PROGRESS REPORT ON DEVELOPMENT OF THE ALLEGHENY COUNTY SANITARY AUTHORITY FACILITIES AT PITTSBURGH, PENNSYLVANIA

By Edwin B. Cobb,* Member, and Henry R. Wheeler, Jr.,** Member

(Presented at a meeting of the Boston Society of Civil Engineers, held on September 24, 1958.)

The task of spending $100,000,000, the total cost of these facilities of the Allegheny County Sanitary Authority, presents interesting possibilities, and in this paper we will describe one way it is being done.

The privilege of addressing you should have gone to my partner, the late Frank L. Flood, a vice president of our Society at the time of his death last February. Mr. Flood had been intimately connected with the project since 1947 continuously until his death. He was the principal engineering consultant for the entire project.

The Allegheny County Sanitary Authority was formed to consider the possibility of collecting and disposing of the waste waters from the 102 communities, which include and surround the city of Pittsburgh, Pennsylvania, and more than 90 industries in Allegheny County. The Authority was made possible by the Pennsylvania Municipality Authorities Act of 1945.

The cost of constructing and operating the system will be met by sewer service charges, with no part of the revenue derived from taxation. Since the various communities were not required to subscribe to the service offered by the Authority, certain communities refused to be served, as might be expected. The system, as presently constituted, will serve 70 municipalities, with an estimated population in 1970 of 1,400,000, and 18 industries.

In this paper we will present a brief description of the project and of the organization of the Authority.

Metcalf & Eddy served as consulting engineers on the preliminary design of the facilities. Later they prepared the contract plans and specifications for the sewage treatment plant, outlying pumping facilities, and for about 30 miles of intercepting sewers of the approximate 65-mile system. The remainder of the intercepting system was designed by the Authority's own engineering staff.

* Partner, Metcalf & Eddy.
** Project Coordinator, Metcalf & Eddy.

We are currently engaged in providing general supervision of construction for our designed contracts and advisory service under the Trust Indenture, established by the bond issues. The Authority is providing resident inspection of construction with its own forces.

Metcalf & Eddy are also under contract to supervise operation of the treatment plant during the first two years of operation.

In a paper before this Society, a description of the Authority's system was presented by Mr. Stanley M. Dore and discussed by Mr. Flood. Mr. Dore, a member of this Society, was formerly Deputy Chief Engineer of the Authority engineering staff. The paper and discussion were published in the April 1953 issue of the B.S.C.E. Journal.

A number of other papers covering various features of the project have been published in other technical publications, and some are listed at the end of this paper. Many of these papers have been prepared by Mr. John F. Laboon, Chief Engineer of the Authority and his most recent paper, titled "Controlled Submergence of Pittsburgh's Deep Sewers", was given before the October 1957 meeting of the American Society of Civil Engineers in New York.

It is difficult to be brief in reviewing the history of the Authority, without repeating material already covered by other papers. The Allegheny County Sanitary Authority was created in 1945 and incorporated in March of 1946. Preliminary work was undertaken until the middle of 1950. The design of the facilities was accomplished during the years from 1950 through 1955. Proposals for 35 construction contracts were received in the fall of 1955. The bids on 33 contracts were accepted immediately. One contract for intercepting sewer construction was readvertised, with an acceptable bid being received in January 1956. Another contract covering the 300-ft. chimney at the sewage treatment plant was readvertised twice before an acceptable bid was received in December 1957.

Currently, (September 1958) 14 of the 35 contracts have been completed. The project is scheduled for completion on March 1, 1959 and there is every indication that this completion date will be met.

The Project

The limits of the service area of the Allegheny County Sanitary Authority are shown on Fig. 1.

The Authority has contractual agreements with 70 municipalities

within Allegheny County. Agreements with 18 industrial corporations have also been consummated. You will note that the city of Pittsburgh occupies a major portion of the Authority's service area.

The system of intercepting sewers is shown on Fig. 2. These sewers drain to the Pittsburgh Sewage Treatment Plant of the Authority located, as you will note, about two miles downstream on the

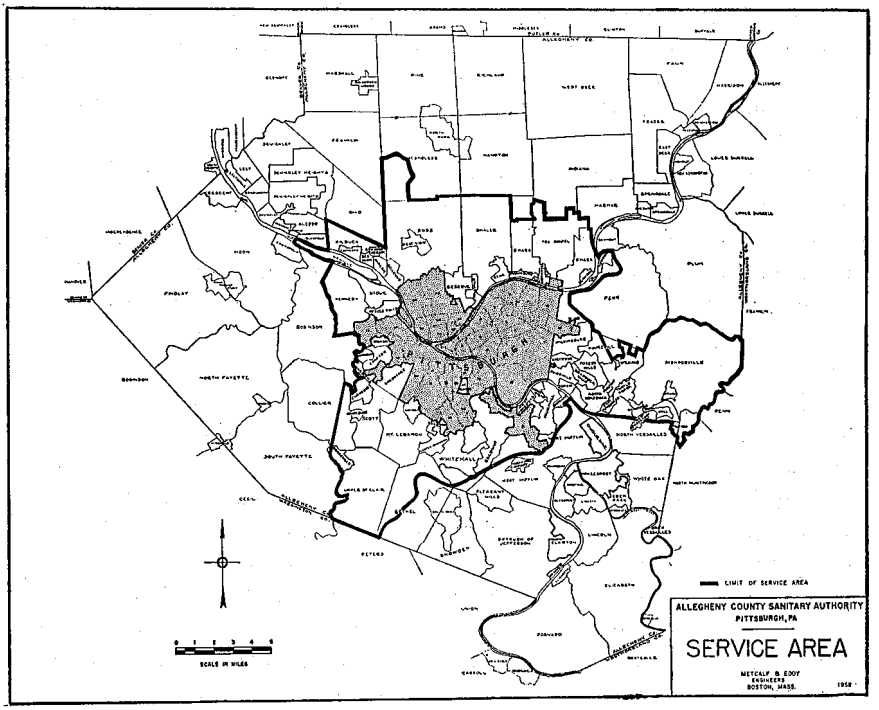

FIG. 1.

Ohio River from its origin at the confluence of the Allegheny and Monongahela Rivers.

Main intercepting sewers, constructed as tunnels, are located along the Ohio River, the Allegheny River, and the Monongahela River. Branch intersecting sewers, constructed by opencut methods, are located along Chartiers Creek and Turtle Creek.

One sewage pumping station and two pneumatic ejector stations lift the sewage from local sewers into the Authority intercepting sew-

ers. These stations are designated Corliss, U5, and Melancthon Street, respectively.

Since the local sewerage systems are of the combined type, overflows have been provided at their connections to the Authority system. The discharge to the intercepting sewers is controlled by an automatic regulator consisting either of a gate or a fixed orifice. The automatic

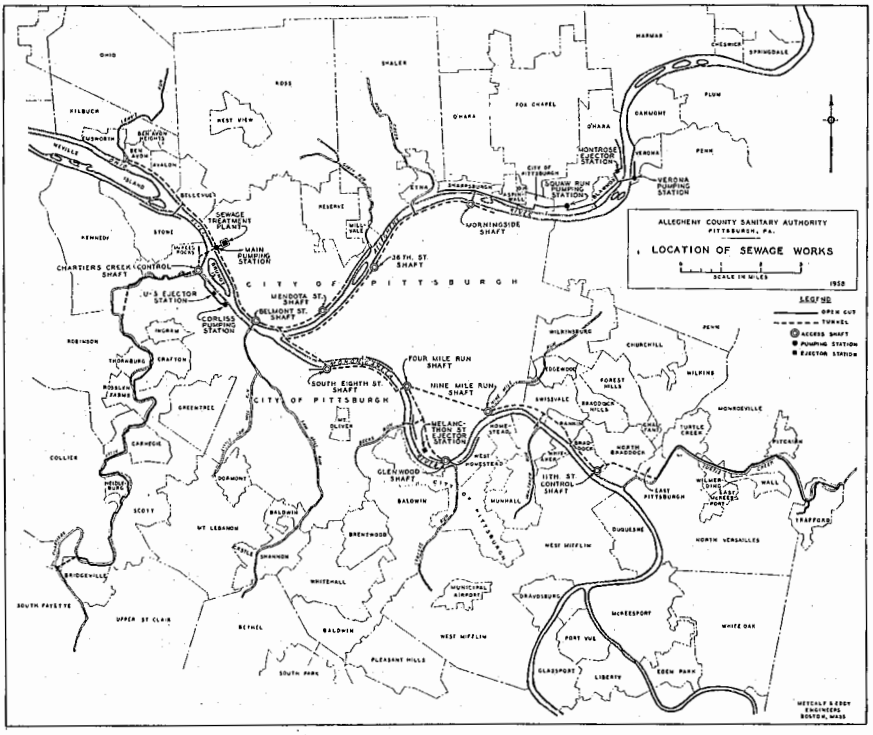

FIG. 2.

regulators of the gate-type are operated hydraulically, without floats, through water pressure on the gate itself.

Control points are located at the lower end on the Chartiers Creek intercepting sewer, where the construction changes from open-cut to tunnel methods, at Morningside, and at 11th Street on the Turtle Creek Intercepting Sewer. These structures are essentially major relief overflows, provided to permit regulation of the discharge from the local sewers to the main intercepting system. This control is neces-

sary to prevent surcharging of the intercepting sewers and, thus, precluding downstream diversions. Control of these overflows will be effected by adjusting the water level in the wet well of the Main Pumping Station at the treatment plant.

Shafts to permit access to the tunnels for inspection and repairs are located at Belmont Street, Mendota Street, 36th Street, South 8th Street, Four Mile Run, Nine Mile Run, and Glenwood.

An extension of the intercepting sewer system above Aspinwall Dam on the Allegheny River has been called the Upper Allegheny System. This system consists of intercepting sewers, force mains, two pumping stations, and a pneumatic ejector station. Negotiations and planning are currently being made to extend the system to provide service for Oakmont Borough.

Operation of System

The sewage treatment plant is designed for an average flow of 150 mgd. in 1970, and a maximum flow of 300 mgd. in the year 2000. Regulating devices along the system have been designed to limit the discharge to the intercepting sewers at the first flush from a storm to 250 percent of the average dry weather flow. Certain of the overflows are equipped with tipping gates and these will automatically cut the diversion back to 200 percent of this flow after the first flush is passed. Normally the system will be operated at as high a hydraulic profile as possible, without causing discharge through any of the numerous overflows. Upon noting impending storm conditions, the water level in the wet well will be lowered to increase the capacity of the sewers. Periodically, the wet well will be pumped down to create sufficient velocity in the intercepting sewers to flush them out.

The normal pumping heads of the Main Pumping Station will vary from a minimum of 39 ft. to a maximum of 78 ft. By maintaining the minimum head for as much of the time as possible, significant savings in the cost of power are anticipated.

Two points in the system are particularly critical hydraulically. These are the 11th Street Control and the Morningside structure. The operators at the Main Sewage Pumping Station will maintain the system hydraulic profile just below that elevation at these two structures which will prevent overflows occurring at diversion structures on tributary sewers.

Sewage levels in the various access shafts will be transmitted

by audi-tone-type of telemetering equipment to an instrument panelboard located in the Main Sewage Pumping Station. This panelboard was a feature exhibit at the Federation of Sewage and Industrial Wastes Associations Convention in Detroit in October 1958.

For those of you who wish additional information in regard to the details of the diversion structures, we suggest that you refer to Mr. Dore's paper.

Pittsburgh Sewage Treatment Plant

The principal features of the Pittsburgh Sewage Treatment Plant are shown in outline form on Fig. 3.

The incoming sewage will enter the Main Pumping Station through three connections, the Upper Ohio, Chartiers Creek, and the Lower Ohio Intercepting Sewers. Three two-speed pumps and two variable-speed pumps will lift the sewage in this station to such a

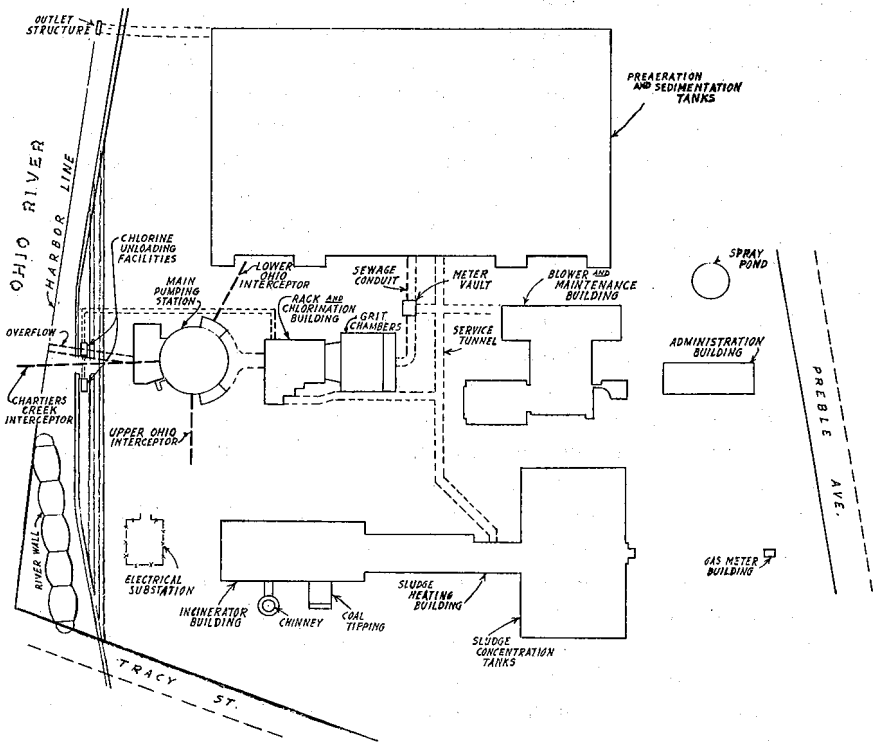

Fig. 3.

level that it will flow by gravity through the remainder of the treatment facilities.

From the pumping station, the sewage will first pass through a battery of four mechanically cleaned bar racks located in the Rack and Chlorination Building. Chlorine for pre-chlorination will be added in the main conduit ahead of these racks.

Chlorination facilities include unloading stations for four railway tank cars located to the west of the Main Pumping Station. Chlorine evaporators, chlorinators and automatic dosage control equipment are located in the Rack and Chlorination Building.

The screened sewage will next pass to four Aerated Grit Chambers. The aeration system is equipped with Walker Process type "Spargers". Grit will be removed from the chambers by clam bucket, operated from a monorail, and after draining in storage hoppers will be loaded into trucks for disposal at a dump purchased by the Authority approximately 1¼ miles distance from the plant site.

After separation of the grit, the sewage will be collected in a single main conduit and passed through the Main Sewage Meter for measurement. This meter, a magnetic flowmeter, has an internal diameter of 6 ft. and is supplied by the Foxboro Company. We are informed that this is the largest application to date of the magnetic type meter.

From the meter, the sewage will pass to the Preaeration and Sedimentation Tanks, laid out in two equal batteries. There are two preaeration tanks, each consisting of two channels and providing 44 minutes detention at the 150 mgd. design rate of flow. Chlorine for post-chlorination is applied in the influent channel of the sedimentation tanks. There are 6 sedimentation tanks, each consisting of 4 longitudinal channels. These tanks will provide 2 hours detention at the 150 mgd. rate of flow. The settled sewage will be collected in an effluent channel and, thence, discharged to the Ohio River through a submerged outlet at the river wall.

Sludge will be collected by drag-type longitudinal collectors and screw-type cross conveyors. Scum will be collected by the return pass of the longitudinal collector flights and discharged to a scum trough by revolving squeegee-type skimmers. This sludge from the tanks will be pumped through four Sludge Pumping Stations to the sludge disposal portion of the plant, which is represented by the Sludge Concentration Tanks, Sludge Heater Building and the Incinerator Building.

Sludge disposal will be by the novel Laboon process. Freshly settled sludge and scum will be pumped intermittently to equalizing tanks at the Sludge Concentration Tanks. The sludge will be pumped from these tanks at a constant rate, passed through Dorr-Oliver Disintegrators to break up all solids which might cause clogging of subsequent facilities, and then passed through sludge heaters.

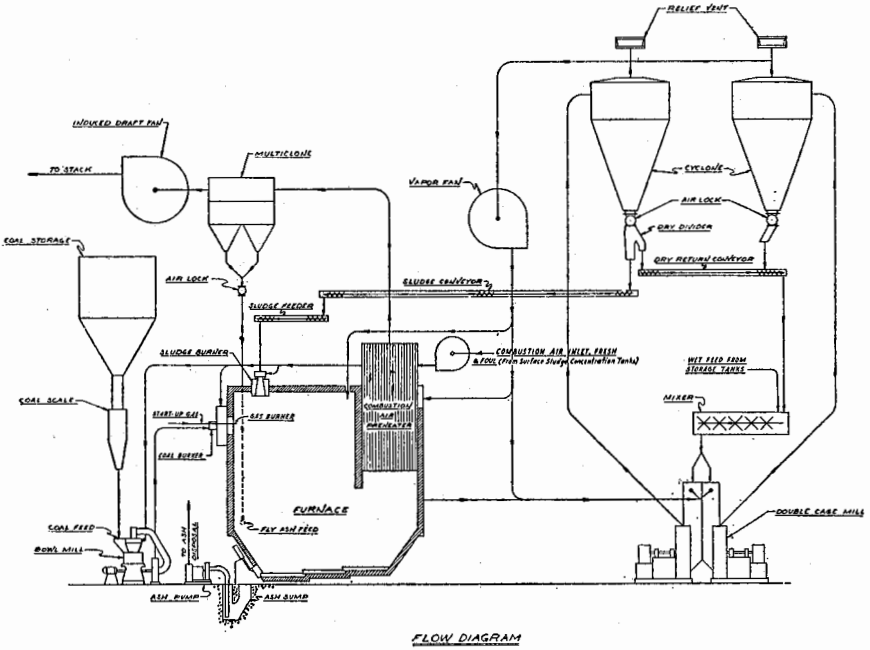

FIG. 4.

The Sludge Heater Building provides space for five initial sludge heaters and two future units with a rated capacity for each unit of 3 million Btu. per hour. These heaters are capable of raising the temperature of the sludge to 95 deg. F. After heating, the sludge will discharge to the Sludge Concentration Tanks.

There are 10 Sludge Concentration Tanks and they will be operated on a batch basis in rotation. The heated sludge when pumped to the tank is expected to average around 92 percent moisture. After the tank has filled, it will be allowed to stand quiescent for 5 days. Initial decomposition will generate gas which will be trapped in the

suspended solids and cause the latter to rise to the surface. By the end of the detention period the subnatant liquid in the lower portion of the tank will be relatively clear and will then be drawn off and returned to the sewage flow at the head of the plant. The sludge solids remaining in the tank are expected to have a moisture content of only around 80 percent.

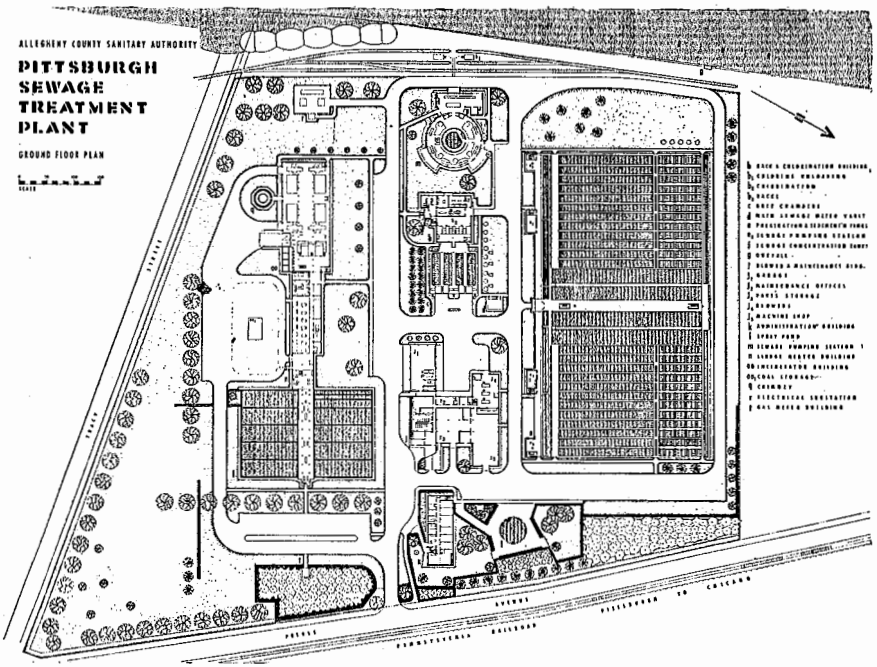

FIG. 5.

Each tank has four longitudinal hopper-type troughs, each equipped with a screw conveyor. The screw conveyors discharge the sludge to a screw-type cross-conveyor which discharges to a screw-type elevator which in turn discharges to the concentrated sludge pumps. The concentrated sludge will be withdrawn from the tanks and pumped by Moyno Pumps to the Incinerator Building.

The sludge incineration facilities consist of four Flash Drying Incinerators of the Raymond Division of Combustion Engineering. The gases are exhausted to the atmosphere through the chimney, which is 300 ft. high with an inside top diameter of 14 ft. Supple-

mentary fuel consisting of slack coal may be used to ensure complete combustion in the incinerators. Gas burners will be used for preheating the combustion chambers. Two Combustion Engineering boilers are also housed in the Incinerator Building to provide steam for the sludge heaters and for the plant heating.

The flow diagram for the sludge incineration process is shown in Fig. 4.

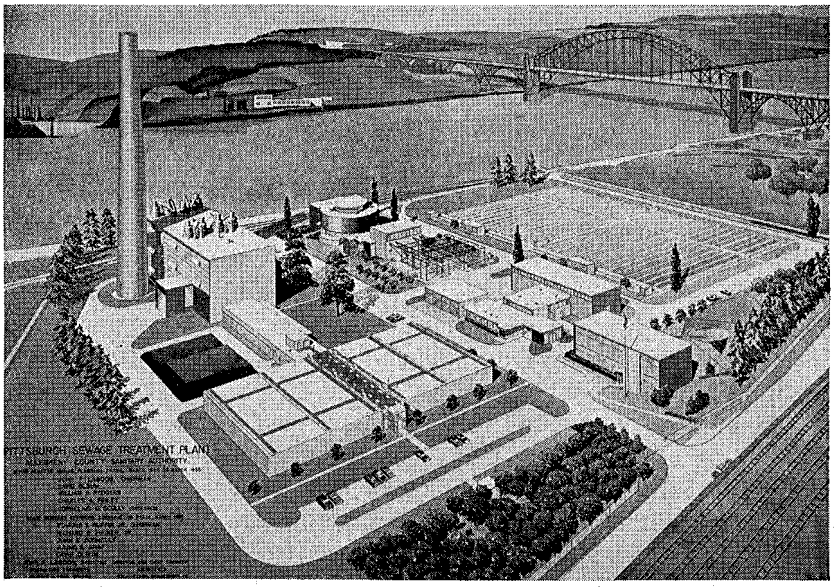

FIG. 6.

The electrical requirements of the plant will be supplied through a substation which is served by means of a 22,000-volt automatic loop type service of the Duquesne Light Company. Two 5,000 kva. oil-filled transformers, owned by the Authority, are provided in this station.

The plan of the treatment plant at ground floor level as depicted by architectural media is shown on Fig. 5.

An architectural rendering of the completed treatment plant is shown on Fig. 6. The highest type of building materials have been utilized to provide durable structures and a pleasing appearance. These materials include face brick for all buildings at the plant which are ceramic glazed in colors of yellow, red, blue, and gray.

Organization of the Authority

The Authority is governed by a board of five members, three of whom are appointed by the city of Pittsburgh, with two being appointed by Allegheny County. Current board members are as follows:

Edmund S. Ruffin, Jr.	Chairman
Julius E. Graf	Vice-Chairman
Richard B. Tucker, Jr.	Secretary
John E. Connelly	Treasurer
David Olbum	Asst. Secy.-Asst. Treasurer

The staff of the Authority is headed by Mr. John F. Laboon, who is Executive Director and Chief Engineer. During the preliminary and design stages of this project from March 1946 to March 1955, Mr. Laboon was not only Chief Engineer but was also Chairman of the Authority.

As noted previously, Mr. Stanley M. Dore, a member of this Society, was formerly Deputy Chief Engineer. This position is now held by Mr. Lawrence M. Gentlemen, also a member of this Society and well known to many members.

The office staff of the Authority is headed by the Deputy Chief Engineer. Since there are many continuing legal points arising, the Authority also has a permanent chief legal council.

The remainder of the office staff may informally be broken down into three groups: administrative, engineering, and estimating.

The field staff of the Authority is headed up by the Construction Engineer, Mr. Richard J. Dougherty. Under him are three divisions for handling the various stages of construction work under contract to the Authority. These are the treatment plant, the tunnels, and the open cut intercepting sewers. The field staff of the Authority also includes a material approval section, which passes on the acceptability of all materials and equipment as meeting the standards established by the contract plans and specifications.

The Authority is served by a number of consultants. The following are the engineering consultants to the Authority for the various phases of the work:

Metcalf & Eddy have been the consulting engineers to the Authority since 1947, carrying through with the preliminary reports, the design of the Pittsburgh Sewage Treatment Plant, and the design of

the intercepting sewers along Chartiers Creek and Turtle Creek and those portions of the Ohio River intercepting sewer in open cut. Celli-Flynn, consulting architects of McKeesport, Pa., were retained by Metcalf & Eddy for reviewing the architectural planning at the plant in regard to materials, colors, and exterior and interior appearances. Betterley Associates, insurance consultants of Worcester, Mass. have

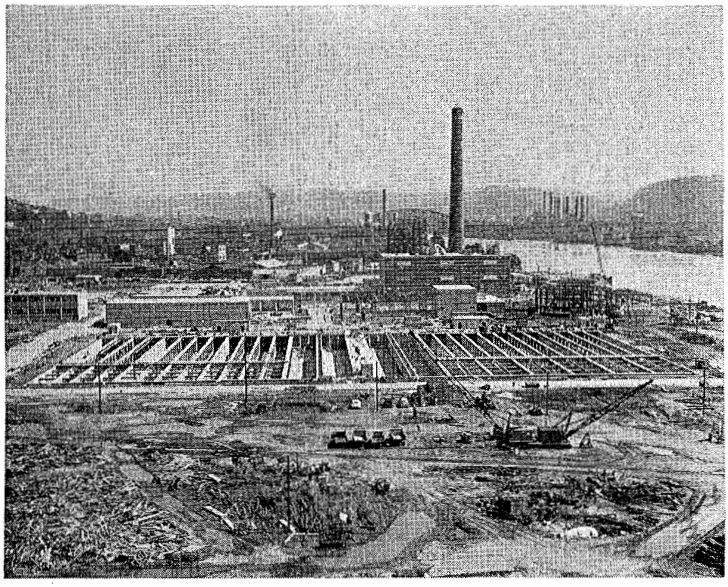

FIG. 7.—GENERAL VIEW OF PITTSBURGH SEWAGE TREATMENT PLANT WITH THE PRE-AERATION AND SEDIMENTATION TANKS IN THE CENTER, THE STRUCTURAL STEEL OF THE CIRCULAR MAIN SEWAGE PUMPING STATION ON THE RIGHT, AND THE INCINERATOR BUILDING AND CHIMNEY IN THE BACKGROUND.

advised us regarding the insurance program of the Authority during the operation of the system.

Philip S. Miller and Associates of West Orange, N.J. have advised the Authority on problems dealing with tunnel construction. On soil problems, the Authority has consulted E. D'Appolonia Associates of Pittsburgh. Thompson & Lichtner Co., Inc. of Boston have been consulted regarding concrete problems, particularly in the manufacture of concrete pipe. Problems of an electrical nature beyond the scope of the Authority's resident staff have been reviewed with Mr. E. T. Wiesmann of Pittsburgh.

Three consultants, all of Pittsburgh, have advised the Authority in financial and other related matters during the course of the construction program. Burgwin, Ruffin, Perry, and Pohl have acted as bond council to the Authority. Singer, Dean and Scribner have been financial advisors to the Authority in determining when the market was favorable for the issuance of bonds. Ebbert, Grant, and Kakel

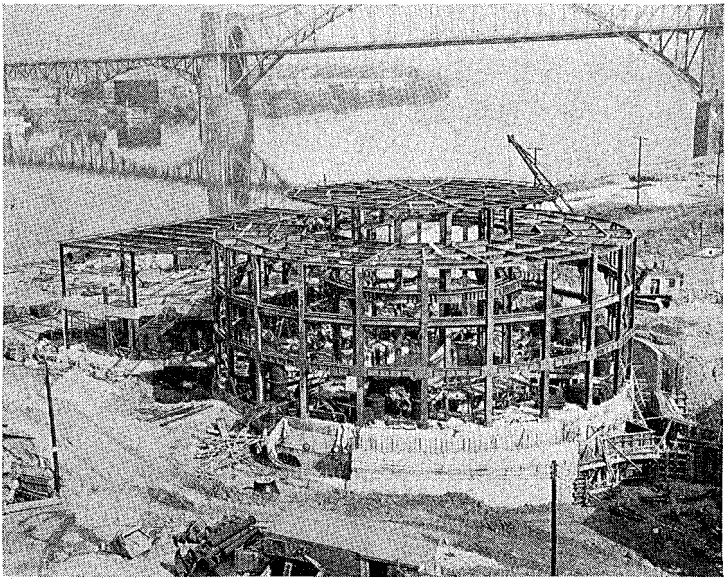

FIG. 8.—STRUCTURAL STEEL FOR MAIN SEWAGE PUMPING STATION IN PLACE, CONTROL BUILDING PORTION TO THE LEFT WITH CIRCULAR WET AND DRY WELLS ON THE RIGHT, CONCRETE WORK IN THE LOWER RIGHT FOR DISCHARGE CONDUIT TO REMAINDER OF PLANT. MCKEES ROCKS BRIDGE ACROSS OHIO RIVER IN BACKGROUND.

have advised the Authority on the acceptability of the insurance coverages required of the various contractors by the Authority as a part of their construction contracts. This firm has also acted as insurance consultants to the Authority.

FINANCIAL

The financial negotiations and arrangements for this project are interesting.

The bond market in the fall of 1955 was not overly favorable for the issuance of bonds for the Authority to start its construction

program. The Authority was fortunate, therefore, in being able to arrange through the Mellon National Bank and Trust Co., of Pittsburgh for a bank loan of $100,000,000, which was consummated on October 4, 1955 for a four-year period. Twenty-four other banking institutions throughout the United States participated with the Mellon Bank in providing this bank loan.

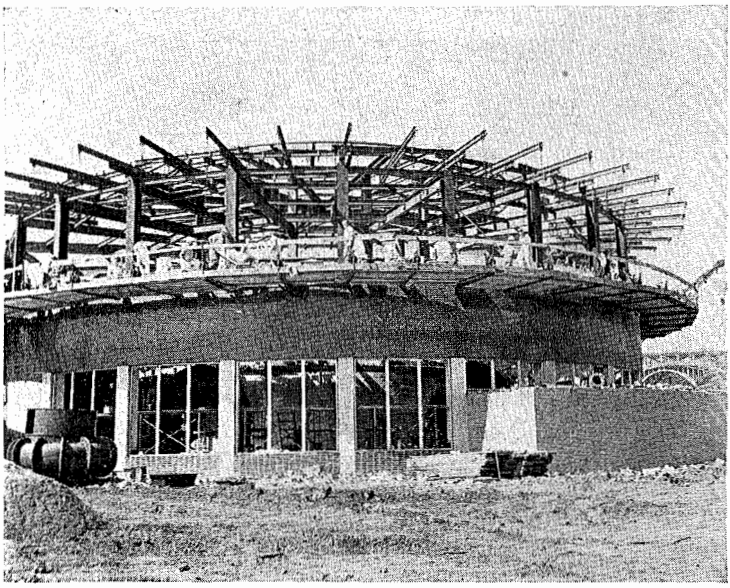

FIG. 9.—LAYING EXTERIOR BRICKWORK FOR MAIN SEWAGE PUMPING STATION. IN THE LEFT OF THE PHOTOGRAPH A 36-IN. MAIN SEWAGE PUMP, SUPPLIED BY WORTHINGTON CORP., RESTS AWAITING LOWERING INTO THE DRY WELL OF THE STATION, 110 FEET BELOW THE FINISH GRADE.

The bank loan bears two rates of interest, depending upon whether or not the money is secured by United States government bonds on deposit as collateral, or is not so secured. If it is secured by government bonds the rate of interest is 2¼ percent. For those portions not so secured, the rate increases to 2¾ percent.

Four issues of sewer revenue bonds have been made to date by the Authority. Certain details pertaining to the issuance of these revenue bonds are shown in Table 1.

The latest estimate of capital costs for this construction program of the Authority are shown in Table 2.

TABLE 1
Sewer Revenue Bond Issues

Series	Date of issue	Amount in millions	Net interest costs, %	Bond discount, %
A	May 1, 1956	$25	3.35	1.73
B	February 14, 1957	15	3.312507	1.97
C	February 4, 1958	25	3.5512	1.98
D	November 13, 1958	20	3.732725	1.99

TABLE 2
Capital Costs

I — Construction and Equipment Costs			
A.	Basic intercepting sewer system	$61,607,000	
B.	Upper Allegheny system	807,000	
C.	Sewage treatment plant	17,500,000	
D.	Maintenance and operating equipment	150,000	
E.	Automotive equipment	203,000	
F.	Other contracts	450,000	
			$ 80,717,000
II — Real Estate and Lands			1,773,000
III — Administrative Costs			
A.	Administration and Engineering		
1.	Engineering		
a.	Resident supervision	2,771,000	
b.	General supervision	296,000	
c.	Trust indenture	109,000	
d.	Other	112,000	
2.	Administrative	881,000	
B.	Fund to cover 1st year's operation	1,000,000	
			5,169,000
IV — Financial Costs			
A.	Repayment of loans, incl. interest	3,007,000	
B.	Net interest costs	3,745,000	
C.	Bond discount	1,924,000	
D.	Expenses in connection with Bond Issues	235,000	
			8,911,000
V — Contingencies and 6 months' interest			3,430,000
VI — Total Costs			$100,000,000

Authority Staff for Operating the System

The office staff of the Authority will consist of three major sections which could be described by their functions as being administrative, engineering, and billing.

The basis for billing the customers, in general, will be the water meter readings. These readings will be furnished to the Authority by

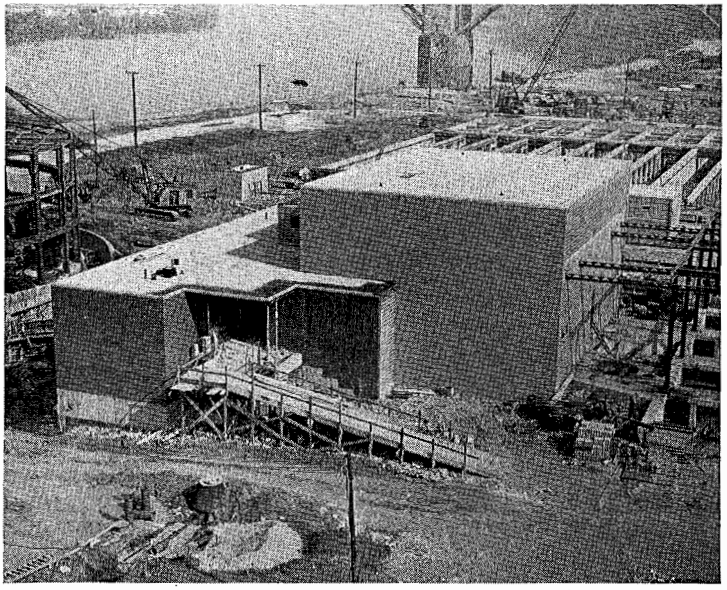

Fig. 10.—View of the south elevation of the Rack and Chlorination Building, with the chlorination facilities located under the low roof and with the racks provided with the high roof. A portion of the Aerated Grit Chambers appears in the right of the photograph.

the various municipal and private water utilities providing public water supply in the service area. The Authority is planning on utilizing International Business Machine type of billing equipment to process the meter reading data and bill the individual customers. The average sewer service charge for domestic customers, based on the water usage of 50,000 gallons per year, has been estimated to be $15 per year.

In the event the customers fail to pay their bills to the Authority, the municipalities in which the customers reside will be required by

their agreements with the Authority to make a payment to the Authority to cover such unpaid bills. In this fashion, the normal municipal processes of placing liens on property may be utilized for the benefit of the Authority.

It is estimated that from 125 to 150 personnel will be required to operate the Pittsburgh Sewage Treatment Plant. The maintenance

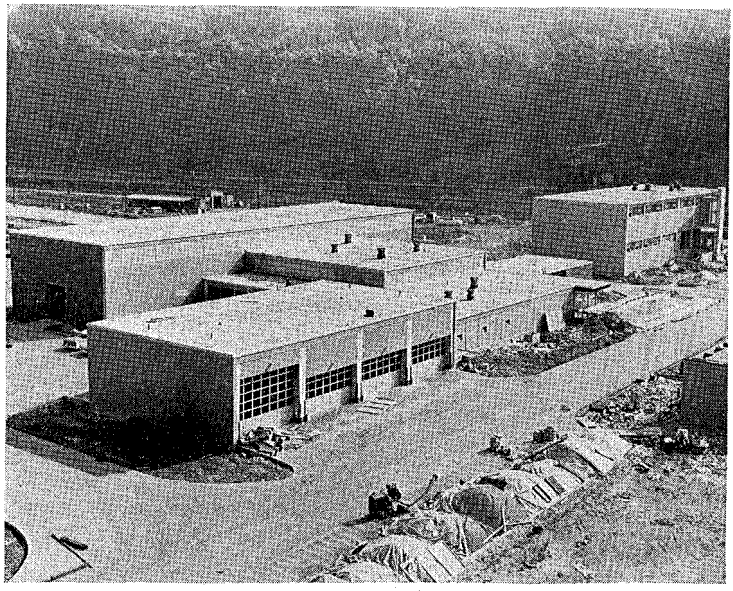

FIG. 11.—THE ADMINISTRATION BUILDING APPEARS IN THE RIGHT OF THE PICTURE. THE BLOWER AND MAINTENANCE BUILDING IS TO THE LEFT. THE LONG PORTION IN THE REAR HOUSES THE BLOWER EQUIPMENT ON THE LEFT WITH A MACHINE SHOP ON THE RIGHT. THE PLANT GARAGE IS IN THE FOREGROUND.

of the intercepting sewers will be handled by approximately 15 men. This group will be provided with a tow boat and barge for accomplishing much of this maintenance work, since many of the locations, along the rivers on the intercepting sewer system, requiring maintenance are difficult to get to, other than by water.

CONCLUSION

This project has not only been of an unusually broad scope, but also a number of unique problems of special interest have been included, several of which have been discussed. Since its conception,

the Authority has been fortunate to have had the continuous service for a period of twelve years, of Mr. John F. Laboon. He has been not only a forceful administrator, but also an engineer through whose efforts the novel Laboon process of sludge disposal has been developed for use in this major sewage treatment plant. The operating results of this new plant are awaited with great interest.

A reference list of published technical papers pertaining to this project, follows:

Illustrations

Progress photographs of the sewage treatment plant are shown in Fig. 7-11 and represent the status of construction in the summer of 1958. These photographs illustrate type of structures provided at this plant.

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