Sewer System
for
Ovid, Michigan.

A Thesis Submitted to
The Faculty of
THE MICHIGAN STATE COLLEGE
OF
AGRICULTURE AND APPLIED SCIENCE

by

A. F. Sheldon F. W. Robb

Candidates for the Degree of
Bachelor of Science
in
Civil Engineering.

June 1925.

Fore word

In view of the fact that all of the states are passing laws compelling all sewage to be treated before dumping into natural water courses and forbidding the use of private vaults and cesspools in municipalities; the writers deemed it wise to investigate a suitable small town in view of designing a sanitary sewer system and disposal plant.

The writers have chosen the town of Ovid, Michigan, for this purpose due to the fact that is is a general problem with no existing system. It is also desirable as it is the home of one of the writers and interest in the welfare of his townspeople was uppermost in his mind.

Location and Present Condition

The town of Ovid up until the present time has no system to care for the sewage. The town is located along the Maple River which for a few weeks in the Spring might care for the sewage by dilution. The rest of the year, however, the flow is so slight that any quantity of sewage dumped by a municipality would polute it.

The land lies in small ridges with intervening valleys making a simple system hard to obtain. The southern portion of the town is very flat and low and can be drained directly to the river. The north part of town drains into a valley and the water is brought down a natural ditch to the river through the west portion of the town. These two natural divisions brought together in the southwest part of town.

Ovid being of small population has never deemed it necessary to install a sewer system. It is inevitable that in the near future they will be forced to do so. It will be much more necessary if the population should increase and the problem which is now relatively easy will become much more difficult. There are at present a few old sewars extending through the business section to care for storm water. The sewage problem is cared for by private outside vaults and cesspools. These are far from being the best of their kind and some improvement must be made in these if the problem is not solved otherwise.

The storm sewers empty into the river at the foot of the main street and consequently all its effluent, of which some is sewage, must flow past a large portion of the town. The sewer line from the school empties into a small natural open ditch and thus causes a great deal of odor before it reaches the river.

As the town is located in a very fine dairy district it has its share of creameries. The largest of the two is the Ovid Creamery Company. This in itself presents a big problem for Ovid as this Creamery is a substation for the Connor Ice Cream Company and consequently has a great deal of waste. It uses 268,000 gallons of water and as near as can be figured pours the same quantity into the river during the morning hours. At the present time this creamery has an eight inch line from its plant to the river emptying just outside the town.

The other creamery called the Clinton Creamery is a great deal smaller using 4,000 gallons and dumping 3,800 gallons during the day. They dump this into an open ditch. This stream is slow flowing and the area around the ditch is contaminated with slimy precipitates and a very foul odor is emitted.

The only solution of this problem is to allow these plants to use the municipal system or install suitable drains to a point well downstream from the town. The latter will be the logical solution as will be shown later. Some action must be taken immediately due to orders from the Board of Health of the State of Michigan.

Preliminary Survey

The writers having chosen this town thought it advisable to consider any existing lines with the thought in view of including them in the proposed system. These were carefully investigated but were found to be so inefficient and so undesirably located that any thought of incorporating them in a new system was dropped.

The first field work to be done was to make a topographic map of the town. This was made during the winter vacation 1924, '25. It was thought sufficient, after looking over the ground, to take elevations at street intersections and at intermediate points on the east and west streets as this is the long way of the blocks. In some cases it was necessary to take them oftener due to sharp breaks in grade. After this work was done and the elevations figured, the map was plotted which will be seen as Plate 1 in the back of this book. A system of semi-permanent bench marks was left the whole length of Main Street, taking the elevation of the mean river water as 100. The water elevation on the west side of town on Front Street was taken and found to be about five feet lower than at Main Street. This slope insures sufficient velocity to carry off treated sewage. The high water mark was taken and at the location of the disposal tank the elevation was found to be 104.

Preliminary Design

The next problem to be faced was the design of the sewer system. Because of the lowness of the southeast portion of town, it proved very difficult to get a satisfactory gravity system. We, however, overcame this but found that we had five places at which we must secure permission to cross the railroad. We were assisted by the fact that the city is using the river bank as its dumping ground. Eventually the ground outline on the included map will be raised to an approximate elevation of 110.

We then interviewed the proper railroad officials as to crossings under their right of way. They would under no consideration allow five crossings. The maximum number of crossings they would allow was two and these on one condition. This was that they be allowed to lay the pipe with their own gang or to be allowed to send an engineer to superintend the work.

This obstacle caused an almost entire abandonment of the original system. We then started in on an entirely new design. The primary idea or thought that had to be held in the mind of the writers was to cut the cost to a minimum and yet to have as effecient a system as possible. This is due to the fact that Ovid is made up of retired farmers who are more or less well to do. They do not wish to spend an exhorbitant amount of money but still wish to have everything necessary to comfort and well-being. Therefore we were forced to keep as near as possible to their conservative ideas of finance.

Final Design

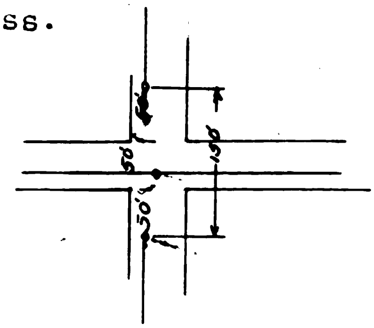
These obstacles surmounted and the new design under way we found that a gravity system would be entirely inadequate. This necessitated a pumping plant to raise the sewage at the disposal plant. This gave us approximately nine more feet of fall. This meant that we had slope enough at almost all points to obtain cleansing velocities. These velocities as given to us by Col. Rich, head of the Michigan State Board of Health, are as follows:

6"	Slope	not	less	than	.4%	Vel.	not	less	than	.6'/sec.	
8"	"	"	"	"	.25%	"	"	"	"	.4'	"
10"	"	"	"	"	.2	"	"	"	"	.29'	"
12"	"	"	"	"	.2	"	"	"	"	.22'	"
15"	"	"	"	"	.15	"	"	"	"	.15'	"
18"	"	"	"	"	.15	"	"	"	"	.15'	"
20"	"	"	"	"	.15	"	"	"	"	.08'	"

As was stated, at almost all pdnts sufficient fall was to be had to give these slopes and velocities. At the points where there was not, we put flush tanks into our design. These tanks which will be shown later are of the automatic type flushing four times each day. These require very little care and as the municipal water supply is unmetered it will prove a very cheap and efficient means of cleansing the sewers.

In designing the size of the pipes we took an average block and counted the people living in it. Then after computing the area we found the average population per acre. This figure we took as fifty for the residential section. For the business section we took a higher figure of ninety. As the water is not metered we had little to go on as to the water consumption. We arrived at the figure of eighty-five gallons per capita per day after study of conditions of other small towns and what little data we were able to collect at the water pumping station. We decided that the greater portion of this water would eventually find its way to the sewer and with the increased quantity due to cistern water the same amount could be used as the sewage per capita per day. From the study of charts it was found that the maximum hourly flow was approximately three hundred percent of the average hourly flow. This large quantity is the quantity for which the sewers must be designed. After the amount flowing in each line was found the size and velocity were determined from charts drawn up from Kutters formula.

The lots in Ovid are on the average sixty feet wide. This made it easy to stop the lines back a considerable distance from the intersection and save considerable expense. It was at first thought advisable to run all the lines at each intersection to one manhole but after proving the above statement it was decided not to. This system has one advantage, however, that during the cleaning of the system there is only one manhole to locate rather than three or four. This is often a great help especially on gravelled or oiled streets. Values will be given to prove the economy of the stopping the manholes back from the intersection. Take for example a corner where there are two lines ending and one going straight across.



Cost per ft. for digging, laying and backfilling	$1.00
Cost per ft. of tile, average,	.90
Total	$1.90

Cost of one manhole $35.00

If tile are stopped fifty feet from property line we have:

50 + 50 + 50 (for street) = 150' saved.

150 x $1.90 = $245.00 Saving on tile.

2 x$35.00 = $75.00 Extra cost of manholes.

$245.00 -$70.00 = $175.00 Total saving on one intersection.

These figures are, of course, only approximate but go to show that the plan adopted was by far the most economical.

Our final design had only two railroad crossings and after further negotiations with the railroad company they agreed to put these in for cost plus fifty percent. The section under the track is to be made of acast iron pipe as clay tile would crack under the vibration of the trains.

It was possible at most points to keep the sewer down to a minimum depth of seven feet so that it might be used as a cellar drain. At the greater number of such places as it was not possible there are no houses and so it will be possible to set the houses at such an elevation as to still be able to drain their cellars to the sewer. This eliminates the extra expense of a storm drain at a great enough depth to care for these drains.

Disposal Plant

The disposal plant as has been previously mentioned was placed in the southwest portion of town on the river bank. The pumping plant is to be on the east side of the river while the Imhoff tank, dosing chamber, filter beds, and drying bed are to be on the west side.

The sewage will enter the well pit at an elevation of 101. There will be a small tank here to care for the maximum flow. It will flow from this tank through a screen made of iron rods placed at an angle of 45 degrees across the opening to the sump. It will be pumped up by means of a centrifugal pump capable of caring for 250,000 gallons per day. This pump will be supplemented by a pump of twice the capacity to be used in case of emergency. The sewage will be raised to an elevation of 110. It will be carried across the river in an 18" cast iron pressure line. From this it will go to the Imhoff tank. It is here that all of the solids are deposited. The tank will be described in detail later in this write-up. The effluent will leave the tank at an approximate elevation of 109.5. It will go to the dosing chamber. This is a tank which collects the effluent and discharges it at regular intervals onto the filter beds. This is done by alternating siphons. As we have only two beds there will be only two siphons necessary.

These are so set that they will trip approximately every six hours. This gives each bed a dose every twelve hours. Each dose is large enough so that it will take approximately six hours for it to drain through the bed. This gives the bed six hours to rest or aerate.

The beds are underlaid with tile which carry the effluent to the river. This effluent is not in a nearly stable condition. That is, all solids have been removed and all of the nitrogen oxidized into nitrites and nitrates. There is no odor emitted and there will be no danger to plant and animal life in the water. It will not, however, be entirely free from bacteria but near enough so that it will be free from them within a very few miles. There will be no other treatment necessary to comply with the new state law of Michigan.

Pumping Plant

The sewage is taken into the well pit through a screen made up of 2" x $\frac{3}{4}$" strap iron with $1\frac{1}{2}$" opening between them. This takes out all debris that might fall into the sewer, also anything in the nature of cloths which might be flushed down the sewer. This material if allowed to pass into the pump might break it or at least clog it and cause a great deal of expense and delay. Also they would not be digested if they reached the Imhoff tank. This screen should be cleaned at regular intervals.

The sewage pit is ten feet deep and twenty feet square. This gives a storage capacity of 25,000 gallons to care for the rush flow.

The bottom of the well pit is seven feet above the bottom of the sewage pit. This means that a flap valve will have to be installed in the top of the suction line in order that the pump will prime automatically. The pump is to be operated by an electric motor. There is an automatic shut-off and starting box so that the pump will stop automatically if the sewage pit becomes dry or the pump breaks or will start automatically if the sewage rises above a certain point when it is not operating.

There is to be an auxilary pump to care for flood flow and to care for the flow in case the regular pump breaks. The motor on this pump is to be automatically started if the sewage reaches a dangerous level.

The capacity of the regular pump is to be 250,000 gallons. daily and of the auxiliary pump twice that amount.

A detailed drawing of the well chamber will be found on the next sheet.

Design of Well Chamber
Capacity of Pit 25000 gal.
Max. inflow 12000 gal

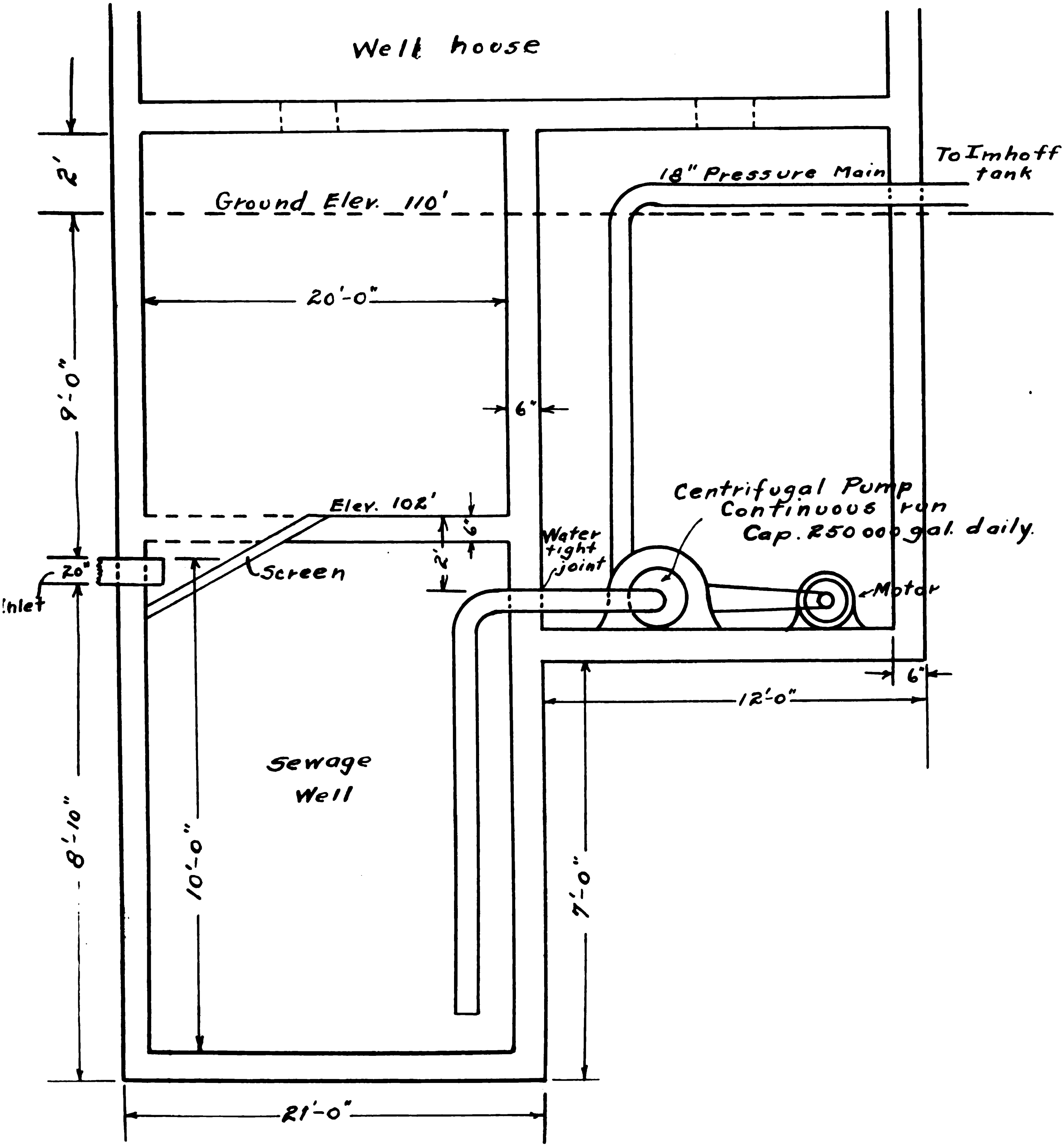


Plate I

Detail of Screen in
Pumping Chamber

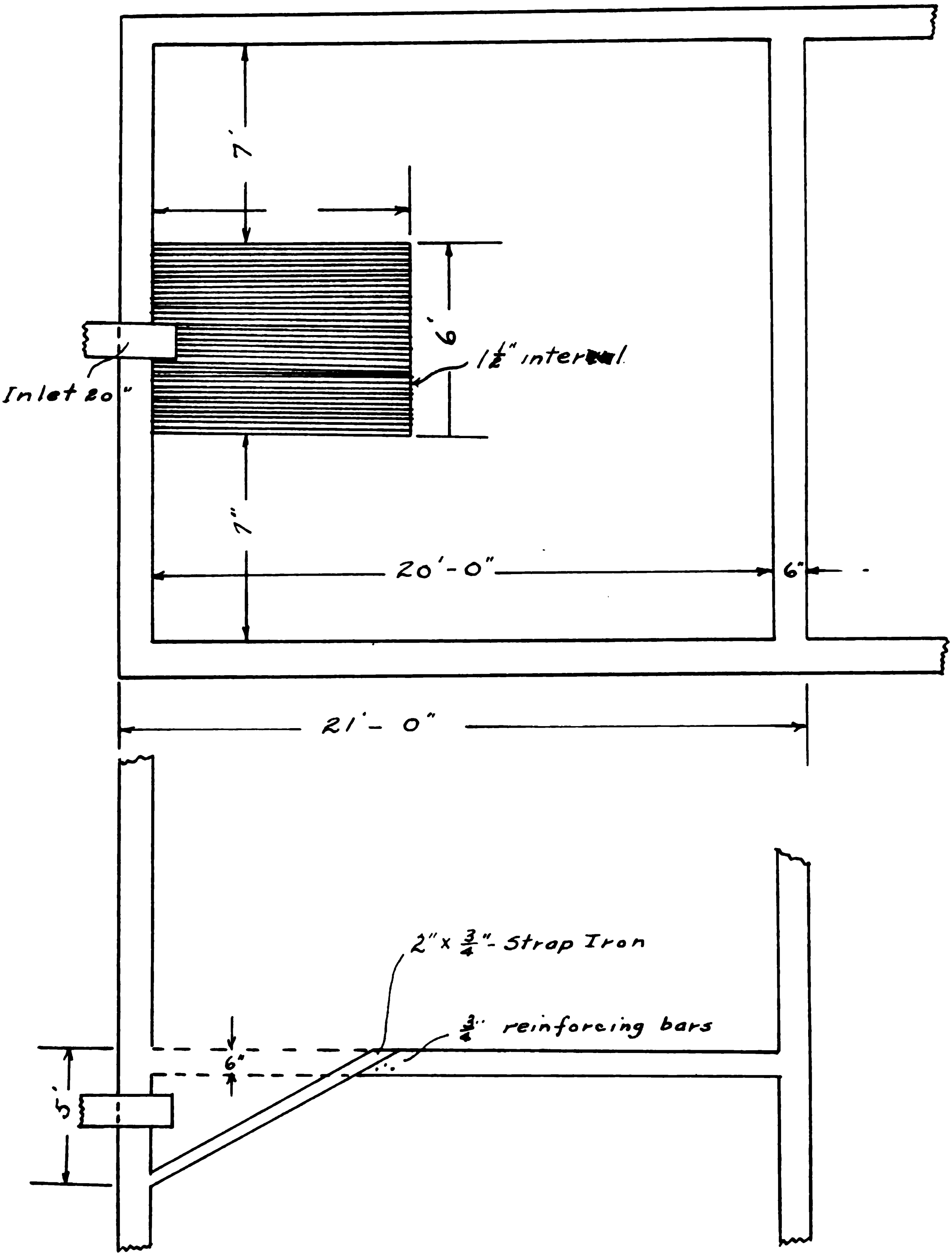


Plate 2.

Imhoff Tank

This tank is for the most part merely a sedementation chamber. The sewage will remain in the tank for an average of four hours. At the time of day when the maximum flow occurs there will a larger percent of liquid so that a four hour retention period will not be necessary. There are baffels at both ends of the tank to break up any currents which might form at the entrance or outlets. This insures an even undistrubed flow causing the solids to drop out very rapidly. These solids are collected in the lower portion of the tank in the sludge chamber. The sludge is allowed to remain here for a period of eight to ten months to ripen. At the end of this time the solids are in a form of sludge of which about eighty-five percent is water. The portion of the sludge in the power portion of the tank is drawn off and spread on the drying bed. After a short time this will have drained out and be in a spadeable condition. Only a small portion of these solids are drawn off each time except in the fall when it is drawn down as far as possible and still not have raw material come out. This is because there can be none drawn off during the winter. The hydrostatic pressure is as a usual thing enough to force the sludge out as the outlet is below the water level. If, however, the pressure is not great enough it can usually be started by loosening the sludge by means of a stream of water forced down the vent in the outlet pipe.

There is a considerable amount of gas formed in the digestion of the solids and sometimes this does not escape readily due to a thick scum which forms on top of the sludge. This scum must be broken up or the tank will overflow. This is done by forcing rods or streams of water down through the gas vents on each side of the flow chambers.

This tank is twenty-five by fifty-one feet inside measurements. There is a wall extending through the center of the tank the short way to divide the two sludge pits. The flow chambers extend the whole length of the tank. They are nine feet and one-half wide and fifteen feet deep. The last six feet is on a slope of one and one-half to one forming a V bottom. The detail view of this tank will be found in the back as Plate 2.

Drying Bed

The drying bed as has been mentioned previously is to take care of the sludge removed from the Imhoff tank. This bed is thrity-five feet square. It is constructed with a floor of puddeled clay. On top of this is ~~l~~laid the drain tile. These are six in. vitrified clay drain tile laid with a wide joint to permit the quick drawing off of the liquid in the sludge. On top of these are spread graded cinders with fine on top. The tile should be covered to a depth of about six inches. The sides are made the same as the floor and extend four feet above the cinders. The effluent from this bed is carried directly to the river. The dry sludge is as odorless as the wet and forms very good fertilizer.

Dosing Chamber

This tank is fifty feet square and seven feet deep. Its use, as has been stated, is to collect the sewage and dose it onto the filter beds at regular intervals. The average interval for each bed being twelve hours. This dosing is done by means of twin alternating siphons. These work together so that one dumps every six hours approximately. There is a slight loss in head of three and one-half feet through the tank. The effluent entering at an elevation of 109 and leaving at 105.5.

The sides and bottom of this tank are of reinforced concrete. There should be a roof over the tank but this can be of wood construction.

A detailed view of this chamber will be found on Plate 2.

Filter Beds

These beds are to be two in number each containing one-half an acre. The sides and bottom are to be formed of puddeled clay. The bottom to be twelve inches thick with the sides thirty-six inches thick and twenty-four inches high.

On the bottom there is to be laid six inch vitrified clay tile with open joints as in the drying bed. Over this there is to be six inches of coarse gravel or enough to just cover all of the tile. Above this is to be three inches of graded gravel between ½ and ¼ inch. On the top is to be three inches of fine sand of .3mm diameter.

The sewage is to be distributed by means of troughs. These troughs are built so that they discharge at several points over the surface. This insures an even distribution of the liquid.

The surface of the filter must not be allowed to become clogged or the filter will lose its efficiency. During the winter months the surface should be furrowed in order that the sewage can thaw through more readily.

The action of the filter will not be very great for about six or eight weeks after it is first put into operation or after a washing of the sand, which should be done annually.

This is because the bacteria must have a chance to collect on the sand particles and it is these organisms that do the greater part of the breaking down of the free ammonia or nitrogen.

There is to be a by-pass around the dosing chamber and the filter beds so that if any thing should happen to either one the effluent from the Imhoff tank can be sent directly to the river. Also there will be a gate valve in the pressure line across the river leading to the Imhoff tank so that during repairs and during high water the sewage can be dumped directly into the river. However, it should not be run directly to the river unless absolutely necessary as it is apt to be dangerous. It may be that it can be sent to the river without filtering during high water without serious danger.

Cost Estimate

The data for the cost estimate was collected from several different sources. The prices of tile were obtained from Briggs Company and Young Brothers and Daley, both dealers in Lansing. For prices on excavation, concrete work, trenching, laying and back filling we went to several of the prominent contractors of Lansing and East Lansing, also to the City Engineering Department of Lansing. We were given comparative costs on Imhoff tanks by the State Board of Public Health.

We divided the town into districts to facilitate the computing of the cost. These districts are shown on Plate 1. For each of these districts we found the amount of each size tile needed also the number of tees, of which we left two every sixty feet for house connections, the number of manholes, and flush tanks. The cost of each of these were then found and the total of each district found.

This method of computing will make it possible to tell how much it will cost to construct any portion in case the people did not feel able to pay the whole cost at once.

After the district totals were found we totaled these and added the general expenses which do not fall on any particular district. These include the cost of the pumping plant, the Imhoff tank, the dosing chamber, filter beds, and engineering expenses.

The complete estimate of cost will be found immediately following.

District I Cost

Item No	Item	Quanity	Unit Price	Amount
1	Trenching	10850	.60 per ft.	6510.00
2	Back Filling	10850	.10 " "	1085.00
3	Man holes	37	$35 each	1295.00
4	Flush tanks	0	40	0
5	Vitrified Pipe			
	6" pipe	7030'	.175 per ft.	1230.00
	8" pipe	550'	.273 " "	150.00
	10" pipe	1600'	.4095 " "	655.00
	12" pipe	1200'	.5265 " "	630.20
6	Tees			
	6"-4" Tees	250	1.08 each	270.00
	8"-4" Tees	18	1.58	28.40
	12"-4" Tees	10	3.24	32.40
7	Laying Pipe			
	6" pipe	7500'	.28 per ft.	2100.00
	8" pipe	550	.30	165.00
	10" pipe	1600	.30	480.00
	12" pipe	1200	.32	384.10
8	Stoppers			
	4" Stoppers	184	.10	18.40
9	Cleaning up	sum	sum	25.00
10	Maintaining traffic	sum	sum	5.00
	Total			15351.50

District II Cost

Item No	Item	Quanity	Unit Price	Amount
1	Trenching	7395'	$ .60	4437.00
2	Backfilling	7395'	.10	739.50
3	Man holes	27	$ 35.00	945.00
4	Flush tanks	2	$ 40	80.00
5	Vitrified Pipe			
	6" Pipe	4870'	.1755	852.25
	8" Pipe	575'	.273	157.00
	10" Pipe	1100'	.4095	449.90
	15" Pipe	400	1.008	403.20
6	Tees			
	6"-4" Tees	180	1.08	194.40
	6"-6" Tees	2	1.08	2.16
	8"-4" Tees	19	1.58	30.02
	10"-4" Tees	35	2.52	88.20
	15"-4" Tees	13	4.32	56.16
7	Laying Pipe			
	6" Pipe	5320'	.28	1489.60
	8" Pipe	575'	.30	172.50
	10" Pipe	1100'	.30	330.00
	15" Pipe	400'	.35	140.00
8	Stoppers			
	4" Stoppers	144	.10	14.40
9	Clean Up	sum	sum	15.00
10	Traffic	sum	sum	5.00
	Total			10596.29

District III Cost

Item No	Item	Quanity	Unit Price	Amount
1	Trenching	3150'	.60	1890.00
2	Back Filling	3150'	.10	315.00
3	Man holes	11	35.	385.00
4	Flush tanks	0	40	0.00
5	Vitrified Pipe			
	6" Pipe	2100'	.1755	367.50
	10" Pipe	400'	.4095	164.00
	12" Pipe	500'	.5265	265.00
6	Tees			
	6"-4" Tees	75	1.08	81.00
	10"-4" Tees	13	2.52	32.76
	12-4 Tees	18	3.24	58.32
7	Laying Pipe			
	6" pipe	2250'	.28	630.00
	10" Pipe	400'	.30	120.00
	12" Pipe	500'	.32	160.00
8	Stoppers			
	4" Stoppers	64	.10	6.40
9	Clean Up	sum		15.00
10	Traffic	sum		5.00
	Total			4529.98

District IV Cost

Item	Item	Quonity	Unit Price	Amount
1	Trenching	5870'	.60	352.20
2	Back Filling	5870'	.10	58.70
3	Man holes	27	35.	945.00
4	Flush tanks	1	40.	40.00
5	Vitrified Pipe			
	6" Pipe	3630	.1755	635.25
	8" Pipe	600	.273	163.80
	12" Pipe	1030	.5265	541.78
	15" Pipe	770	1.008	776.16
6	Tees			
	6"-4" Tees	130	1.08	40.40
	8"-4" Tees	20	1.58	31.60
	12"-4" Tees	35	3.24	113.40
	15"-4" Tees	25	4.32	108.00
	15"-6" Tees	1	4.32	4.32
	6"-6" Tees	1	1.08	1.08
7	Laying Pipe			
	6" Pipe	3400	.28	952.00
	8" Pipe	600	.30	180.00
	12" Pipe	1100	.32	352.00
	15" Pipe	770	.35	269.50
8	Stoppers			
	4" Stoppers	65	.10	6.50
	6" Stoppers	2	.15	.30

9	Clean Up	sum	sum	20.00
10	Traffic	sum	sum	5.00
	Total			5596.99

District V Cost

1	Trenching	5440	.60	326.40
2	Back Filling	5440	.10	54.40
3	Man holes	20	35.	700.00
4	Vitrified Pipe			
	6" Pipe	2500	.1755	437.50
	10" Pipe	700	.273	191.10
	12" Pipe	800	.5265	411.20
	15" Pipe	840	1.008	846.72
	18" Pipe	600	1.30	780.00
5	Tees			
	6"-4" Tees	90	1.08	97.20
	15"-6" Tees	2	4.32	8.64
	15"-4" Tees	30	4.32	129.60
	12"-4" Tees	28	3.24	90.72
	10"-4" Tees	25	2.52	63.00
6	Laying Pipe			
	6" Pipe	2700'	.28	756.00
	10" Pipe	750'	.30	225.00
	12" Pipe	850'	.32	272.00
	15" Pipe	900'	.35	315.00
	18" Pipe	600'	.35	210.00
7	Stoppers			

Item No	Item	Quanity	Unit Price	Amount
	4" Stoppers	90	.10	9.00
	6" Stoppers	2	.15	.30
8	Clean up	sum	sum	25.00
9	Traffic	sum	sum	5.00
	Total			5953.78
	Dis	trict VI	Cost.	
1	Trenching	2610	.60	156.60
2	Back fill	2610	.10	26.10
3	Man holes	11	35.	385.00
4	Flush Tanks	3	40.	120.00
5	Vitrified Pipe			
	6" Pipe	1285	.1755	224.87
	8" Pipe	275	.273	75.08
	15" Pipe	500	1.008	504.00
	18" Pipe	550	1.30	71.50
6	Tees			
	6"-4 Tees	45	1.08	48.60
	8"-4 Tees	10	1.58	15.80
	15"-4" Tees	16	4.32	69.12
	18-"4" Tees	18	6.00	108.00
7	Laying Pipe			
	6" Pipe	1375	.28	385.00
	8" Pipe	275	.30	82.50
	15" Pipe	500	.35	175.00
	18" Pipe	550	.35	192.50

8	Stoppers			
	4" Stoppers	43	.10	4.30
9	Clean up	sum	sum	20.00
10	Traffic	sum	sum	3.00
	Total			2666.97
	District VII			
1	Trenching	3750	.60	225.00
2	Back Fill	3750	.10	37.50
3	Manholes	12	35.	420.00
4	Flush Tanks	3	40.	120.00
5	Vitrified Pipe			
	6" Pipe	3000	.1755	526.50
	8" Pipe	550	.273	150.15
6	Tees			
	6"-4" Tees	110	1.08	118.80
	8"-4" Tees	18	1.58	28.44
7	Laying Pipe			
	6" Pipe	3200	.28	896.00
	8" Pipe	550	.30	165.00
8	Stoppers			
	4" Stoppers	78	.10	7.80
9	Clean up	sum	sum	10.00
10	Traffic	sum	sum	2.00
	Total			2707.19

District VIII Cost

Item No	Item	Quanity	Unit Price	Amount
1	Trenching	9475	.60	567.50
2	Backfill	9475	.10	94.75
3	Man holes	34	35	1190.00
4	Vitrified Pipe			
	6" Pipe	5610	.1735	980.18
	8" Pipe	930	.273	253.89
	18" Pipe	2125	1.30	2762.50
	20" Pipe	300	1.68	504.00
5	Tees			
	6"-4" Tees	190	1.08	205.20
	8"-4" Tees	35	1.58	55.30
	18"-4" Tees	30	6.00	180.00
6	Laying Pipe			
	6" Pipe	6000	.28	1680.00
	8" Pipe	1000	.30	300.00
	18" Pipe	2175	.35	761.25
	20 Pipe	300	.35	105.00
7	Stoppers			
	4" stoppers	154	.10	15.40
8	Clean up	sum	sum	20.00
9	Traffic	sum	sum	2.00
	Total			9676.97

Total Cost of System.

Item No	Item	Quanity	Unit Price	Amount
1	Trenching	48540	.60	27124.00
2	Back Fill	48540	.10	4854.00
3	Man holes	179	35	6265.00
4	Flush tanks	9	40	360.00
5	Vitrified Pipe			
	6" Pipe	30025	.1755	5254.38
	8" Pipe	3480	.273	954.04
	10" Pipe	3800	.4095	1556.10
	12" Pipe	3530	.5265	1858.55
	15" Pipe	2510	1.008	2530.08
	18" Pipe	3275	1.30	4257.50
	20" Pipe	300	1.68	504.00
6	Tees			
	6"-4" Tees	1070	1.08	155.60
	6"-6" Tees	3	1.08	3.24
	8"-4" Tees	120	1.58	189.60
	10"-4" Tees	73	2.52	183.96
	12"-4" Tees	91	3.24	294.84
	15"-4" Tees	84	4.32	362.88
	15"-6" Tees	2	4.32	8.64
	18"-4" Tees	48	6.00	288.00
7	Stoppers			
	4" stoppers	744	.10	74.40
	6" stoppers	4	.15	.60
8	Clean Up	sum	sum	250.00

9	Laying Pipe			
	6" Pipe	31745	.28	8888.60
	8" Pipe	3550	.30	1065.00
	10" Pipe	3850	30	1155.00
	12" Pipe	3650	.32	1168.00
	15" Pipe	2570	.35	899.50
	18" Pipe	3325	.35	1163.75
	20" Pipe	300	.35	105.00
10	Maintaining Traffic	sum	sum	32.00
11	Imhoff Tank	sum	sum	6850.00
12	Railroad fee	sum	sum	147.00
13	Pumps (reciprocating			
	175 gal. pump	1	200	200.00
	250 gal. pump	1	160	160.00
14	Cast Iron Pipe			
	18" Pipe	166	2.75	456.50
	15" Pipe	66	2.10	170.50
15	Well Chamber	sum	sum	2059.26
16	Filter beds	sum	sum	7000.00
17	Electric Motors			
	3 H.P. Engine	1	68	68.00
	6 H.P Engine	1	98	98.00
18	Dosing Chamber	sum	sum	480.00
19	Engineer	sum	%	9000.00
	Grand Total of System.			98473.61

Conclusion

This plant will with proper care dispose of all the sewage that the town of Ovid will produce for many years to come. Its capacity is approximately 2500 people. This is almost 75% increase over the present population. The units installed are, however, as small as will operate effectively and efficiently.

As has been stated the two creameries should be refused permission to dump their wastes into this system. This is because dairy wastes are very difficult to digest. They also are apt to precitipate on the walls of the tile causing them to stop up frequently. There are cases on record where dairy drains had to be cleaned at least every two weeks. This would cause a great deal of extra expense. Also, the Ovid Creamery Company dumps as much waste as the rest of the town which would mean that the town would have to build a plant of twice the capacity of the proposed one. Of course one might argue that if the company paid the extra expense incurred it would be fair. It must, however, be approached from the sanitary view point. If these dairy wastes got into the tank and were not digested it would cause a weakening of the action on the rest of the sludge. The sludge then drawn off would be very offensive and not fit to be cared for properly. The sludge content of the dairy waste is much higher than that of sewage and this would still further increase the cost of the plant as the sludge tank is one of the most expensive items.

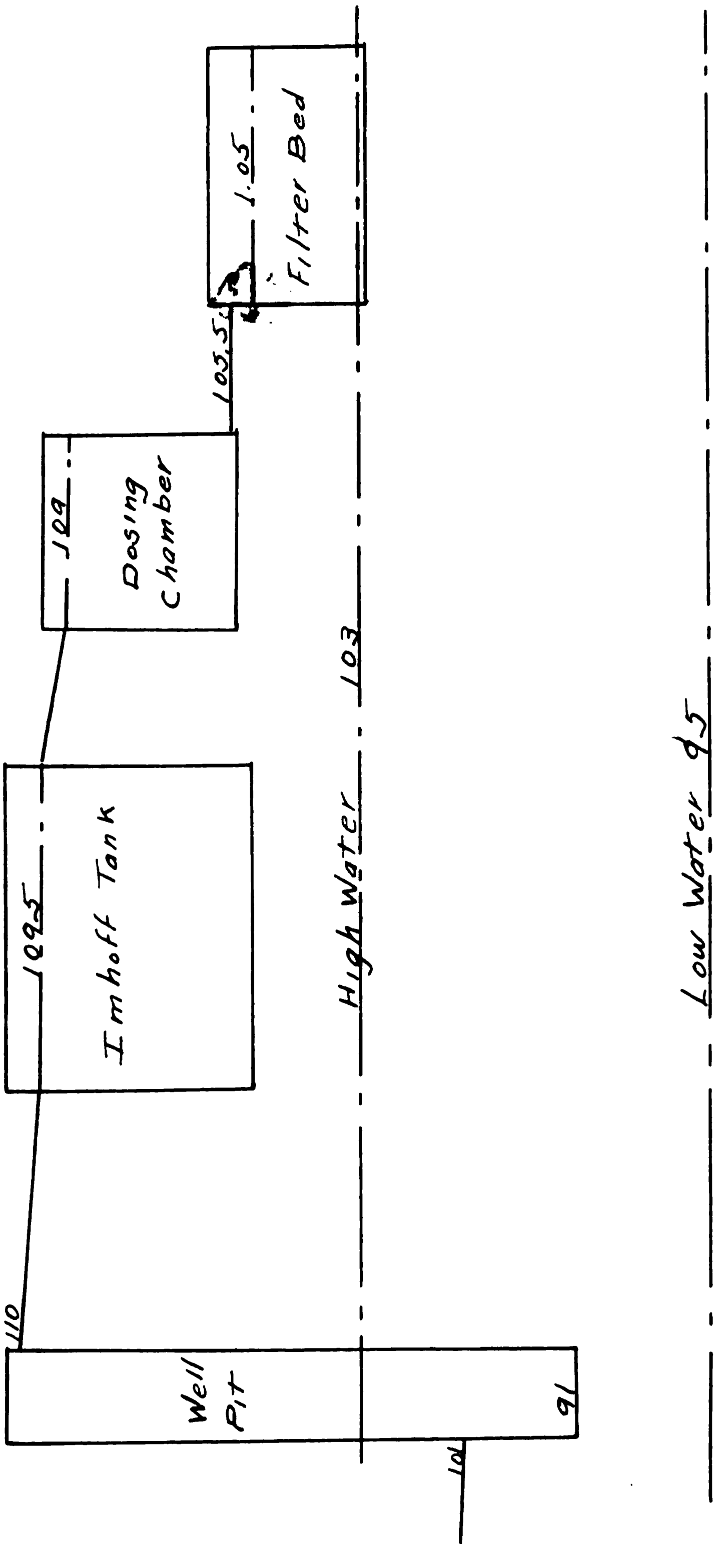
In this design no effort was made to plan the smaller details of reinforcing and other parts of the various tanks but have rather spent the time on the things actually concerning the caring for the sewage.

The main sources of information on which we based our design were Sewerage and Sewage Disposal by Metcalf and Eddy, and Sewage Disposal by Fuller. We also received much helpful information from Col Rich, Mr. Heppler, and Mr. Faust, all of the Michigan State Board of Public Health, also Professor Allen of the Michigan State College.

The problem of Sewage Disposal is at best an unpleasant one to place before the people of a municipality as it is one of our natural tendencies to look only to our own comfort. However, we must take proper precautions to safeguard our neighbor who may live downstream from us. To do this properly all wastes must be properly treated before allowing them to enter any natural body of water or watercourse. It is commonly understood that this is one of the biggest fields open at the present time.

A Digram Showing Elevations at

all points in the Disposal Plant



No	From	To	Street		Inc	Total	Daily	Water	MG	Cu ft/sec	Size "	Capacity	Velocity Cu ft	% Slope	Surface Elev.	Upper	Lower
1	5	6	Mobbitt	350	1.95	1.95	.009	.004	.013	.2	6	.9	3.6	2.7	150.1	143.13	132.6
2	6	7	Mobbitt	350	1.90	3.90	.018	.008	.026	.4	6	.9	4.1	2.7	145.01	132.68	123.2

No	Manhole From	Manhole To	Street	Lgth	Area Inc	Area Total	Million Gals. Daily	Ground Water	Total Max Flow M.G	Total Max Flow Cu ft/sec	Size "	Capacity	Velocity Cu ft	% Slope	Surface Elev.	Invert Elev. Upper	Invert Elev. Lower
1	5	6	Mabbitt	350	1.95	1.95	.009	.004	.013	.2	6	.9	3.6	2.7	150.1	143.13	132.68
2	6	7	Mabbitt	350	1.90	3.90	.018	.008	.026	.4	6	.9	4.1	2.7	145.01	132.68	123.23
3	7	8	Mabbitt	350	1.95	5.85	.027	.012	.039	.6	6	.9	4.6	2.7	137.2	123.23	113.78
4	8	9	Williams	400	2.10	7.95	.035	.016	.051	.78	10	1.0	2.1	.25	117.4	113.78	112.78
5	9	10	Williams	400	2.10	10.05	.046	.021	.067	1.05	12	1.7	2.2	.25	116.6	112.78	111.78
6	10	11	East	150	.3	10.35	.047	.021	.068	1.05	12	1.7	2.2	.25	117.80	111.78	111.40
7	13	12	East	200	.40	.40	.002	.001	.003	.05	6	.8	2.05	2.3	131.8	122.9	118.3
8	52	51	Pearl	350	.75	.75	.0033	.0015	.0048	.075	6	.9	2.5	3.0	130.6	139.3	128.8
9	51	112	Pearl	350	.75	1.50	.0066	.0030	.0096	.15	6	.9	3.1	3.0	130.6	128.8	118.3
10	12	11	East	300	.60	2.5	.011	.005	.016	.25	6	.8	3.5	2.3	123.0	118.3	111.4
11	11	63	Williams	275	.75	13.6	.06	.027	.087	1.35	12	1.7	2.3	.25	118.9	111.4	110.71
12	63	60	Williams	275	.75	14.35	.063	.029	.092	1.42	12	1.7	2.4	.25	120.7	110.71	110.02
13	62	60	Park	150	.3	.3	.0013	.0006	.0019	.03	6	.3	1.1	.4	117.5	110.62	110.02
14	61	60	Park	200	.4	.4	.002	.001	.003	.05	6	.3	1.1	.4	121.2	110.82	110.02
15	60	59	Williams	275	.75	15.8	.069	.032	.101	1.57	12	1.7	2.4	.25	119.6	110.02	109.33
16	59	58	Williams	275	.75	16.75	.074	.034	.108	1.67	12	1.7	2.2	.25	119.1	109.33	108.64
11	57	58	Main	225	.60	.60	.0026	.0012	.0038	.059	6	.3	1.1	.40	117.6	109.54	108.64
18	58	64	Main	250	.65	17.95	.079	.036	.115	1.78	15	2.9	2.2	.20	118.5	108.64	108.14
19	64	65	Main	220	.45	19.40	.085	.039	.124	1.95	15	2.9	2.3	.20	120.5	108.14	107.7

21	113	65	Front	250	.65	1.30	.0066	.0026	.082	.124	6	.5	1.6	.4	123.8	108.7	107.7
22	65	80	Main	300	.80	21.5	.095	.043	.138	2.14	15	2.9	2.6	.2	121.7	107.7	107.
23	80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.143	2.22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

20	114	113	Front	250	.65	.65	.0028	.0013	.004	.062	6	.3	1.1	.4	125.5	109.7	108.7
21	113	65	Front	250	.65	1.30	.0056	.0026	.082	.124	6	.3	1.6	.4	123.8	108.7	107.7
22	65	80	Main	300	.80	21.5	.095	.043	.138	2.14	15	2.9	2.6	.2	121.7	107.7	107.
23	80	81	Main	300	.80	22.3	.098	.045	.143	2.22	15	2.9	2.7	.2	121.8	107.1	106.5
24	81	95	Main	300	.80	23.1	.104	.046	.150	2.34	15	2.9	2.7	.2	110.3	106.5	105.
25	93	92	Elm	225	.50	.50	.0022	.001	.0032	.05	6	.3	1.4	.4	116.8	107.5	106.8
26	92	95	Elm	225	.50	1.00	.0044	.002	.064	.010	6	.3	1.8	.4	115.9	106.8	105.9
27	95	94	Main	300	.60	25.7	.179	.054	.173	2.68	15	2.9	2.7	.2	114.85	105.9	105.3
28	72	71	East	150	.3	.3	.0015	.007	.0022	.034	6	.3	.2	.18	116.1	109.56	109.2
29	66	67	Front	225	.50	.50	.0022	.001	.0032	.05	6	.3	1.4	.46	121.5	112.94	112.02
30	67	69	Front	225	.50	1.0	.0044	.002	.0064	.010	6	.3	1.8	.46	119.8	112.02	111.1
31	76	69	Park	150	.3	.3	.005	.007	.0022	.034	6	.3	.9	.4	119.6	111.7	111.1
32	68	69	Park	220	.50	.50	.0022	.001	.0032	.05	6	.3	1.4	.4	117.5	112.0	111.10
33	69	70	Front	225	.50	2.3	.0103	.0046	.015	.23	6	.32	2.1	.46	118.45	111.10	110.18
34	70	71	Front	225	.50	2.3	.0124	.0056	.018	.28	6	.32	2.1	.46	116.85	110.18	109.26
35	71	73	East	300	.60	3.7	.0163	.0074	.0237	.368	8	.49	1.7	.18	116.53	109.26	108.72
36	79	78	Clinton	225	.50	.50	.0022	.001	.0032	.05	6	.3	1.5	.42	120.3	112.36	111.45
37	78	75	Clinton	225	.50	1.00	.0044	.002	.0064	.10	6	.3	1.8	.42	119.5	111.45	110.59
38	77	75	Park	200	.4	.4	.002	.001	.003	.05	6	.3	1.1	.4	120.2	111.39	110.59
39	75	74	Clinton	225	.50	1.90	.0084	.0037	.0121	.185	6	.33	2.0	.42	119.74	110.54	109.63
40	74	73	Clinton	225	.50	2.40	.0105	.0048	.0153	.236	6	.33	2.1	.42	119.92	109.63	108.72

42	82	83	Oak	350	.70	.70	.003	.0014	.0044	.069	6	.38	1.4	.47	120.2	115.04	111.
43	83	85	Oak	350	.70	1.4	.006	.0028	.0088	.138	6	.38	1.9	.47	120.1	111.44	109.7
44	85	86	[illegible]	350	[illegible]	[illegible]	.009	[illegible]	.132	.204	[illegible]	.38	[illegible]	.47	[illegible]	[illegible]	[illegible]

41	73	86	East	300	.60	4.3	.0199	.086	.0276	.425	8	.49	1.75	.18	119.2	108.72	108.18
42	82	83	Oak	350	.70	.70	.003	.0014	.0044	.069	6	.38	1.4	.47	120.2	113.09	111.44
43	83	85	Oak	350	.70	1.4	.006	.0028	.0088	.138	6	.38	1.9	.47	120.1	111.44	109.79
44	85	86	Oak	350	.70	2.1	.009	.0042	.132	.207	6	.38	1.95	.47	120.1	109.79	108.18
45	86	87	East	300	.60	7.0	.031	.014	.045	.695	10	.85	1.65	.18	119.7	108.18	107.64
46	87	88	Elm	225	.50	7.5	.033	.015	.048	.745	10	.85	2.0	.18	114.8	107.64	107.24
47	88	89	Elm	225	.50	8.0	.035	.016	.051	.79	10	.85	2.0	.18	118.4	107.24	106.84
48	84	89	Park	225	.50	.50	.0022	.0011	.0038	.05	6	.30	1.4	.4	121.0	107.74	106.84
49	89	90	Park	300	.60	9.1	.04	.018	.058	.9	12	1.45	2.0	.18	116.9	106.84	106.3
50	93	92	Elm	225	.50	.50	.0022	.0011	.0033	.05	6	.30	1.4	.4	116.5	107.7	106.8
51	92	95	Elm	225	.50	1.0	.0044	.002	.0064	.10	6	.30	1.1	.4	115.9	106.8	105.9
52	90	91	South	275	.60	9.7	.0425	.0195	.063	.925	12	1.45	2.0	.18	110.0	106.3	105.8
53	91	94	South	275	.60	10.3	.0455	.0206	.066	1.02	12	1.45	2.1	.18	110.9	105.8	105.3
54	100	99	Gratiot	225	.50	.50	.0022	.001	.0032	.05	6	.30	1.4	.4	116.0	105.8	104.9
55	99	98	Gratiot	150	.20	1.7	.0075	.0034	.0109	.169	6	.30	1.9	.4	110.0	104.9	104.3
56	94	97	Interceptor	300	0	36.0	.159	.072	.221	3.43	18	4.7	2.7	.2	110.0	105.3	104.7
57	97	98	Interceptor	300	0	36.0	.159	.072	.221	3.43	18	4.7	2.7	.2	110.0	104.7	104.3
58	96	101	Elm	225	.50	.50	.0022	.001	.0032	.05	6	.30	1.4	.4	112.0	106.7	105.8
59	101	99	Elm	225	50	1.0	.0044	.002	.0064	.10	6	.30	1.1	.4	111.0	105.8	104.9
60	98	159	Interceptor	300	0	37.7	.166	.075	.241	3.72	18	4.7	2.8	.2	110.0	104.3	103.7
61	159	158	Interceptor	300	0	37.7	.166	.075	.241	3.72	18	4.7	2.8	2	110.0	103.7	103.1

62	25	24	North	250	.65	.65	.0028	.0013	.004	.062	6	.59	2.0	1.2	145.0	137.03	133.7
63	24	23	North	250	.65	1.3	.0056	.0026	.0082	.124	6	.59	2.4	1.2	143.0	133.73	130.4
64	23	26	East	275	.70	200	.0083	.004	.0128	.2	6	.59	2.6	1.2	146.0	130.43	127.1
65	26	27	East	275	.70	2.7	.012	.0054	.0174	2.69	6	.59	2.9	1.2	143.0	127.13	123.83
66	1	2	Mabbitt	250	.65	.65	.0028	.0013	.004	.060	6	.75	2.1	2.0	145.0	137.27	132.2
67	2	3	Mabbitt	250	.65	1.3	.0056	.0026	.0082	.124	6	.75	2.4	2.0	134.0	132.27	127.27
68	4	3	Mabbitt	350	.75	.75	.0035	.0019	.0054	.072	6	1.00	2.7	4.0	150.5	141.27	127.27
69	3	22	Prospect	250	.60	2.65	.0115	.0052	.016	.255	6	.40	2.0	.69	135.0	127.27	125.55
70	22	27	Prospect	250	.60	3.25	.0143	.0065	.0208	.322	6	.40	2.2	.69	134.0	125.55	123.83
71	31	30	Prospect	350	.75	.75	.0035	.0019	.0054	.072	6	.39	1.7	.56	136.6	130.85	128.87
72	30	29	Prospect	350	.75	1.5	.007	.0038	.0108	.144	6	.39	1.8	.56	138.2	128.87	126.91
73	29	28	Prospect	350	.75	2.25	.0099	.0045	.0162	.216	6	.39	2.2	.56	137.99	126.91	124.95
74	28	27	Prospect	200	.50	2.75	.012	.0055	.0175	.27	6	.39	2.2	.56	138.68	124.95	123.83
75	27	32	East	200	.50	6.5	.029	.013	.042	.65	8	1.20	3.2	.8	135.8	123.83	122.03
76	17	18	First	250	.60	.60	.0026	.0012	.0038	.059	6	.9	2.4	2.6	152.0	141.53	135.03
77	18	19	First	250	.60	1.2	.0052	.0024	.0076	.118	6	.9	2.8	2.6	149.5	135.03	128.53
78	19	35	East	250	.60	1.8	.0078	.0036	.0114	.177	6	.9	3.2	2.6	149.57	128.53	122.03
79	32	33	Ditch	350	.75	8.05	.0354	.016	.0514	.795	10	1.3	2.1	.39	129.53	122.03	120.28
80	33	34	Ditch	350	.75	8.80	.0388	.0175	.0563	.875	10	1.3	2.2	.39	127.0	120.28	119.11
81	35	34	Park	200	.50	.50	.0022	.001	.0032	.05	6	1.5	4.0	7.2	144.0	137.0	119.11
82	34	36	Ditch	300	.70	1.0	.044	.02	.064	.99	10	1.3	2.3	.39	126.0	119.11	117.44

54	38	37	Main	200	.50	.50	.0022	.001	.0032	.05	6	1.2	3.2	6.0	135.1	128.77	116.77

83	36	37	Ditch	300	.70	10.7	.047	.021	.068	1.05	10	1.3	2.3	.39	125.0	117.94	116.77
84	38	37	Main	200	.50	.50	.0022	.001	.0032	.05	6	1.2	3.2	6.0	135.1	128.77	116.77
85	39	37	Main	200	.50	.50	.0022	.001	.0032	.05	6	1.2	3.2	6.0	135.0	128.77	116.77
86	37	135	Ditch	300	.70	12.4	.0545	.0248	.0793	1.23	10	1.3	2.5	.39	123.51	116.77	115.42
87	135	134	Ditch	300	.70	13.1	.0575	.0262	.0837	1.31	12	2.1	2.8	.39	121.0	115.42	114.25
88	134	133	Ditch	300	.70	13.8	.0606	.0276	.0882	1.36	12	2.1	2.85	.39	119.0	114.25	113.08
89	133	132	Ditch	300	.70	14.5	.0639	.0290	.0927	1.43	12	2.1	2.95	.39	116.7	113.08	111.41
90	21	40	First	350	.75	.75	.0035	.0019	.0054	.072	6	.51	1.9	1.08	145.2	138.37	134.59
91	40	41	First	350	.75	1.5	.0070	.0038	.0108	.144	6	.51	2.0	1.08	144.3	134.59	130.81
92	41	42	First	350	.75	2.25	.0105	.0045	.0150	.216	6	.51	2.0	1.08	145.9	130.81	127.03
93	42	136	First	350	.75	3.0	.014	.0062	.0202	.284	6	.51	2.2	1.08	146.7	127.03	123.25
94	136	137	First	350	.75	3.75	.0165	.0075	.024	.372	6	.51	2.4	1.08	136.1	123.25	119.47
95	137	138	First	350	.75	4.50	.0198	.009	.0288	.446	6	.51	2.6	1.08	131.3	119.47	115.69
96	138	132	First	350	.75	5.25	.0231	.0105	.0336	.52	8	1.1	3.0	1.08	129.0	115.69	111.91
97	132	130	Mill	300	.70	20.45	.0945	.043	.1375	2.12	12	2.1	2.5	1.08	119.3	111.91	110.74
98	131	130	High	375	.75	.75	.0035	.0019	.0054	.072	6	.3	1.0	1.08	118.6	112.24	110.74
99	130	129	High	75	.20	21.3	.0965	.044	.1405	2.18	15	4.0	3.1	.39	116.8	110.74	108.79
100	125	126	High	350	.75	.75	.0035	.0019	.0054	.072	6	5.1	1.8	1.12	130.0	125.94	120.21
101	126	128	High	350	.75	1.50	.007	.0038	.0108	.144	6	5.1	1.9	1.12	125.7	120.21	115.28

104	50	53	Pearl	250	.60	.60	.0026	.0012	.0038	.059	6	.3	.9	.40	122.9	1175	[illegible]
105	53	54	Pearl	250	.60	1.2	.0052	.0024	.0076	.118	6	3	1.2	.40	[illegible]	[illegible]	[illegible]

104	50	53	Pearl	250	.60	.60	.0026	.0012	.0038	.059	6	.3	.9	.40	122.9	117.59	116.59
105	53	54	Pearl	250	.60	1.2	.0052	.0024	.0076	.118	6	.3	1.2	.40	122.48	116.59	115.59
106	49	54	Park	200	.50	.50	.0022	.001	.0032	.05	6	1.0	2.2	4.5	130.0	124.59	115.59
107	54	55	Pearl	275	.60	2.3	.0099	.0046	.0145	.232	6	.3	1.9	.40	121.7	115.59	114.49
108	55	56	Pearl	275	.60	2.9	.0128	.0058	.0186	.288	6	.3	2.0	.40	117.8	114.49	113.39
109	16	15	High	250	.60	.60	.0026	.0012	.0038	.059	6	.7	1.9	1.8	145.0	138.4	133.7
110	15	14	High	250	.60	1.2	.0052	.0024	.0076	.118	6	.7	2.1	1.8	140.49	133.7	129.0
111	20	14	East	350	.75	.75	.0035	.0019	.0108	.144	6	.9	2.2	2.8	146.2	140.0	129.0
112	14	48	High	400	.8	2.75	.0121	.0055	.0176	.272	6	.45	2.1	.8	134.17	129.0	125.8
113	48	47	High	400	.8	3.55	.0156	.0071	.0228	.354	6	.45	2.2	.8	132.1	125.8	122.6
114	43	47	Park	220	.55	.50	.0022	.001	.0032	.05	6	1.3	3.2	7.0	145.0	138.0	122.6
115	47	46	High	275	.60	4.70	.0207	.0094	.0301	.467	6	.47	2.2	.8	133.63	122.6	120.4
116	46	45	High	275	.60	5.30	.0234	.0106	.0339	.525	8	1.0	2.9	.8	132.55	120.4	118.2
117	44	45	Main	200	.50	.50	.0234	.0106	.0032	.05	6	.65	1.9	1.6	135.0	121.4	118.2
118	45	56	Main	300	.70	6.50	.0286	.023	.0416	.645	8	1.4	3.5	1.6	130.35	118.2	113.39
119	56	123	Pearl	275	.60	10.0	.044	.02	.064	.99	10	1.3	2.5	.4	117.4	113.39	112.29
120	123	124	Pearl	275	.60	10.6	.047	.021	.068	1.05	10	1.3	2.6	.4	117.43	112.29	111.19
121	127	124	Gratiot	200	.50	.50	.0022	.001	.0032	.05	6	.3	1.1	.4	122.0	111.89	111.19
122	124	142	Pearl	275	.60	11.7	.0515	.0234	.0749	1.16	10	1.3	2.6	.4	116.5	111.19	109.99
123	142	139	Pearl	275	.60	12.3	.054	.025	.079	1.22	10	1.3	2.7	.4	117.04	109.99	108.79

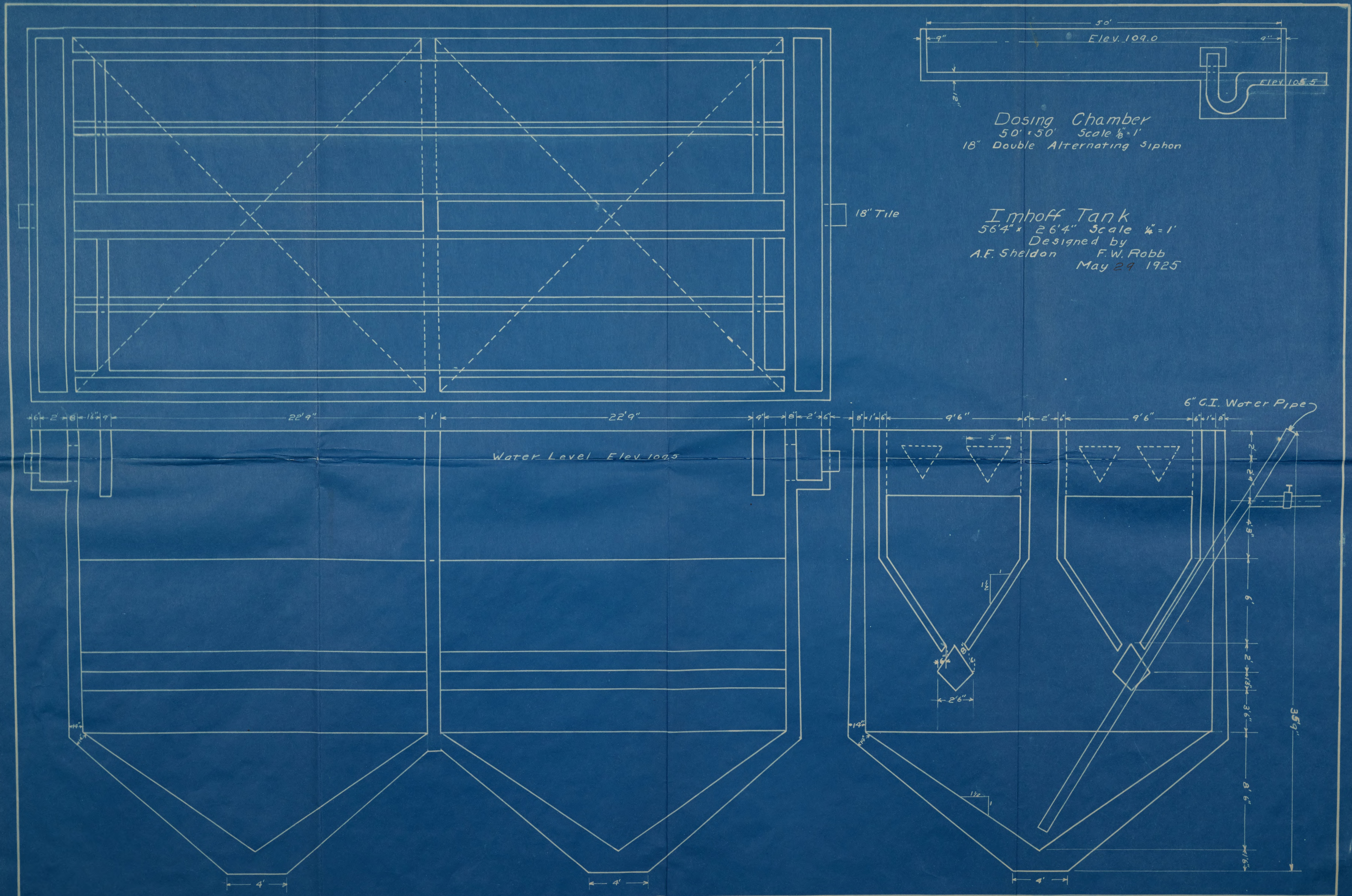
124	141	140	Pearl	240	.60	.60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
125	140	139	Pearl	240	.60	1.2	.0052	.0024	.0076	.118	6	.3	1.2	.4	117.74	109.75	[illegible]
[illegible]	[illegible]	[illegible]	Mill	250	.70	28.45	.169	.077	[illegible]	3.81	15	[illegible]	3.2	.38	115.5	108.79	107.62

124	141	140	Pearl	240	.60	.60	.0026	.0012	.0038	.059	6	.3	.9	.4	118.3	110.71	109.95
125	140	139	Pearl	240	.60	1.2	.0052	.0024	.0076	.118	6	.3	1.2	.4	117.74	109.75	108.79
126	139	144	Mill	350	.70	38.45	.169	.077	.246	3.81	15	4.0	3.2	.39	115.5	108.79	107.62
127	119	120	Williams	275	.60	.60	.0026	.0012	.0038	.059	6	.3	.9	.4	118.1	111.97	110.87
128	120	121	Williams	275	.60	1.2	.0052	.0024	.0076	.118	6	.3	1.2	.4	116.65	110.87	109.77
129	118	121	Gratiot	200	.50	.50	.0022	.001	.0032	.05	6	.3	1.1	.4	121.0	110.57	109.77
130	122	121	Gratiot	175	.40	.40	.0018	.0008	.0026	.04	6	.3	.6	.4	117.0	110.47	109.77
131	121	143	Williams	275	.60	2.5	.0011	.005	.016	.248	6	.3	2.2	.4	118.25	109.77	108.57
132	143	144	Williams	275	.60	3.1	.014	.006	.02	.311	8	.75	2.1	.4	117.47	108.57	107.62
133	146	144	Mill	175	.40	.40	.0012	0008	.0026	.04	6	.3	.6	.4	119.0	108.07	107.62
134	144	145	Williams	275	.60	42.55	.188	.085	.273	4.25	18	6.6	3.6	.39	115.72	107.62	106.32
135	145	163	Williams	275	.60	43.15	.19	089	.279	4.34	18	6.6	3.7	.39	115.0	106.32	105.37
136	169	170	Elsie	300	.70	.70	.003	.0014	.0044	.069	6	.3	1.1	.4	116.9	112.17	110.97
137	170	171	Elsie	300	.70	1.4	.0062	.0028	009	.139	6	.3	1.2	.4	114.8	110.97	109.77
138	171	172	Williams	275	.60	2.0	.0088	.004	.0128	.198	6	.3	1.25	.4	110.9	109.77	108.67
139	172	173	Williams	275	.60	2.6	.012	.0052	.0172	.266	6	.3	1.9	.4	113.0	108.67	107.57
140	174	173	Short	350	.75	.75	.0035	.0019	.0054	.072	6	.3	1.15	.4	114.8	108.79	107.57
141	173	175	Williams	275	.60	3.95	.0173	.0079	.0252	.392	8	.75	2.0	.4	114.75	107.57	106.47
142	175	163	Williams	275	.60	4.55	.02	.009	.029	.45	8	.75	2.2	.4	115.2	106.47	105.37
143	168	167	High	350	.75	.75	.0035	.0019	.0054	.072	6	.3	1.15	.4	119.6	112.17	110.77
144	167	166	High	350	.75	1.50	.007	.0038	.0108	.144	6	.3	1.8	.4	117.2	110.77	109.37

145	166	165	High	300	70	2.2	.0097	.004	.0137	.216	6	.3	2.0	.4	120.24	107.37	108.17
146	165	164	West	350	.75	2.95	.013	.0059	.0189	.292	6	.3	1.9	.4	118.34	108.17	106.77

145	166	165	High	300	.70	2.2	.0097	.004	.0137	.216	6	.3	2.0	.4	120.24	109.37	108.17
146	165	164	West	350	.75	2.95	.013	.0059	.0189	.292	6	.3	1.9	.4	118.34	108.17	106.77
147	164	163	West	350	.75	3.7	.0163	.0074	.0237	.368	8	.75	2.1	.4	118.50	106.77	105.37
148	163	162	West	200	.50	51.9	.228	.104	.332	5.15	18	6.6	4.1	.39	117.3	105.37	104.59
149	162	160	West	275	.60	52.5	.231	.105	.336	5.21	18	6.6	4.15	.39	113.0	104.59	103.52
150	149	150	Front	240	.55	.55	.0024	.0011	.0035	.055	6	.61	1.9	1.6	119.1	111.21	107.37
151	150	160	Front	240	.55	1.1	.0048	.0022	.007	.109	6	.61	2.4	1.6	115.06	107.37	103.52
152	160	154	West	300	.70	54.3	.239	.109	.348	5.4	18	6.6	4.3	.39	110.0	103.52	102.36
153	151	152	Clinton	240	.55	.55	.0024	.0011	.0035	.055	6	.21	.9	.2	110.0	103.46	102.91
154	152	154	Clinton	240	.55	1.1	.0048	.0022	.007	.109	6	.2	1.1	.2	110.0	102.91	102.36
155	154	161	Clinton	350	.75	56.15	.248	.113	.361	5.6	18	6.6	4.2	.39	110.0	102.36	101.0
156	116	115	Gratiot	175	.40	.40	.002	.001	.003	.05	6	.35	1.0	.5	124.5	119.22	118.34
157	115	117	Front	300	.70	1.1	.0048	.0022	.007	.109	6	.5	2.0	.94	126.18	118.34	115.52
158	117	148	Front	300	.70	1.8	.0079	.0036	.0115	.179	6	.5	2.1	.94	125.1	115.52	111.82
159	147	148	Mill	175	.40	.40	.002	.001	.003	.05	6	.35	1.0	.50	120.1	112.7	111.82
160	148	112	Mill	300	.70	2.9	.0128	.0058	.0186	.288	6	.5	2.5	.94	124.6	111.82	110.62
161	107	106	Clinton	275	.60	.60	.0026	.0012	.0038	.059	6	.3	1.0	.42	121.8	115.34	114.29
162	106	108	Clinton	275	.60	1.2	.0052	.0024	.0076	.118	6	.3	1.2	.42	121.9	114.29	113.14
163	176	108	Gratiot	200	.40	.40	.002	.001	.003	.05	6	.35	1.0	.50	125.0	113.94	113.14
164	108	111	Clinton	275	.60	2.2	.0097	.0044	.0141	.218	6	.31	1.95	.42	122.18	113.14	111.88
165	111	112	Clinton	275	.60	2.8	.0123	.0056	.0179	.278	6	.31	2.1	.42	120.94	111.88	110.62

168	103	104	Oak	275	.60	1.2	.0052	.0024	.0076	.118	6	.37	1.6	.57	120.1	113.11	111.6
169	105	104	Gratiot	200	.40	.40	.002	.001	.003	.05	6	.35	1.0	.4	121.2	112.4	111.6
170	104	109	Oak	300	.70	2.3	.0101	.0046	.014	.228	6	.37	2.1	.57	116.94	111.6	109.8
171	109	110	Oak	300	.70	3.0	.0132	.006	.0192	.298	6	.37	2.2	.57	111.0	108.89	108.18
172	110	153	Oak	300	.70	10.1	.0445	.0202	.0647	1.0	8	1.1	3.2	.94	110.0	108.18	105.46
173	153	155	Oak	300	.70	10.8	.0476	.0216	.0692	1.07	8	1.1	3.1	.94	110.0	105.46	102.74
174	177	155	West	200	.40	.40	.002	.001	.003	.05	6	.8	1.8	2.1	110.0	106.94	102.7
175	155	156	Oak	100	.20	11.4	.0501	.0228	.0729	1.12	8	1.1	3.0	9.4	110.0	102.74	101.8
176	158	157	Interceptor	300	0	37.7	.166	.075	.241	3.72	18	4.7	2.8	.2	110.0	103.1	102.4
177	157	156	Interceptor	300	0	37.7	.166	.075	.241	3.72	18	4.7	2.8	.2	110.0	102.4	101.8
178	156	161	Interceptor	300	0	49.1	.220	.099	.319	4.9	20	6.0	2.7	.2	110.0	101.8	101.0
179	178	179	Front	250	.50	.50	.0022	.001	.0032	.05	6	.3	1.6	.4	110.2	106.0	106.
180	180	179	Front	250	.50	1.0	.0044	.002	.0064	.10	6	.3	1.6	.4	111.0	106.0	105.
181	179	161	Ditch	300	1.2	1.2	.0060	.003	.009	.20	6	.8	1.9	1.33	111.2	105.0	101.



Dosing Chamber
5.0' x 5.0' Scale ½" = 1'
18" Double Alternating Siphon
Elev. 109.0
Elev. 105.5
18" Tile
Imhoff Tank
56'4" x 26'4" Scale ¼" = 1'
Designed by
A.F. Sheldon F.W. Robb
May 29 1925
Water Level Elev. 109.5
6" C.I. Water Pipe

Plate 2.