

THE PROPOSED DAM ACROSS THE DELAWARE RIVER TO EXCLUDE TIDES, AND ITS POSSIBLE EFFECTS ON MOSQUITO CONTROL

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The purpose of this paper is to bring to your attention a proposal which would change existing conditions in a large tidal river basin. It is intended to indicate some of the very complex problems involved:— economic, engineering, legal, physical and health effects, including mosquito control arising from this proposal. There is no historical precedent for a proposal such as this, so we are on our own, so to speak, in speculating as to results.

The Delaware River carries the water run-off of about 7,000 square miles of eastern Pennsylvania, part of New York, western New Jersey and northern Delaware. From Trenton, New Jersey, southward past Philadelphia, it is tidal for 75 miles to Delaware Bay, flowing through a highly industrialized and heavily populated area. Although there is a normal rise and fall of tide of about six feet, the water is fresh down to about Wilmington, Delaware. The deep water channel averaging 40 feet in depth at Philadelphia, carries an enormous river traffic.

Because of the fresh water in the river, the water is used for industrial and residential purposes in large quantities. However, even larger quantities of fresh water will be needed in the future. The State of Delaware, looking ahead to water requirements for the next fifty years, has therefore asked that the comprehensive resources survey of the water of the Delaware River, now being carried on by the United States Engineers, consider the feasibility of a barrier dam in the Delaware estuary. A preliminary survey of this proposal has been approved and is now underway.

The proponent of the barrier, the State of Delaware, suggests a site in the New Castle-Pea Patch Island locality. The primary purpose of such a structure would be to prevent the intrusion of salt water into the area upstream of the barrier. The barrier would create a slack fresh water pool at the elevation of the present mean high tide extending from the structures to the head of tide at Trenton, New Jersey,

on the main stem of Delaware River and upstream on the tributary streams above the barrier to the head of tide on these streams. All communities above and below the barrier in the tidal section of Delaware River and its tributaries would be affected.

The proponents of the barrier anticipate vast benefits to industries requiring fresh water. They also envision the expansion of present industries and the development of new industries as a result of the fresh water supply.

Proponents also feel that the creation of a fixed shore line will greatly improve recreation facilities, and that the barrier dam will prevent damage by hurricane or extra high tides backing up from Delaware Bay and also from flood run-off from the headwaters upstream. The barrier dam would also result, by raising the water level six feet, in increasing the channel depth by this amount.

On the other hand, opponents point out that the enormous water borne commerce amounting to 101,000,000 tons yearly and requiring nearly 800 passages daily in and out of the River, would require very large locks, 1,200 feet long, 150 feet wide and 50 feet deep, through the dam. There would be large losses of time waiting to transit the locks, more chance of ship collisions, and in the event of war, a possible complete blockage of Navy vessels at the Philadelphia Navy Yard as well as commercial vessels.

Information will also have to be secured as to fish and wildlife effects, on oyster culture, an important industry in Delaware Bay, and the effect of the proposed dam on existing drainage systems, flood heights above and below the barrier, and on existing sewer and waste outfalls.

The legal problems arising in connection with the proposed dam across the Delaware are many and complex. To put the plan into operation may require legislation to change existing law or to define certain areas within the law with respect to the relative rights of individuals, municipalities, the four states, and the federal gov-

ernment. The constitutional questions of the police powers of the states and the federal government's powers with respect to the commerce clause, national defense and emergency, and public health and welfare all pose problems of considerable breadth and scope.

Now, as to mosquito control—At present the movement of tide water, fresh water most of the 75-mile stretch of the River, sweeps out mosquito breeding along the banks of the Delaware. The tidal rise and fall in tributary streams and side marshes also reduces mosquito breeding considerably.

What would be the effect of substituting a 75-mile-long lake in place of the present tidal river?

Would mosquito-eating fish tend to increase or decrease?

Would aquatic vegetation also increase, forming dense masses and prevent fish from penetrating side marsh areas?

Let us consider the effect on various species of mosquitoes—

1. Would *Anopheles quadrimaculatus* increase in permanent side pools?
2. With less fluctuating all year water elevations, would *Mansonia* species increase in breeding?
3. With the river water in varying degrees of pollution from slight to heavy, due to sanitary or industrial waste,—would breeding of *Culex pipiens* or *Culex salinarius* increase along the river edge to any considerable extent or in tributary creek swamps?
4. What would be the effect on breeding of *Aedes vexans* and similar flood-water varieties?

In a recent paper by W. E. Snow of the Tennessee Valley Authority: "Production and Control of Floodwater Mosquitoes Incidental to Water Level Operations on Reservoirs of the Tennessee Valley Authority," read at the Tenth International Congress of Entomology (Vol. 3—Proceedings), the Abstract reads, as follows:—

"As the marginal growth band has be-

come more stabilized along the main river reservoirs due to regularity of water level operations, the floodwater mosquito *Aedes vexans* has become well established in the zone just above top summer pool level in certain reservoir areas. This zone is surcharged in the spring to strand flottage, as a malaria control operation, and incidentally hatches an initial brood of floodwater mosquitoes. If the surcharge phase and recession to top pool level occur over a period of about 5 days, many larvae in grassy, well-drained situations become stranded in the vegetation. On the other hand, if water remains in the surcharge zone for several weeks, emergence of *A. vexans* generally occurs. The weekly cyclical fluctuation and seasonal recession phases of the malaria control program are especially favorable for the control of floodwater mosquitoes. Even when rains coincided with the upper end of the cycle and hatching in marginal grass occurred, scheduled recession over the next few days was sufficient to eliminate larvae by stranding. On many of the reservoirs in the tributary watershed, seasonal water level recession is a regular operation whereby stored water is gradually released during the drier periods in summer and fall for downstream use. A recession rate of 0.2 to 0.3 feet per week beginning shortly

before July 1 has been found adequate for mosquito control. When stored water is allowed to remain in the marginal growth band for several weeks in the spring before recession is begun, small numbers of *A. vexans* usually emerge. In instances when the growth band has become periodically flooded during the summer with intermediate drawdown periods of several weeks intervening, very large populations of *A. vexans* have been produced."

The point is that the T.V.A. lakes have somewhat controlled draw down periods. In the case of the proposed Delaware River impoundment there would not be a controlled drawdown of water. Hence heavy rains in the upper Delaware Valley above the tidal pool might easily raise the water level in the pool for long enough periods with the possibility of liberating a large brood or broods of *Aedes vexans*.

This paper does not pretend to give the answers to the above problems. It is intended to show how mosquito control ties in when changes concerning water conditions are involved. It is hoped to have you contribute ideas of your own, as there is no precedent for the Delaware River proposal, as far as I know. In the future, however, there may be similar proposals elsewhere in the world that you may have to consider.

UTAH MOSQUITO ABATEMENT ASSOCIATION

Sixty per cent of the people in the state of Utah are now living within the boundaries of organized mosquito abatement districts.

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