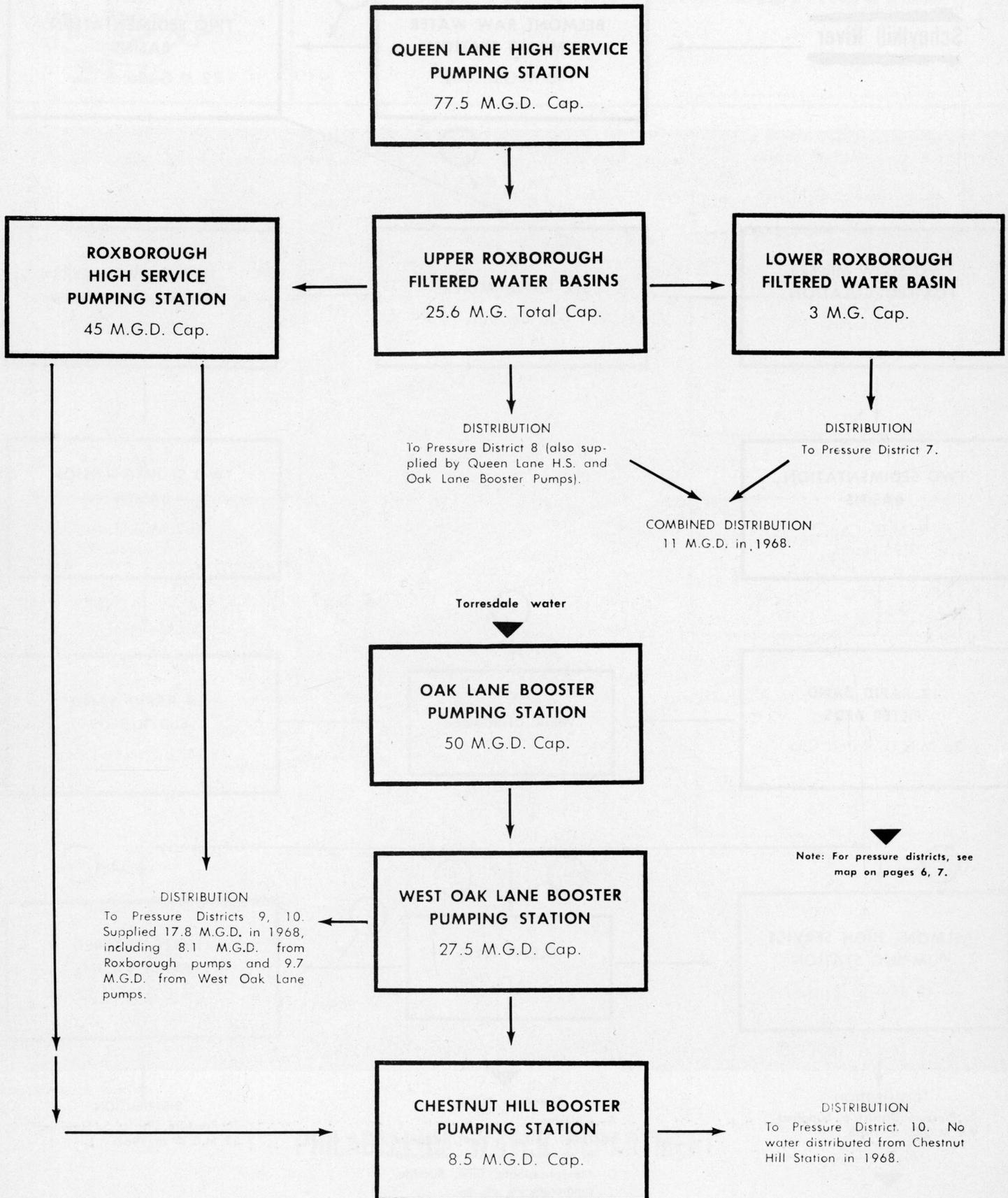


FIG. V-BELMONT WATER TREATMENT PLANT--1968

