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## Water supply - Manitowoc. 1935

Thwaites, F. T. (Fredrik Turville), 1883-1961

[s.l.]: [s.n.], 1935

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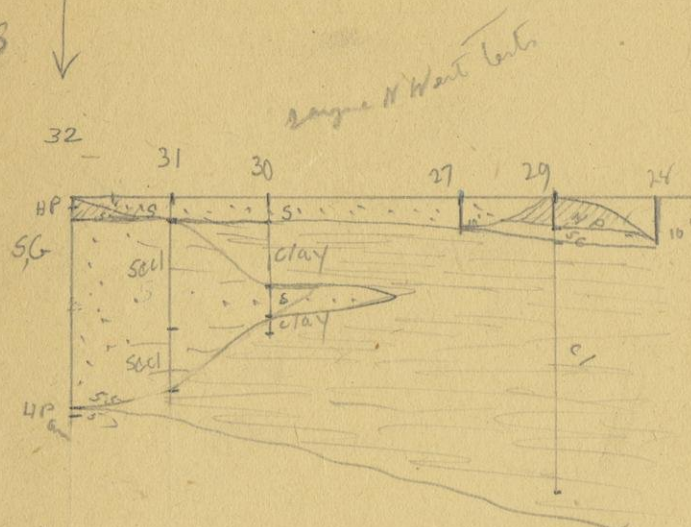
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1" = 200'  
 1" = 50'

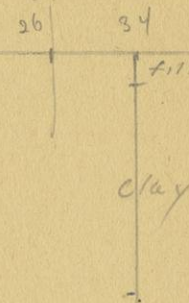
Well No 2



blow sheet 80  
 60  
 540

map  
 6.4 = 5280'  
 1" = 825 ft

Wp 35' T.D.



360  
 1040  
 160  
 1600

Valdens well 480

Geology of water supply at Montrose, W. Va.

- Introduction
- St Peter and older sandstones
- Neogam dolomite
- Surf
- Summary

- Illustration
- ✓ geol. map Sec. Valdens - Montrose ✓ out
- ✓ Region of better formation - fine
- maps showing gravel detri. outcrops, fine
- ✓ Chart of mineral analyses
- at wells
- at Mont
- Rahr - done
- Sleepy Run
- Two Rivers shallow deep

Photos 362 ✓  
 1188  
 1193  
 1189 done

Valders

812  
massen

Twp 12mo

Drift

Twp

Twp 12mo  
sheep farm

Rahr

do not use

LAKO

NIA GARA

RICHMOND

GALENA - PLATTEVILLE

ST PETER ETC

Niagara

Richmond

Galena -  
Platteville

ST Peter  
etc

260

1005

1263

1680 T.D.

812  
852  
2

Valders sta 812

Cats NW cor 35 269 = 850  
@ NE " 259 = 840

near Rapids

@ 35 111 = 692  
34 siber 2 158 = 731

1" = 1 mile  
1" = 500'

Radonakt Pit

L N to Tests in gravel

1  
1A) near No 1

2

11

✓ 17 = No 1 city

✓ 18

✓ 19

25 in pit

✓ 32 = No 2 city

✓ 35 in city North Medium Hammer

gray malarja tests in gravel

North

Kusch

Hammer

June 4, 1935

Mr. J. Albert M. Robinson,  
228 North La Salle St.,  
Chicago, Illinois

Dear Mr. Robinson:

In response to your request of some time ago I am sending you herewith the information you wanted in regard to the geology of the water-bearing gravels at Manitowoc, Wisconsin. Data on the chemistry of the underground waters of that vicinity is also enclosed.

The information was obtained in part from published sources, in part from the files of the Wisconsin Geological Survey, and in part in the field both when on trips with ~~cases~~ and on the trip made at your request in May, 1935.

A study of the table of analyses which I recomputed so as to be all comparable shows at once that the only waters suitable for a public supply at Manitowoc are (a) from gravel deposits in the glacial drift, and (b) Lake Michigan.

The waters from the Niagara limestone are, so far as known, all of the "mineral water" class in or near the city. I had formerly supposed that these are waters from the deeper formations which are rising along a "fault" or break in the rock layers but I am now doubtful on this point for two reasons: (a) the proof on which the assumption of a fault rests is the log of the first deep well in Two Rivers which may be unreliable, and (b) a cover of shale over the limestone such as is known in the northern part of Milwaukee and is reported at Two Rivers would serve to prevent flushing of the Niagara by fresh waters and bring about the presence of highly mineralized water close to the surface. The suggested shaliness not extend farther west than the lake shore. Moreover, it is reported that the water in the lower part of the test well drilled in 1934 at the Rahr Maltine Co. is salty and unlike the Niagara waters.

The waters in the gravel deposits are almost all very hard and contain much permanent or sulphate hardness. I formerly explained this on the assumption that these waters are in part derived from the underlying bed rock. However, an alternative view is to ascribe this condition to relative stagnation of these waters in discontinuous bodies of gravel through which there is no active circulation of fresh rainwater. The softest water is that from No. 2 city well at the power plant. Under the second theory this fact would be capable of explanation either (a) because the water escapes into the lake or (b) pumping draws in considerable lake water. Existing information is not enough to decide which explanation is best.

The source of the iron which is so troublesome in some of the gravel waters is made evident from the photograph of the Radandt pit southwest of the city. Here it is clear that the vegetation of the soil is dissolving iron from the surface red clay or till (glacial deposit). This is deposited in part as iron oxide in

the subsoil particularly where the roots of trees once were and the remainder is carried down into the ground water. The recent drought lowered the level of the underground water causing the deposition of much of the iron as iron oxide just above the present water level. Analyses indicate that there is less iron in the waters north of the city. It seems possible that this is because there is less of a cover of red clay and red till on them although this is not proved.

The geology was in large part worked out while on field trips with students and the present study in connection with your request of logs of test borings has confirmed earlier conclusions. I also had a conference with Mr. R. E. Milneger who furnished logs of all of the Gray-Milneger test borings of 1933-34. To facilitate both brevity and understanding by laymen I have condensed most of my geologic data into maps and cross sections.

The map, fig. 1 is presented in pencil and is based both on the soils map and on field observation. It makes clear the distribution of the two main gravel deposits north and south of the city respectively. The deposit near to No. 3 city well appears to be limited in extent as it could not be traced to either north or south. A Gray-Milneger test close to Layne-Northwest No. 35 which is northwest of the well at the power plant failed to find a significant amount of gravel.

Fig. 2, also in pencil, is an actual section through the northern gravel deposit at the city gravel pits based upon the Layne-Northwest tests

Fig. 3 is a series of five generalized or hypothetical sections showing the origin of the gravels. The two advances of the glacier which brought about this work were the last two in the region. The ice came from Canada through the basin of Lake Michigan. As each advance wasted away the water level of the lake was fixed by the elevation of the divide to Des Plaines River west of Chicago. At first this was about 60 feet above Manitowish city datum. Later, after these events shown in the diagrams, the outpouring waters wore away the divide to its present condition.

From the standpoint of underground waters the following facts are important: (a) the sand and gravel deposits are deltas of rather limited horizontal extent and are unlike blanket deposits, (b) the deltas have steeply inclined layers so that tests a short distance apart show different materials, (c) the sides of the gravel bodies are rather abrupt, (d) when the ice came over the deltas it folded the layers and mixed in shoved masses of lake clay and sand adding greatly to the complexity and rendering interpretation of test borings very difficult.

Attention should be directed to the fact that other similar gravel deposits occur southwest of the city. The elevation is not known but if above 60 feet city datum they may prove to be of the blanket type, that is rather thin but of wide extent.

J. A. M. R., 3

With the above facts in mind it is not hard to see why the capacity of the city wells has diminished during the recent dry years. The extent to which deposits of iron, silt, and calcium carbonate (lime) in the gravels and screens has permanently affected the capacity of the wells can only be determined by underground exploration.

I do not desire to pass upon the question of changing to lake water. Even if this were done the time required would be so great that well water will have to be used for a long period yet.

If you copy any of the diagrams I have enclosed for your report please state on each that it is material furnished by me. I would greatly appreciate having <sup>two</sup> copies of each, one for the Survey file and one to use in connection with trips to the region with students.

My bill for expenses is enclosed. Mr. Bean states that I am not allowed to charge anything for time as the account is to be charged to the city. I regret that time did not permit inking in the diagrams.

Very truly yours,

F. T. Thwaites, In charge of well records,  
Wisconsin Geological Survey

WATER ANALYSES  
MANITOWOC AND VICINITY

| Well                            | Date | Hard-<br>ness | Alkalinity | Iron | Chlorine | Total Solids |
|---------------------------------|------|---------------|------------|------|----------|--------------|
| <u>DRIFT</u>                    |      |               |            |      |          |              |
| No. 1 city                      | 1926 | 378           | 230        | 0    | 20       | 514          |
|                                 | 1934 | 305           | 256        | 0    | 16       | 730          |
| No. 2 city                      | 1927 | 208           | 170        | 0    | 20       | 298          |
|                                 | 1934 | 235           | 176        | 0    | 14       | 289          |
| No. 3 city                      | 1927 | 314           | 230        | 0.6  | 8        | 388          |
|                                 | 1934 | 385           | 222        | 1.0  | 17       | 516          |
| No. 4 city                      | 1930 | 428           | 254        | 0    | 16       | 466          |
|                                 | 1934 | 400           | 252        | 0    | 19       | 530          |
| Dug well                        | 1907 | 204           | 178        | -    | 7        | 252          |
| Muth test                       | 1933 | 1160          | 248        | 0    | 23       | 1764         |
| <u>Gray-Milaeger</u>            |      |               |            |      |          |              |
| No. 1                           | 1933 | 440           | 210        | 0.4  | 20       | -            |
|                                 | 1934 | 440           | 196        | 0.7  | 25       | -            |
| <u>NIAGARA "mineral waters"</u> |      |               |            |      |          |              |
| Sheep farm                      | 1927 | 1927          | 215        | 4.0  | 187      | -            |
| Manitowoc<br>Malting<br>Company |      | 1838          | 237        | 0.6  | 105      | 2544         |
| Rahr 150'                       | 1877 | 2193          | 268        | -    | 196      | 3244         |
| Two<br>Rivers                   | 1914 | 1330          | 248        | -    | 343      | 3257         |
| <u>NIAGARA normal waters</u>    |      |               |            |      |          |              |
| Cleveland                       | 1907 | 403           | 263        | -    | 12       | 477          |
| Kiel                            | 1905 | 277           | 274        | -    | 7        | 281          |
| <u>ST. PETER, ETC.</u>          |      |               |            |      |          |              |
| Two<br>Rivers                   | 1914 | 1527          | 991        | -    | 104      | 3548         |
| Sheboygan                       | 1876 | 3953          | 202        | 4.7  | 5099     | 11370        |
| <u>LAKE MICHIGAN</u>            |      |               |            |      |          |              |
| Port Wash-<br>ington            | 1907 | 115           | 110        | -    | 4.7      | 134          |
| Manitowoc                       | -    | 135           | 133        | -    | 4.3      | 197          |





1189

TAMR

Shows westward slope of  
layers in gravel pit  
north of city.

McVIGAR PHOTO SERVICE  
QUALITY PRINT

J. ALBERT M. ROBINSON  
CONSULTING ENGINEER  
228 NORTH LA SALLE STREET  
CHICAGO

CENTRAL 9129

May 3, 1935

Prof. F. T. Thwaites  
RFD No. 4  
Madison, Wisconsin

Dear Prof. Thwaites:

Answering your letter of the 30th ultimo, I am planning on going to Manitowoc by sleeper during the night of the 10th instant in order to be with you there on Saturday the 11th. As I have plenty of other work to do there, I will remain until the morning of the 14th.

I have written to Manitowoc stating that you will look the situation over on your return from Two Rivers next Sunday morning.

Will you please advise if you can be in Manitowoc on Saturday the 11th.

Yours very truly,

JAMR/ljm

P. S. Inasmuch as you have access to U.S.G.S. maps in Madison, I wish that you would get one for me that will cover this entire Manitowoc area and take it with you for my use.

JAMR

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F. M. GRAY, Pres.

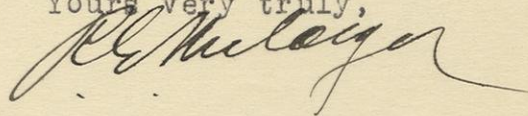
May 27, 1935

Mr. F. T. Thwaites.  
University of Wis.  
Madison, Wisconsin

Dear Sir:

Answering yours of the 21st and 23rd, I wish to say that I will be in Madison on Wednesday or Friday most likely on Friday, and will take up the Madison water survey with you, and will have all information pertaining to same with me.

Yours very truly,



water analysis chart.

DRIFT

|                                 | Date     | H.   | A   | Fe  | Cl  | TS    |
|---------------------------------|----------|------|-----|-----|-----|-------|
| Cty No 1                        | 1926     | 378  | 230 | 0   | 20  | 514   |
|                                 | 1934     | 505  | 256 | 0   | 16  | 730   |
| No 2                            | 1927     | 208  | 170 | 0   | 20  | 298   |
|                                 | 1934     | 235  | 176 | 0   | 14  | 289   |
| No 3                            | 1927     | 314  | 230 | 0.6 | 8   | 388   |
|                                 | 1934     | 385  | 222 | 1.0 | 17  | 516   |
| No 4                            | 1930     | 428  | 254 | 0   | 16  | 466   |
|                                 | 1934     | 400  | 252 | 0   | 19  | 530   |
| old dug well<br>muth test       | 1907     | 204  | 178 | -   | 7   | 252   |
|                                 | -        | 1160 | 248 | 0   | 23  | 1764  |
| NIAGARA "mineral" water         |          |      |     |     |     |       |
| Sheep Farm well                 | 1927     | 1927 | 215 | 4.0 | 187 | -     |
| mantowoc maly Co                | -        | 1838 | 237 | 0.6 | 105 | 3544  |
| Rahr 150ft well                 | 1877     | 2193 | 268 | -   | 196 | 3,244 |
| Two Rivers <sup>depth</sup> 800 | 1914     | 1330 | 248 | -   | 343 | 3,257 |
| normal water                    |          |      |     |     |     |       |
| Cleveland depth 219             | 1907     | 403  | 263 | -   | 412 | 477   |
| Kiel                            | 472 1905 | 277  | 274 | -   | 7   | 281   |
| DRIFT                           |          |      |     |     |     |       |
| jug malyer No 1 well            | 1933     | 440  | 210 | .4  | 20  | -     |
|                                 | 1934     | 440  | 196 | .7  | 25  | -     |

DEEP WELLS

|                                  |      |      |     |     |       |        |
|----------------------------------|------|------|-----|-----|-------|--------|
| Two Rivers <sup>depth</sup> 1640 | 1914 | 1527 | 991 | -   | 104   | 3,548  |
| Sheboygan                        | 1476 | 3955 | 202 | 4.7 | 5,099 | 14,370 |

LAKE MICHIGAN  
~~Lake Michigan~~

|                 |      |     |     |   |     |     |
|-----------------|------|-----|-----|---|-----|-----|
| Port Washington | 1907 | 115 | 110 | - | 4.7 | 134 |
| mantowoc        | -    | 135 | 133 | - | 4.3 | 197 |

New #2 well @ 500-600 gpm lower #1 about 4 ft.

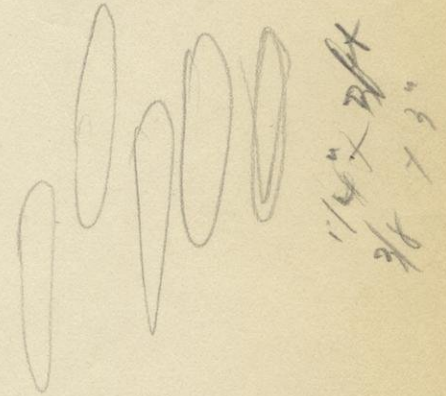
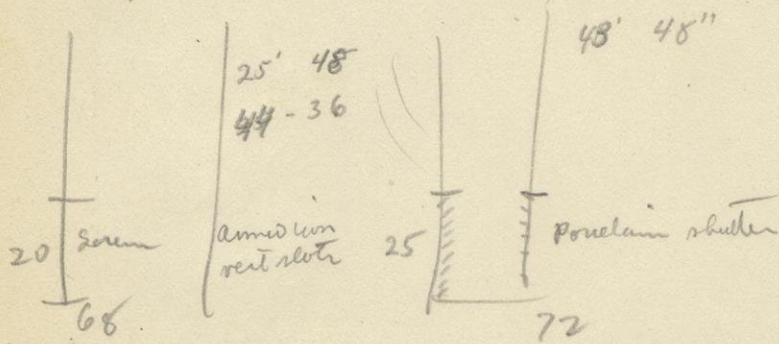
red clay at variable depths to 44 ft - more than one streak  
 main clay at 24  
 blue clay in gravel - thin - 55 ft

Top

|                       |    |      |
|-----------------------|----|------|
| sand                  | 5  | 5    |
| clay-red              | 19 | 24   |
| gravel & sand-water   | 8  | 32   |
| red clay & sand       | 12 | 44   |
| fine sand             | 24 | 68   |
| gravel with blue clay |    |      |
| streak at 50-55       |    | 5-73 |

hardpan-gray

N. area gravel rests on lime causing hard water  
 turned down on this account



well No. 1. 8-11-34

alt 196 H. 440

7-29-33 210 440

cl 25.0 Fe 0.7  
 20 .4

average Fe .7 to .8  
 H 4400-425 on  
 long test

AP wells 3-  
1000 gpm - others 400-500 gpm  
deep well timber  
used for condenser

Flowing wells W of N gravel pits 200-300' W of road  
in Little Manawoc

gray esp limited to S of creek  
Iron low or absent - but hardness excessive

9<sup>th</sup> checked Logans log

N side 3 wells, 6, 8, 10" wt of water

Thome drilled 2 wells at Silver Creek, 1st test 40' S of Thome #2  
= GM #12

N & E of final well - hole all sand

Tested N of pit S of Silver Creek  
lots of iron

Seven day test on well No 1

2096 gpm max.

iron increased with decreased rate

Silver Creek No 1 - N & E - all sand 200-300'

S & W - all gravel.

New pit, 89' - 56' gravel below day  
near test <sup>point</sup> bridge 25' E. <sup>bottom</sup>

water level = lake level ~~5'~~ 5' below floor

No 1. Pumping 1852 gpm - 50' - water at 26'-2" (normal 5')

in well ~~7'~~ lowered 45'

later test water lowered 45' well only 14'

in wells 4 ft away! Trouble due to silt

45' ~~21~~

1640 2 Run

No 1

Cl 10.39 pp 100,000  
103.9 ppm

H = 1527 ppm

perm. H = 15270

Temp H = 0

W left out

mg CO<sub>3</sub> ~~196~~ ppm

835. x .714 = 596 x 166 = 991

no mg SO<sub>4</sub>

1000

at 800

T.S = 3470 ppm

Cl 343.2

H = 1330.5

perm H = 1330.5

x .714

= 149.3 CO<sub>3</sub> = 248

mg CO<sub>3</sub> 209.4 ppm note error

=

259

SW compared 1 & 2



Casco pit ~~T-24~~  
78450

Slungun Bay  
H 20 gpg in S.B. well 43 gpg total solids  
14 gpg in sample

~~ST~~ T-27

Casco pit well  
water at 1200  
H = 371  
alk 305

43.  
17.  
301.  
43  
731

T.D. H. 1300  
alk 160  
Cl 500  
T.Sol 2006

May 6, 1935

Mr. J. Albert M. Robinson,  
228 North LaSalle St.,  
Chicago, Illinois

Dear Mr. Robinson:

Yours of the 3rd arrived while I was in the field with my class.

I was in Manitowoc Sunday morning but it was raining and little was accomplished. Besides we were late off from our stay in Two Rivers and had a long day ahead of us.

There is no U. S. G. S. map anywhere near Manitowoc. I will look up the U. S. Lake Survey chart which I think shows most of the city, also my soils map which is accurate and up to date but shows no elevations. Probably the city engineer can furnish elevations. I hope they have copies of the logs of the test holes.

I will meet you in Manitowoc early on Saturday the 11th probably at the Hotel Hay but will write again when I find out whether it is best to drive up in my car or to go on the bus. I think it probable that I will drive up. I must be back for a class on the afternoon of the 13th, Monday.

Sincerely,

F. T. Whaites

J. ALBERT M. ROBINSON

CONSULTING ENGINEER

228 NORTH LA SALLE STREET

CHICAGO

CENTRAL 9129

May 8, 1935

- Prof. F. T. Thwaites,  
211 Science Hall,  
University of Wisconsin,  
Madison, Wisconsin.

Dear Prof. Thwaites,

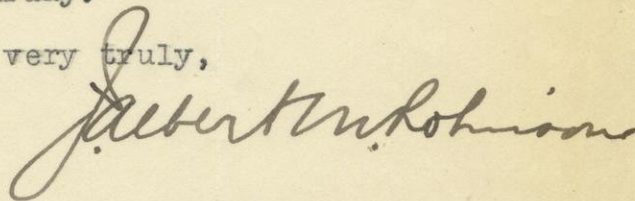
Your letter of the 6th instant came while I was not in the City, hence the delay in answering it.

I have a Lake Survey chart, but no U. S. G. S. I believe that they have rather complete information on the test wells.

I would drive if it were not for a Board meeting on Friday night, hence must go by sleeper. I think that it would be better if you drive, although I have asked for a Department car, but have not heard whether I can get it. I will return by sleeper on Monday night.

I will be at the Manitowoc Hotel and will look for you there or at the office of the Commission, 817 Franklin Street. I will be at the office after 8 AM, Saturday.

Yours very truly,



J. ALBERT M. ROBINSON  
CONSULTING ENGINEER  
228 NORTH LA SALLE STREET  
CHICAGO

CENTRAL 9129

April 26, 1935

Re: Public Utilities Commission  
Manitowoc, Wisconsin.

Prof. F. T. Thwaites  
211 Science Hall  
University of Wisconsin  
Madison, Wisconsin

Dear Prof. Thwaites:

It was with real regret that I was notified on Wednesday afternoon that my telegram had not reached you as you were at Devils Lake. I had wanted to talk to you Wednesday evening at your home on the subject of water supply for the above as I was leaving by sleeper that night to attend a meeting last night, wherein I hoped to be appointed as Consultant to make an investigation and report in accordance with the following resolution.

"BE IT RESOLVED by the Common Council of the City of Manitowoc that the Public Utilities Commission be and it is hereby authorized and directed to engage the services of a competent engineer with the approval of the Board of Public Works to make a thorough survey of our water supply for the purpose of ascertaining whether an adequate supply of potable ground water is available and the desirability of constructing a reservoir and such other information as may be necessary to determine the most desirable source of potable water and the manner of development thereof."

The above resolution is not perfectly clear but the intention is to advise these people whether ground water supply can be depended upon for the future and a number of other questions in this connection must be answered. With further reference to this I am enclosing a copy of the statement of the Commission concerning the situation. You may keep this copy as I am asking for another to be sent to me.

The result of this matter last night was that I have been appointed to make this investigation and report and you automatically are appointed to do your end of the work handling it, I believe, through me. In connection with remuneration for your services, I explained that I had been unable to get in touch with you for a proposition but assumed that it would run somewhere in the neighborhood of \$150.00 -- somewhat more or less makes no material difference. The Commissioners understand that you are my geologist on this project. Undoubtedly your invoice when approved by me will be paid direct by

Prof. F. T. Thwaites  
University of Wisconsin

- 2 -

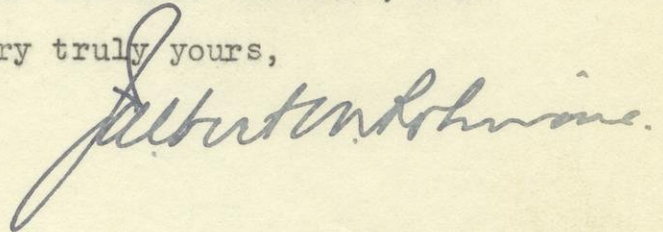
the Commission. Although I am quite familiar with the geology of that section myself, I think it would be advisable for you to study up on the subject and arrange to meet me there at a later date. It is possible that I will be in Manitowoc for at least two days next week, yet I may be unable to go until the following week which would permit me to be there longer if necessary. Owing to very important work being carried on for the E. I. duPont deNemours Co., and Cardinal Mundelien, it may be impossible to go next week.

As soon as possible I would like to hear from you and be in a position to tell me whether you could be in Manitowoc on a Saturday morning, in order to spend most of the day with me on the ground.

Although I am and must be open minded on this matter, I have placed myself on record with the Commissioners and Board of Public Works that it is only a question of time until this city will do the sensible thing and go to Lake Michigan for water. The investment, however, in wells at the present time is so great that something must be done to get return on it if it is economical to do it.

With kind personal regards to yourself and Mrs. Thwaites, I am

Very truly yours,



JAMR/ljm

cc Mr. W. C. Staeffler, Asst. Sec'y.  
Public Utilities Commission  
817 Franklin Street  
Manitowoc, Wisconsin

April 15, 1935

MANITOWOC'S WATER SUPPLY

\* \* \* \* \*

The City of Manitowoc with a population of approximately 24,000 and numerous small and large industries and 4,300 homes, is situated on the west shore of Lake Michigan. The City is divided by the Manitowoc River, a navigable stream for lake steam ships for a distance of approximately two miles up river.

The City's public water supply is now obtained from four gravel wall wells, two on the north side of the river and two on the south side. These wells were installed between 1926 and 1930 by the Layne-Bowler Company under a "No Water - No Pay" contract. The depth of these wells is from 53 to 65 feet.

Prior to 1926 the City was dependent on a shallow dug well sunk in 1911 on the lake shore for its water supply. This source was adequate up to about 1923, when with the gradual increasing demand, it was found wanting. One of the new wells installed near it in 1926 took away practically all of its then rated production of 1,800,000 gallons per day. This was compensated for in the new well. In recent years only a few feet of water remained in the old well making it useless. The four new wells were capable of producing the following after a year's service and at which ratings they were accepted.

|          |                   |                |        |
|----------|-------------------|----------------|--------|
| #1 - 53' | deep (North Side) | 625,000        | g.p.d. |
| #2 - 55' | " (South Side)    | 3,740,000      | "      |
| #3 - 51' | " (South Side)    | 855,000        | "      |
| #4 - 65' | " (North Side)    | <u>500,000</u> | "      |
| Total    |                   | 5,720,000      | g.p.d. |

Approximately seventy test hole borings were made within and adjacent territory of approximately a half mile outside of the City, before these wells were located and developed.

Their present maximum capacities under the most favorable conditions during summer months is:

|              |                |        |
|--------------|----------------|--------|
| #1 - - - - - | 175,000        | g.p.d. |
| #2 - - - - - | 2,000,000      | "      |
| #3 - - - - - | 800,000        | "      |
| #4 - - - - - | <u>185,000</u> | "      |
| Total        | 3,160,000      | g.p.d. |

This reduced production of 45% over a period of from five to nine years indicates that the infiltration from water-bearing strata is due either to sand clogging the gravel area around the wells or the recession of the underground water levels.

All of the pumps are electrically operated and of the deep well turbine type.

The chemical results in parts per million of these wells after taken in were:

| Date - - -         | <i>Plant</i>                |                            |                            |                              |
|--------------------|-----------------------------|----------------------------|----------------------------|------------------------------|
|                    | <u>#1</u><br><u>6/22/26</u> | <u>#2</u><br><u>3/7/27</u> | <u>#3</u><br><u>8/3/27</u> | <u>#4</u><br><u>12/23/30</u> |
| Turbidity - - - -  | 0.                          | 0.                         | 0.                         | 0.                           |
| Odor - - - - -     | 0.                          | 0.                         | 0.                         | 0.                           |
| Color - - - - -    | 5.                          | 5.                         | 0.                         | 0.                           |
| Nitrogen as:       |                             |                            |                            |                              |
| Free Amonia - -    | .272                        | .064                       | .140                       | .048                         |
| Alb. Amonia - -    | .069                        | .037                       | .092                       | .048                         |
| Nitrites - - -     | .003                        | 0.                         | 0.                         | 0.                           |
| Nitrates - - -     | 1.                          | .06                        | 0.                         | .6                           |
| Cl. as Chlorides - | 20.                         | 30.                        | 8.                         | 16.                          |
| Hardness - - - -   | 378.                        | 208.                       | 314.                       | 428.                         |
| Alkalinity - - - - | 230.                        | 170.                       | 230.                       | 254.                         |
| Iron - - - - -     | 0.                          | 0.                         | .6                         | 0.                           |
| Manganese - - - -  | 0.                          | 0.                         | 0.                         | 0.                           |
| Total Solids - - - | 514.                        | 298.                       | 388.                       | 466.                         |
| Oxygen Content - - | .5                          | 1.7                        | 2.9                        | --                           |

The last results on analyses taken on dates shown, follow:

| Date - - -         | <i>Plant</i>                |                             |                             |                             | <i>Lab. notes</i> |
|--------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|
|                    | <u>#1</u><br><u>2/27/34</u> | <u>#2</u><br><u>2/27/34</u> | <u>#3</u><br><u>2/27/34</u> | <u>#4</u><br><u>2/27/34</u> |                   |
| Turbidity )        |                             |                             |                             |                             |                   |
| Odor )             |                             |                             |                             |                             |                   |
| Color )            | N O T                       | T A K E N                   |                             |                             |                   |
| Nitrogen as: )     |                             |                             |                             |                             |                   |
| Free Amonia )      |                             |                             |                             |                             |                   |
| Alb. Amonia )      |                             |                             |                             |                             |                   |
| Nitrites - - - -   | .001                        | .002                        | 0.                          | 0.                          |                   |
| Nitrates - - - -   | .14                         | .50                         | 0.                          | 1.4                         |                   |
| Cl. as Chlorides - | 16.                         | 14.                         | 17.                         | 19.                         |                   |
| Hardness - - - - - | 505.                        | 235.                        | 385.                        | 400.                        | <i>increase</i>   |
| Alkalinity - - - - | 256.                        | 176.                        | 222.                        | 252.                        | 111               |
| Iron - - - - -     | 0.                          | 0.                          | 1.                          | 0.                          | 128               |
| Manganese - - - -  | 0.                          | 0.                          | 0.                          | 0.                          | .4                |
| Total Solids - - - | 730.                        | 289.                        | 516.                        | 530.                        | 197 ?             |
| Oxygen Content - - | --                          | --                          | --                          | --                          |                   |

Except for increased Hardness in all except #4 well and a greater Iron content in well #3, there has been little or practically no change. The increased Hardness and Iron have become very noticeable in the areas supplied by these wells.

Because of the apparent dislike of lake water by Manitowoc citizens, the City in what might be considered a final attempt to obtain water from wells, advertised for bids and signed a contract with the Gray-Milaeger Drilling Company of Milwaukee, Wisconsin, for a three million gallon per day well water supply over two years ago. The specifications and contract limit the hardness to 23 grains and iron to .3 p.p.m.

After studying the logs of the former contractor and drilling a dozen or more test wells in various points within and near the City, the Contractor proceeded with the construction of a well near the lake shore and our present #3 well. Previous test holes drilled by us at approximately the same locations before advertising disclosed that the hardness and iron content of this supply was in excess of the limitations specified in the present contract. The contractor has practically completed the construction of two wells which he expects will produce the three million gallons. He proposes to reduce the iron content from approximately .8 to .3 by aerating and passing the water through a coke bed filter with a \$7,000. or \$8,000. treatment plant which will have to be built at his own expense. There has been considerable delay in completing his work because of numerous difficulties encountered by him. At the present he is getting ready for a capacity test. We expect it will be some time before definite and satisfactory plans for an iron reduction plant are made and construction of the plant is completed.

In view of our past experiences, we desire a complete survey of our City water supply system and a geological study as to the further possibilities of obtaining a more permanent, ample and good quality of underground water supply with recommendations from a competent water works engineering organization. This recommendation and report to take into consideration the cost of development, distribution, storage and pumping cost.



WISCONSIN TELEPHONE COMPANY  
TOLL SERVICE AND OTHER CHARGES

FORM S.N. 643A

1940 R F  
APR  
25

CGO

PLACE CALLED

AMOUNT

CODE\*

TAX †

70

10

*Maintenance job*

U. S. GOVERNMENT TAX

10

TOTAL

80

† SCHEDULE OF U. S. GOVERNMENT TAX

TELEPHONE MESSAGES (LESS THAN 50¢) — NO TAX  
 .. .. (50¢ TO 99¢) — 10¢ EACH  
 .. .. (1.00 TO 1.99) — 15¢ ..  
 .. .. (2.00 OR MORE) 20¢ ..

TELEGRAPH MESSAGES 5% OF EACH CHARGE  
 CABLE .. 10¢ EACH  
 RADIO .. 10¢ EACH

\* EXPLANATION OF CODE:

P—PERSON TO PERSON RATE

A—APPOINTMENT RATE

M—MESSENGER CALL RATE

MS—MESSENGER SERVICE CHARGE

E—EVENING RATE (7 P. M. TO 8:30 P. M.)

N—NIGHT RATE (8:30 P. M. TO 4:30 A. M.)

R—REPORT CHARGE

T—TELEGRAM

NO CODE—STATION TO STATION DAY RATE (4:30 A. M. TO 7 P. M.)

C—IN PLACE CALLED COLUMN INDICATES MESSAGE RECEIVED COLLECT.

J. ALBERT M. ROBINSON  
CONSULTING ENGINEER  
228 NORTH LA SALLE STREET  
CHICAGO

CENTRAL 9129

May 14, 1935

Prof. F. T. Thwaites,  
211 Science Hall,  
University of Wisconsin,  
Madison, Wisconsin.

Dear Prof. Thwaites,

The data on the missing elevations is as follows:-

|                                |              |                |     |
|--------------------------------|--------------|----------------|-----|
| 9th and Madison Streets        | 23.48        | - Hole 33 & 35 | 606 |
| 9th and Marshall "             | 25.80        |                |     |
| 17th and " "                   | 30.70        | Hole 36        |     |
| Top of foundation of standpipe | 75.43        |                |     |
| Height of stand pipe           | 120.00 feet. |                |     |

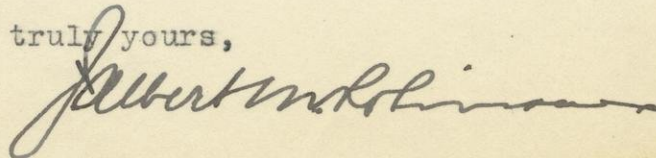
Today I sent the map showing well holes as it was not possible to get a sufficiently good print of it. When through with it, please return it to me, as I will later need it.

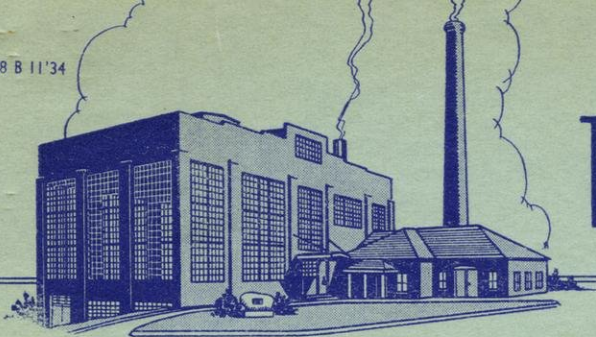
The logs were not yet copied when I left last night, but will probably be mailed direct to you today with copy here.

I hope that you returned safely on your trip.

Very truly yours,

JAMR/s





# PUBLIC UTILITIES COMMISSION

817 FRANKLIN STREET  
MANITOWOC WISCONSIN



May 15, 1935

TELEPHONE 1285

Prof. Fred Thwaites,  
211 Science Hall, U. of W.,  
Madison, Wisconsin

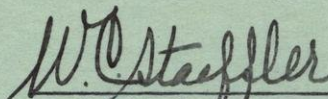
Dear Prof. Thwaites:

At the suggestion of Mr. Robinson, I am enclosing a copy of the logs on soil formations as reported by the Layne-Bowler Company of Chicago, Illinois, at the time they were under contract with us in locating a ground source of water supply about eight or ten years ago. A like copy is also being sent Mr. Robinson.

Mr. Robinson, Mr. Schroeder and I drove out to the Radandt Gravel Pit to look over the formations in the gravel pit cut on S. 14th Street, south of the city. This was very interesting to us and certainly shows why we are having iron trouble with the Silver Creek Park wells.

If there is any other information or data which we can obtain for you, we should like to have you feel free to call on us for same.

Yours very truly,

  
Ass't Secy.

WCS/REK  
Encl.

April 30, 1935

Mr. J. Albert M. Robinson,  
228 North LaSalle St.,  
Chicago, Illinois

Dear Mr. Robinson:

Yours of the 26th reached me on my return from the field at Devils Lake where I go with my class in geological surveying every spring. I had to come to Madison for a few hours on the 25th and then called your office to tell where I was as I had failed to get the telegram.

I am familiar with the water supply situation at Manitowoc, Wisconsin as I helped Gray with his problems several times. However, I have never had a chance to examine any logs of the numerous test holes.

This week I have to go to Two Rivers with my class in glacial geology. As you doubtless know this city is very close to Manitowoc. However, I will be extremely busy and it would not be possible to combine two kinds of business. We spend Saturday night at Two Rivers. I will have only four students with me and we will try to spend a little time looking around the city in connection with the water supply problem. This will be on Sunday morning.

I would be able to meet you there almost any time the following week although I would prefer Saturday. I also have no classes now on Tuesday for the surveying course ended with the field trip.

I spoke to Dr. Leith and he said it would be all right for me to work through you at usual commercial rates. If the city had applied to me direct, however, I would have been obliged to charge only a nominal lump <sup>sum</sup> per diem for expenses.

I too have come to the same conclusion about the future water supply at Manitowoc!

Sincerely,

For W.G. Kirschner

Water analyses <sup>14</sup>  
Manitowoc and vicinity <sup>22</sup>

Well Date Hardness Alkalinity Iron Chlorine Total Solids

DRIFT

|            |      |      |     |     |    |      |
|------------|------|------|-----|-----|----|------|
| No. 1 city | 1926 | 378  | 230 | 0   | 20 | 514  |
|            | 1934 | 505  | 256 | 0   | 16 | 730  |
| No. 2 city | 1927 | 208  | 170 | 0   | 20 | 298  |
|            | 1934 | 235  | 176 | 0   | 14 | 289  |
| No. 3 city | 1927 | 314  | 230 | 0.6 | 8  | 388  |
|            | 1934 | 385  | 222 | 1.0 | 17 | 516  |
| No. 4 city | 1930 | 428  | 254 | 0   | 16 | 466  |
|            | 1934 | 400  | 252 | 0   | 19 | 530  |
| Dug well   | 1907 | 204  | 178 | -   | 7  | 252  |
| Muth test  | 1933 | 1160 | 248 | 0   | 23 | 1764 |

NIAGARA "mineral waters"

|                |                      |      |     |     |     |       |
|----------------|----------------------|------|-----|-----|-----|-------|
| Sheep Farm     | <del>1927</del> 1927 |      | 215 | 4.0 | 187 | ---   |
| Man. Malt. Co. | -                    | 1838 | 237 | 0.6 | 105 | 2,544 |
| Rahr 150'      | 1877                 | 2193 | 268 | -   | 196 | 3,244 |
| Two Rivers     | 1914                 | 1330 | 248 | -   | 343 | 3,257 |

NIAGARA normal waters

|           |      |     |     |   |    |     |
|-----------|------|-----|-----|---|----|-----|
| Cleveland | 1907 | 403 | 263 | - | 12 | 477 |
| Kiel      | 1905 | 277 | 274 | - | 7  | 281 |

ST. PETER ETC.

|            |      |      |     |     |       |        |
|------------|------|------|-----|-----|-------|--------|
| Two Rivers | 1914 | 1527 | 991 | -   | 104   | 3,548  |
| Sheboygan  | 1876 | 3955 | 202 | 4.7 | 5,099 | 11,370 |

LAKE MICHIGAN

|                 |      |     |     |   |     |     |
|-----------------|------|-----|-----|---|-----|-----|
| Port Washington | 1907 | 115 | 110 | - | 4.7 | 134 |
| Manitowoc       | -    | 135 | 133 | - | 4.3 | 197 |

DRIFT CONT

|                      |      |     |     |    |     |   |
|----------------------|------|-----|-----|----|-----|---|
| Gray-Milwaukee No. 1 | 1933 | 440 | 210 | .4 | 20. | - |
|                      | 1934 | 440 | 196 | .7 | 25. | - |

Handwritten notes in a circle, including "362" and other illegible text.

For W. G. Kuehler

Deep wells in Manitowoc, Wis.

Rahr Mating Co. - blue print enclosed

They also have a shallower well in Niagara.

A & P Products Co.

|       |              | Thickness | Depth, feet |
|-------|--------------|-----------|-------------|
| no. 1 | Drift        | 31        | 31          |
|       | Niagara lime | 271.5     | 302.5       |

no 2 about the same - sampler not described

natural flow of No. 1 200 g.p.m.

400 g.p.m. draws down 6 1/2 ft

They may have another well

well at Brewery near hospital - no data.

Notman Grain Co. well at Sheep Farm SW of city  
near the railroad yards on switch track to city.

|                                    | Thickness | Depth, feet |
|------------------------------------|-----------|-------------|
| Drift all clay except first 6 feet | 90        | 90          |
| Niagara lime                       | 735       | 825         |
| Iron ore (34%)                     | 55        | 880         |
| Shale                              | 106       | 986         |

350 g.p.m. pumped - no data on draw down - static level 14'

10" diam to 150' 7" to 400' 113' drive pipe