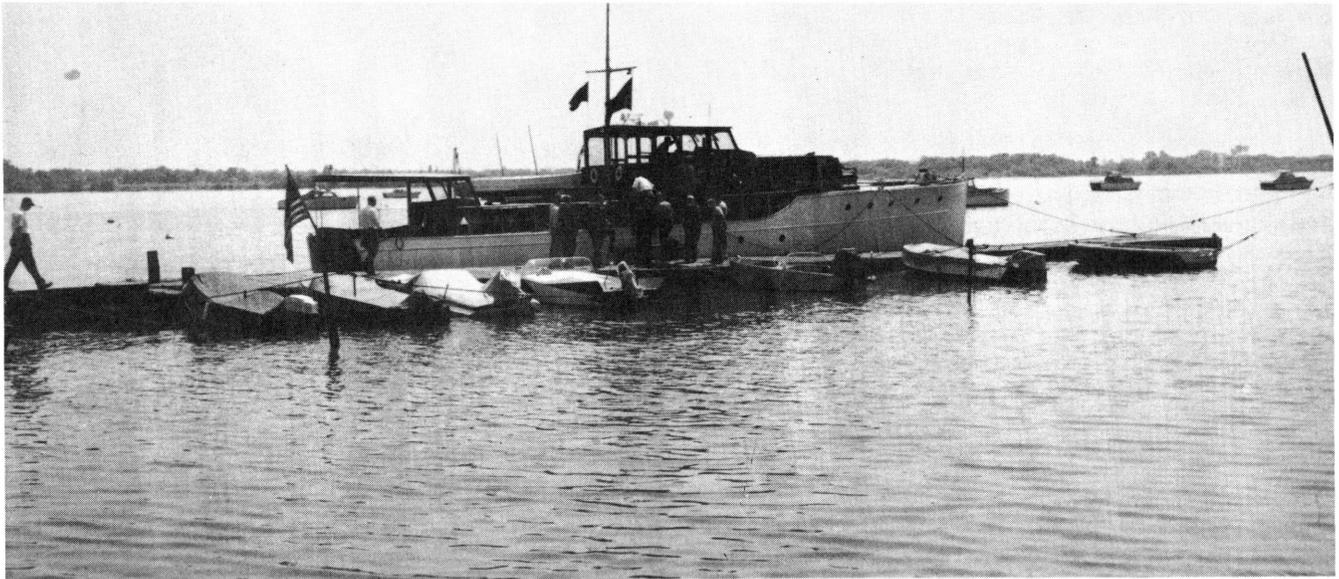




TREATMENT and DISTRIBUTION of WATER---1966

PHILADELPHIA WATER DEPARTMENT



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.

In 1966 about 31% of plant output was delivered by gravity and 69% was pumped. Of the latter, about 15% was repumped at booster stations.

*Since the closing of the old Roxborough Plants, Roxborough and Manayunk also receive water from Queen Lane. The water is pumped to basins at Roxborough and then redistributed by pumping and gravity.

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 nine pressure districts. The fact that Philadelphia takes its water from three different river sources also makes this 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. 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. Total hardness of water delivered to distribution in 1966 averaged 98 parts per million from the Torresdale Plant on the Delaware and 171 parts per million from the plants on the Schuylkill.

The total population served is now two million, and the average amount of water delivered into the distribution system in 1966 was 338.7 million gallons daily—equal to 169 gallons per day for every person in Philadelphia. Since much of this water goes to industries, stores, and public uses, the actual consumption by individuals is much below these figures.

The distribution system contains 3,189 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 73,000 valves and close to 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 1966 averaged as follows: Belmont, 61 million gallons; Queen Lane, 108 million gallons; and Torresdale, 177 million gallons.

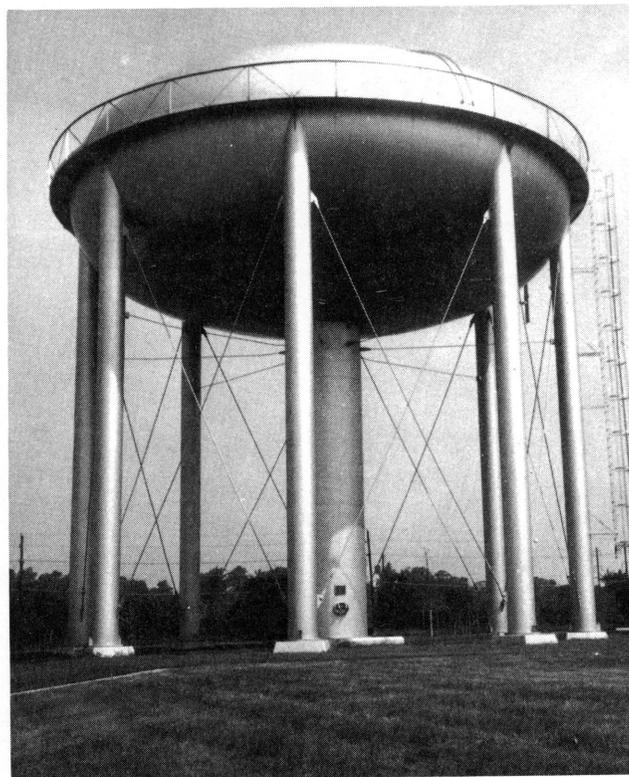
Successive steps in treatment at the plants in 1966 may be summarized as follows:

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, (4) rapid mixing of chemicals with water, (5) flocculation and settling, (6) rapid sand filtration, (7) post treatment, including chlorination, metaphosphate treatment, fluoridation, and pH control with lime.

Queen Lane: (1) Pre-chlorination to free chlorine residual, carbon treatment, (2) settling for 20 hours, (3) chlorination, (4) application of alum with lime for pH adjustment, (5) rapid mixing of chemicals with water, (6) slow mixing of chemicals with water to form "floc," (7) settling, (8) chlorination if required, (9) rapid sand filtration, (10) post treatment, including chlorination and fluoridation 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) presedimentation, (3) chlorination, (4) pre-treatment including application of alum and lime; also 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.

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



CAPACITIES OF WATER SYSTEM — 1966

Treatment Plants

(in millions of gallons daily)

	Rated	Peak Rate
Belmont Plant	78	108
Queen Lane Plant	120	150
Torresdale Plant	282	423

Filtered Water Storage

(in millions of gallons)

	Total
East Park—open reservoir	677
Oak Lane—open reservoir	70
Torresdale—underground basins	193
Belmont—underground basins	18.6
Queen Lane—underground basins	40
Roxborough—underground basins	28.6
Roxborough—two 5.5 M. G. standpipes	11
Fox Chase—one standpipe	1.5
Somerton—two 5 M. G. Standpipes	10

Chestnut Hill Booster Station operates from April through November. During winter months, Chestnut Hill is fed from the West Oak Lane-Roxborough High Service Stations.

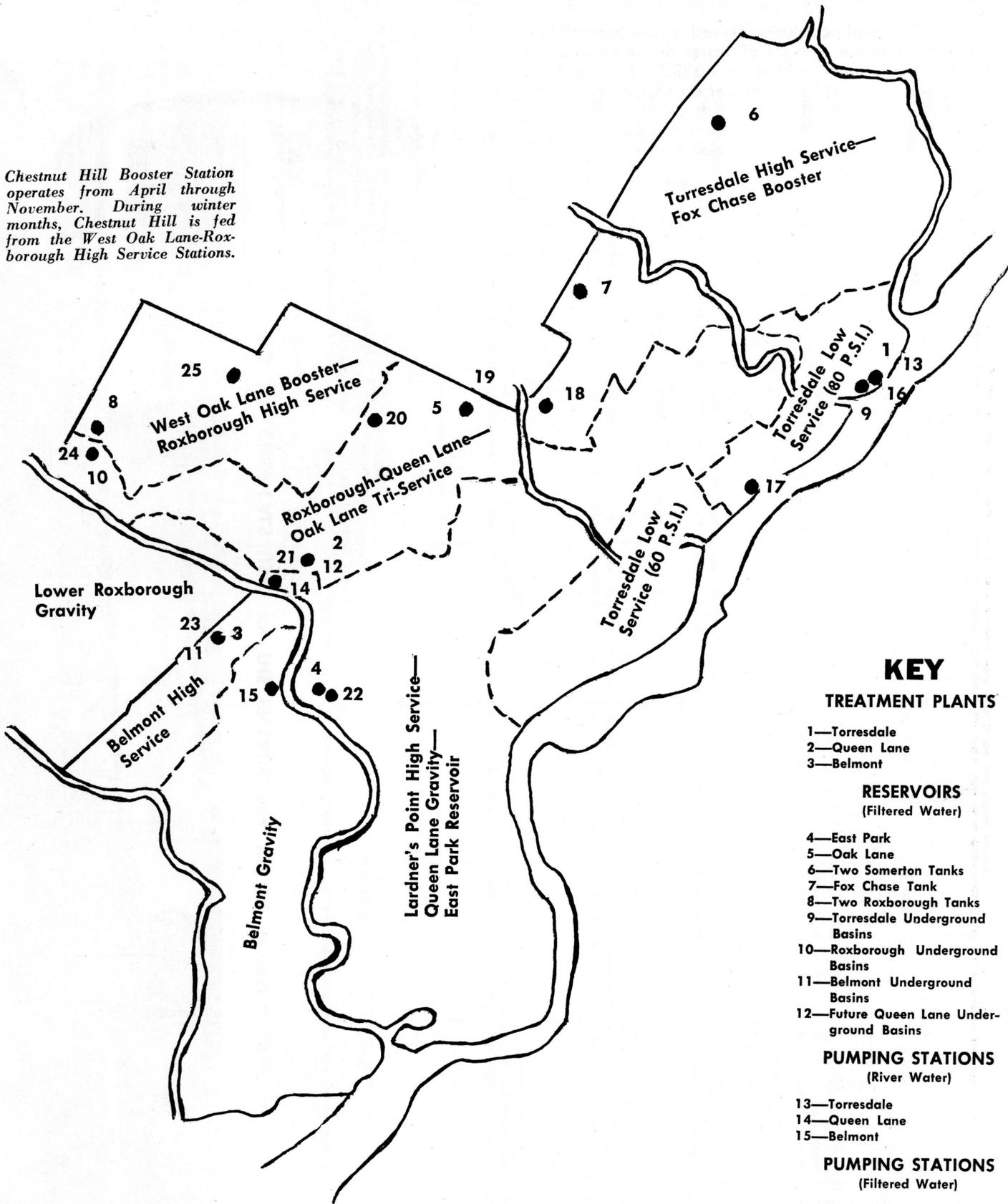


Fig. 1

Philadelphia Water Facilities and Water Pressure Districts

KEY

TREATMENT PLANTS

- 1—Torresdale
- 2—Queen Lane
- 3—Belmont

RESERVOIRS (Filtered Water)

- 4—East Park
- 5—Oak Lane
- 6—Two Somerton Tanks
- 7—Fox Chase Tank
- 8—Two Roxborough Tanks
- 9—Torresdale Underground Basins
- 10—Roxborough Underground Basins
- 11—Belmont Underground Basins
- 12—Future Queen Lane Underground Basins

PUMPING STATIONS (River Water)

- 13—Torresdale
- 14—Queen Lane
- 15—Belmont

PUMPING STATIONS (Filtered Water)

- 16—Torresdale (Low and High Service)
- 17—Lardner's Point
- 18—Fox Chase Booster
- 19—Oak Lane Booster
- 20—West Oak Lane Booster
- 21—Queen Lane High Service—Roxborough Express
- 22—East Park Booster
- 23—Belmont High Service
- 24—Roxborough High Service
- 25—Chestnut Hill Booster

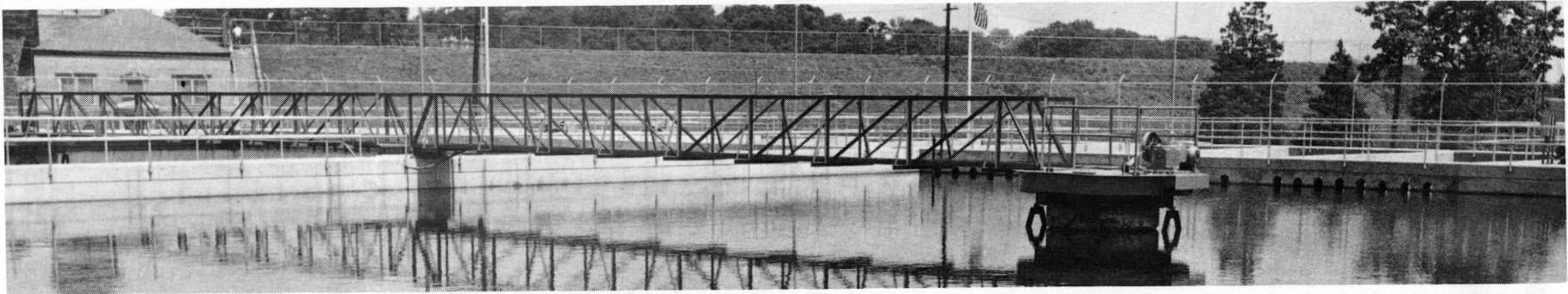


FIG. II — CHEMICALS USED BY THE PHILADELPHIA WATER SYSTEM — 1966

CHEMICAL:	Aluminum	Lime	Chlorine	Activated Carbon	Hexametaphosphate	Sodium Chlorite	Fluosilic Acid
	Commercial aluminum sulphate $Al_2(SO_4)_3 \cdot 18 H_2O$	Oxide and hydrate CaO & $Ca(OH)_2$	Cl_2	C	$(PO_3)_6$	$NaClO_2$	H_2SiF_6
STORAGE:	Dry in bulk, liquid in lead-lined tanks	Dry and bulk	150-lb. cylinders, ton-cylinders, 55-ton R.R. tank cars	Bags; also bulk R.R. car to slurry	Bags, 1½ - ton unit hoppers	Dry in drums, liquid in stainless steel tanks	Rubber - lined steel tanks
FEED:	Belt-type dry feed and rotodip	Belt - type dry feed (slakers for the oxide)	Commercial chlorina - tors with evaporators	With slurry feeder pump	Solution tank and diaphragm feeder pump	Solution tank and auxiliary tank to feeder pump	Measuring tank and diaphragm feeder pump
POINTS OF APPLICATION:	Inlet to rapid mix or mixing basin	Inlet to rapid mix, mixing basin or filter effluent	Plant intake, rapid mix, or filter effluent	Rapid mix or applied to filters	Filter effluent	Plant intake, rapid mix, or filter effluent	Filter effluent
PURPOSE:	Clarification	pH adjustment, also to increase alkalinity	Taste and odor control (contact 16 to 20 hours), sterilization	Taste and odor control	Reduce corrosion in distribution	Form chlorine dioxide for control of tastes, odors, or algae	Reduction of dental decay
MAXIMUM DOSAGES:	2.5 gpg	1.0 gpg	16 ppm	12 ppm	1 ppm	1.5 ppm	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. III—TORRESDALE WATER TREATMENT PLANT—1966

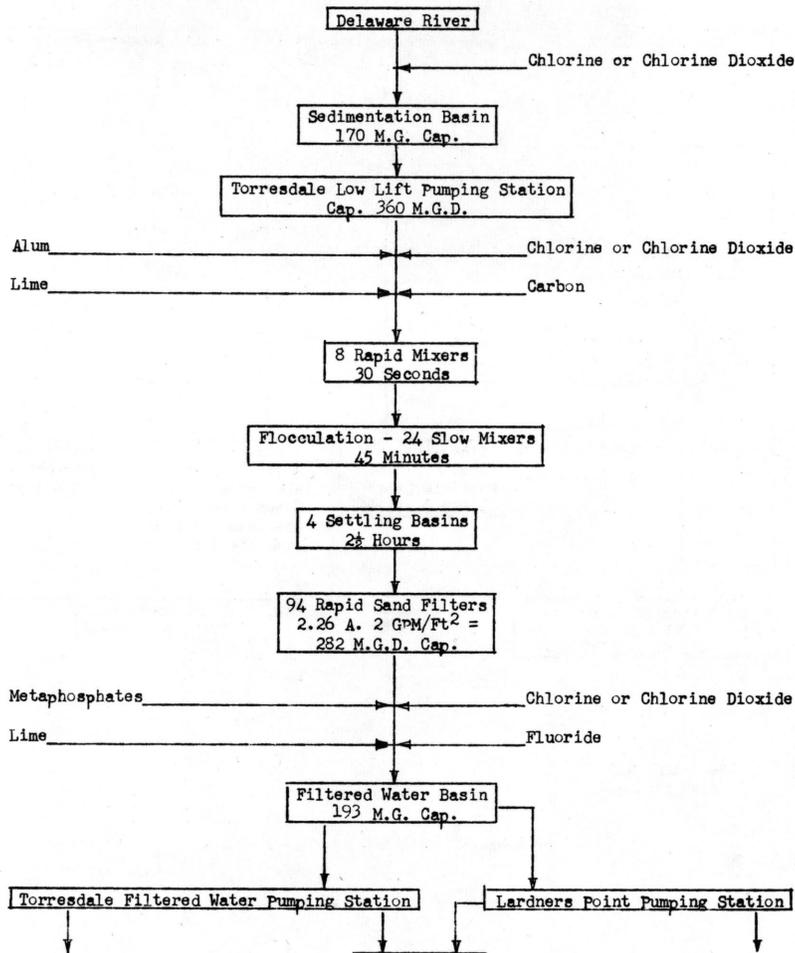


FIG. III-A—DISTRIBUTION FROM TORRESDALE—1966

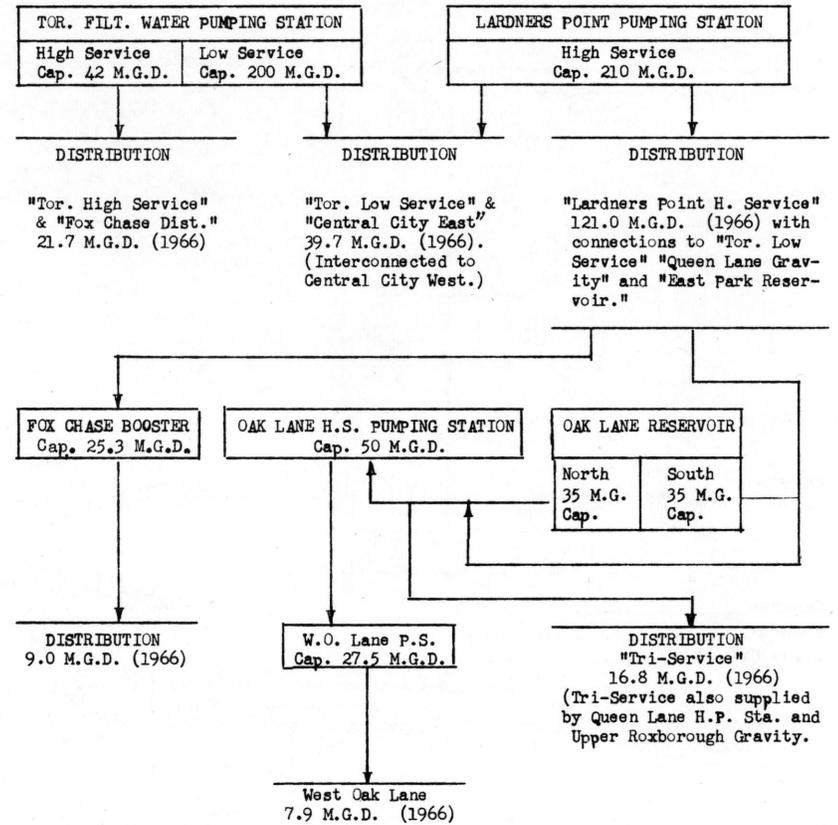


FIG. IV—QUEEN LANE WATER TREATMENT PLANT—1966

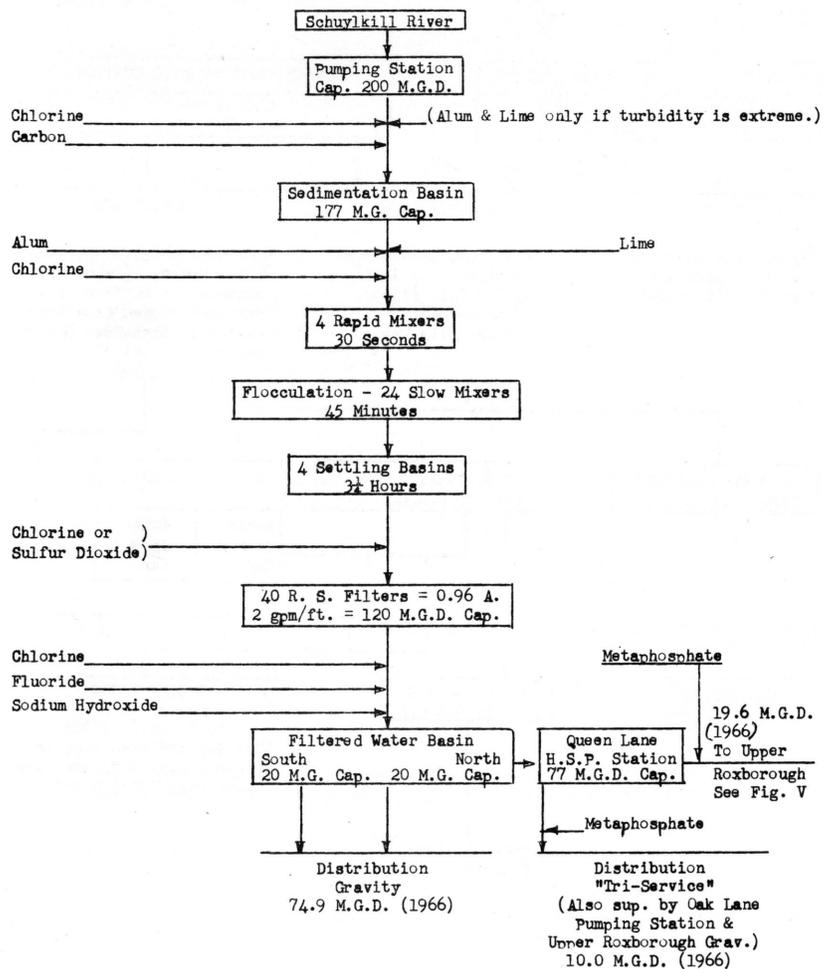
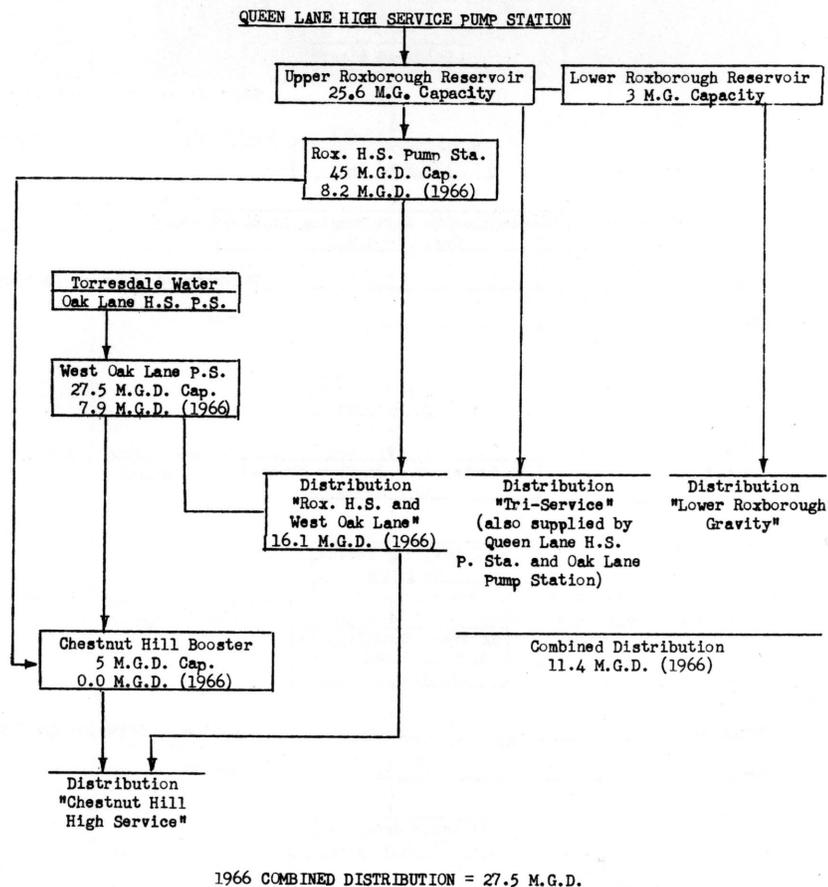
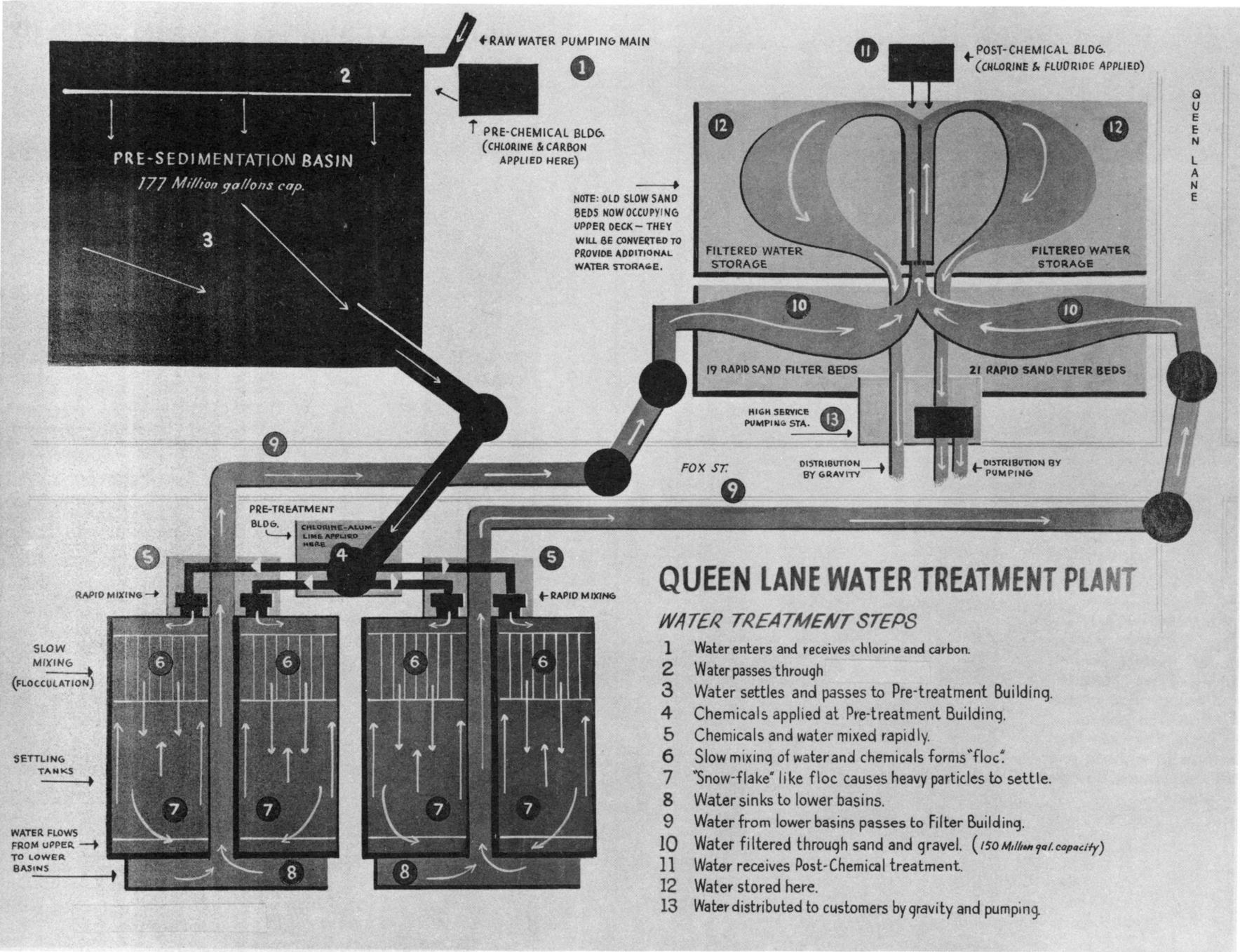


FIG. V—DISTRIBUTION FROM ROXBOROUGH—1966



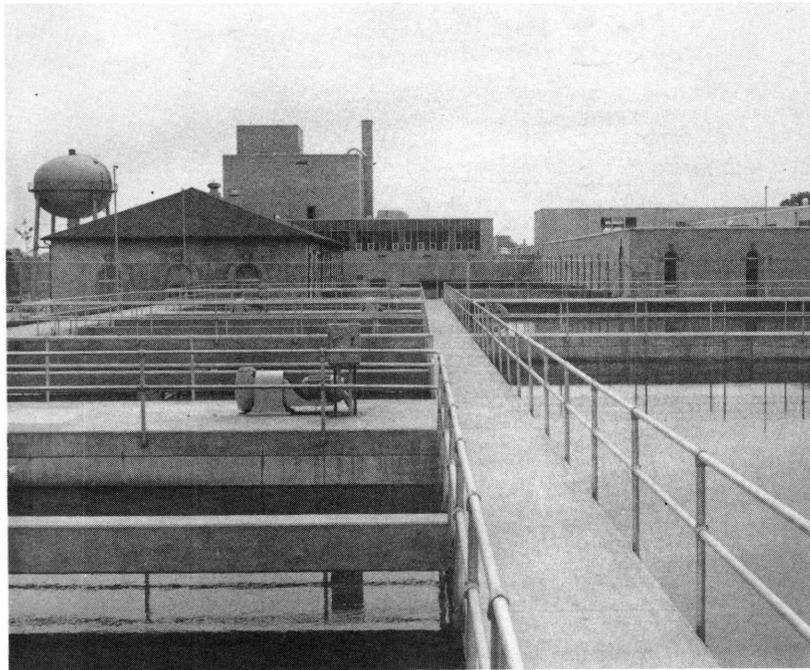


QUEEN LANE

QUEEN LANE WATER TREATMENT PLANT

WATER TREATMENT STEPS

- 1 Water enters and receives chlorine and carbon.
- 2 Water passes through
- 3 Water settles and passes to Pre-treatment Building.
- 4 Chemicals applied at Pre-treatment Building.
- 5 Chemicals and water mixed rapidly.
- 6 Slow mixing of water and chemicals forms "floc".
- 7 "Snow-flake" like floc causes heavy particles to settle.
- 8 Water sinks to lower basins.
- 9 Water from lower basins passes to Filter Building.
- 10 Water filtered through sand and gravel. (150 Million gal. capacity)
- 11 Water receives Post-Chemical treatment.
- 12 Water stored here.
- 13 Water distributed to customers by gravity and pumping.



THE BELMONT PLANT above is the city's newest plant for treating water. Supplying West Philadelphia, it has a rated capacity of 78 million gallons of water daily. The lime feed mechanism at right is one of many automatic devices in the plant.

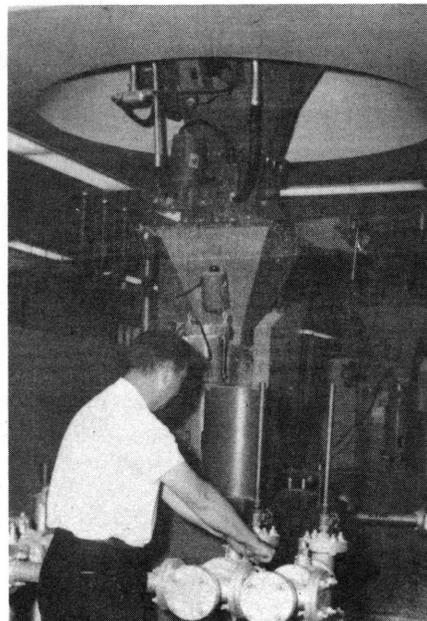


FIG. VI—BELMONT WATER TREATMENT PLANT—1966

