WATER SUPPLY OPTIONS ANALYSIS - 2009

This report covers a new water supply options analysis conducted in June 2009. Slightly earlier, it was determined that Well #2 was producing a granular material that was determined to be magnetic and, hence, likely to have come from the well casing. The question before the Water Supply Planning Committee is, "Now what?"

RESOURCES

First, a quick review of the resources available:

Well #1: Well #1 was recently "refurbished" by inserting a 4" plastic liner and a new pump. The original casing had deteriorated and efforts to clean the casing may have caused further degradation. 2009 capability is 37 gpm, and a 15 year life is predicted (2023 will be last year used). Because the work and equipment are new, these are considered "very good" estimates.

Well #2: This well seems to have contracted the same "disease" as Well #1. There are three options apparent:

1) Abandon the well.
2) Refurbish similar to Well #1. It is believed that the capability of this well is primarily limited by its depth and the flow resistance of the aquifer. As a result, putting in a 4" liner may not significantly reduce its flow capability, although the increased flow resistance will have some effect. However, during pumping, the water level inside the liner will be lower than that currently experienced. This effect may reduce the capability, or it may cause this option to be non-viable. The useful life is projected to be only seven years after refurbishment. Optimistically, this well would contribute only about 12% or less of the system capability. This seems to be a relatively high cost option with considerable uncertainty regarding its benefits.
3) Install a "sand separator" and use only in the summer. This is clearly a "stop-gap" measure as continued deterioration of the casing is highly likely. Further, the type of sand separator we would probably use operates after (downstream of) the pump. That means that we would be passing sand through the pump and gradually (or perhaps not gradually) eroding or otherwise damaging it. Still, this is a fairly simple, quick, and inexpensive solution that might be used to buy a year or three if it were used only in the Summer.

Well #3: This is the one non-compliant well in the system. It cannot be used unless the water is treated. Previous studies have shown that schemes for mixing are likely to be uneconomic or impractical, or both. There are several options that may be considered relative to this well:

1) Do not use.
2) Use on an "economic dispatch" basis – that is, use other sources first and this well only when they are insufficient. This will require treatment of 1-2 million gallons per year. It will also require either a more sophisticated control system than we now have, or a perhaps significant amount of manual valving.
3) Use only during the summertime. If Wells #1 & #5 are used, Well #3 will contribute about 26% of the system capacity, and treatment of 3-3.5 million gallons of water will be required.
4) Use on a year-around basis. Treatment of around 9 mgal/yr will be required.
5) Enhance capability beyond 50 gpm by installing a booster pump after (downstream of) the arsenic treatment facility.

This well has experienced some corrosion (erosion?) in the past and this will likely continue. The projected life is 10 years after restart or perhaps 16 years from 2009. Since it's not clear what will cause an end-of-life condition, the lifetime is rather conjectural.

Well #5: This well is relatively new and has a stainless steel casing. It has a capability of 110 gpm and will likely survive a 30 year lifetime with a couple of cleanings. There is a concern that we could "over-pump" the aquifer, causing us to lose capability faster than anticipated.

Well #6C: A well to replace #1 and/or #2. It has compliant water. It does not enter into this study.

Well #6N: A well to replace #3. It has non-compliant water. It does not enter into this study.

Reducing the Arsenic Content

Next, a quick review of what we know about arsenic treatment options. There are two general processes. In the "absorption" system, the water is passed through a "bed" of material. The arsenic adheres to that material and the water exiting the system has a lower arsenic level that it had upon entry. Over a period of time, the arsenic builds up on the bed material, gradually reducing its effectiveness. Eventually, the exit water will be higher in arsenic than desired and, before that, time, the bed material is replaced. In some arrangements, the contractor exchanges the bed materials and disposes of the old, "spent" material. In others, LMWC would have to purchase the bed material from a vendor and we would exchange the materials ourselves, disposing of the spent material. This approach is considered especially applicable to small systems. In the second approach, a chemical is added to the water that makes the arsenic come out of solution and the water is then passed through a filter. The arsenic solids are captured in the filter. Every so often, the filter is backwashed to flush out the arsenic solids. The backwash water can be dumped on the ground in some cases or evaporated and the residue disposed of. Although it is yet an open question, the absorption system is probably best for our purposes.

We have talked to several vendors and can probably make some fair estimates of how we could accommodate water treatment and what it would cost. One important factor to consider is that there is a pressure drop across the treatment system. Because of the way pumps work, this would reduce the flow capability of the well being treated. We have estimated that a system at Well #3 would probably reduce the flow from around 65 gpm of untreated water to about 50 gpm of treated water.

Developing a Path Forward.

Our operating criterion is that we like for the pumps to operate less than 60% of the time. To keep the language simple, we define, for the purposes of this study, the "pump factor" as the percent of the time that the pumps actually operate. Thus, our operating criterion is that we do not exceed a pump factor of 60%.

With only Wells #1 & #5 operating, we may already be over our 60% pump factor criterion. Figure 1 shows the projected pump factor for the next few years. The red line considers only Wells #1 and #5, while the blue line also includes Well #2. The demand is what we would expect one year in ten, averaged over the three summer months (June, July & August).

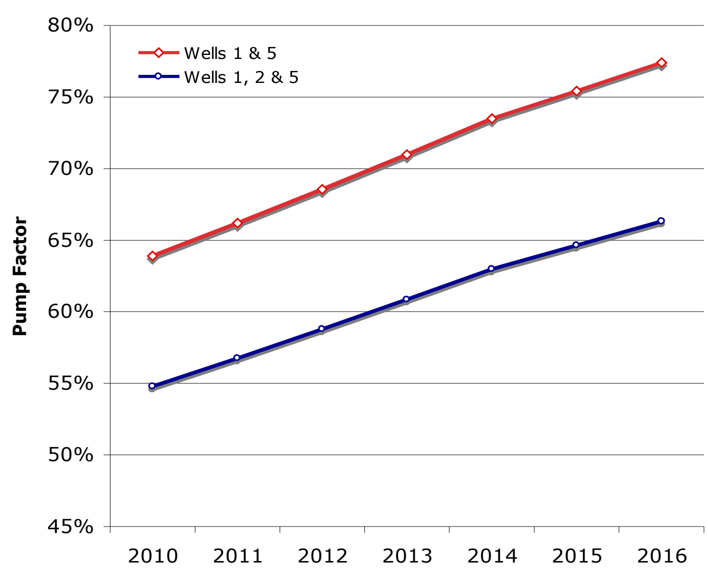

Figure 1. Projected Pump Factor (One Summer in Ten)

We could consider operating at pump factors over 60%, but it seems prudent to keep them below 65% with perhaps an absolute upper limit of 70%. On that basis, we need to do something by 2011 and certainly by 2013. We would be interested in doing something by 2013 even if Well #2 were still functional.

Refurbishing Well #2 is an option that could be considered. However, there are several reasons why it may not be a good choice: 1) success is uncertain; 2) a significant cost may be involved (~$50 K); and 3) an additional source of water will be needed around 2013-2015 even if Well #2 is functioning – it might be better to install that source sooner, rather than later.

Drilling a new well is a good long-term solution, but the schedule to implement it would be difficult for us and would not be sufficiently robust to accommodate any "stumbles" along the way. Without extensive analysis, the concept of treating water from Well #3 seems to be the best approach. Figure 2 shows how that would fit into our system. The upper, blue line is the pump factor that we would expect. The lower, red line is the amount of water that would require treatment over the course of the three summer months.

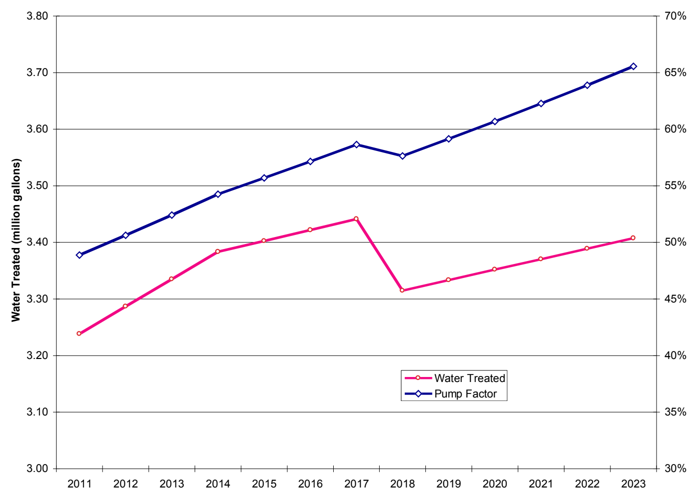

Figure 2. Effect of Adding Treated Water from Well #3

With Well #3 able to produce about 50 gpm, we are looking for a treatment system that would handle a 50 gpm flow rate and would be capable of treating 3 to 4 million gallons over a three-month period. The amount of water to be treated is determined by realizing that Well #3 accounts for about 26% of the capacity of the three-well system consisting of Wells #1, #3 & #5, and that the demand we plan for during the next several years is around 160 gpm with a pump factor of 60%. We could use some elements of our control system to reduce the amount of water treated and thereby reduce costs, but the savings are modest.

Using Well #3 in this manner allows us to defer consideration of another water source until around 2020 (the "jog" in the lines is due to an anticipated cleaning of Well #5). During the time between now and then, we would have an opportunity (or perhaps several) to assess system performance as well as demand, and to make decisions regarding to ensuing 5-10 years. By that time, one possibility would be to consider a larger treatment capability. We may be able to pump up to 90 gpm if we add a booster pump downstream of the treatment facility. This would require a number of other changes, including doubling the size/capacity of the treatment facility. However, this would approach the size of a facility to handle a (nominal) 100 gpm well. Such a treatment facility could be used to treat the production from a replacement to Well #3 and eliminate the need to provide both a well and a complete treatment facility at the same time.

Figure 3 (on the next page) shows the situation considering both treatment of Well #3 water and an "enhanced" Well #3 in which the water is treated and then "boosted" to achieve the equivalent of 90 gpm. The top, red line is the pump factor with only Wells 1 & 5 operating – the current condition. The next line, a very light blue, is what we were expecting with Well #2 operating in conjunction with #1 and #5. We anticipated and "End of Lfe" condition at Well #2 in 2017, so at that time, the line representing Wells #1, #2 & #5 becomes the same as for Wells #1 and #5 alone. The next lower line - a medium blue – assumes that Well #3 water is treated and its operation begins in 2011. Notice that this allows pump factors below 60% until 2020. The dark blue line, the lowest of them all, represents the situation with Well #3 enhanced, beginning in 2020. Notice that pump factors thereafter are very low for potentially many years. However, our current estimates are that Well #1 will reach its "End of Life" condition in 2024 and Well #3 in 2025. Thus, the decision as to what course of action to take in 2020 will have to consider times well after that year and, possibly, well after 2025. Fortunately, there is a decade in which to figure that out. In 2020, we estimate Well #1 will be producing about 28 gpm and an enhanced Well #3 about 75 gpm. A new 100 gpm well would effectively replace those two wells.

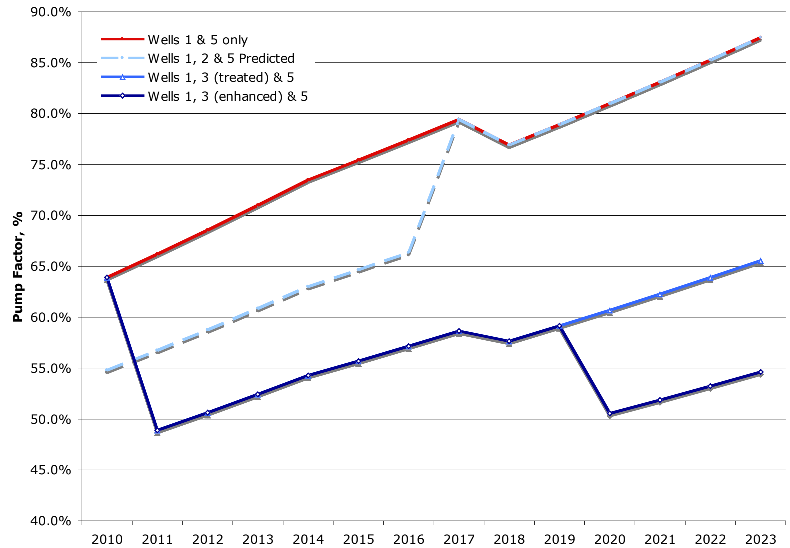

Figure 3. Pump Factors for Four Different Scenarios

The primary risk in this approach is that the most attractive systems for our near-term use are absorption systems. Those systems are sensitive to the amount of silica in the water. The silica can produce a gel that plugs the absorption bed. It will be necessary to run a pilot test with our water to make sure the system we order will perform adequately. Difficulties in this respect, or from other issues could delay adding the treatment facility. In that case, we could consider using a sand separator on Well #2 for the summer months and offset a year deferral without impacting our customers.

THE PLAN

The first step is to obtain information on the treatment system we want to install. It is probably prudent to minimize cost and that can probably best be done by asking for bids on a system. We probably want a system that is skid-mounted so that we can minimize the creation of any structures around Well #3. We could then put up a fence around the system for security. It would also be advisable to locate the facility away from any place where we might place a larger facility to handle a replacement for Well #3.

The system should be able to treat 50 gpm and produce up to 3.5 million gallons of treated water over the course of a three-month summer operating period. Presumably we would then drain the system and shut off Well #3. For some systems we have looked at, it appears the media would only need to be changed after 5-8 years of operation. We would need some assurance that we could drain the system in the fall and restart in the summer without having to replace the absorption media.

We should then begin to plan for our next well. Well #3 is similar to Wells #1 & #2, and we need to be prepared to deal with a similar degradation in capability. A short-term fix might be to use a sand separator at Well #2. For the next few years, until we can afford a new well and, possibly, a treatment system, we will need to have some kind of "shovel-ready" backup.

The timing probably looks something like this:

Year	Activity
2009	Develop a RFQ for an arsenic treatment system at Well #3. Contract award should include a pilot test of their system with our water and some. Criteria for vendor selection should include all costs – capital for their system plus any site work required

	by LMWC and operating costs over some period of time, say 4-10 years.
2010	Select one or more prospective vendors and run pilot tests on their systems. Award a contract for purchase and installation no later than April 2011
2011	Start up treatment system and use during the summer.
2012	Begin siting studies for a new well.
2013	Select site for new well, develop site layout, including treatment facility, if any. Projected need date is 2020.