Notes about Water Wells

The water needs of all homes in Creston are served by drilled wells. However, many wells here have low-volume output – less than 2 gallons per minute (gpm), the oft-perceived minimum requirement - due primarily to our elevation. To achieve high output, wells typically – but not always - have to be drilled very deep with, of course, a corresponding higher cost. This article is intended to assist those who have not yet built a home here – especially those who have always had their water needs served by a municipal water system – in living with a low-output well.

The per-day water requirement of a family of 4 may be as high as 500 gallons (the *average* usage is 400 gallons per day and the minimum is 300 gallons per day). If consumption were uniform throughout the day, the per-minute consumption rate for a family of this size would be a constant and very minor .35 gallons per minute (500 divided by 24 hours divided by 60 minutes per hour). An extreme example: as near as Debbie and I can tell, our well likely has a flow rate of about ¼ gal. (one quart!) per minute. But that represents 360 gal./day, sufficient for our 2-person household's needs; we have drained the well only two or three times in 6 years (due in all cases to a toilet left 'running') and recovery was comfortably prompt.

Of course, consumption is *not* uniform; it peaks at a far higher rate, especially in the morning. To compensate for the higher peaks in consumption, one would need either a higher flow rate, a reservoir of stored water or some combination of both.

In most cases, the primary reservoir is the well bore itself. A well that is 6" in internal diameter (typical) has a capacity of about 1.5 gallons of water per vertical foot. For those interested in the math, the formula is pi [3.1416] multiplied by radius [3"] squared [9 sq. in.(0625 sq. ft.)] multiplied by height [1 ft.]. Thus, 1 vertical foot of water = .1964 cubic feet and since 1 cubic foot equals 7.48 gallons, 1 vertical foot of water in a 6" diameter well bore equals 1.469 gallons.

The total amount of water that can be stored in any particular well is, of course, a function of the difference in height between the pump (usually just a few feet above the bottom of a well) and the top level of the water when the well has recovered from prior usage and is 'static'. For example, a well that is, let's say, 700 feet deep and has a static water level that is 200 feet below the top of the casing holds 500 feet of water. At 1.469 gallons per foot, that's a healthy 735 gallons of stored water (not counting the 40 gallons or so that is typically stored in the indoor pressure tank).

If the above calculations for any particular well demonstrate that the volume of stored water will serve an entire day's consumption and if the flow rate of the well can replenish that reservoir in 24 hours, then there should be little need for any additional actions other than following standard conservative consumption practices (more on this later). If, on the other hand, calculations suggest that a household could consume the entire available reservoir of water in the bore in a day *or* the well's recovery rate (flow rate) cannot replenish the typical daily consumption, then additional steps need to be taken.

One possible means to increase the amount of water stored in a reservoir is to increase the diameter of the well bore. A bore that is 8" rather than 6" in diameter would hold 2.6 gallons per foot rather than 1.5, a 73% increase. However, when queried on this option, one local well drilling company advised that the incremental cost of drilling a wider-diameter bore is likely to render this option less attractive than a secondary reservoir in the form of an external storage tank of appropriate capacity. Even then, this may not be the ultimate solution; if the overall volume of stored water - in the bore plus in an external tank - cannot be replenished over a longer period, as usage patterns ebb and flow, then eventually the reservoirs could run dry. Assuming, however, that the larger reservoir is primarily intended to serve intermittent, very high peaks in usage (lots of visitors for a while, an imperative to do several loads of laundry in quick succession, a need to refill a hot tub, etc.) or to deal with seasonal fluctuations in well output (drought, etc.), this option could work well. Steve Swanberg and Jane Basford are among those residents who have installed secondary reservoir tanks.

If no one or more of the above strategies satisfy a home's needs, then, indeed, drilling a well deeper (typically $10 or more per foot) remains an option, as does hydraulic fracturing (hydrofracturing).

Hydrofracturing is a well-stimulation technique in which rock is fractured by a pressurized liquid - water in the case of residential wells - into a well bore to create cracks in the deep-rock formations through which water will flow more freely (thank you, Wikipedia). Unlike in many other areas of the country where well drilling companies also offer hydrofracturing services, this appears not to be the case in our area. Therefore, a well driller will probably not offer hydrofracturing, as part of any performance warranty, to improve the performance of a well that they drill (in Maine, we had a well go dry and the well drilling company that drilled it hydrofractured it at no additional cost; part of their performance guarantee).

Not to beat it to death, but the essential requirements are that 1) there is enough stored water to cover peak demand and 2) that the well's recovery rate can, over time, replenish what has been consumed.

Conservation measures:

Common, well known and intuitive ways to reduce water consumption include:

- Staggered, short-duration showers and few baths
- Larger clothes and dish-washer loads rather than many smaller loads
- Low volume (1.6 gal. per flush) toilets (may already be mandated by code; don't know)
- Dual-flush toilets (not as many design choices, but *very* efficient)
- Use automatic dishwashers rather than hand washing; if hand washing is necessary, don't let water run between rinses
- Don't let water run while brushing teeth
- Repair leaking faucets and pipes
- Fix any toilet that may be prone to continuous running
- Use low-flow shower heads
- No or very little watering of landscaping

Other less obvious conservation actions include:

- Install one or more on-demand circulation pumps. These pumps circulate hot water from your heater to high-demand delivery points, most typically showers, and back to the heater via the home's cold water pipes until hot water arrives where it has been requested. There is still a wait (typically shorter in duration, though), but no water is wasted down the drain while waiting. An example can be found here: http://www.gothotwater.com. Debbie and I have used such a system for over 20 years in two different homes and are very happy with it.
- Install a single pump that circulates hot water continuously. This not only eliminates the waste but also the wait, i.e. hot water is available at every outlet all the time. However, this approach requires a dedicated return line (the on-demand units discussed above usually use the cold water piping for the return) at higher installation costs. Furthermore, of course, keeping the water in the line hot at all times, even when water is not being used, will affect your electricity and/or propane usage. John and Rose Simons have such a system.
- Install point-of-delivery water heaters. These are placed right at the delivery points and provide almost instant hot water; water doesn't have to travel from a distant water heater and there is thus no waste *or* wait. The potential downsides to this option include 1) more up-front electrical wiring and associated expense, 2) depending on the number of such units, the acquisition expense can be high and 3) since they use electricity to heat the water, operational costs can be more expensive than a propane-fueled central (ideally tankless) water heater.
- Install a cistern to collect rain water. Water collected in this fashion can be used to supply toilets or other non-potable applications and, of course, can be used to water landscaping, but this solution can be quite complex (the Belfors have installed this solution).

Other notes:

- Wells that were drilled a long time before a home is built may have silted up due to disuse during the interim, so the flow rate on the casing's label, which was as measured when the well was first drilled, may no longer be accurate.

- Since hydrofracturing involves injecting several thousand gallons of water into a well under extreme pressure, it can take quite a while for that artificially-introduced water to drain back out of the fissures so, should hydrofracturig be deemed appropriate, be wary of any performance measurements taken within just a couple of days of the process.

- Be sure that your well pump is protected by a PumpTec or similar device (http://franklinwater.com/products/drives-protection/residentiallight-commercial/pumptec-family/). If, for whatever reason, the well does on occasion get drained, a PumpTec will automatically shut off the pump for a preset period of time to prevent the pump from burning out. Most well drillers include such a device as part of their standard installation, but if not, be sure to add it; it's cheap insurance (the cost to replace a burned out pump can be in the thousands of dollars).

- Another benefit of an external reservoir tank is the ability to pump water from it to critical usage points, especially toilets, with a much smaller ‘secondary’ pump. The latter would only have to lift water 10 or 20 feet and thus can be of very low power (as compared to the 1- or 2-horsepower pumps required to lift water out of a well that is several hundred feet deep). Although power outages in Creston have been very few and usually of short duration, a secondary pump that can be operated by a very small generator – or maybe even by a battery – would provide a low-cost means to survive longer-term power outages.