THE USES AND WASTES OF WATER ON THE MICHIGAN STATE COLLEGE CAMPUS

Thesis for the Degree of B. S.

A. H. Patterson J. P. Morrow

1928

Michigan State College of Agriculture and Applied Science — Water-supply

THE USES AND WASTES OF WATER
ON THE
MICHIGAN STATE COLLEGE CAMPUS

A THESIS SUBMITTED TO THE FACULTY OF THE
MICHIGAN STATE COLLEGE
OF
AGRICULTURE AND APPLIED SCIENCE

BY

A. H. PATTERSON J. P. MORROW

CANDIDATES FOR THE DEGREE OF
BACHELOR OF SCIENCE

JUNE 16, 1928

The authors wish to take this opportunity to heartily thank the department of Buildings and Grounds for their co-operation and untiring efforts in helping whenever the opportunity was presented.

When the Michigan Agricultural College was founded in 1857 there was only one building, four miles distant from Lansing and surrounded by woods and fields. Naturally the water supply system was in accordance with the demand and the times which meant that the old fashioned shallow well hand pump was used. This - or perhaps these - took care of the demand until, as the college grew, in 1884 a boiler house and a pump house were built and water mains laid to the various parts of the campus. This water supply system was put in operation at a cost of $4,267.00 and consisted of a Worthington high pressure pump of one million gallons per day capacity, a storage tank of 16,000 gallons capacity placed in the tower of William's Hallat an elevation of eighty feet, and four, six and eight inch wooden mains. The tank was connected to the mains through valves so that the system could receive its pressure either indirectly from it or directly from the pump. The tank also provided some storage for use in case of fire.

The fire protection at that time consisted of "a small hose cart and three hundred feet of two and one half inch hose, operated by two student fire companies"

(Mich. Agr. Col. Report, 1884)

A connection was made form the pump to the river so that river water could be used in case of a very severe fire exhausting the well.

In the school year of 1886 and '87 a great number of students became ill resulting in two deaths and it was found that the sickness was of a typhoidal nature carried by the water supply. As the college had been steadily growing during it's existance, and as a modern sewage system had not then been a plied to the campus it is not to be wonderd at that the shallow wells had become polluted. Therefore in 1887 a new deep well was drilled near the boiler house to a depth of 343 feet. For this work an appropiation of $1000.00 was made in addition to which $2000.00 was apprppiated for extending the system of mains.

As stated before the well was drilled to a depth of 343 feet althe most of the water came from a strata above that. The quantity of water wa s such that a constant supply of 130 gallons per minute could be pumped by the large pump and this was enough to provide for fire protection without storage.

In the report of this work it says, "We feel ---- no apprehensions for the future supply of good water for the largest demands, and that the future health of the institution is assured". Another hose cart and 250 feet of hose were purchased at this time.

The engineer who made the report of 1890 was very optimistic for he said, "Our pumping capacity is sufficient for all the needs the college is likely to experiance, but the use of water and perhaps the waste is constantly growing."

From that time until 1921 various changes were made in the system, one of which was the change, in 1905, from the old wooden mains to iron ones which was made due to the fact that the wooden ones were becoming unreliable and were hard to mend. In 1921 a new boiler house and a power house were erected, and in 1924 a generator room and pump house, as part of an extensive building program. The new pumping equipment consisted of a 200,000 gallon reservoir. a centrifugal pump of 2,100 gallon per minute capacity, a gas deep well, and two air lift wells. Compressed air is supplied to the air lift wells by one steam air compressor of 731 cu. ft. of free air per minute capacity and one electric compressor of 440 cu. ft. of free air per minute capacity. The system of mains at present consists of 4", 6", and 8" cast iron pipe and the pressure in them is kept at 80 lb. by the stand pipe, pressure in the various buildings being lowered to 40 or 50 lb. by reducing valves, some of which do not work.

During the period between 1921 and 1927, inclusive, the following buildings were erected on the campus: horse barn, horticulture building, chemistary bldg., library, home economics, union, weather bureau, Demonstration Hall, and the stadium. Of course the water supply system was extended to each of these in addition to which it was extended to some of the barns and farm lots, thus increasing the "use and perhaps the waste of water" as was found in 1890.

It is to be expected of course that the waste of water will increase with the use but the proportion between the waste and the use should be constant. The average waste throught the United States is 25% and if the waste on the campus does not exceed this the system may be considerd to be in fair condition. If, on the other hand, the waste exceeds 25% steps should be taken to reduce it.

Bldg.	Date	Present Reading	Previous Reading	Cu. Ft.	Gal.
Library (New)	5/15	25430			
	16	27900	25430		2470
	17	32983	27900		5080
	18	36320	32983		3340
	21	44820	36320		8500
	22	47230	44820		2410
	23	49778	47230		2548
Wells Hall	5/17	4920			
	18	7530	4920		2610
	21	14020	7530		6490
	22	16440	14020		2420
	23	18970	16440		2530
Harrison Ave. Bridge	5/17	277800			
	18	278240	277800		440
	21	279700	278240		1460
	22	280480	279700		780
Gym.	5/17	836900			
	21	903460	836900		66560
	22	941030	903460		37550
	23	971800	941030		30770

Bldg.	Date	Present Reading	Previous Reading	Cu. Ft.	Gal.
Hosp.	5/14	0026535			
	15	0027921	0026535		1386
	16	0029530	0027921		1609
	17	0034864	0029530		5334
	18	0040719	0034864		5855
	21	0045297	0040719		4578
	00	0046500	0045297		1203
	23	0049140	0046500		2640
Weath. Bur.	5/14	023677			
	15	023880	023677		203
	16	024230	023880		350
	17	024735	024230		505
	18	025270	024735		535
	21	026934	025270		1654
	22	027367	026934		443
	23	027920	027367		553
Dem. Hall	5/14	28240			
	15	30420	28240		2180
	16	32950	30420		2530
	17	35400	32950		2450
	18	37710	35400		2310
	21	45060	37710		7350
	22	89350	45060		44290
	23	91020	89350		1670

Bldg.	Date	Present Reading	Previous Reading	Cu. Ft.	Gal.
Dairy Barn	4/24	0	0		0
	25	5978	0		5978
	26	12320	5978		6342
	27	18655	12320		6335
Forestry	4/30	21765	18655		3110
	5/1	22755	21765		0990
Botany (Back)	2	23650	22755		0895
	3	25465	23650		1815
	4	29505	25465		4040
Botany (Front)	7	32117	29505		3612
	8	32220	32187		0103
	9	32960	32220		0740
	10	33715	32960		0755
Old Libr.	10	33715			
	11	35730	33715		2015
	14	45475	35730		9745
	16	52626	45475		7151
Abbot Hall	21	66436	59956	(Three days)	6480
	22	68158	66436		1722
	23	69550	68158		1392

Bldg.	Date.	Present Reading	Previous Reading	Cu. Ft.	Gal.
Chem. (New)	5/15	20010			
	16	38490	20010		18480
	17	59470	38490		20980
	18	84700	59470		25230
	21	119530	84700		34830
	22	131220	119530		11690
	23	143370	131220		12150
Womans	14	210670			
	15	228625	210670		17955
	16	251760	228625		23135
	17	276410	251760		24650
	18	297600	276410		21190
	21	362280	297600		64680
	22	382405	362280		20125
	23	406710	382405		24305
Ag. Hall	21	106970			
	22	120550	106970		13580
	23	126940	120550		6390
H. E.	21	19750			
	22	23600	19750		3850
	23	27960	23600		4360

Bldg.	Date	Present Reading	Previous Reading	Cu. Ft.	Gal.
Dairy	5/14	2714530			
	15	2718282	2714530	3752	28100
	16	2722660	2718282	4378	32800
	17	2726664	2722660	4004	30000
	18	2721365	2726664	4601	34500
	21	2743042	2731265	11777	87800
	22	2747552	2743042	4510	33800
	23	2751238	2747552	3686	27600
Engineer.	5/21	1600			
	22	3150	1600		1550
	23	5160	3150		2010
Union	5/23	0000			
	24	23700	0000		23700
	25	51510	23700		27810

With the increased number of large buildings on the campus the demand for water has increased until the wells and pumps are taxed to the limit of their capacity. It does not seem possible that the 284,000 gallons of water which are pumped daily can be going to a good use and it is the purpose of this thesis to try to find wastes or at least to show where the water is going.

The flow meter readings on the pumps show that very little more water in the early summer - up until June - than is pumped during the winter althe there are irrigation lines to the ferrestry, on the south side of the river, and to the farm lots at the east edge of the campus, showing that if any appreciable ammount is used on these lines it is during the summer when the total ammount used is small.

To check up on the system accurately meters should be installed on all of the buildings and irrigation lines and the the summation of the readings of these checked against the flow meter readings on the pumps, taking into consideration the water supplied to the college by East Lansing and vice versa. This procedure would require the expenditure of a considerable sum of moneyand a longer period of time than three months, allowing for delays.

As it was impossible to purchase enough meters for all of the buildings, enough were orderd to meter the following, the figures indicating the size used on each building:

Building	Size
Ag. Hall	1½"
Chem. (New)	2"
Engineering	2"
Gymnasium	2"
Hospital	¾"
New Library	1"
Well's Hall	1½"
Womans Bldg.	2"
Union	1½"
Home Ec.	1½"

In addition to these there were already installed the following meters:

Demonstration Hall	1½"
Dairy	2"
Harrison Ave. Bridge	1"
Weather Bureau	¾"

One ¾" meter was borrowed from the city of East Lansing and was hooked up with two pieces of hose and various sized reducers and with it the Forrestry, Botany, and Old Library buildings, the dairy barn, and Abbot Hall were meterd for a short period of time.

TOTAL MONTHLY WATER PUMPED

From flow meters.

Sept. 1927 (Last 3 weeks)	7478600	7478600
Oct.	9227300	16705858
Nov.	8626700	25332558
Dec.	9399600	34732158
Jan. 1928	7618400	42350558
Feb.	8485000	50835558
March	9399000	60234558
April	9044000	69278558
May		

AVERAGE DAILY CONSUMPTION.

Bldg.	Gal.
Chem.	15500
Woman's	21300
Ag. Hall	10000
H. E.	4000
Dairy barn	6220
Forestry	1000
Botany	3700
Old Library	3150
Well' Hall	2500
New Library	3000
Abbot Hall	1920
Harrison Ave Bridge	600
Gymnasium.	22000
Hospital	2500
Weather Bureau	400
Demonstration Hall	2400
Engineering	2000
Dairy	30500
Union	25000
Total	161380

ESTIMATED DAILY AVERAGES

Bldg.		Cal.
Power plant make up water		10000
Constabulary		6000
Piggery		700
Horse barn		2000
Vet. clinic & poultry yards		1000
Beef, sheep, & bull barns		2000
Industrial chem lab		5000
Work shop		500
Wood shop		1000
Foundry & forge		1000
Residences on Faculty Row & off Farm Lane		6000
Hort.		4700
Greenhouses	Hort.	3000
	Gunnson's	1000
Bacty. Bldg.		4700
Entymelugy		100
Total		48700

SUMMATION SHEET.

Summation of water pumped for seven months:

	9227300
	8626700
	9399600
	7618400
	8485000
	9399900
	9944000
Total	61800900

Average daily water pumped:

61800900 ÷ 7 x 31 = ... 284800

Total water consumed = estimates plus meter readings:

161380 plus 48700 = ... 210080

Percentage of total water accounted for:

210080 ÷ 284800 = ... 75%

Losses in wastes 25%

The lines which were not meterd had to be estimated and this was very diffieult as the un-metered lines inchude such buildings as the steek and sheep barns, the veterinary building, and the poultry yards,and no data was to be had on the consumption to be expected in such places.

The estimates made on the beef, bull,and sheep barns were arrived at by comparison with the with the ammount used by the dairy barn, which was metered. The State Constabulary was at one time metered and the figure given for that was taken from old readings. The estimates on the other lines were made after observation of the lines and inquires made of the people who work in the buildings. No willful wastes of water were noticed while making the observations and no irregularaties in the system other than the faiaure of some of the reducing valves to function. The Forestry, Engineering Ag., and New Hort. buildings have pressure gauges on the building side of the reducing valves and of these the Forestry and Ag. gauges read about 80 lbs., showing that the valves do not work. The gauge in the gymnasium also read about 80 lbs., showing thatthat valve also does not work. If all of the buildings were tested a great number of them would probably be found to have 80 lbs. pressure within the building which is not desirable as it puts unnecessary strain upon the plumbing fixtures and small pipes.

On the following pages are given the average daily ammounts as determined from the meter readings, the estimated daily ammounts for buildings not metered, and the average daily ammount pumped together with a comparison of these quantities.

After all services are metered there is still a large ammount of water furnished which is not accounted for. This discrepency or loss is due to three causes: errors in meters, errors in estimating the pumpage, and actual loss thru leaks and breakages.

In this case, however, the meters were new in practically all cases and so should read nearly correct.

The greatest loss will be due to leakage and waste and is apt to be a large item. Taking into consideration the allowed leakage on tests, which ranges from one to five hundred gallons per day per mile per one inch diameter of pipe, a large percent of the waste on the campus could be accounted for, as the mains are 4", 6", and 8" diameter and of considerable length.

Also pipe leakage is almost certain to increase as the system gets older, on account of the loosening of joints thru settling, leakage of valves, hudrants, and services and undetected breaks, and since the most part of the college system has been installed for some twenty years, this item may easily be considerd a maximum.

It can be observed from the meter readings that the ammounts of water used in the various buildings varies a great deal from day to day, and an attempt was made to determine the cause of this. The chem. building was chosen towork on and the method of procedure was as follows:

A schedule of the building was obtained with the number of students enrolled in each course. Lecture courses were

Disregarded as the amount of water used during lecture hours is inconsequental. Then by multiplying the number of persons in a lab course by the number of hours during the period the number of "person hours" was determined. If the amount of occupation of the labs had an effect on the water used the days during which the labs were most occupied should correspond to the days during which the most water was used. Such was not the case however. Evidently, if the variable consumption of water is in the labs the nature of the experiments performed must be determined before the variation can be accounted for.

[redacted]

[redacted]