FOREST WORKING PLAN FOR LAND BELONGING TO THE CITY OF FALL RIVER ON THE NORTH WATUPPA WATERSHED

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BELONGING TO THE

CITY OF FALL RIVER

ON THE

NORTH WATUPPA WATERSHED.

BY

MASSACHUSETTS FOREST SERVICE.

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PREFACE.

At the invitation of the Reservoir Commission of the City of Fall River, — a Board created for the purpose of protecting the purity of the city's water supply, — the State Forester's department has made an examination of the watershed of the North Watuppa Pond, located in the city of Fall River and the town of Westport, and herewith presents the results of said examination, with such recommendations as to it seem wise.

This publication is printed by the Massachusetts State Forester, believing that, while primarily it is of direct application to the handling of the particular work at Fall River, secondarily such a treatise cannot help being of valuable assistance in carrying out and developing equally good work for other cities and towns, not only in Massachusetts, but throughout New England and elsewhere. It speaks volumes for what municipal forests can accomplish.

ACKNOWLEDGMENTS.

To Mr. H. O. Cook, M.F., my assistant in charge, is due the credit of carrying out and completing this work; and to His Honor Mayor John F. Coughlin, City Water Commissioner Wm. Sullivan and City Engineer Philip D. Borden of the Reservoir Commission we are greatly indebted for their interest and many courtesies.

F. W. RANE,
State Forester.

STATE HOUSE, BOSTON, MASS.

PART I.

INFLUENCE OF FORESTS ON WATER SUPPLIES.

Although this is a subject of great importance to this country, and one much discussed of late, it has never been carefully studied. Even European foresters, who have investigated this subject for many years, have not as yet established their final conclusions covering the whole field. That a relation does exist is indisputable, for forest destruction always produces a change in the character of the stream flow.

INFLUENCE OF FORESTS ON RAINFALL.

Rainfall is caused by the cooling of moisture-laden air to below the dew point. Forests shade the ground, making it cooler and consequently keeping the air above it at a lower temperature than that of the surrounding air. It is reasonable to suppose that rain might fall over a forested area when it would not if that area were cleared. On the western prairies this is a popular conviction, but observations made in Europe have yielded conflicting results, and no definite conclusion can be drawn from them.

INFLUENCE UPON THE DISPOSAL OF RAINFALL.

It is after the rain has reached the earth that the forest exerts its most potent influence. Rainfall escapes in four ways from the ground upon which it falls: by evaporation, transpiration, surface run-off and seepage run-off.

Evaporation.

The rapidity with which moisture evaporates depends on its exposure to the sun and wind. A thick forest cover shades the ground from the direct rays of the sun, thus preventing too rapid evaporation. Experiment has shown that from the surface of a small pond, situated in the open, three to four times as much evaporation took place as from a similar sheet of water in the forest. Experiments made on the surface soil in California gave practically the same results. From 1,000 square centimeters of bare ground 5,730 grams of water were evaporated in the months of July and August; while from ground under a heavy mulch of leaves on the forest floor it was but 1,150 grams. In the thick spruce woods of Maine one will often find snow on the ground in June, whereas in the open it disappeared before the first of May. Evaporation is profoundly affected by wind. Observations of the United States Weather Bureau indicate that with a wind velocity of 5 miles an hour, other conditions being equal, the rate of evaporation is 2.2 times that of a calm; at 10 miles an hour, 3.8; at 20 miles, 5.7; and so on. It will be readily seen that, by the check in the velocity of the wind that a forest cover causes, the amount of water lost in this way is greatly reduced. Not only is the force of the wind broken within the woodland, but it is retarded for a considerable distance to the leeward. In general, the retardation is felt over 20 feet of horizontal distance for every foot in the height of the trees. Thus a stand of trees 50 feet in height all around North Watuppa Pond would materially reduce the evaporation caused by the wind over a water surface of 1.4 square mile, or about one-half the total area of the pond.

Transpiration.

Vegetation in the process of growth uses up a large amount of water, which is gathered from the soil by the roots and is then transpired to the air through the leaves. Only a small portion of it remains in the structure of the plant. From a lengthy series of experiments, Risler came to the conclusion that a forest takes up less than one-half as much water as an ordinary agricultural crop. We infer from this that a soil covered with grass or other herbaceous growth loses more moisture from this cause than one covered by a forest.

Different species of trees take up varying amounts of water. For deciduous species the average amount during one season is 470 pounds of water for every pound of leaf matter; but in the case of coniferous trees it is but 43 pounds, or one-tenth as much. In one or two other respects a broad-leaf wood has slight advantages over the evergreen one as a conserver of moisture; but this matter of transpiration points to the latter as the most efficient protector of water supplies.

Evaporation and transpiration represent actual losses of water. Just how great this loss is, will appear from the following table, taken from the excellent report of the Reservoir Commission for 1902. We are indebted to Mr. Safford's work for a great deal of careful information used directly and indirectly in this report. This table shows the precipitation on the watershed of North Watuppa Pond, compared with the amount of water which found its way into the pond, for the different months of the years 1899 to 1902. On the average, nearly

50 per cent. of the total rainfall was lost. Although there were undoubtedly other factors of waste, the larger part of the loss must have come from evaporation and transpiration. A minus sign indicates that the evaporation from the water surface was greater than the total amount coming into the pond; consequently, the amount collected was a minus quantity.

TABLE SHOWING THE AVERAGE NUMBER OF INCHES OF PRECIPITATION WHICH HAVE FALLEN ON THE NORTH POND WATERSHED, COMPARED WITH THE ACTUAL YIELD OF THE POND, REDUCED TO INCHES, COLLECTED ON THIS WATERSHED.

[Watershed of North Watuppa Pond, 11.444 square miles; area of North Watuppa Pond at "full pond," 24.7 per cent. of this, or 2.821 square miles.]

MONTHS.	1899.			1900.			1901.		
	Average Precipitation on North Pond Watershed (Inches).	Number of Inches collected.	Per Cent. of Precipitation collected.	Average Precipitation on North Pond Watershed (Inches).	Number of Inches collected.	Per Cent. of Precipitation collected.	Average Precipitation on North Pond Watershed (Inches).	Number of Inches collected.	Per Cent. of Precipitation collected.
January,	5.624	5.011	89.10	4.520	2.201	48.69	2.220	1.301	58.60
February,	3.840	4.375	113.93	5.125	4.067	79.36	0.948	0.483	50.95
March,	6.187	7.253	117.23	4.017	4.014	99.93	6.835	4.823	70.56
April,	2.174	2.654	122.08	2.100	1.638	78.00	8.390	7.129	84.97
May,	1.810	1.009	55.75	5.330	2.942	55.20	8.050	5.404	67.13
June,	3.858	0.095	2.46	1.682	—0.221	—13.14	1.685	1.159	68.78
July,	2.785	—0.285	—10.23	2.917	—0.519	—17.79	3.185	—0.054	—1.70
August,	1.641	—0.525	—31.99	2.020	—0.489	—24.21	2.462	0.033	1.34
September,	7.056	1.112	15.76	3.537	0.109	3.08	2.510	—0.281	—11.20
October,	1.937	0.681	35.16	5.002	0.941	18.81	3.173	0.368	11.60
November,	2.215	0.565	25.51	3.925	1.319	33.61	2.177	0.420	19.29
December,	1.260	0.735	58.33	2.460	1.590	64.63	8.640	4.384	50.74
Total,	40.387	22.680	–	42.635	17.592	–	50.275	25.169	–
Average,	–	–	56.16	–	–	41.26	–	–	50.06