1906

REPORT

OF

MESSRS. WHITMAN AND HOWARD

Civil Engineers

ON PROPOSED DIKE

AT HERRING RIVER

WELLFLEET, MASSACHUSETTS

Also copy of Bill accompanying Petition for Legislature to authorize the town of Wellfleet to build the Dike.

H. T. WHITMAN CHANNING HOWARD

CIVIL ENGINEERS

BOSTON, February 5, 1906.

MESSRS. N. H. PAYNE, FREDERIC W. SNOW, M. D. HOLBROOK,
THOMAS A. NEWCOMB, L. D. BAKER, JR.,
Committee, Wellfleet, Mass.

Gentlemen,— We have been asked by you to make surveys, plans, and estimates, and report on the matter of diking out and draining the large area of marshes tributary to Herring River in the Town of Wellfleet. We have caused such surveys and examinations of the locality to be made as the short time available will permit, and we think we understand the situation. The problem is one of considerable magnitude; but, after having given it due study, we believe it can be solved without undue expense, and all the underlying principles of its accomplishment are, after all, simple as to fundamentals.

We understand the first and main object sought is to exterminate the mosquito pest; the second, the draining of the marshes so they may be brought into valuable lands; the third, to transform the unsightly swamps (which must, as they grow worse and more neglected, be a direct menace to health) into clean and healthy areas which will add to, instead of detract from, the beautiful landscape with which nature has richly endowed this locality. We do not consider ourselves authority on the very aggravating mosquito problem; but, from a smattering of information,— which is all we can claim as to this particular phase of the matter,— we have no doubt that you are proceeding in the right direction, and accomplished in this way the work is done for all time. We might here suggest that to use oil at an annual expense of $1,000, as has been done in the last two years, is equal to paying interest at four per cent. on $25,000, and this is a fair comparison, as your work is never completed. More than that, the oil spoils what little product there is from the marshes, while draining them will be their complete salvation. We see by a recent government report, issued by the Department of Agriculture, this statement: " Marshes and stagnant

pools of water are the principal breeding-places of mosquitoes, and, to remove the pests, such places should be drained and the lands reclaimed for agricultural purposes."

Of course the first step in drying out and draining tidal marshes is to exclude the sea. These marshes are in general about the elevation of mean high tide, and are only covered by the spring tides or in case of the water being driven in by storm. There seems to be no doubt that the easiest way to exclude the sea is to build a dike in the location which has been suggested to us by the committee,— between the two hills a little less than a mile above Wellfleet Harbor. This position is indicated on the plan which we submit herewith, and is marked on the ground by two large stakes which we have driven in the sand-bank, one on either side of the river. While in this location the dike, if built, will be subjected to some wave action in case of storm, yet we are told and believe from our observation of locality, that it will be such as to present but little danger.

The mean rise of tide in Wellfleet Harbor is 10.7 feet.

We have proposed to build the dike to a total height of seven feet above mean high tide, which ought to be protection against not only all ordinary conditions, but even against such storms and extraordinary tidal conditions as the famous storms of 1851 and 1898. The total length of the dike from hill to hill will be 935 feet, the distance across the river proper being about five hundred feet. The bottom of the river at this point is at an elevation of about two feet above mean low water. While we are told that the tide-water seldom leaves this place altogether, it is not because the bottom is below mean low tide, but because the very large quantity of water coming from the estuaries above this location has not time to completely run away before the in-coming tide meets it. We propose to build the dike twenty-two feet in width on top, surfaced for a roadway and fenced on either side, giving a roadway twenty feet in clear width, the side slopes to be one and one-half horizontal to one vertical, making the extreme width of fill in the river, at the bottom of the dike, about sixty-eight feet. Through the fill, and, of course, before the filling is placed, we would put a line of four-inch tongued and grooved sheeting well driven into the bottom. This ought to make an effectual dam as against all leakage, even percolation, and it seems impossible for any waterway ever to establish itself through such a dike. We would maintain the outer slope of the dike by a heavy coating or layer of granite stone averaging about one and

one-half feet in thickness, and such as will necessarily be placed by a derrick. This will be what is known as heavy rip-rap, to extend to mean high tide only. Above mean high tide we would place marsh mud and marsh sods, well rammed together for a thickness of about four feet, the same extending under the stone rip-rap, the purpose being to prevent any possible wave action getting at the sand and thus making a washout.

The inner slope would be covered in the same way with some four feet in depth of marsh mud and sods well rammed together. This will grow vegetation and ought to sufficiently maintain the inner slope.

We propose building a sluiceway through the dike of timber, consisting, practically, of three sluiceways six feet wide each, by four feet high. In two of these sluiceways will be hung tide-gates so designed as to shut automatically with the in-coming tide, keeping out all salt water, but to readily open to let out the water from above at any time when it may be higher than the tide outside. We have carefully designed these tide-gates, and, having used similar ones before, we believe they will work very satisfactorily, opening readily and closing on a rubber seat which will make them tight. All metal parts will be Tobin bronze, which will resist all action of the salt water. The gates themselves are to be hard pine. In the third sluiceway we would place an ordinary sluice or flash-board gate, operated vertically by hand in the simple method that such gates through dams are usually operated. This gate will not be automatic, and will only be used on the volition of some one having to do with the welfare of the project. Our idea of this additional sluiceway is that it will give additional safety in time of extraordinary freshet, a man going to and raising the gate by a ready method. It will also serve as a gateway for the passage of fish at such times as the tide-gates are not open, depending, of course, on the opening of it by the person in charge at such times as it is desired.

Most of the lumber will be kept wet or damp all the time by the salt water, and so will not rot. We think there will be no opportunity for the worms to work in the lumber at any point.

At each end of the sluiceway it will be necessary to place roughly a considerable quantity of stone to prevent washouts.

The fill, proper, will be readily made from the sand hills on either side, and the handling of it will be very cheap on account of the short distance and nature of the material.

As soon as the dike is built our sluiceways through the dike

have to assume the responsibility of taking care of the rainfall from the very large watershed lying in any wise tributary to Herring River. We have fixed the size of the sluiceways at what we believe is amply safe under the circumstances to care for the rainfall on this large area. It is very fortunate that inside the dike location there is the large natural basin which will hold as a reservoir an immense quantity of water contributed from the large watershed above. This basin together with the creeks and ditches running into it give a water surface of approximately eighty acres, and will hold, up to one foot below the surface of the marsh, roughly, say, eight and one-half million cubic feet of water. This fact gives us a considerable assurance of safety, as in case of very extraordinary conditions of rainfall and thaw, if it should prove that the entire quantity of water would not flow out through the sluiceways at any one tide, this very large amount might be retained without damage in the basin and creeks.

The total area of the marshes, including water surfaces of the basin and creeks, is about 1,100 acres as shown by scale on the plans of the United States Geological Survey. We have checked this up by our observations in a general way, and believe it to be about correct. A rainfall of one inch on this entire area would be something less than four million cubic feet.

The entire watershed tributary to Herring River is about 5,800 acres or nine square miles. While this is a very large area and under some conditions would demand an outlet larger than the waterways through the dike which we have planned, yet the nature of the land is such that we believe the immediate " run-off " would be an extreme minimum and in this case it is a decided advantage.

The present condition and the end desired to be accomplished justifies a minute and careful description of the present condition of the marshes and their future treatment. The marshes are now drained by three principal tidal creeks or ditches, the principal one running to Herring Pond, and one lying more to the south running to and a short distance easterly of the main road to Truro, and the third running easterly and southerly of Bound Brook Island to the vicinity of the South Truro railroad station. These creeks or ditches are each one very long and circuitous. Along the main creek to the upper end of the marsh, to the east of the main road to Truro, is about three miles in a straight line measuring from the proposed dike, but by the meanderings of the brook it is about five miles. The southerly creek or ditch will measure from the dike to

the easterly end of the marsh about three and one-half miles, while the remaining creek, measuring from dike to near the South Truro station, is about four and one-half miles. These are very long distances, which fact, together with the obstructions in the creeks, account for the water at the upper ends of the marshes not running out at low tide any better than it does. The water being held back in the main ditch nearly to the surface of the marshes accounts for the wet, swampy condition which prevails in the upper ends of all these marshes. The salt water scarcely gets to these upper ends at all, and the result is that the product of the marshes is not good salt hay or anything else, being the valueless coarse grasses, rushes, etc., usually produced under these conditions. Our observations indicate that in the main ditch in the vicinity of the highway to Truro, the water surface fluctuates very little with the tide, standing at about two feet below mean high water. Obstructions of sand in the ditch below this point prevent both the fresh water from running down or the tide waters from coming up to any considerable extent. As the surface of the marsh in this vicinity is about one foot below mean high tide it will be seen that the ground must be full of water and nothing of value can be produced. It will be necessary to straighten all these main ditches, so far as may be reasonably possible, thus reducing the length, and to thoroughly clean out and lower these ditches particularly toward their upper ends. The bottom of the main brook near the main highway should be lowered at least to five feet above mean low water, and the bed of the brook from there to the new dike reduced to practically an even slope. Tide water having been excluded at the new dike, and the tidal basin become available for the storage of fresh water, and these main brooks having been deepened and straightened, as suggested, will give an increased velocity to the fresh water finding its way through them, and it will give a chance to dig lateral or side ditches into all sections of the marshes, thus reducing the level of the ground water, and making possible a very different state of affairs from what now exists over the entire area of these marshes. The distances are so long that the velocities will not be great in any case, and therefore it will be necessary always to pay considerable attention to keeping the ditches well cleaned out. To thoroughly drain out such marshes as these, so that they may become available for good crops, the water level should be reduced, if possible, to three feet or more below the surface. The culverts under the highway should be lowered and increased in size, if necessary. The tide-gate and small

dam (" Pole Dike ") near the railroad may be done away with after this dike is built. We believe that the simple fact of opening up a clear waterway through this small dam would somewhat improve the condition of the marshes extending up to the village.

If it should seem desirable to retain more water in the basin and the lower ends of the creeks than will be produced in a dry time by the natural flow of fresh water, it will be easy to manipulate a gate in the dike so as to produce any desired result.

The history of like undertakings shows that upon removing the water from marsh lands of this nature, the marshes subside, and we shall expect this result to a limited extent.

From the slight examination made we should say that these marshes and meadows were largely underlaid with sand, the earth deposit being of the nature of peat or muck, about as is usual in salt marshes. These marshes are made by the deposit, through a long term of years, of material washed from the surrounding uplands and also borne in by the in-coming tide, distributed and evened up by the moving waters. Thus, in the course of a very long time, mud or sand flats become salt marshes, the surface being practically on the elevation of mean high tide. It will readily be seen that these surfaces will continue to build up until they reach the limit of the flow of the tide, and they cannot rise higher as there is no vehicle to convey and distribute the material.

These washings from the hills and the water-borne materials coming in on the tide are largely organic matter, and thus the marsh mud, so called, is usually the very richest of soil. Once remove the salt, drain the marshes reasonably, and keep them so that surface water is taken off with reasonable alacrity, there is a splendid opportunity to conduct farming or gardening operations without the use of fertilizer for many years to come. These lands should be, at least in part, splendid cranberry raising lands, the brooks furnishing good opportunity for flowage from above. These diked marshes produce most excellent hay crops, and generally will produce any crops desired within the bounds of reason. The Green Harbor marshes at Marshfield, this State, while probably not made the most of, yet according to the State investigation and report of 1898 there is about five hundred acres of mowing land from a part of which " large crops of hay are harvested." There are in the towns of Revere and Winthrop, this State, about four hundred to five hundred acres of marsh lands from which the tide has been diked with success, the marshes being successfully turned into arable lands,