HISTORY OF WATER SUPPLY

STILLWATER, MINNESOTA

1. Original system

   1. First commercial supply

      a. Owned and operated by C. M. Hathaway
      b. Located between Myrtle and Chestnut Streets on So.Third St.
      c. His first thoughts were to supply his blacksmith shop, but later sold water to adjoining buildings and supplied a standpipe for horsedrawn tank wagons.

   2. Source - Storage, etc.

      a. Water flowed freely out of springs in bluff into his man-made reservoir of 300 barrels capacity.
      b. He pumped out of reservoir by means of horse treadmill affair into piping system.
      c. Possibly first commercial system in state.
      d. Daily capacity - 700 barrels.

2. McKusick Lake Supply

   1. In 1880 a private corporation known as Stillwater Water Co. came into existence under 30 years franchise to the city thus forcing Hathaway out of the water business.

      a. The water supply at this time was taken from McKusick Lake in northwestern corner of city at an elevation ideal for storage of the city supply.
      b. The lake covered 40 acres in area and was fed by Briggs' Creek which rises in the form of a large spring about six miles northwest of the city, near Withrow - and also was fed by large underground springs at the head of the lake.
      c. Estimated gallons per day was set at about 1,000,000 at which these sources fed the lake.
      d. Lake elevation at this time was 181 feet above that of Lake St.Croix.

3. Piping system, filtering, etc.

   1. Owing to the topography of city, water system is divided into two separate systems known as the high and the low systems. The high system serving the residents on the hill and the low serving the downtown area.

      a. The low system flowed by gravity to the downtown area by way of 6 to 16 inch mains running thru a ravine.
      b. This water was partially filtered and screened but was not treated in any other way. It was quite common to have services plugged with weeds and sometimes fish.
      c. The high system supplied mostly residents on the hill and was steam pumped at a rate of approximately two million gallons per day capacity to two wooden standpipes, later replaced by steel tanks.
      d. From its existence until 1891 all water came from McKusick Lake.

4. Advent of Deep Well

1. In the late 1880's gas and oil production was spreading throughout Ohio, Pennsylvania and other eastern states. The idea of oil or gas fields in the mid-west fired minds of enterprising men of Stillwater with the idea that perhaps there was gas or oil here also.

A large spring known as the "McKusick spring" was located just west of the present Third Street pumping station. This spring or the pond around it would at times in the winter freeze over and some of the old timers noted bubbles of green and rainbow hue frozen in the ice, and they also discovered that by pricking these bubbles gas would escape and could be ignited, throwing off a blue flame; this they thought was sure proof that there must be natural gas in the ground at that point. A number of business men banded together forming a company to drill for gas. In order to interest others in their venture many schemes were tried but the one that really worked the best was that they would take a rubber bladder, cut a hole over a gas bubble at the spring, allowing the gas to escape into the bladder. Later, approaching a prospect, would demonstrate to the skeptical one by allowing the gas to escape from the bladder and lighting it with a match. It was rumored that this method of selling was very successful and in that way stock was sold to finance the venture. Mr. Paige Guthrie of Pittsburgh, Penn. was the contractor for the drilling and he spudded in on June 22, 1888. The work was continued thru the balance of the year and into the next when a depth of over 3,640 feet was reached, the deepest drilling in the west. Mr.Harrison, then engineer for the Stillwater Water Company, was also one of the parties interested in the drilling venture and he noticed that in passing thru the Cambrian sand stone great quantities of water were encountered. As for gas or oil the well was a 'duster' and abandoned. Mr. Harrison saw great possibilities for a water supply, however, and upon his recommendation the well, which was cased for 710 feet, to the base of the Hinckley sandstone, was plugged back to the base of the Franconia sandstone and has since become the chief source of water supply for the City. Even now it is perhaps the finest flowing well in this artesian basin. This well together with the McKusick Spring which flows approximately 200,000 gallons in 24 hours, were piped together and give a total estimated flow of 2,000,000 gallons per day. In speaking of the Stillwater water supply at this time, Dr. G. B. Frankforter, PH.D. professor of chemistry at the University of Minnesota in writing to a friend said "the water supply of Stillwater, Minnesota, is superior in absolute purity to any other in the country."

In October, 1891 it is recorded that the Stillwater Water Company had completed a new pumping station on North Third Street designed to furnish water from the McKusick spring and artesian well. The pumping station floor is 67 feet above Main Street at the crossing of Myrtle Street. Smedley Compound steam pumps with a capacity of 1,000,000 gallons per day were installed. The high system was then separated from the low system and since that date the high system has been supplied with the finest quality of pure spring water. In addition to the high and low systems, water is piped from the wells in the rear of the Third Street station and runs by gravity to the business district where it supplies water to restaurants and for drinking purposes. This supply is limited of course to the surplus in the pump wells after supplying the pumps. This gravity system is carefully guarded; no toilets or other connections, excepting fountains, are allowed on this system.

The high and low systems have check valve connections, so that a failure on the fire sprinkler system would at once be supplied from the low system. The maximum high pressure is 130 pounds and the maximum low pressure system is 75 pounds.

In the spring of 1911 the City of Stillwater purchased the Water Works System and placed it under the management of a Board of Water Commissioners, consisting of three members, appointed by the Mayor. Each Commissioner's term is for a period of three years or until his successor has been appointed, their terms and appointments are made in such a manner that their terms expire on different years, in this way there are always two experienced men on the Board.

In 1912 the wooden elevated tank on South Fourth Street was replaced by a steel standpipe, and the north and west hill standpipes raised about 8 feet, increasing the water pressure about three and one-half pounds and increasing the storage capacity 194,159 gallons.

In 1917 the Third Street station was electrified. A three stage Platt centrifugal pump of 800 gallons per minute capacity, direct connected to a 75 H.P. Allis-Chalmers motor was installed for use on the high system. Starting and stopping is automatic, Cuttler and Hammer controllers being used. The Smedley steam boilers were kept in place as a stand-by for emergencies.

The low system was kept in use as originally constructed until January 1, 1926, using the gravity supply from McKusick Lake. As long as the water in this lake could be maintained at its normal level, it was undoubtedly an asset to the City for fire protection and manufacturing purposes on account of the cheapness of maintenance, but the water which was never safe for domestic use, was condemned by the State Board of Health in 1912 and we began to use hypochlorite. In 1923 the State Board of Health declared the conditions of the water very dangerous and were about to forbid its use due to possibility of contamination thru cross connections with the high system and other factors let to the installation of a Wallace & Tiernan chlorination plant using chlorine. We were allowed to use this supply two years longer and in the meantime the water in McKusick Lake fell lower and lower and it became impossible to keep it anywhere near its normal level. Large quantities of water had to be turned in from the high system to help carry the load. This was a serious drain on the high service and in December 1924 the water dropped so that there were only four inches running in the outlet pipe. In August, 1925 all the water left the lake except a small pond in the middle of the Lake and from that time practically all the water used in the low system for the balance of 1925 was supplied from the high system, and a small pump installed on a platform in the St. Croix pumping directly into the mains.

STORAGE TANKS

1. North Fourth Street Tank (Steel tank to replace old wooden tank)

   a. Erected 1906
   b. 122,204 gallons capacity
   c. 932.34 elevation of base of tank

2. West Myrtle Street tank

   a. Erected 1888
   b. 101,765 gallons capacity
   c. 908.42 elevation of base of tank

3. South Fourth Street tank

   a. Erected 1912
   b. 264,360 gallons capacity
   c. 935.45 elevation of base of tank

4. Olive Street tank

   a. Erected 1958
   b. 750,000 gallons capacity
   c. 969.30 elevation of base of tank

5. Laurel Street Reservoir

   a. Constructed 1925
   b. Brick & cement construction
   c. Underground
   d. Located at North Owens St. & West Laurel Street.
   e. 500,000 gallons capacity.
   f. Serves low system only

6. Mulberry Street Tank

   a. Erected 1925
   b. 352,720 gallons capacity
   c. Serves low system only
   d. Strictly gravity
   e. Reservoir flows into tank & tank supplies downtown
   f. 811. 25 elevation

7. Third Street Reservoirs

   a. 5,651 gallons capacity
   b. 8,832 gallons capacity
   c. Located behind Third Street office and pumphouse
   d. Elevation 763.00 feet above sea level
   e. The McKusick spring and well flow into these reservoirs and then the water is pumped into the high pressure mains.

Owens Street Well

1. Constructed in 1925

   a. Elevation @ floor level 854.00 feet above sea level.
   b. Depth of well, 786.75 feet (Hinckley formation)
   c. Well data-
      176 feet of 20" steel casing
      303 feet of 19" opencore hole
      307.75 feet of 12" open corehole
   d. Static level - 707.70 feet
   e. Water level pumping @ 800 gpm. 677.70 feet
   f. Drawdown - 30 feet
   g. In using this well, "Red Water" or iron was very much in abundance. Because of this and the fact that an iron removal-plant was so costly, it was decided to place this well on a stand-by basis. Water pumped from this source was treated with ammonia gas and chlorinegas. This water at time of installation was for the downtown system also, flowing through large reservoir at Owen and Laurel Streets, on down to the Mulberry Street tank and eventually into the downtown system.

Second Street Well

1. Constructed 1948

   a. Elevation 718.32 feet above sea level
   b. Depth of well - 440 feet
   c. Data -
      50 feet of 32" outside casing
      236.6 feet of 24" inside casing
      203.40 feet of 23" open corehole
      50 feet of cement grout between casings
      Static water level @ time of construction 709.72
      Water level pumping @ 800 GPM 669.72 ft. above sea level
      Drawdown - approximately 40 feet
   d. Well terminates in Franconia formation and partially in the Dresbach
   e. Because of differences of head and the fact that this pump in operation affected the output of several private wells in the same formation plus large amount of iron in water, warranted putting this pump on stand-by basis and eventually putting well out of service. The pump, controls,etc, being used on a new well on West Olive Street and Center Street, constructed in 1963.

Wilkin Street Well

1. October 1955 drilled test well (no information on test well)

2. Completed well

   a. 164'10½" - steel 30" outer casing
   b. Well depth 242.2 feet
   c. Floor elevation of well pumphouse 941.40 (also top of well)
   d. 175'10" - 24" inside casing
   e. Cemented grouted between casings
   f. Open corehole 23" diameter - 66.2 feet
   g. Static head - 138'
   h. Drawdown @ 800 GPM 32'
   i. Log

Glacial drift	0 to 15 feet	- red clay & silt
	15 to 25 "	- reddish clay & silt somewhat more sandy
	25 to 30 "	- reddish impure sand and gravel
	30 to 40 "	- reddish clay, silt with numerous small dark pebbles
	40 to 55 "	- reddish clay & silt
	55 to 65 "	- impure red sand
	65 to 80 "	- brown fairly sure coarse sand
	80 to 95 "	- dark brown, limonitic, impure sand, silt,clay, gravel, especially @ 90-92 feet. Probably in part, weathered bed - rock.

Oneota dolomite	(95 to 100 feet	- highly limonitic, badly weathered dolomite, some admixed drift. From 100 on, becomes less limonitic, weathered dolomite. Some sandstone interbedded. Brownish to light at depth.
	(153 to 157 "	- interbedded sandstone and gray dolomite
Jordan Sandstone	(157 to 238 "	- Brownish to light yellowish sandstone at places, almost white. Medium grained, poorly cemented and only moderately well sorted.
	(238 to 239 "	- Mixed sand and grayish silt. Probably about contact with St.Lawrence formation.

j. The above information all at time of construction of well.

PROBLEMS WITH WILKINS STREET WELL

At a September 10, 1958 meeting of the Board, it was decided to advertise for bids on some desanding equipment due to the fact that the well was producing large quantities of sand, this being detrimental to equipment. (pumps, shafts, bowls, etc.)

On March 2, 1958 the Board purchased a Dorr-Clone desander with a 2.9 cu.ft.grit pot, automatic grit discharge valve.

August 6, 1959, it was reported that the Dorr-Clone was operating fine excepting the fact that more and more sand was being encountered and that the well should possibly be dynamited.

August 31, 1959- Department employees met with contractor who developed well. Contractor recommended well be surged and pumped with air which would tend to loosen sand thus enlarging area of percolation resulting in a decrease in velocity of water entering hole, but in no way affecting amount of flow into cavity.

September 22, 1959- 40 yards of sand were bailed out of well, after the well had been blasted with 155 pounds of dynamite and air jetted-pump and Dorr-Clone re-installed and put back into service.

On July 2, 1966 problems with well were again encountered when the well completely collapsed thus allowing no water at all to enter the cavity. Thus the pump ran for sometime without the presence of water, ruining shafts, bowls assembly, etc.

With the demand that it was, work started immediately to repair damage. The same contractor bailed the well, installed 16" liner and stainless steel screen and gravel packed the well. The purpose of gravel packing is to prevent the flow of sand into the screen openings thus acting as a filter for the sand. By gravel packing, this cut the output of the

well from 600 gallons per minute down to 240 gpm. With no further need of the original 800 gpm, 75 horsepower pump, a 250 gpm, 25 hp pump was installed.

At this date June 6, 1967 with the pump running approximately 12 hours per day, daily, little or no sand has been encountered and the pump has been operating at its maximum efficiency.

Olive Street Well

1. Completed 3/26/63
2. Elevation - 890.15 feet above sea level. (floor elevation)
3. Well log

0 to 48	feet - drift
48 to 125	" -Shakopee limestone
125 to 215	" -Jordan sandstone
215 to 220	feet-St.Lawrence

4. Static level - 822.15
5. Test pumped 120 ½ hours from 500 to 1500 gpm.
6. Drawdown @ 1500 gpm - 58 feet
7. 155'4" of 24" inner casing
8. 48'6" of 30" outer casing
9. Cemented between casings
10. This well has operated as our primary pump almost steadily since installation. It has pumped @ approximately 750 gpm continuously with no appreciable change in water level. In fact, it has improved between 1965 and 1967.

South Fourth Street Test Well

1. Drilled and completed June, 1966
2. Ground elevation 933 feet above sea level
3. Well log -

0 to 40	feet - sandy clay
40 to 58	" - clay
58 to 80	" - brown limerock
80 to 95	" - limerock
95 to 185	" - brown limerock
185 to 192	" - limerock
192 to 198	" - limerock
198 to 245	" - Sandrock
245 to 269	" - Sandrock and Limerock
269 to 276	" - Gray limerock

4. 8" Borehole open from 200' to 276' - cased above
5. Tested @ 200 gallons per minute
6. Static level 163'
7. Pumping level 176'
8. Draw down 13'
9. Results of test well pumping indicate that theoretically a 30" x 24" cased well at this location would produce approximately 600 GPM.

South Fourth Street Well

1. Drilling completed March 3, 1967
   a. Drilled approximately 10 feet away from test well
   b. Total depth 271 feet from ground level of 934 feet above sea level
   c. Well log-

0 to 2 feet	- pipe above ground
2 to 37 "	- sandy clay
37 to 39 "	- decomposed sandrock
39 to 55 "	- clay and sandrock
55 to 58 "	- clay and limerock
58 to 84 "	-Shakopee
84 to 118 "	- broken Shakopee
118 to 192 "	- Shakopee
192 to 270 "	- Jordan
270 to 271 "	- St.Lawrence

   d. Static water level from top of pipe - 165 feet
   e. First test run on well -

GPM	Ft. drawdown	Hours pumped
100	16'3"	45 minutes
150	27'9"	2 hours
150	28'10"	8 hours

   f. At 8 hours steady pumping, pump was breaking suction - this meant that the flow of water thru the crevices into the well cavity was slowing down so rapidly thus deeming it impossible to develop the well.
   g. Treated well with muriatic acid to improve the output.
   h. Used 2,500 gallons of acid and approximately 4,000 gallons of water on top of acid. (detention time approximately 8 hours, and then pumped to waste.)
   i. Tested well again. This time @ 350 gpm-well attained 35'10" drawdown.
   j. Decided to give well another acid treatment, this time using 4,000 gallons of muriatic acid.
   k. Developed well and tested @ 350 gpm - 35'10" drawdown
   l. Pulled pump, bailed, reinstalled pump and developed
   m. Final test - 500 gpm - 30'6" drawdown - 400 gpm 23' drawdown
   n. Decided to install pump with 450 gpm capacity and plan on pumping about 425 gpm. on a summertime basis- (during peak times when supply has run low)
   o. Pump not yet installed - should be in operation June 1, 1967

FUTURE PLANS

In a study conducted by a consulting engineering firm the following information was compiled. At present the population of Stillwater is approximately 9,000.

1. Year	Population	Avg.Day MGD	Max.Day MGD	Ratio Max/Avg	Gal.per person per day Avg.Consumption
1965	9,000	1.05	1.83	1.74	117
	10,000	1.25	2.81	2.25	125
	15,000	1.95	4.87	2.5	130
	20,000	2.70	6.75	2.5	135

It is desirable to anticipate any water works systems deficiencies before they occur if the water utility is to meet future demands. This is especially true in areas of extensive population growth rates.

The present water system was capable of meeting the past maximum demands without use of the stand-by Owen & Laurel street well, Second Street well, or putting into use the standpipes at North Fourth Street, South Fourth Street and West Myrtle Street. The pump on the Second Street well has been removed thus making it impossible to use this well at this time. Owens Street well is still on a stand-by basis as of this date (6/1/67) and during the summer of 1966 the three tanks were removed because of the following reasons:

1. They differed in elevation from that of the new Olive Street standpipe thus requiring altitude valves ahead of each tank.
2. When used in conjunction with the new Olive Street tank, all three would fill and then the electrically operated valve would close. The principle of this worked fine. In reality, it was a different story.
3. When the water level or head in the Olive Street tank reached a point equal to that of the other three tanks the valves would supposedly open thus emitting water into the system. The only thing wrong with this theory was the fact that the Olive Street tank never got low enough to put the other tanks into operation.

A common method of estimating future water requirements is to project past water production to future conditions using different anticipated future populations.

The trend of the last five years indicates that the City of Stillwater could have a 10,000 population in the very near future. Based on the projected water production of the above table the average rate of demand on the maximum day is expected to be 1,955 GPM. Adding a fire demand of 3,000 gpm. results in a total required rate of 4,955 gpm. This can be met from a combination of supply and storage. The fire demand of 3,000 is intended to be that required for the downtown business area. It can be assumed that this flow would be from the low pressure system. With this assumption, the net deficiency in storage and supply of the present system serving 10,000 population is estimated to be 848 gpm. With the new South Fourth Street well in operation (on a summer time set-up) we would still have a deficiency of approximately 432 gpm.

It appears that the growth of the city is moving in a westerly and southerly direction so the logical direction that the Water Board has in mind for future extensions to the system would be to the southwest of the city. Coupled with the fact that the better producing well lies to the west end of town, our next step would be to probably drill another well in the

vicinity of the present Olive Street tank and at a later date possibly erect another storage tank. (in the same area due to the fact that the elevation is approximately the same as the present site.)

Sept 29, 1969 Seigfried Construction awarded bid to build S 4th St Pumphouse
Nov 13. 1969 awarded bid for flouridaton equipment to Feed-Rite Controls inc
Jan 1970 installed flouride equipment to meet State specifications
April 13, 1972 Keys Well Drilling awarded bid to drill well #7, price of $14,840.00. Had to drill thru Jordan formation to Hinckley because of Iron and manganesse in the water total Jordan depth of 236' , Hinckley depth of 840'.In August 1983 the well was abandoned in favor of Well Site #8, on Sunrise Avenue.

The Sunrise well was drilled to a depth of 242' and remains in the Jordan formation. This well had good water qualities and is capable of delivering 1000 GPM

October 31, 1973 the Wilkin Street Well was shut off. There was a sand problem with this well that we were unable to correct. Because of the decrease in GPM that this well was pumping it was decided we would be better off discontinuing its use.

October 13, 1977 Keys Well Drilling awarded the bid to drill Well #9 on the Hooley property which will be in the proposed Industial Park.By May 1978 the well was finished being drilled and in July A & K Construction was awarded the contract for the construction of the pumphouse.

In December 1977 we advertised for bids for a 500,000 gallon Hydropillar Water Tank which was awarded to PDM Inc in January 1978. On Sept 7, 1979 Well No. 9 and the new Tank were put into service for the first time.

In October 1987 Keys Well Drilling began a test well in the SW Corner of the Benson Farm. This was abandonded and filled Nov 19, 1987.

Permanent well #10 was drilled approximately 700' East of test well site by Layne-Minnesota for a bid price of $78,755.00. Construction began on February 8, 1993 . Total depth of well is about 300'. This well had a lot of sand pumping out of it and requiredmany hours of air surging and bailing to remedy the situation. We finally began pumping water into our system on January 31, 1995 at 700 GPM and eventually increased this to its present 1000 GPM capacity.

In April 1999 the Board determined that to adequately serve the proposed new development in the western part of the City that a new well and storage facility would need to be constructed. Two types of storage were considered, a 500,000 gallon elevated water tank and a 1,500,000-gallon underground reservoir.

After much discussion and cost analysis the Board agreed that the underground reservoir would be more cost effective in the long run.

In September 1999 drilling of well #11 began. By March 2000 the well was completed. This well was drilled to a depth of 200'. The well can produce up to 1200 GPM of water if needed but normally pumps at 1000 GPM.

Total cost for drilling well was $55,000.00.

In May 1999 TKDA Engineering was awarded the contract for plans & specifications for the construction of a 1,500,000-gallon underground reservoir.

January 2000 Natgun Corporation was awarded the contract for construction at a price of $1,322,10.00.

Construction started in spring of 2000 and the reservoir was completed and in operation on January 3, 2001 at the bid price.

This well & reservoir is now the primary source of water for over ½ of the City of Stillwater.