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STATE OF NEW JERSEY

REPORT

OF THE

**SPECIAL COMMITTEE ON
WATER SUPPLY**

TO THE

SENATE AND GENERAL ASSEMBLY

SPECIAL COMMITTEE ON WATER SUPPLY

HON. CHARLES E. LOIZEAUX, *Chairman,*

HON. OSCAR R. WILENSKY, *Secretary*

HON. CRAWFORD JAMIESON,

HON. DOMINIC A. CAVICCHIA,

HON. WALTER J. FREUND,

HON. FRED W. DEVOE,

Committee.

HON. ROSCOE P. MCCLAVE, *Speaker, member ex-officio,*

EXPLANATION

The Special Committee on Water Supply held an all-day meeting in the Down Town Club, Newark, New Jersey, October 24, 1940, at which this report was considered, amended, and copies, with the amendments, ordered distributed to the members. Thereafter, it was approved as amended by a majority of the committee, orally or by letter. The chairman directed that it be set up and made available in proof form for formal adoption and printing. The committee, however, held no further meetings, but the type has remained standing. I have caused it to be printed.

In connection with the report, the Special Committee drew up several bills to create a State Water Authority and to discontinue conflicting powers vested in existing water supply commissions. Since the report was written circumstances have made it seem desirable to omit one of the bills drafted by the committee that would have transferred the operating function of the North Jersey District Water Supply Commission to the proposed "authority," so that bill has not been printed. In the draft of the bills, as now sent to the members of the Legislature with the report, technical changes recommended recently by Dean Frank H. Sommer and Mr. Arnold Frye have been incorporated.

ROSCOE P. McCLAVE,
Speaker of the House of Assembly.

September 22, 1941.

SENATE CONCURRENT RESOLUTION NO. 4

A CONCURRENT RESOLUTION creating a committee of the Senate and House of Assembly to confer with the Governor and report to the Legislature a plan for the solution of the Water Supply Problem of the State.

BE IT RESOLVED *by the Senate and the House of Assembly concurring:*

1. There is hereby created a committee consisting of three members of the Senate to be appointed by the President pro tempore and three members of the House of Assembly to be appointed by the Speaker, said committee to be known as the Special Committee on Water Supply.

2. It shall be the duty of that committee to meet with the Governor when he so requests and to confer with him for the purpose of formulating a plan for the solution of the Water Supply Problem of the State. The said committee shall perform its duty expeditiously and report its findings to the Senate and House of Assembly not later than the second Monday in April, nineteen hundred forty.*

This resolution shall take effect immediately.

Passed in Senate, February 12, 1940.

Passed in Assembly, February 26, 1940.

* Time extended to December 15, 1940.

Report of the Special Committee on Water Supply

December 9, 1940.

To the Senate and General Assembly:

The Special Committee on Water Supply was created by a Concurrent Resolution of the Senate and House of Assembly and charged with the responsibility of "formulating a plan for the solution of the Water Supply Problem of the State." Since there can be no such plan except in the form of suitable legislation, the committee submits herewith a series of bills intended to accomplish the desired end. Their purpose is set forth herein and their passage is recommended.

These bills, if enacted into law, will create and define the powers of a "State Water Authority," comprising three members appointed by the Governor with the advice and consent of the Senate.

The "authority" will succeed to the powers and duties of the State Water Policy Commission and in addition thereto it will be entrusted with these important functions:

1. To acquire, own and operate water supplies and their facilities.

The local distribution systems within individual municipalities will continue, or will be placed, under municipal ownership and management wherever the municipality so desires.

The North Jersey District Water Supply Commission will be discontinued if, and as soon as, the Wanake water supply and its facilities are acquired by the "authority" from the group of eight municipalities that owns them and for which the district commission is the operating agent.

The Passaic Valley Water Commission will be continued in the role of a water department for Paterson, Passaic and Clifton, but it will cease to be an owner and operator of sources of supply if, and as soon as, the "authority" acquires the Wanaque water supply, the Little Falls water plant, and their transmission systems.

The law permitting county water commissions will be repealed. Under this law, no commission has ever functioned.

2. To consolidate and interconnect both public and private water supplies for their more economical and general use.

3. To construct, own and operate new water supplies.

4. To raise funds—without incurring a debt of the State—with which to purchase, consolidate and interconnect existing water supplies and with which to construct new water supplies.

The aim of the proposed legislation is expressed in the opening sentence, paragraph six, of the main bill, which reads:

"The authority is hereby empowered to construct and operate new or additional water supplies, and it shall have the power to acquire, consolidate, maintain and operate water supplies publicly owned and water supplies owned by private water companies, to the end that the water resources of the State may be utilized more efficiently and economically."

The bills submitted are an expansion of the water policy and general water supply acts that have proved adequate in their sphere. These acts have stood the test of both experience and court review. However, they are not sufficient, as they stand, to permit consolidation and interconnection of present supplies. Nor is it possible under them to build a large-scale, additional supply. Municipalities in the congested parts of the State, with the exception of the few that acted for their own protection long ago, cannot

save themselves in time of drought. They cannot go out into the remaining, undeveloped watersheds of the upland counties and acquire a supply for an increasing population or for an extensive enlargement of industry. In the first place, they have wholly insufficient credit. Secondly, they are too scattered for action in common.

These facts, recognized for years, are a vital reason for the broadening of our water supply laws by new and original provisions which have been incorporated in the bills, thereby making it possible, through a central agency of the State, to finance, consolidate, construct and interconnect water supplies. Areas wherein there are numerous disconnected supplies of local origin—having uncertain capacity and doubtful dependability—cannot do this. Their equipment is becoming run-down. They must ultimately give way to a major new supply for all whom they now serve. The fiscal provisions of the bills will enable the “authority” to effectuate a single co-ordinated system of supply in the northern industrial section, as now needed, and to bring about like benefits to other sections, as time goes on, and circumstances warrant. This is a very pertinent consideration to keep in mind.

The solution of this difficulty is the essence of the bills. It constitutes a good and sufficient reason for their passage, along with the obvious and potent reason that a unified water supply for largely populated sections is just as much in the public interest here in New Jersey as it is in Massachusetts, New York and the two great business centers of California.

Important objectives covered by the bills include:

1. Protection of the lake regions. The “authority” is prohibited from undertaking “the development of a new water supply that may affect a lake used for recreational purposes without first obtaining from the Legislature approval of the project.” This should satisfy a section of the State that has feared prior legislative proposals and that has done much to thwart their passage.

2. Audit by the State Comptroller of the accounts of the “authority.”

3. Public hearings before acquisition by the "authority," in whole or in part, of private water companies, or public water supplies; or the construction of additional and new water supply projects.

The purpose of (2) and (3) is to place ample safeguards around the fiscal operations of the "authority."

4. Protection of municipalities against loss of ratables through transfer of taxable property to the "authority."

5. Power to effect the interconnection of water supplies which the "authority" may not find it desirable to buy or operate.

The composition of the "authority" has received most serious consideration. The committee recognizes that success, or failure, hinges on the way in which so large a public undertaking is administered. The size of the "authority" cannot be unwieldy, for it must expedite a huge and complicated task without concessions to too many personal viewpoints. The committee arrived at the conclusion that an "authority" membership of "three" meets this necessity. This is the minimum number required by law for a private corporate body.

The members must be capable of successful negotiation with owners of water supplies; they must have a knowledge of finance; they must be able to assume responsible direction of the building of a new water project. They must cope with the intricacies of water supply—administrative and technical—as well as with broad questions of public policy.

The "authority" will be charged with the duty of buying, and joining together, seven to fifteen water supplies, with an estimated value in the neighborhood of \$150,000,000. The "authority" must, at the same time that it is engaged in this business of consolidation, determine upon and go ahead with the construction of a new supply costing around \$45,000,000. The working-out and execution of financial measures and policies wherewith to do these things will be

a task in itself. While these matters are receiving attention, the "authority" must continue to carry on the determination of local questions of water supply, the planning and supervision of flood control measures, the insurance of safety in the construction of dams, and the prevention of encroachment on rivers and minor streams through public and private building operations.

Problem Primarily Financial

The problem to be solved is mainly one of finance. There must be an agency of the State, created as a corporate body, and clothed with the power to raise its own funds. Its operating costs should be paid from, and its liabilities secured by, revenues from properties it owns and operates. The principle must be applied to a general unit of control and operation, functioning for the northern industrial counties, in place of a greater part of the 33 separate and distinct public and private water supplying agencies now spreading over the area. So long as the present arrangement continues, with its countless conflicting interests, there cannot be efficiency or economy in water supply. The area cannot be protected against the potential calamity of a water shortage.

Succeeding Legislatures have recognized these facts, but they have tried ineffectually to meet them. Four successive Governors—George S. Silzer, Morgan F. Larson, A. Harry Moore and Harold G. Hoffman—have called for action, but without avail. These governors have been pronounced in their belief that the State should build a new water supply for the northern and central industrial counties.

Delaware and Raritan Canal Project Proposed by Governor Moore

Governor Moore advised the 1938 Legislature to utilize the Delaware and Raritan Canal, which is the property of the State, as a right-of-way for transmission of a water supply from the Delaware River at the Bull's Island, or

Raven Rock, intake of the canal above Stockton, to a location near Bound Brook, from which point it would be pumped to a high elevation known as Dock Watch Hollow, thence delivered by gravity flow to wherever it might be needed. The Governor again stressed his belief in this mode of developing a new water supply in a communication to the 1939 Legislature, and in an informal, open conference with the 1940 Legislature. He assured the Legislature with complete confidence that the project would be financed and built by the Federal Work Projects Administration and the Reconstruction Finance Corporation.

Up to now all plans prepared for the development of a new water supply have come to naught because neither the State nor any combination of municipalities has been in a position to pay for one. The Governor's assurance seemed a way out of this dilemma. Hence, the committee gave early consideration to his plan. The engineers, who had already worked out the details of the plan, were called into consultation. The committee held hearings, and those interested in the problem were invited to attend and give the committee the benefit of their advice.

Danger of Water Shortage

There was agreement among those present that it is high time the State did something to forestall a water shortage. Danger of such a shortage was visualized by the object lessons of the drought beginning in the summer of 1939 and continuing until the spring of 1940. Governor Moore vividly portrayed by wall charts and photographs, on the occasion of his conference with the Legislature, the extent of the draw-down of reservoirs and the predicament we would have faced if the drought had been prolonged into the succeeding summer. Fortunately, this did not happen, for there were copious rains in April and May—far in excess of ordinary expectancy. His charts, prepared by Messrs. Charles H. Capen, engineer of the North Jersey District Water Supply Commission, and Howard T. Critchlow, engineer of

the State Water Policy Commission, indicated that we would now be in the midst of a general water shortage, without war or drought, if the year by year pre-depression increase in consumption had continued unabated.

Consumption of Water in Relation to National Defense

As a matter of fact, the consumption of water in the northern district dropped from the peak load of 305,000,000 gallons a day, which was the average at the beginning of the depression in 1929, to a daily average of 256,780,000 in 1938. While industry lagged, so did water requirements. Then the daily load rose again to 275,000,000 in 1939. Defense measures are now stimulating industrial activity and consumption has climbed steadily since early 1940. If the demand for water in 1941 equals that of 1929 and we have a recurrence of drought like that of last year, the exigency will be critical.

The safe yield of water supplies in the area, when reservoirs and wells are full, is estimated at 305,000,000 to 340,000,000 gallons a day, but this total is not available at all points. That is because there is a lack of proper interconnection of the pipes of one system with those of another. The smaller figures contemplate retention of 25 per cent of capacity in the large surface reservoirs, which is desirable to maintain quality and insure safety. The larger figures assume the exhaustion of all water in these reservoirs, leaving no reserve at the end of a dry period and no factor of safety in unpredictable circumstances. Augmentation of shipping on the New Jersey side of New York Harbor in World War No. 1 overtaxed water supplies—causing one transmission service to collapse. The experience may be repeated. The margin of safety offers too little insurance against such contingencies as these.

New Reservoir Required

The engineers tell us we ought to increase our surface supplies by building a reservoir with a capacity of 150,000,000 gallons a day to be on the safe side. Even

then, as brought out by one of the Governor's comparative charts, the northern counties would not have a measure of protection equal to that of Massachusetts, New York and California industrial centers of comparable size and importance.

The Board of Trustees of the New Jersey Section of the American Water Works Association, comprising 210 engineers, superintendents, operators and officials concerned with water supply, submitted to the Governor, under date of April 4, 1940, a comprehensive report in which they expressed "deep conviction that prompt action should be taken in the interest of public safety and public health."

Delaware and Raritan Canal Project

With accord in respect to the need for a new supply, the committee turned to the determination of the feasibility of the Governor's recommendation that we obtain our next supply from the Delaware River by means of what is commonly called his "Canal Project." With a single exception, and insofar as they were willing to commit themselves, the engineers who appeared before the committee endorsed the "Canal Project." Major Arthur H. Pratt, consulting engineer of the North Jersey District Water Supply Commission, was the exception. He favored the Chimney Rock Project, which, he said "originally was fathered by me in 1925." No one advocated the Bunnvale project of the State Water Policy Commission of 1929. No one spoke in favor of any of the plans from time to time prepared by individual water engineers on their own behalf.

Federal Aid for "Canal Project"

State Director of W.P.A., Robert W. Allan, has forwarded the Canal Project plans and estimates of cost to Washington for W.P.A. approval. The chairman of the State Water Policy Commission, at the Governor's request, conferred with the legal, engineering and financial heads of the R.F.C. in Washington and furnished them with data

requested. The R.F.C. is expected by the Governor to loan a duly constituted agency of the State the difference between the total estimated cost and that covered by W.P.A. labor and materials. Division of costs is summarized in Appendix A of this report.

Canal Project Engineeringly Practicable

The engineers engaged in study of the Canal Project assured the committee that it is practicable from an engineering standpoint. They submitted three reports on this phase of the project, two of which are in print. Their first cost estimates were revised after a field survey made in September, with engineers of the W.P.A. Final figures include expense of a double conduit to be laid in the canal bed a distance of 51 miles; four miles of force main and tunnel (one mile tunnel) from the terminus of the conduit to a reservoir at Dock Watch Hollow on Second Watchung Mountain; a fully equipped pumping station at Bound Brook to send the water from the conduit to the reservoir; land and construction costs of the reservoir to impound 15,000,000,000 gallons; filtration plant at the outlet of the reservoir; 21 miles of transmission lines from the reservoir to the junction with present pipe lines at, or near, Elizabeth, and a compensation reservoir of 1,200 acres to be located on some one of the New Jersey tributaries of the Delaware River.

Capital investment is all that is included in the revised estimates and not a capital cost, as first calculated, that reflects an annual pumping charge. The latter was made a part of the original calculation for comparative purposes. This cost is now carried in the estimate of operating costs and revenues.

Legal Phases of Canal Project

Consideration of the Canal Project raised a number of legal questions that had to be answered. There was the query as to whether the State has a right to divert water

for potable purposes, by way of the canal, to the same extent that it was done for transportation use. Would New York and Pennsylvania institute court proceedings to block such a diversion? Will difficulties arise from riparian claims in connection with property rights along the canal?

On the first question, interstate in scope, the committee directs attention to the opinion of Duane E. Minard, Special Counsel, given in writing to the Governor May 16, 1938. The second difficulty, it seems from conference with interstate representatives, can be overcome by the building of a compensation reservoir. A report on legal questions, presented to the committee by Morgan R. Seiffert, Secretary, Delaware and Raritan Canal Commission and dated June 3, 1940, appears to dispose of doubts created by the third.

Mr. Minard reviewed the history of the canal, cited the long line of suits in connection with it, explained the charter rights granted by the Legislature in 1830, analyzed prescriptive and diversion rights, change of use, and arrived at the conclusion that:

“It seems, therefore, quite clear that, independent of the rights acquired by the State in the Delaware and Raritan Canal and feeder, and independent of the amount of water habitually withdrawn for canal purposes, and independent of whether the water is diverted at the source of the feeder and carried through it into the canal, or whether the water is withdrawn from the river at some other point, the State has the right to divert water from Delaware River for public purposes, without the consent of Pennsylvania, to the extent that such diversion will not cause substantial damage to the State of Pennsylvania.”

To ascertain the attitude of Pennsylvania the committee and its advisers devoted several days to discussions with the Interstate Commission on the Delaware River. While the members of that commission could not bind their States without the separate approval of their respective Legislatures, nevertheless it was conceded that, so long as New Jersey keeps within the limiting diversion provisions of the

decision of the Supreme Court of the United States as they apply to the State of New York, neither Pennsylvania nor New York is in a position to contest the contemplated diversion for the Canal Project.

The Supreme Court in the Delaware Diversion Case restricted diversion by the City of New York from tributaries within the State of New York to an average of 440 million gallons per day. In order to provide this amount of water to the City, and also the compensation flow required, New York City is developing a drainage area totalling 450 square miles. The Court required that the compensation flow of the streams below the reservoir be released during periods when the flow at Port Jervis, New York, or Trenton, New Jersey, is below a rate of 0.50 cubic feet per second per square mile (c.s.m.) which is equivalent to 1,535 cubic feet per second (c.f.s.) at Port Jervis and 3,400 c.f.s. at Trenton. The compensation flow is to be at the rate of 30 per cent of the average annual yield of the watersheds developed. For New York State tributaries this compensation flow is equivalent to 0.66 c.f.s. per square mile, or 297 c.f.s., which, in turn, is equivalent to 192 million gallons per day (m.g.d.).

During the year 1939 the flow at Trenton was below 3,400 c.f.s. for 88 days between June 26 and September 30. The City of New York would, therefore, have been required to let down a total of 16,900 million gallons during that period. A more severe period occurred in 1923 when the flow at Trenton was less than 3,400 c.f.s. for a period of 89 days between June 24 and September 30. The longest period during which the flow at Trenton was less than 3,400 c.f.s. occurred in the fall and winter of 1930-31, when it continued 165 days.

Had the proposed Delaware and Raritan Canal water supply project been in operation during 1939, and had the rule of compensation flow as set up in New York diversion case been applied, it would have been necessary to release from storage reservoirs between June 26 and September 30, about 4,000 million gallons. The engineers recommend a

storage reservoir for compensation waters having a capacity of at least 10,300 million gallons. This is based on a period of low flow of 165 days which, it is estimated, might occur during a dry period. The drought of 1909, based upon the Riegelsville records, continued for 156 days.

Whether the rule of compensation flow as established by the Supreme Court in the New York City case would apply to the Delaware and Raritan Canal water supply project we do not know, because the type of development is different in that the water is to be taken from the ordinary flow of the Delaware River at Stockton, New Jersey, and transported through an aqueduct to the pumping station at Bound Brook. This would mean diverting water continuously, regardless of the flow in the Delaware River and, under assumption made herein, letting down from the storage reservoir on a tributary of the Delaware River within New Jersey, compensation water at the rate of 62.5 million gallons daily, calculated on the basis of the drainage area necessary to produce 150 million gallons daily from a storage reservoir.

The engineers are of the belief that a compensation reservoir of the size recommended by them and made a part of the Canal Project will meet the situation.

Capacity of the Canal and Reservoir

A survey of the canal was made by C. C. Vermeule and published in 1894 as part of a book on "New Jersey Water Supply, Geological Survey." Mr. Vermeule found that as much as 210,000,000 gallons a day was entering the feeder at Raven Rock. The navigable portion of the canal extended from Bordentown to New Brunswick via Bound Brook. Below Bound Brook the canal was fed from the Raritan River. The feeder emptied into the navigable section in Trenton, from which part of the water went north through a series of locks and the rest back to the Delaware at Bordentown. The latter quantity, therefore, was not classed as a diversion from the river. How much went north is a matter of opinion. The committee received no

proof. Engineer Critchlow estimated the diversion north to the Raritan at 110,000,000 to 128,000,000 gallons a day and expressed the belief that the State is entitled to this quantity under the opinion of Mr. Minard.

Since the Canal Project contemplates storage of a water supply to yield 150,000,000 gallons a day, the compensating reservoir would have to hold enough to let down 62,500,000 gallons a day to keep the low flow of the river at Trenton at the level ordered by the Federal Court.

Riparian Rights Along the Canal

The very thorough brief prepared by Mr. Seiffert discusses in detail various questions of prescriptive rights and possible claims for damages, riparian, reversionary and otherwise, along the line of the canal itself. He arrives at the conclusion that rights to damages, which might have been inherited, are inconsequential; that damage claims resulting from condemnation rights acquired long ago are uncertain and doubtful; that adverse rights in the case of Miles Smith heirs and other perpetual water rights, are vague at best. The opinions are based on examination of deeds to the canal properties on file in Hunterdon, Somerset and Middlesex Counties; litigation in connection with abandonment of the Morris Canal as it might be applied to the Delaware and Raritan Canal; and principles of law as they might be invoked for and against claimants.

"Only one deed was found wherein there was an express condition that the land would revert in event the property was no longer used for the canal," states Mr. Seiffert. "Another contains a reversion against the Canal Company selling building lots or erecting buildings on the premises conveyed. Another contains a reservation of fishing rights along the shores of the canal. Inquiry of those formerly in charge of the canal elicited no knowledge of any further reserved rights presently claimed or enjoyed. Hence, I feel warranted in the assumption that there are no substantial rights reserved in original deeds. Damages in most cases are so vague as to be described as illusory." He seems to

have established the fact that burden of proof resting with claimants stands in the way of likely interference with conversion of the canal to potable water purposes.

In light of these legal opinions the committee leans toward the conviction that the Canal Project could be undertaken without prolonged retardation from intercession of the courts. Nevertheless, the committee is aware that there can be no determination of either type of legal issue until such time as the Legislature has created a water authority, or other duly constituted agency to adjudicate them.

Johnson and Johnson at New Brunswick obtain a large volume of water from the canal, but there should be no legal obstacle to the continuance of this privilege by agreement.

Recommendation Respecting "Canal Project"

Based solely on the evidence presented, it would seem that the "Canal Project" lends itself most readily to present-day financial opportunities and that its construction is practicable on engineering grounds. Nevertheless, the committee is in agreement that the "authority," and not the Legislature, should decide which project is best for the State. Legal involvements should be settled before construction is begun. There are further details and consequences which should be studied and weighed. Neither the Legislature, nor this committee, is in a position to adequately evaluate them. They are administrative—not legislative. Therefore, the committee recommends that responsibility for the next water supply project be vested in the "authority," without prejudice, as provided in the accompanying legislation.

Interconnection of Supplies

The North Jersey District Water Supply Commission and the State Water Policy Commission dropped a bitter controversy and got together four years ago for joint study of the problem of interconnection of water supplies in the

northern counties. The State Water Policy Commission has since finished a similar study of conditions in the southern counties. The Legislature and the Work Projects Administration appropriated money for the studies.

The report, with explanatory maps and charts, was completed for the North Jersey District in 1939 but none of the interconnections, except a few forced by the acute emergency of that year, has been made. Conflict of local interests is the sole reason. Interconnection of the pipes of the Commonwealth Water Company with those of Montclair, Verona, Essex Fells and South Orange has been stalemated by the question of whether or not there should be a standby charge and how costs ought to be apportioned. Governor Moore wrote urgent letters during the most threatening period of the 1939-1940 drought to water companies and municipalities, appealing to them to proceed with the interconnections declared most seriously needed. Nobody budged. Fortunately the drought ended suddenly, but this experience furnishes an example of the danger inherent in the existing division of responsibility among so many independent and self-contained public and private owners of supplies.

Places Hit by Drought

Before the drought of 1939-1940 ended there was fear of shortage of water in places served by the Wanaque, Pequannock and Rockaway Reservoirs. The first named was down to its lowest recorded level. Water in storage at Wanaque fell from 29.5 billions to 11 billions of gallons. The Oak Ridge Reservoir of Newark's Pequannock system—largest of the five reservoirs in the system—nearly ran dry. The Rockaway Reservoir at Boonton early in 1940 dropped to an all-time low and, if rain had not come as it did, Jersey City would have been forced to extreme measures to curtail water usage. Advertisements appeared in newspapers advising consumers to return to the Saturday night, one-bath-a-week, of grandfather's day.

The reservoir of the Commonwealth Water Company was so low residents of the higher sections of West Orange were temporarily without water. The emergency was met by opening a standby connection to Montclair, which had been ordered removed because of its age but which fortunately had been left in place.

Orange was so close to the end of its supply, with one reservoir dry, and the other nearly so, the city was forced to order the Edison industries to stop using water from the city mains. The company works were not shut down because there was a connection with another supply.

One of the first municipalities to realize a shortage of water was the Borough of Lodi. Wells were unable to function, but water was secured through a main of the Passaic Valley Water Commission.

The most spectacular shortage was in Haledon. The impounding reservoir was drawn down below the normal intake pipes and it became necessary to utilize the lower intake pipes, thus delivering to the filters a water difficult to treat. The municipality became alarmed and ordered the silk mills within the borough to cease using municipal water for industrial purposes. This caused a shutdown of the main industrial occupation of the inhabitants, until a connection could be rushed a distance of 3,000 feet to tie in with the Passaic Valley Water Commission system.

Garfield was forced to place in operation two old wells previously discontinued and considered obsolete. When these were on the point of giving out, an emergency connection was made possible by fortuitous proximity of the Passaic Valley Water Commission's industrial line.

The Borough of Wallington escaped a water shortage but its water superintendent expressed fear of one because the lowering of the water level in the wells caused the pumps to draw air.

Necessity and Cost of Interconnections

The engineers of State and District commissions agreed that there are 35 points at which interconnection of supplies is essential to public safety. Eight others are listed as desirable but not imperative. Cost of the essential is estimated at \$2,125,453. Cost of the less urgent is \$1,149,055. The total is \$3,274,508. They should be built as early as possible. Obviously, nothing short of a water authority with ability to raise the money to pay for them as a part of the new water supply project, will cause their construction.

Interconnections are vitally necessary to a sound, economic use of our developed water supply resources. They are a prerequisite to the future use of present undeveloped resources. Without interconnections a new supply will have insufficient customers. Municipalities that will be the first to require additional water, after present surpluses have been allocated up to limits of safety, are very scattered. The alternative to interconnections is a costly duplication of delivery systems. We have too many paralleling pipe lines already, as a consequence of the 33 independently owned and operated sources of supply. Several compete with each other, selling water out of town in competition at less than cost, home taxpayers making up the difference.

No one would suggest that it would be better to have 33 independent sparsely connected telephone systems, or 33 isolated gas and electric systems, in the territory of these 33 separate and distinct water supplies. Their maintenance is costly to the consumer far beyond his realization. It is reflected in 71 varieties of water rates.

Public interests would be served exceedingly better with unification of the important sources of supply for the wholesaling of water, without disturbing the general principle of local retail distribution. Ultimately water would cost the consumer less.

Savings from Reorganization

There are many possibilities of a higher degree of efficiency, with resultant economies sooner or later to be reflected in lower water rates, through a simplified and centralized control and management of water supplying agencies serving a territory like that of the northern industrial counties of the State. Numerous incidental economies in operating costs should follow the substitution of one managing agency in place of the present 33—or a goodly part of them. These economies have been estimated in excess of \$300,000 a year by accountants and engineers advising the committee.

Concentration of authority in the manner recommended would eliminate much of the payroll expense for the management of both public and private water supplies. Salaries of officers of private water companies would be saved. So would the salaries of the five commissioners and of numerous officials of the North Jersey District Water Supply Commission. The payroll of the latter exceeds \$100,000 just for the maintenance of a single reservoir—the Wanaque. Reduction of operating overhead automatically cuts down direct costs.

Largest savings can be reflected in capital costs. Present debts are carried at interest rates out-of-line with the current market. These debts undoubtedly can be consolidated, refunded and reduced by the “authority” with its contemplated powers. Lower debts and lower interest rates will have a downward influence on operating costs—and reduction along these lines inevitably means lessening of the cost of water to industries and homes.

Reasons for New Agency—Rather Than Enlargement of an Existing Agency

The committee has considered reasons for and against an extension of the powers and duties of one of the existing agencies and has come to the conclusion that the situation calls for an entirely new set-up. The State Water Policy

Commission has functioned satisfactorily in recent years but its membership of seven is too large.

The district water commission idea has not worked out as anticipated. One can come into being only at the instance of a group of municipalities. The South Jersey District exists by statute but has no commission. North Jersey District commission represents but eight of the 311 municipalities within the district. Repeated efforts have failed to induce others to employ its services. Since the members of the commission may be appointed from all over the district, the eight municipalities whose money it spends, never have even a majority representation. There is a second district commission within this district commission's territory, known as the Passaic Valley Water Commission. In consequence, the two commissions are in a perpetual quarrel and have been fighting each other in first one, then another, of the courts of the State since June, 1937.

These reasons convinced the committee that no good result may be expected from the widening of the scope of existing agencies and that the thing to do is to create a wholly new agency in their stead.

The Problem of Finance—Opinion of Arnold Frye

Speaking on the subject of financing, Arnold Frye, of Hawkins, Delafield and Longfellow, said to the committee: "You have two methods. One is by the municipalities. We have been through the difficulties of getting a group of municipalities to function together. We have been through it in connection with the Passaic Valley Sewer, Wanaque, the Rahway Valley Sewer—all joint projects. They are time-consuming—with delays and uncertainties. They are expensive, the method is cumbersome, and is practically out of consideration at the present time, to all intents and purposes, because in the municipalities that might otherwise join, the taxpayers are not willing to incur additional debt to the extent necessary.

"There remains the method by which some other body would of itself be authorized to issue bonds. A great deal

of consideration has been given to the establishment of a single authority for the State. That would be desirable in many ways. There is a constitutional difficulty involved and probably no lawyer would be willing to approve the bonds that would be required to be issued by such an authority until there is a test case and the Court of Errors and Appeals again interprets the Constitution on the basis of facts different from those which existed when the Wilson (or Wharton) case was decided."

The court in that case held that the action of the State Water Supply Commission in supporting its bonds with a mortgage on its prospective properties would create a moral obligation of the State, hence would be unconstitutional because such indebtedness of the State had not been authorized.

"Now," added Mr. Frye, "I believe, and a certain number of lawyers agree with me, that it could be re-presented to the court, under different circumstances, and the court would distinguish that case so that a single State Water Authority would be possible and could sell its bonds at an advantageous price. As to any other legal problems involved in such an authority, we believe they can be solved by proper legislation."

Mr. Frye went on to explain that financing in the first instance might be by State or Federal government aid. Bonds are not salable privately at an advantageous price until there is an "experience table" that reflects an established revenue from operations. That difficulty confronted the Port of New York Authority until overcome by appropriations from New Jersey and New York and until ownership of the Holland Tunnel was transferred to its jurisdiction. The Tri-Borough Bridge in New York City was financed in the first instance by the R.F.C. The same was true of the Southern California Water Supply and Power Project.

"Private investors will not put money in a construction project when they are not sure of income," continued Mr. Frye. "You can't blame them. But the government can do

that when its engineers assure it the project is workable and the anticipated revenue will be adequate. Thus Tri-Borough Bridge was constructed with R.F.C. money in the first instance, the bonds were made callable, and they have since been refunded privately. The Southern California development was similarly financed. Large amounts of bonds have been sold to the general public. That can be done with an assured income based on experience. You need an income for your authority in order to be able advantageously to sell bonds which are payable only from income. That could be accomplished by some arrangement by which a reservoir could be taken over by the authority, as the Holland Tunnel was taken over by the Port of New York Authority."

The point to be kept in mind is that the "authority" could commence operations at once with R.F.C. aid and, in that case, would not require private financing, or substantial State aid. With the accumulation of assets in the form of existing water supplies, by exchange of securities, it could be made a going concern almost immediately.

Opinion of Frank H. Sommer

On testing the applicability of the Wharton Case to an "authority" bond issue, Dean Frank H. Sommer had this to say:

"We can secure a determination of all legal questions within at most six months after legislation is enacted, because there is now a declaratory judgment act, and if you set up the 'authority' and these questions arise, that 'authority' can present them to the Supreme Court of New Jersey and more or less informally secure a determination. Within three months afterward you can have the determination of the Court of Errors and Appeals. I don't think we are going to get anywhere if we hold back because of the Wharton Case. I have distinct convictions as to what will happen to that case if it is re-presented to the court. I would love to re-present it. Because we can now secure a speedy determination of constitutional questions, some of

us hope you will enact legislation that will enable us to bring these questions before the Court again and get this thing that has been bedeviling us for years out of the way."

Self-Sustaining Income

The likelihood of a profitable investment is indicated by an accounting and engineering examination of the various factors of assets and liabilities, operating costs and income, that would influence the financing of a plan of consolidated water supply. The R.F.C. has required an answer satisfactory to its officials before it will commit the Federal government to what Mr. Frye typifies as a "first instance" loan. The best available answer is set forth in an extended report on the subject to the R.F.C. by George S. Burgess, chairman of the State Water Policy Commission, who is an accountant of wide experience. The prospects are therein summarized thusly:

"The estimate of revenues and expenses is based on known figures extended over a period of years, graduated to an average for the period. By this method it has been found that the average cost of water for the three principal municipal systems (Wanaque, Pequannock, Rockaway) is \$77 per million gallons, based on present rate of consumption. Acquirement of the wholesaling portion of the plant within the territory supplied by Passaic Valley Water Commission would raise the average to \$85. This is a result of the disparity between consumption and supply available through the industrial pipe line. When its usage approaches capacity the average cost will be appreciably lowered.

"Gross corporate income of the private companies (receipts minus operating and overhead costs other than debt service, as set up on their books) exceeds annual debt service requirements, hence under consolidation there would be an immediate profit from this source, even accepting seemingly excessive book values of plant as a purchase basis.

“The estimate indicates the volume of increased consumption at present rates, and, therefrom, deduces a reasonable use of waters from the Delaware and Raritan Canal Project to supply a part of this increase. Starting at a top price of \$84 per million gallons it seems apparent that this rate can be scaled down to \$77 within 20 years, while providing a debt service that will amortize the project and continue existing supplies under consolidated management without a general advance in water rates.

“It is assumed, for purposes of computation, that the annual debt service will be equal to 5 per cent of the gross debt under consolidation. Interest and amortization are calculated respectively at $3\frac{1}{2}$ per cent and $1\frac{1}{2}$ per cent (40-year bonds). The former, it should be noted, is slightly lower than the customary 4 per cent charged by the R.F.C. It is justified, however, by current market selling probabilities.”

Procedure of the Committee

The Special Committee on Water Supply has made a searching inquiry into the pertinent phases of the water supply problem of the State and has reached its conclusions after nine meetings, and following conferences with everyone who has indicated an interest in the subject. Throughout its proceedings it has been advised by Dean Frank H. Sommer, George S. Burgess, Charles H. Capen and Howard T. Critchlow—the four recognized authorities with longest experience in New Jersey water supply matters. The entire committee went to Washington with Governor A. Harry Moore, where it conferred with Colonel F. C. Harrington, at that time Federal Director of the Works Progress Administration, and Jesse H. Jones, Chairman of the Reconstruction Finance Corporation. The Washington authorities plainly indicated a favorable inclination to render Federal aid to a new water supply for the State if,

and when, there is an agency empowered, as Chairman Jones put it, to "give me a good note."

Respectfully submitted,

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Acknowledgment is made to the following, in addition to those cited in the text of this report, for their advice and assistance to the committee:

EDWARD EDELMAN, Counsel, Reconstruction Finance Corporation.

RICHARD DICKER, Assistant Counsel, Reconstruction Finance Corporation.

WALTER L. DRAGER, Chief, Engineering Section, Reconstruction Finance Corporation.

ROY BURTON, Engineer, Reconstruction Finance Corporation.

R. A. BERGSTROM, Financial Examiner, Reconstruction Finance Corporation.

HARRY G. SMITH, JR., Assistant Examiner, Reconstruction Finance Corporation.

JOSEPH STERLING, President, Delaware and Raritan Canal Commission.

ROBERT W. ALLAN, State Administrator, Work Projects Administration.

CLYDE POTTS, President, State Board of Health.

HARRY P. CROFT, Engineer, State Department of Health.

THOMAS J. GRAVES, New Jersey State Chamber of Commerce.

FRED S. CHILDS, Works Engineer, State W.P.A.

Appendix A

COST ESTIMATE

FOR

NEW WATER SUPPLY—ACQUIREMENT AND CONSOLIDATION OF EXISTING WATER SUPPLIES

PREPARED FOR

THE SPECIAL COMMITTEE ON WATER SUPPLY OF THE NEW JERSEY LEGISLATURE

By

GEORGE S. BURGESS

Chairman, State Water Policy Commission

Assisted by

CHARLES H. CAPEN

Engineer, North Jersey District Water Supply Commission

MAY, 1940

CAPITAL EXPENDITURES REQUIRED

Acquirement and Consolidation of Water Supplies

	<i>Original Cost</i>	<i>Outstanding Bonds</i>	<i>Present Equity of Owners</i>	<i>Reproduction Cost (New)</i>
1. PUBLIC SUPPLIES				
a. Pequannock (Newark)	\$11,154,000	\$2,200,000	\$8,954,000	\$18,500,000
b. Rockaway (Jersey City)	14,248,000	8,000,000	6,248,000	18,500,000
c. Little Falls (Pass. Valley Comm.) ...	8,800,000	7,400,000	1,400,000	10,000,000
d. Wanaque (No. J. D. W. S. Comm.) ..	31,000,000*	26,540,000*	4,460,000	29,000,000
Total (4 main systems)	\$65,202,000	\$44,140,000	\$21,062,000	\$76,000,000

* Wanaque bonds totalled \$33,428,000. Proceeds, plus interest, less rebates and diversions, used for Wanaque was \$31,000,000. Close to \$1,500,000 was diverted by issuing municipalities to surplus and general accounts. Nearly \$1,000,000 not needed for Wanaque, plus interest on bank deposits, plus money deposited in closed banks, was returned or credited to partners.

d. Wanaque (Sub-divided):

1. Newark	\$13,187,000	\$10,470,000	\$2,717,000+	
2. Paterson	5,518,000	4,730,000	788,000+	
3. Passaic	3,041,000	3,123,000	82,000—	
4. Kearny	4,381,000	3,870,000	511,000+	
5. Clifton	1,869,000	1,860,000	9,000+	
6. Montclair	1,525,000	1,165,000	360,000+	
7. Bloomfield	1,247,000	1,116,000	131,000+	
8. Glen Ridge	232,000	206,000	26,000+	
Totals	\$31,000,000	\$26,540,000	\$4,460,000+	\$29,000,000

(Note: Appropriation of Paterson, Passaic and Clifton to Wanaque was \$10,832,044, although they issued \$11,182,044 of "Wanaque Bonds" (Paterson, \$5,631,635; Passaic, \$3,460,427; Clifton, \$2,089,982). Actually contributed=\$10,428,000.)

CAPITAL EXPENDITURES REQUIRED (Continued)

Acquirement and Consolidation of Water Supplies

2. PRIVATE SUPPLIES	<i>Outstanding Bonds</i>	<i>Equity Claimed by Owners</i>		<i>Book Value</i>
		<i>Capital Stock</i>	<i>Surplus</i>	
a. Commonwealth Water Company	\$5,010,000	\$2,051,000	\$143,760	\$8,483,054
b. Elizabethtown Water Company Consolidated,	125,000	4,000,000	3,099,746	6,174,894
c. Hackensack Water Company	14,350,000	9,187,500	5,717,606	32,123,192
d. Middlesex Water Company	1,700,000	850,000	537,057	3,510,950
e. Plainfield-Union Water Company	1,250,000	1,144,600	1,420,646	4,960,232
Totals	\$22,435,000	\$17,233,100	\$10,918,815	\$55,252,322

Note 1. Book value is \$4,665,407 larger than aggregate of three preceding columns, because it includes miscellaneous claimed assets.

Note 2. Hackensack Water Company figures are for 1938; others, 1939.

CAPITAL EXPENDITURES REQUIRED (Continued)

New Water Supply—Delaware River via Delaware & Raritan Canal

Summarized from Report of Engineers

1. WORK PROJECTS ADMINISTRATION (Clearing canal and reservoir sites; constructing portion of aqueduct, dam, tunnel and buildings)			
a. Labor	\$19,712,500		
b. Materials	1,000,000		
			\$20,712,500
2. SPONSOR SHARE (Purchase of reservoir sites, rights of way—other than canal; power plant equipment (some labor); concrete, pipes, filters, etc.)			
a. Water supply reservoir real estate	\$1,000,000		
b. Compensation reservoir real estate	1,000,000*		
c. Compensation reservoir construction	2,000,000		
d. Engineering and legal expense	3,000,000		
e. Power and construction equipment and materials	15,350,000		
		\$22,350,000	
Compensation reservoir construction (c) unnecessary at present		—2,000,000	
			20,350,000
3. TOTAL W.P.A. AND SPONSOR COSTS			\$41,062,500**

* Musconetcong River at Saxton Falls. Alternate site in Flat Brook Valley, probably less for land but more for construction.

** This amount is larger than the \$40,693,000 total in the report of the engineers (Appendix B) because of subsequently added items. The W.P.A. Estimate of \$45,670,000 includes still later additions by W.P.A. engineers.

Note: These figures do not include \$10,400,000 pumping cost capitalized at 5 per cent—Report of Engineers, Feb. 6, 1939. Pumping costs affect price at which water must be sold, but are not a "capital outlay."

RECAPITULATION—CAPITAL EXPENDITURES REQUIRED

	<i>Amortized by Revenue from Sale of Water</i>		
	<i>New Bonds</i>	<i>Outstanding Bonds</i>	<i>W.P.A. Contribution</i>
1. PUBLIC SUPPLIES			
a. Revenue bond proceeds—to purchase owners' equity	\$21,062,000		
b. Guarantee Contract to pay interest and maturities on bonds outstanding (to be met from revenue) ..		\$44,140,000	
c. Estimated mark-up of property purchase price ...	10,000,000		
2. PRIVATE SUPPLIES			
d. Revenue bond proceeds to purchase owners' equity	28,151,915		
e. Guarantee Contract to pay interest and maturities on bonds outstanding (to be met from revenue) ..		22,435,000	
3. NEW WATER SUPPLY			
f. Revenue bond proceeds for sponsor's costs	20,350,000*		
g. W.P.A. contribution			\$20,712,500*
4. INTERCONNECTION OF WATER SUPPLY SYSTEMS			
h. Essential	715,000		580,000
i. Desirable	631,000		633,000
TOTALS	\$80,909,915	\$66,575,000	\$21,925,500

AGGREGATE COSTS

1. New revenue bonds	\$80,909,915
2. Revenue from sale of water to pay interest on and retire present bonds	66,575,000
3. W.P.A. contribution	21,925,500
Total	\$169,410,415
4. Ultimate additional requirements, purchase of smaller supply units, abandonment of unsuitable supplies	20,000,000
Ultimate total	\$189,410,415

* Concerning revision of estimate, see note under preceding table.



Appendix B

REPORT ON DELAWARE AND RARITAN CANAL WATER SUPPLY PROJECT FOR NEW JERSEY

MADE TO

THE SPECIAL COMMITTEE

ON

WATER SUPPLY

BY

ENGINEERING COMMITTEE

CHARLES H. CAPEN

HOWARD T. CRITCHLOW

HARRY P. CROFT

MAY, 1940

On May 24, 1938, Governor A. Harry Moore proposed a water supply plan for New Jersey to utilize the water rights and rights-of-way available through the Delaware and Raritan Canal, and under date of February 13, 1939, issued a special message on this subject. This proposal has been widely considered and has received impetus by the water shortages that occurred in the latter part of 1939 and early part of 1940.

An important stage, in efforts to attain a solution to the water supply situation, was reached at the time of the special conference of the Legislature called by Governor Moore on February 12, 1940, as a result of which the Legislature appointed a special committee to consider the entire problem. (The committee has held several meetings and conferred with the official commissions and others familiar with the water situation.) At the meeting of the said committee held on April 26, 1940, the engineers who made the report to Governor Moore on October 4, 1938, were asked to bring certain information up to date and to report on additional items to meet certain interstate problems which have been raised. This report covers the engineering and related phases of the problem.

SUMMARY OF REPORT

This report may be briefly summarized by the following statements:

1. A new water supply is urgent.
2. The plan proposed by Governor A. Harry Moore to utilize the Delaware and Raritan Canal as part of a water supply system is readily adaptable to present-day conditions.
3. This plan has been described in Governor Moore's special message to the 163rd Legislature, dated February 13, 1939. The only change in the plan is the immediate construction of the Dock Watch Hollow Reservoir to its full capacity and provision for a future compensation water reservoir.
4. The entire cost of all the work, including the compensation reservoir, is estimated at \$40,693,000, based upon doing all work by direct contract.
5. Allowing for deferred items, amounting to \$5,000,000, and taking into consideration the possible co-operation of the Federal Government through the Works Projects Administration, the present cost is estimated at \$19,925,000 for the Federal Government's share and \$18,696,000 for the State's share, a total of \$38,621,000. This includes \$2,599,000 for interconnections.
6. The value of the Canal for water supply purposes is estimated to be many millions of dollars.
7. The State has a right to divert from 110 to 128 million gallons per day by virtue of the rights of the Delaware and Raritan Canal.
8. Work can be started within a very short time—one month—because of State ownership of much of the lands and right-of-way.
9. A sum of at least \$100,000 will be required to purchase office equipment, survey equipment, and to engage the necessary personnel for an initial period.
10. Interconnections would be carried forward as a necessary part of the program and should be properly co-ordinated to any new work.
11. Highways can be constructed on part of the right-of-way now owned, but additional costs will be required.

CONSIDERATION OF THE PROBLEM

The water supply problem may be divided into the general classifications of: Need for water, and, if there is a need, what course should be followed and what plan adopted.

Regarding the need for additional water supply, there was unanimous opinion that a new major supply is urgent. It is true that there are some supplies which were not unduly depleted last year (1939-1940), and the owners of such supplies may naturally state that there is no immediate need for concern. It is a fact, however, that several supplies (including both small and large ones) were short of water or seriously threatened with a shortage in the future. Expansion in industries has taken place in the northeastern part of New Jersey and has already caused an increase in water consumption. Additional water will also be required to take care of industrial expansion produced by war preparedness. It is obvious that additional sources will be necessary to safeguard the future with respect to adequate supplies of water.

The preponderance of opinion of those appearing before the committee was in favor of following the Governor's plan to utilize the Delaware and Raritan Canal. The opinions of the Engineering Committee are clearly expressed in the report of October, 1938, to Governor Moore. Two important points of superiority of the Delaware and Raritan Canal project are the short time of construction and its adaptability to Federal aid in financing.

To sum up, the weight of evidence is in favor of Governor Moore's plan.

DESCRIPTION OF PROJECT

A description of the principal engineering features of the proposed plan is given on page 35 of the Special Message of Governor Moore to the 163rd Legislature. The original plan proposed the construction of a storage reservoir at Dock Watch Hollow in two steps; first, with a flow line elevation of 380 and later with an elevation of 460. The plan now recommended contemplates building this reservoir to the higher level at once. A brief description of this plan follows:

The Delaware and Raritan Canal Water Project considers the utilization of the canal properties as a feeder for a new water supply project for the Metropolitan District of New Jersey. The properties studied to that end extend from the feeder intake on the Delaware River at Raven Rock, New Jersey, to a point near Bound Brook, a distance of 49 miles.

This plan provides that a maximum of 230 million gallons daily (m.g.d.) and an average of 180 m.g.d. will be diverted and transported by gravity with provisions for taking 30 m.g.d. at Trenton for use in that area. The remainder of 200 m.g.d. maximum and 150 m.g.d. average will be delivered by gravity to a pumping station at Bound Brook. Provision, however, is made for taking by gravity up to 10 m.g.d. of water from the canal at Bound Brook for use of the New Brunswick area.

An electrically operated pumping station of 200 m.g.d. capacity will lift the water through a pressure aqueduct 4.16 miles long into a storage reservoir at Dock Watch Hollow, north of Bound Brook. This basin has a total area of about 1,500 acres, and its rim varies in elevation, the

lower places being 460 feet above sea level. The entire basin of 1,500 acres should be acquired in order to better control the entire natural drainage area. Water would be stored up to an elevation of 460 feet and could be drawn down to 360 feet as required, the total storage thus available being about 15 billion gallons.

Immediately below the dam the water will be filtered and then carried in a transmission main of 200 m.g.d. capacity 20.75 miles to a point at the southern terminus of the 60-inch diameter supply main of the Wan- aque system at the Newark-Elizabeth boundary.

ESTIMATE OF COST

The original estimate of cost of the recommended plan was 33,743,000. In order to raise the dam at Dock Watch Hollow to the proposed maximum height, an expenditure of \$3,950,000 additional will be required. This will bring the cost to \$37,693,000 under recommended plan of the engineering report.

In the supplemental report (dated April, 1939) requested by Governor Moore, consideration is given to the use of a compensation reservoir on a tributary of the Delaware River. Such a reservoir site can be located on Musconetcong River or Flat Brook and the cost of site and construction is estimated at \$3,000,000. If the entire project is built at once, the total cost would be \$40,693,000.

It is believed that use of Federal Aid will require certain changes in methods of construction that will add to the cost.

TOTAL SUM FOR STATE AND FEDERAL GOVERNMENT TO PROVIDE

In order to arrive at the total cost under Federal Aid through the Works Projects Administration, a separate tabulation has been prepared and is attached to this report (See Table 1). This table shows the total cost to be \$20,712,500 for Federal contribution and \$20,350,000 for the State, or a combined total of \$41,062,500. This does not include \$2,000,000 for construction cost of the compensation reservoir which may be deferred. These estimates are, of course, tentative and may be subject to some reasonable revisions.

A detailed application for W.P.A. funds cannot be made for a project of this size without further time and thought, and co-operation of W.P.A. administrators and engineers will be required in the preparation of such an application.

DIVERSION RIGHTS FROM DELAWARE RIVER

By virtue of the ownership by the State of New Jersey of the Delaware and Raritan Canal, the State has acquired certain water rights in the Delaware River. In the opinion of Duane E. Minard, special counsel, the State has the right to divert water from Delaware River for public purposes without the consent of Pennsylvania to the extent that such diversion will not cause substantial damage in the State of Pennsylvania.

The amount of water withdrawn for canal purposes has been deter-

mined to be 324 cubic feet per second (c.f.s.), or 210 million gallons daily (m.g.d.). (See Geological Survey of New Jersey Report on Water Supply 1894, page 228.) Of this water, 100 c.f.s. was used for lockage of boats through the canal and the balance, 224 c.f.s., to restore leakage and evaporation losses. Of these amounts, it has been determined on the basis of the relative lengths of the canal and feeder in the Delaware watershed, that from 170 to 198 c.f.s., or from 110 to 128 m.g.d., was permanently diverted from the Delaware River. This establishes a right of diversion for navigation which may be changed by Legislative enactment to water supply use. Therefore, it would seem that the proposed Delaware and Raritan Canal water supply system could divert from 110 to 128 m.g.d. for the Northern Metropolitan District under water rights owned by the State.

It is now proposed to build the Dock Watch Hollow Reservoir up to elevation 460 and thereby provide 15 billion gallons of storage capacity. It will be possible, therefore, to stop taking water from the Delaware River during periods of low flow and supply up to 125 m.g.d. from storage in Dock Watch Hollow reservoir, and during the succeeding period of high flow in the Delaware River to replenish the water in the reservoir.

The period of low flow in the Delaware River during which it is conceivable that the diversion might be discontinued would be determined by the time when the flow in the Delaware River is below the minimum fixed in the Delaware Diversion Case by the U. S. Supreme Court (283 U. S. 805). The critical flow was determined to be 3,400 c.f.s. at Trenton and the flow has been less than that amount for 165 days during certain dry periods.

Under the conditions laid down in the Delaware Diversion Case, when the flow at Trenton falls below 3,400 c.f.s., the City of New York must release from storage reservoirs in the State of New York a certain compensation flow up to 30 per cent of the average annual yield of the drainage area above their water supply reservoirs. This may amount to as much as 297 c.f.s.—192 million gallons a day. Therefore, any diversion of the flow from Delaware River that affects the flow at Trenton would in turn affect the amount of water which must be released by the City of New York. Since the Delaware and Raritan Canal has been diverting water for canal purposes for over 100 years and was so doing at the time the Delaware Diversion Case was before the U. S. Supreme Court, this diversion, in variable amounts, has already been taken from the flow above Trenton. Furthermore, in case of necessity, it would be possible to stop diverting water through the canal and draw from the storage in Dock Watch Hollow reservoir.

On the other hand, when the diversion for water supply purposes exceeds the amount permanently diverted from the Delaware watershed for navigation purposes, it is probable that compensation flow from a compensation reservoir would be required.

COMPENSATION RESERVOIR

The U. S. Supreme Court in the Delaware Diversion Case required the City of New York to release water from storage when the flow in the Delaware River at Trenton was less than 3,400 c.f.s. Applying this "Rule of Release" to a New Jersey development for a diversion of 150 m.g.d., it would be necessary to provide storage equivalent to a storage development of 231 square miles on some tributary of the Delaware River in New Jersey, that drainage area being the amount necessary to produce 150 m.g.d. continuously. The compensation flow from such a storage development under the U. S. Supreme Court rule would be 30 per cent of the average annual yield of New Jersey tributaries of the Delaware River, or 62.5 m.g.d. Compensation flow might be required for a period of 165 days. This would require a reservoir having storage capacity of 10.3 billion gallons. Taking into account the evaporation loss from such a reservoir, the total required storage would be 11.2 billion gallons. In order that water would be available for filling such reservoir in a dry year, the watershed tributary to it should be approximately 70 square miles. Two sites on the Musconetcong River—one at Saxton Falls and the other at Changewater, and one site on Flat Brook above Flatbrookville, have been studied. The estimated cost of constructing such a reservoir for compensation flow is \$3,000,000.

If compensation water is necessary for the diversion in excess of the amount diverted for navigation purposes, the amount of land to be acquired for a reservoir should be the same, but the cost of the dam would be reduced.

During the early years of operation of the Delaware and Raritan Canal Water Project, it would be unnecessary to provide any compensation flow since the diversion would be less than the amount diverted for navigation. It would only be necessary, therefore, in the early days of the project to purchase the land necessary for the construction of the compensation dam and reservoir and defer the construction costs until the conditions require compensation flow. The land necessary is approximately 1,200 acres.

VALUE OF CANAL

As stated in the original report, the Canal has a value as a part of a water supply system which cannot be determined by a simple process. The report says: "One item of this value is that of a right-of-way, which is estimated to be at least \$792,000." Other elements which must be considered are the value of water rights, saving in time on account of State ownership of water rights and land, existing maps and surveys of property and reduction in length of tunnel required as compared with other projects.

Taking all these factors into consideration, it seems reasonable to state that the Canal has a value for water supply purposes, including water and property rights, of many millions of dollars.

TIME OF STARTING WORK

It is estimated that within less than a month of the time of starting, an office force could be organized to begin laying out work. It is estimated that field parties could begin within a month and the first labor forces shortly thereafter. It would probably take two or three months before a large force could be in active operation and a peak would be reached some time after six months expires.

When the land for the reservoir is obtained, that portion of the work involving clearing of the site could start almost immediately. This is also true of some of the work in sections of the Canal and feeder in and near the City of Trenton where existing information is rather complete. In many instances, the co-operation of State, county and city engineering forces, which will have a certain interest in parts of the work, can undoubtedly be obtained to good advantage.

FUNDS FOR STARTING WORK

It is estimated that a sum of at least \$100,000 would be immediately required for the setting up of offices, organizing a staff to prepare plans, specifications and contracts for work programs, starting legal procedures and other attendant costs.

The next step will be dependent on the decision as to what method of construction will be used for the various items. Federal Aid may be enlisted with regular W.P.A. procedure (tantamount to force account) and with W.P.A. contract. It is probable that the most desirable procedure would be to use both of these methods, varying the type to suit different portions of the work. In either case, certain heavy equipment will be required, and provision for this is made in the estimate of cost.

Assuming that land required should be purchased at once, it would be necessary to have \$1,000,000 available immediately for that purpose. If this is not possible, operations would have to be largely confined to the Canal pending the purchase of land for the other right-of-way and the reservoirs.

INTERCONNECTIONS

Engineers are agreed that the interconnection of existing water systems is a necessary adjunct to a new water supply for the Northern Metropolitan district, as well as to the present facilities. It is well known that much of the water to be developed in any future supply cannot be marketed unless these interconnections are made.

During the past year, engineers of the various State departments made a detailed study and report on this subject. Some of their recommendations are already being carried out by local water supply agencies and it is probable that a number of the others will be completed this year. Most of these interconnections, however, are of small sizes. As yet only one interconnection between large mains is planned.

All of the parties concerned with any major expenditures appear to be waiting for some move on the part of the State to construct the larger interconnecting lines. It is estimated that about \$3,500,000 in total will

be required to construct the large lines, although only half of this would be spent immediately. If these interconnections are to be constructed in conjunction with the transmission line of the Delaware & Raritan Canal Water Supply Project, nearly \$1,000,000 of the interconnection cost will be saved, as part of the lines are coincidental.

This work lends itself well to W.P.A. construction and it is estimated that one-half to two-thirds of the cost can be met by government funds.

HIGHWAYS

Much consideration has been given to the matter of constructing a highway either on top of or alongside of that portion of the aqueduct within the canal and feeder, but no extra cost was included for it in the final estimate because it was not considered as fundamentally a part of a water system.

Nevertheless there is much to be said in favor of a joint use of the canal. The width of the canal and towpath in most locations amounts to about 125 feet. The average width of the concrete aqueduct would be about 31 feet. The aqueduct could either be placed at one side and the highway adjacent, or the aqueduct could be placed in the center with a roadway on each side. In either case, extra expense will be involved and this should be borne by the parties responsible.

The portion within the feeder is not so readily treated because the feeder is narrower and its location does not lend itself to ready expansion because of the railroad and highways adjacent to it for a long part of its length. Except at constricted portions within the municipalities, however, there is ample width if a highway is laid over the top of the aqueduct. Here again no provision has been made for carrying heavy vehicles on the roof of the aqueduct and the extra expense would have to be borne by others.

May 21, 1940.

TABLE I
**SUMMARY OF ESTIMATE OF COST TO ACCOMPANY ENGI-
NEERING REPORT TO LEGISLATIVE COMMITTEE
ON WATER SUPPLY**

ITEMS FOR W.P.A.

	<i>Cost</i>	<i>Man Months</i>
Excavation, earth	\$1,500,000	23,100
Excavation, rock	487,500	7,500
Concrete	11,300,000	174,000
Buildings	900,000	12,000
Drainage System	475,000	6,780
Miscellaneous	250,000	3,580
Pipes (transmission)	4,400,000	58,700
Filters	400,000	5,720
Labor	\$19,712,000	291,380
Materials	1,000,000	
Total	\$20,712,500	

ITEMS FOR STATE

Construction equipment	\$750,000	
Concrete	9,000,000	
Buildings	500,000	
Pumps, chemical feed, etc.	400,000	
Pipe	4,500,000	
Drain pipe, etc.	200,000	
Filters	1,000,000	
	\$16,350,000	
Less W.P.A. contribution on materials..	1,000,000	
Net cost of materials		\$15,350,000
Real estate for Dock Watch Hollow and rights-of-way	\$1,000,000	
Engineering, legal and contingencies ...	3,000,000	
		4,000,000
Real Estate for Compensation Reservoir	\$1,000,000	
Construction Costs for Compensation Reservoir	2,000,000	
		3,000,000
Total eventual cost for State		\$22,350,000
Less Compensation Reservoir not now needed		2,000,000
Present State cost on basis of full construction except for compensation reservoir		\$20,350,000

TABLE I (Continued)

	<i>W.P.A. Share</i>	<i>State Share</i>	<i>Total</i>
Total costs for new water supply project	\$20,712,500	\$20,350,000	\$41,062,500
Interconnections—Class A .	580,000	715,000	1,295,000
Interconnections—Class B .	633,000	631,000	1,264,000
Total	\$21,925,500	\$21,696,000	\$43,621,500

Note: Only about 1/3 to 1/2 of buildings, pumps and filters need be installed now, and except in difficult places, only one of the transmission lines need be built. On this basis it is estimated that the following reductions may be made:

<i>Item</i>	<i>Reduction in</i>		
	<i>W.P.A. Share</i>	<i>State Share</i>	
Excavation	\$300,000		
Buildings	500,000	\$300,000	
Pumps		200,000	
Pipe	1,000,000	2,000,000	
Filters	200,000	500,000	
Total Saving	\$2,000,000	\$3,000,000	\$5,000,000

RECAPITULATION

	<i>W.P.A. Share</i>	<i>State Share</i>	
Total costs with interconnections	\$21,925,500	\$21,696,000	
Less saving on deferred items	2,000,000	3,000,000	
Net present outlay	\$19,925,500	\$18,696,000	\$38,621,500
May 21, 1940.			



