A Design for a Sewerage System for a Portion of the Town of Walpole Mass.

May, 1891.

Fred F. Moore, '91.

DESIGN
for a
SEWERAGE SYSTEM
for a portion of the
Town of Walpole Mass

Thesis Drawing

M. I. T. May, 1891

Fred F. Moore, '91.

10 10 inch pipe
8 inch pipe
6 inch pipe
OFT. Flush-tank.
Manhole
Lamphole.

Datum plane is mean low water at Boston.

SCALE:
100 0 200 400 600 800 1000 2000 Feet.
0 100 200 300 400 500 600 Meters.

1" = 300'

Morey's Pond
Mill Brook
Lewis Pond
Stetsonis Pond
Union Pond
Diamond Pond
Neponset River
Neponset River
PROPOSED FILTRATION AREA
NORFOLK ST.
ALLEN ST.
SPRING ST.
OLD COLONY RAILROAD
NEW YORK AND NEW ENGLAND RAILROAD
WEST ST.
MAIN ST.
LEWIS ST.
SOUTH ST.
CLARK AVE
ELLIS ST.
CLAPP ST.
STONE ST.
DIAMOND ST.
EAST ST.
SCHOOL ST.
MORTON ST.
CROSS ST.
KENDALL ST.
NEW YORK AND NEW ENGLAND RAILROAD
NOT A PUBLIC WAY
CEMETERY ST.
NORTH ST.
MILL ST.
MAIN ST.
RIVERSIDE PK.
COMMON
PRIVATE WAY
UNION MILL
SAND & GRAVEL BANK
GRAVEL BANK
RAILROAD SIDE AND OVERHEAD WORKS
MOREY'S MILL FORMERLY E. F. LEWIS WOOL SCOURING
SAND & GRAVEL BANK
DEPOT
HOTEL
CHURCH
SCHOOL
STATION

A Design for a Sewerage System for a Portion of the Town of Walpole Massachusetts.

The Problem.-

Walpole is an old town, on the Neponset river, twenty miles from Boston.

The total population is about twenty-six hundred, divided into three settlements, Walpole Centre, East Walpole, and South Walpole.

The first mentioned, with a population of more than one-half the above, somewhat evenly distributed over one and one-half square miles of territory, is the section treated in this design.

Nearly the whole town is within the Neponset river basin. a small corner with some two hundred inhabitants

is in the Charles river valley. The surface is gently rolling, and traversed by many streams forming the head waters of Rejonset river. The highest elevation in the section covered by this system is about two hundred and forty feet above the level of the sea, and the lowest about one hundred and forty, the latter occuring near the centre, toward which the land slopes in all directions, thus forming a sort of bowl the only outlet from which is that taken by the river on its way north, after uniting with streams from the north, east, and west.

The junction of the New York and New England and the Framington and Mansfield Branch of the Old Colony railroad is at Walpole.

and there are a number of manufacturing establishments, some of which badly pollute the streams upon which they are situated.

The worst case of pollution, that of mill brook by the wool scouring establishment of E. F. Lewis, has been abated within a year by a discontinuance of the business, after several law suits had been brought against the owner by manufacturers on the river below, who claimed that the water was rendered too unclean for their use, and that the stream was, moreover, in an unhealthful and offensive condition.

Before giving up the business, Mr. Lewis expended upward of $20,000 in new and special machinery designed to reduce the volume of

sewage turned into the stream, but little good was accomplished: he also contemplated pumping the waste to chemical works, and treating it by some method of precipitation.

The Walpole Dye and Chemical Works drain into Mill brook. The sewage from this place consists of dilute sulphuric, chlorhydric and nitric acids, aniline dyes, logwood, etc. Although considerable in volume and quite high colored, the drainage does not seem to smell badly. About twenty hands are employed here who use a dry earth closet.

At the bleachery and dye house of S. Gray & Co., on Main St., some two thousand pounds of yarn are dyed daily.

The refuse, consisting principally of spent dye liquors, passes through a ditch into the river. The drainage looks black and offensive, but seems to have no marked odor.-

The Union Mill Company makes carpet-lining, cotton batting, stair-pads etc., and discharges no manufacturing waste into the stream. However, the water closet, used by twenty or thirty hands, empties into the river, through the raceway.

On the shore of Stetsons Mill pond, near the dam, is Stetsons Card Clothing factory. No sewage is discharged into the stream at this place. Owing to the contaminating influences

on the streams which feed this pond, the surface is covered with an unsightly film of an oily nature, and the bottom appears to be spread over with a dirty deposit. The growth of algae is said to be excessive at times, due without doubt to the polluted condition of the water; the quiet surface of the pond, together with the contained organic matters, furnishing favorable conditions for their propagation. These slimy growths finally settle to the bottom decompose and give rise to disagreable odors.

Thus, it will be seen that the present condition of the town is far from sanitary: upon the introduction of a public water supply a sewerage system would

become almost an absolute necessity.

Method of Disposal.

The first question to be considered in the solution of this problem was what disposition should be made of the sewage, and, hence, to what point should it be carried. There are three practicable methods of sewage disposal: first, it may be turned in a crude state into large bodies of water; second, it may be treated by one of the known precipitation processes, and the clarified effluent turned into water; third, it may be purified on considerable areas of land.

Of these three methods the first is, evidently, entirely out of the

question in this case, because, at the present time the streams, as already shown, are polluted badly by the sewage which finds its way into them.

As regards the second method of disposal, it may be said that the feasibility of discharging the effluent from any precipitation process into the river would be questionable, the amount of solids actually removed, under working conditions, not exceeding on an average more than fifty to sixty percent. Only a moderate amount of the dissolved impurities are removed. Moreover, the cost would be much larger than by any other method. The disposal of the precipitated matter, or "sludge", has

been found difficult and expensive, when this method has been employed.

This leaves the last, or purification on land, as the only recourse. Having decided upon this mode of disposal, it was desirable to find some suitable tract to which the sewage would flow by gravity. As will be seen by reference to the map, Plate I., there is no point above Stelson's dam to which the sewage of the whole district would flow by gravity, and, moreover, if any available area could be found, it would be undesirable from the fact that if any small quantities of untreated sewage should escape into the still water above the dam, trouble might ensue.

The conditions necessary for successful treatment upon land are a nearly level bed of loose, gravelly soil, at least five or six feet in depths. It should be somewhat remote from thickly populated districts, and not too high in cost. The only tract within a reasonable distance, which can be made to answer these requirements, and to which the sewage will flow by gravity, is found just below Stetson's dam, on the north bank of Neponset river, adjacent to Main street. (Dedham Turnpike.)

The amount of sewage which may be purified by filtration through earth, varies from 25000 or 30000 up to 100000 gallons per acre per day. The value for this

purpose, of any particular soil must be determined by experiment. As will be shown later, the system is planned for an ultimate amount of 10000 gallons per day, and I have assumed that 16.000 square feet or about three and eight-tenths acre of land will be required. Probably much less than this would suffice at first; the determination of the area necessary should be made the subject of experiment, the result of which would undoubtedly show that the above estimate is well on the safe side.

The System.

In any method of sewage treatment, as small a volume as possible is the desideratum.

To accomplish this, all rain water should be excluded, only house sewage and manufacturing waste being admitted to the sewers. Such a system, known as the Separate system, from the fact that distinct channels are provided for the removal of surface water, was first used by Col. Geo. E. Waring, and sometimes bears his name.

The system is planned for twenty five years in advance: that is, it is so designed that, according to the estimates, it would be working under normal conditions, in 1915. A consideration of the probable increase in population, shows that, in 1915, there are liable to be 2000 inhabitants within the district. At thirty five gallons

per head per day, a libeal estimate for towns of this size, gives 70.000 gallons of sewage. To this must be added a certain amount for ground water, which always finds it way into sewers, however well constructed: to provide for this I have assumed that one-fourth of the capacity of the sewer, at the outlet, will be taken up by ground water, giving, say, 100.000 gallons per day to be provided for.

As we have seen, the surface slopes from all directions towards the center of the district, and, hence, the sewers radiate to the low point at the intersection of Main and Stone streets.

Here, the main sewer begins, and goes through private land to

the filtration area; after crossing the head of Stetson's pond, by means of an inverted siphon, it follows the north shore of the pond to the end of the dam. This sewer has a uniform grade, for the entire length of 3450 feet, of one in five hundred, and the changes in direction are made by curves of long radius. This sewer, from the manhole on Main street to a point one hundred feet south of the manhole on the south bank of Stetson's pond, is to be of salt glazed sewer pipe, with cemented joints; from this point, to the manhole at the end of the dam, it should be of sewer pipe, with lead joints, as it is below the ordinary level of the water

in the pond. The remainder can be of sewer pipe.

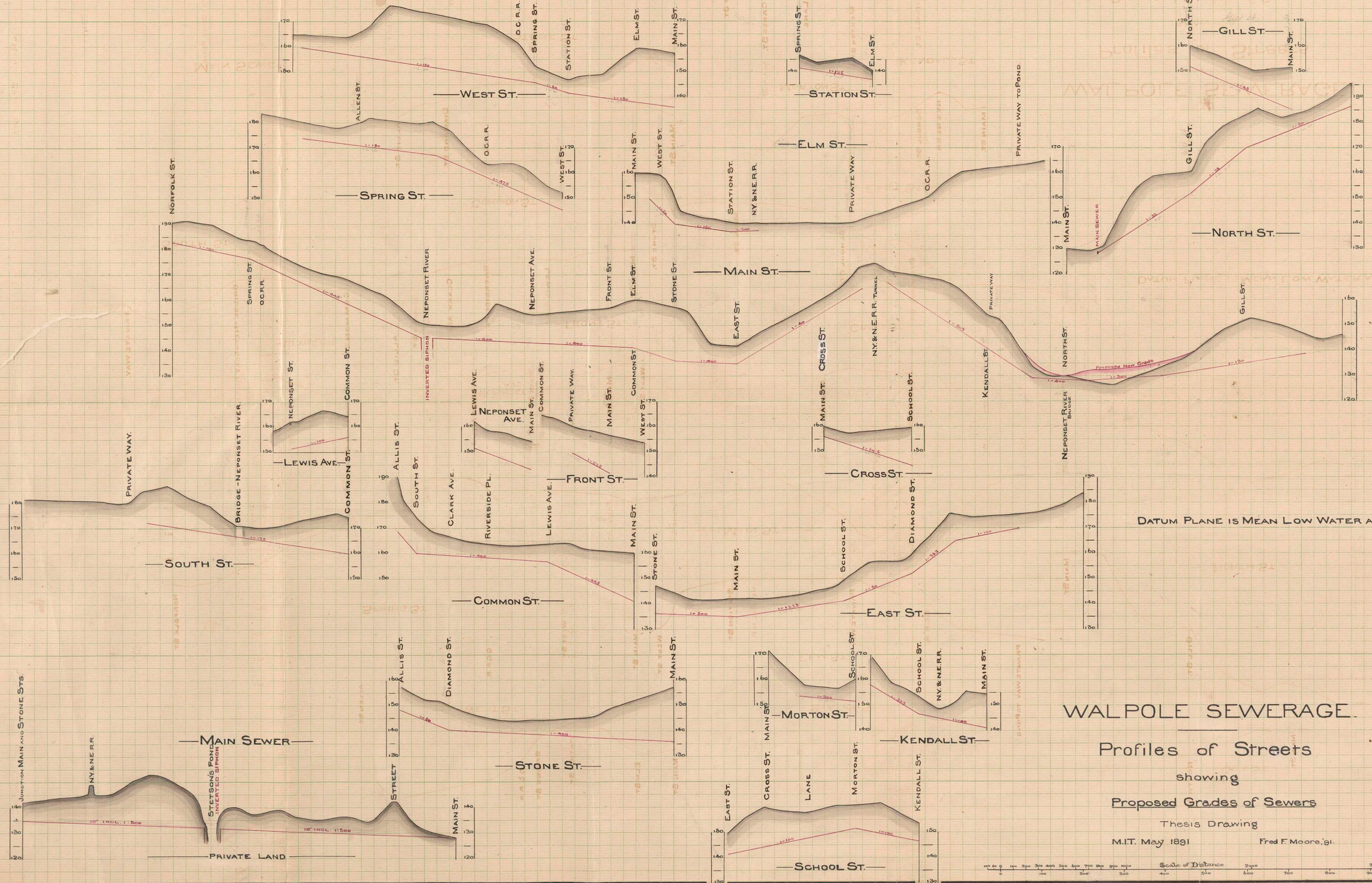
As will be seen from the profiles, the grade of the main sewer, at Main street, will necessitate the filling in of the hollow in the street at that point. Such regrading would cost but little, and would greatly improve the street.

With the exception of one or two minor laterals, which are six inches in diameter, all of the sewers, aggregating about six miles in length are of eight inch pipe. The main sewer is of ten inch pipe

Where the pipe in Main street crosses the river, at the head of Lewis pond, an inverted siphon is employed, and the sewer is to

be of iron pipe for one hundred feet on each side, to prevent an undue seepage of ground water. At all other points of crossing of streams, the pipe placed in a wooden box, to prevent freezing, can be carried under the bridges, above the surface of the water.

A manhole, or in some few instances a lamphole, has been placed at every change in alignment or grade. It would seem that the advantage of thus making the sewer accessible at every such change, as an element in economy of maintenance, is too often lost sight of, and in the endeavor to keep down the first cost, the maintenance accounts for cleaning, etc. are



WALPOLE SEWERAGE.

Profiles of Streets

showing

Proposed Grades of Sewers

Thesis Drawing

M.I.T. May 1891 — Fred F. Moore, '91.

Scale of Distance — Feet. — Meters.

increased in an entirely disproportionate ratio.

Five automatic flush tanks will be necessary, at the ends of laterals of low grade, as shown on the map. Plate I In all other cases an occasional flushing through the manhole would probably be sufficient. If found desirable, other flush tanks could be introduced in the manholes provided.

The grades (see Plate II.) are in general sufficient to give velocities which will prevent deposits. The maximum grade, one in twenty, is found for about two hundred feet of the sewer in Elm street. The minimum grade, of the eight inch sewer,

WALPOLE SEWERAGE

PLAN of PROPOSED FILTRATION FIELD

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BRIDGE

MAIN STREET

MAIN SEWER

MANHOLE

1280

126.6

126

10" PIPE

127.6

126.8

INCL. 1:600

10" PIPE

128

127.3

CESSPOOL

10" PIPE

ROAD

ROAD

200

124

INCL. 1:300 No. 1

126.0

200

INCL. 1:300 No. 2

126.0

200

126.5

SLOPE 1:6

124

200

No. 3 INCL. 1:300

128

No. 4 Cellar INCL. 1:300

130

128

123

200

124

123

Neponset River

Datum = Mean Low Water at Boston.

SCALE:

100 50 0 100 200 300 400 Feet.

0 100 Meters.

one in four hundred occurs at several places. The pipe, laid at the latter grade, will require occasional flushing, which can be conveniently done through the manholes, by a connection with an adjacent hydrant, or otherwise.

It will require about one and one-half hours for sewage, from the most remote points, to reach the filtration area. Before passing onto the land it goes through a cesspool, (see Plate III.), nine feet in diameter and six feet in depth below the outlet. This gives sufficient capacity to hold the flow for from ten to fifteen minutes, when taking place at the maximum rate.

The filtration area is

divided into four equal square beds, two hundred feet on a side, by little embankments, one foot in height; over the pipe lines the height is increased to three feet.

To prevent the sewage from passing off without percolating through the beds, the outer edges also are embanked about one foot above the graded surface.

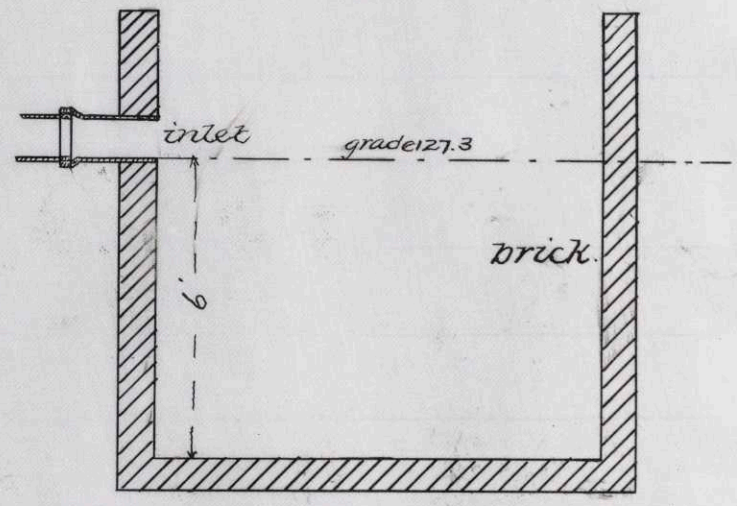
The point of discharge into the beds is in each case at a corner, (Plate III.), and they have a uniform grade of one in three hundred, along the diagonal from that point.

The preparation of the beds will require the removal, for a short distance, of about 3000 cubic yards of material now in

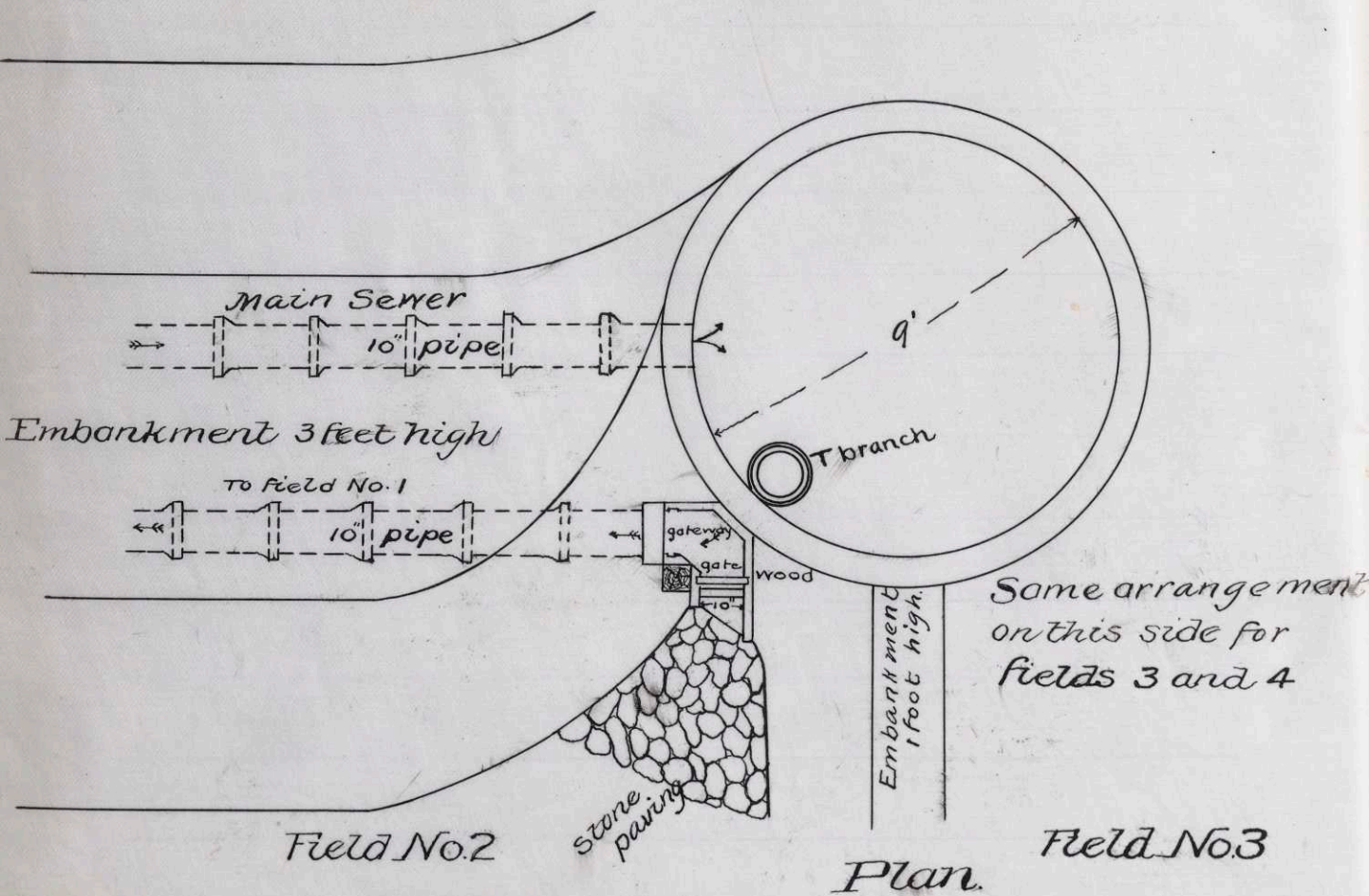
Plate IV.

Sketch
Showing
Detail at Outlet

Scale $\frac{3}{4}$" = 1 foot.



Section.



Plan.

place on the site. This soil is a loose gravel, and would seem to be most excellent for the purpose. In addition to this, about 7700 cubic yards of new material will have to be procured. The latter, of a suitable nature for the purpose, can be obtained from the gravel bank near the depot. The haulage would, in this case, be about one mile, and it may be possible to find good material nearer to the area.

The outlet from the cesspool, as shown on the accompanying drawing, (Plate IV.) is, by means of T branches, below the surface of the sewage standing in it, so that objects, which either float or sink, are held

back until sufficiently changed, by chemical or other action, to flow uniformly with the rest of the liquid, instead of being thrown out upon the ground, where they would be offensive, or ill adapted for percolating through the soil. A little sediment will collect in the cesspool, and will require removal as it fills up, perhaps once a year.

Passing from the cesspool the liquid enters two wooden compartments, each having two gates. The four gates allow the sewage to be turned upon any one bed at will. The outlet to the beds numbers 1 and 4 is in each case by means of two hundred

feet of ten inch pipe, laid at an inclination of one in six hundred: the discharge upon numbers 2 and 3 is directly from the wooden compartment. Every other day, the gates should be changed, so as to turn two days sewage upon a subdivision, and then give six days rest, to allow it to sink into the ground, and the surface to become dry enough for another dose.

The ordinary level of the water in the river is about six feet below the surface of the filtration area. Occasionally, in times of freshets, this may be reduced by as much as one and one-half feet, for a short

time. No underdrainage is considered necessary.

As shown by the following approximate estimate, the entire cost of the system would be about $60,500. For the sewers alone the average cost is $6150 per mile.

As regards the maintenance expense, the greatest labor involved would be the regular changing of the gates. The surface of the filtration area should be harrowed occasionally, the embankments kept in repair, and the wooden parts replaced when they decay. The total expense of this should not exceed $100 per annum.

No provision is made for the sewage from Morey's mill, as the buildings are not at present in use. The pipe in Elm street can be continued, to an interior with a sewer from the mill, laid over private land.

Estimate of Cost

Section	Size of Sewer	Average Cut, Feet	Length Feet	Approx. cost per ft.	Total Cost	Remarks
				₵	₵	
Main Sewer	10 inches	9	3450	2.50	8625.00	Wet. 1400 feet iron pipi; siphon.
Stone street	8 "	9	3050	0.90	2745.00	Sand and gravel
Common street	8 "	8	2260	0.80	1808.00	
South street	8 "	10	1575	0.95	1496.25	
Lewis Ave.	8 "	10	440	0.95	418.00	
Neponset Ave.	8 "	10	440	0.95	418.00	
Front street	8 "	10	270	0.95	256.50	
Main street	8 "	8½	8760	1.00	8760.00	100 feet siphon
Diamond street	8 "	7	730	0.65	474.50	
East street	8 "	7½	3990	0.80	3192.00	
West street	8 "	12	3310	1.00	3310.00	
Spring street	8 "	8	2185	0.85	1857.25	
Cross street	8 "	9	670	0.90	603.00	
Morton street	8 "	5	460	0.60	276.00	
School street	8 "	10	1470	0.95	1396.50	
				Carried on	₵ 35636.00	

Estimate of Cost (continued)

Section	Size	Average Cut, Feet	Length Ft.	Approx Cost per Ft.	Total Cost	Remarks.
					$35 636.00	Brought over.
North St.	8 inches	9	2150	$ 0.90	1935.00	
Gill St.	8 "	8	500	0.85	425.00	
Kendall St.	8 "	7	560	0.75	420.00	
Six inch Laterals	6 "	6	1200	0.50	600.00	
75 Manholes at $40.					3000.00	
5 Flush-tanks $60					300.00	
4 Lamp-holes at $25.					100.00	
Land and other damages					1000.00	
Filtration Area:						
Purchase 4 acres at $100						
Purchase 2 " at 30					520.00	
Preparation					6000.00	
Distribution pipe	10 inches		800	0.50	400.00	
Cesspool					100.00	
Engineering and contingencies 20%					10 087.00	
Total					$ 60,523.00	

Appendix.

Population of Walpole.

Year.	Population.
1865	2018
70	2137
75	2280
80	2484
85	2443
90	2604

Population of District treated.

1890, 1500; 1915 (estimated) 2000

Synopsis of Calculations.

Population in 1915	2000
At 35 gals. per capita per day (24 hours)	70000 g.
Ground-water and guard daily flow (say)	25000
Total daily flow in 1915 (say)	100000 g.
Hourly flow, average	4200 g
Hourly flow, maximum; two times mean	8400 g

Some of the Principal Bench Marks Established during the Survey.

Datum Plane - Mean Low Water at Boston.

Initial Point - B.W.W. New York and New England Railroad; on corner of third stone from the bottom, right or west side, at west end of tunnel, east of Walpole station about 250 ft just Elev = 153.307 ft.

Bench Marks.

Location.	Elev. Feet.
Common St. opp. South St.	
Top of stone post 	181.77
East St.	
Right outer corner lower stone step Congregational church	145.10
Left outer corner lower stone step entrance to Catholic church	161.88
Right outer corner Mr Gaskey's	197.19

Bench Marks (continued)

Elm St. Elev.

Highest point cast end of large flat rock at N.E. corner of house on S.W. corner, intersection Elm and Station Sts. 143.01

On highest point of end stone (2'x2'x1') 12" from picket fence, in Morey's retaining wall, left side of entrance to mills at Morey's pond 164.37

Lewis Ave.

Highest point, conglomerate boulder So. side of avenue east of Neponset St. 162.62

Main St.

Top of boulder at foot of Maple (W.) 20' So. of station house C.C.R.R. crossing 171.72

Top of stone at foot of sign board corner Neponset Ave 154.78

Top of stone post in Common fence two panels from corner (Main & Front) west side of Main St. 158.72

Main St. Elev.

Top of staple in stone post west of
gate at entrance to Peter Daly's 145.53

Right outer corner lowest stone step
of Town Hall 160.54

North St.

Top of large boulder, 3 feet high,
in stone wall at south end of bars
on west side of street. 133.01

South St.

Highest point of stone, west side of
street opposite barn fence with
red capping, 2 feet from line of
street, about 1150 feet from Common St. 182.27

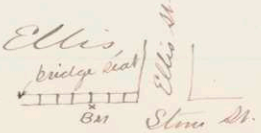
Spring St.

On south west corner stone wall
north side of street near Main St. 184.79

Stone bound north side of street west
of barn Bar'm bound
St. North 182.73

Stone St.

Bridge abutment corner Ellis,
main corner, third course 164.34



West St. Elev.

Lower mitre corner bound stake (cord)
to Mrs. Welch's house S. side street 168.84
On stone post 2' high (8" x 8") 4'
from south-west corner long tenement house, north side of street 165.10

Intersection O.C. R.R. and N.J. and
N.E. R.R. top of rail (March 28th, 1891) 159.12