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Sharon Jackson
Interim Town Manager
Town of Fryeburg

Review of Groundwater Issues, Wards Brook Aquifer, Fryeburg.

Dear Ms. Jackson

It has been my pleasure to serve the needs of the Town of Fryeburg since 2004, under a different Manager, Town Council and Planning Board. Many things have changed and some stayed the same since then. I intend to use this opportunity to bring you up to date on what issues were before your predecessors then, how they have been resolved, and what issues present themselves now.

Background

Emery & Garrett Groundwater, Inc. (EGGI) first appeared before the Fryeburg Planning Board in 2004. We had been invited to review an application to permit the WE Corporation Well for the withdrawal of water for bottling. We agreed with the applicant that the well was undoubtedly capable of withdrawing the very large volume of water proposed¹. The same could be said of other wells specifically designed for bottled water withdrawals by Pure Mountain Springs (sold to Nestle/Poland Springs) and by another two wells proposed, but never developed, by other entities.

Our concern was that though the Wards Brook Aquifer from which all wells were withdrawing water was clearly productive, it had limits, and that water withdrawals, if unlimited, might have the potential to very significantly reduce flow from the springs and through Wards Brook. We feared that, if pumped to capacity, the wells could dry up Wards Brook.

We proposed instead that the Planning Board take on a study of the entire aquifer system using data already gathered, so that it could properly evaluate the water resources of the aquifer and of the Town. Specifically we proposed that a computer-generated numerical groundwater flow model of the Wards Brook Aquifer be constructed and calibrated for use by the Town in review of current and future groundwater withdrawals for bottled water. We were eventually contracted, by the Fryeburg Aquifer Resource Commission (FARC) working on behalf of the Town, to complete that work. Our report was issued in 2005, using data from a wide variety of sources.

¹ The WE Corporation Well was eventually permitted for withdrawal of 450,000 gallons per day.

Our study was the first of its kind in Maine. It allowed the Planning Board to have its own independent assessment of the impacts of bottled water withdrawals. It was well reviewed by all parties that provided data (consultants to the WE Corporation, Pure Mountain Springs, and others) and by the State. The results were also presented at regional forums on groundwater issues, for instance at the National Ground Water Association's Eastern Regional meeting in Portland Maine, the New England Water Works Association Water Resource Symposium in Westford, Massachusetts, the Maine Water Conference in Augusta, Maine, and the Maine Geological Society meeting in Poland Spring.

Apart from reviews by professional hydrogeologists, our results were also presented in a format that was understandable to the lay public. In particular, we provided graphics and a way to compare water availability and use with a bank account's expense sheet. "Expenses" included "fixed" expenses (like taxes and the mortgage) and "discretionary" expenses (such as a trip to Florida). Fixed expenses in this case included the routine supply of water for the Town, and at least a minimum flow through Wards Brook. "Discretionary" expenses included withdrawals for bottled water and flow of water from springs and in the brook above the minimum flow.

The numerical value the model put upon the discretionary expense was 805,000 gallons per day. This was reduced by the application of a safety factor to 603,000 gallons per day on average (or 220 million gallons per year), which is 75% of the total available "discretionary expense".

Follow-up studies: Precipitation, Groundwater Levels, Spring Flows, Surface Flow, and Well Withdrawals

Several follow-up studies have been undertaken by others. Both Poland Spring and the WE Corporation submit monthly, quarterly and annual reports to the Town that include water level data from wells, spring flow and stream flow measurements, measurements of precipitation from on site and other nearby gauges, and total withdrawals from wells used for bottled water. The Fryeburg Water Company also submits withdrawal data².

Results of these follow-up studies are summarized below.

- Measurements of water levels in wells throughout the aquifer confirm the generalized flow of groundwater from south to north, as demonstrated in our modeling study. Water levels in many wells go up and down 4 to 5 feet both seasonally and as a result of rainstorms or snow melt events.
- Spring flow measurements are also variable and are also greatly affected by precipitation events. Unfortunately there is too little data on the pre-pumping flows from springs to evaluate whether spring flow has decreased significantly due to withdrawals from wells (though we know that springs close to pumping wells are affected by pumping).
- Streamflow is not currently measured (see discussion below), though measurements of water levels are recorded at several gauges along Wards Brook and one on the Saco River.
- Well withdrawals for bottled water are provided on a monthly basis. Table 1 gives the monthly data for 2008 and 2009. As noted above, water withdrawals for bottled water, because the water is trucked out of the watershed, have a direct bearing on the flow of

² Note however that the majority of public water supply withdrawals return to Wards Brook via drainage from septic systems in the Town and are therefore not really a part of our considerations for regulation of withdrawals.

water out of springs and down Wards Brook to Lovewell Pond. We labeled such withdrawals as a “discretionary expense” in the aquifer “bank accounting”, and specifically required that it be limited to 603,000 gallons per day (gpd). In fact, in 2008 withdrawals averaged 308,538 gpd. In 2009, withdrawals were lower at 241,338 gpd (due in part to the economic decline). These withdrawals are about half or less of the threshold limit of 603,000 gpd.

Table 1. Average Daily Groundwater Withdrawals (gallons per day) from Commercial Wells in Fryeburg trucked out of the watershed for Bottled Water, 2008, 2009

Month	2008		2009	
	WE	Nestle	WE	Nestle
January	2,935	257,218	8,423	231,317
February	5,951	297,546	8,746	192,500
March	4,765	541,677	2,952	266,207
April	6,813	538,624	4,384	237,645
May	8,423	379,273	8,118	431,920
June	8,973	536,226	7,894	407,685
July	13,587	313,534	6,594	250,602
August	11,397	207,610	7,639	354,955
September	7,623	140,297	5,193	118,419
October	7,377	163,413	2,675	190,895
November	5,270	135,912	3,844	76,400
December	6,303	96,126	4,767	58,863
Average Daily	7,483	301,055	5,936	234,784
Total Avg Daily Withdrawals	308, 538		241,338	

Follow up studies: Biota of Ward’s Brook

One of the recommendations made by us in our 2005 modeling report was that: “A consulting biologist be hired by the Town to assess the biological assets of Wards Brook including Wards Pond, with the specific task of determining the sensitivity of the native biota to seasonal reductions in base flow.”

The biologists hired were from Normandeau Associates of Bedford, New Hampshire. Their report (to FARC), noted that despite the cool spring flow entering Wards Pond, its open water condition allowed water temperatures to be dominated by trends in air temperature. Brook trout, the commonest fish species in the cool water section from the Old Mill site to the Route 113 dam/weir, dominated by spring flow, were considered to be the most sensitive species to reduced flow in the Brook due to withdrawals from the aquifer. Other fish species (e.g. largemouth bass and yellow perch) are “habitat generalists” and are more common in the wetland downstream from the Old Mill.

Other fauna considered in Normandeau’s evaluation included insect larvae, which were “not likely to be impaired by reduced flows in the Brook. However, the herbaceous layer of wetland vegetation in the section of the wetlands between Route 113 and the Old Mill is sensitive to water level changes and would likely show some minor alteration in the small wetlands in that region of Wards Brook.

Overall, Normandeau concluded that “the impacts of water withdrawal from the vicinity of the commercial springs are likely to be minor in all areas, but most pronounced along the small streamside wetlands in the middle section of the stream.”

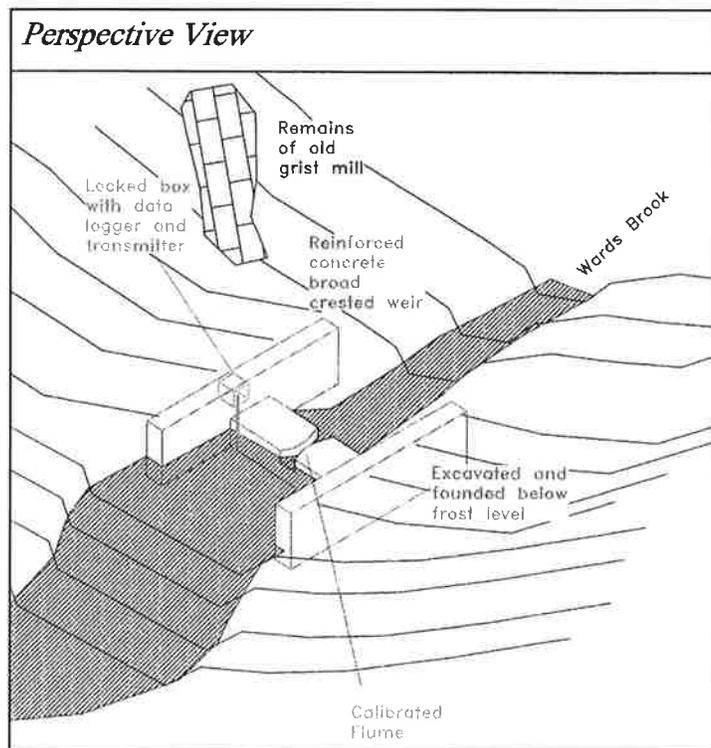
Measurement of Flow in Ward’s Brook

The WE Corporation and Nestle (and before them Pure Mountain Springs) maintain surface water monitoring stations at several points along Ward’s Brook. Measurements of water level are read off staff gauges and converted to elevation by reference to a surveyed mark on each gauge. These measurements, however, cannot be directly translated to flow measurements of water through Ward’s Brook. Instead it is necessary to measure flow in the Brook by direct measurement of flow of water using a flow meter at several stations across a transect of the bed of the brook. These flow measurements should then be compared with simultaneous measurements of water level elevation at that point in the Brook. Under ideal conditions, water elevation measurements, which are simple to make, can be calibrated to water flow.

One of the recommendations made by us in our 2005 modeling report was that:

“Improvements should be made in the measurement of flow through the Wards Pond / Wards Brook drainage. We especially recommend a new weir should be constructed at the downstream end of Wards Brook, just above where it empties out into a wetland connected to Lovewell Pond. A long-abandoned grist mill dam at this location would be a suitable location for such a weir. Water levels and water flows should be observed/calculated at the weir on a periodic basis by staff of the Fryeburg Water Company or the Town. Monthly measurements should suffice for most of the year. However, in dry summers, when water levels in Wards Brook are low, daily measurements may be necessary.”

This recommendation makes mention of a weir, which is a small dam built in the streambed. Flow is measured through a flume, a narrow passage for water through the weir which allows the accurate measurement of flow especially at times of low flow. It was this type of structure (see original schematic at right) that was proposed for construction at the Old Mill site. A Permit by Rule was applied for through the DEP, and granted. The project was taken on by the Water District as a useful service to the Town. The District applied for funds from a variety of Charitable Foundations for this work. An engineer (Wright Pierce) who had installed a similar structure for Nestle in Kingfield was chosen for preparation of a design and bid specs. A local contractor was hired.



Unfortunately, the year 2009, when the weir and flume was due to be installed, was a very wet year through August, with unusually high flows in the Brook. Thus the weir and flume were not put in place by the deadline of October 2nd. The project then had to go to the US Army Corps of Engineers for review. The Army Corps consulted with US Fish and Wildlife biologists who would absolutely not agree to such a structure constructed in the Brook.

So now we are in a situation where low flows must be measured from a staff gauge set in the Brook, and we are now in the process of calibrating measurements of water level with flow rate. Problems we have found to date include the facts that:

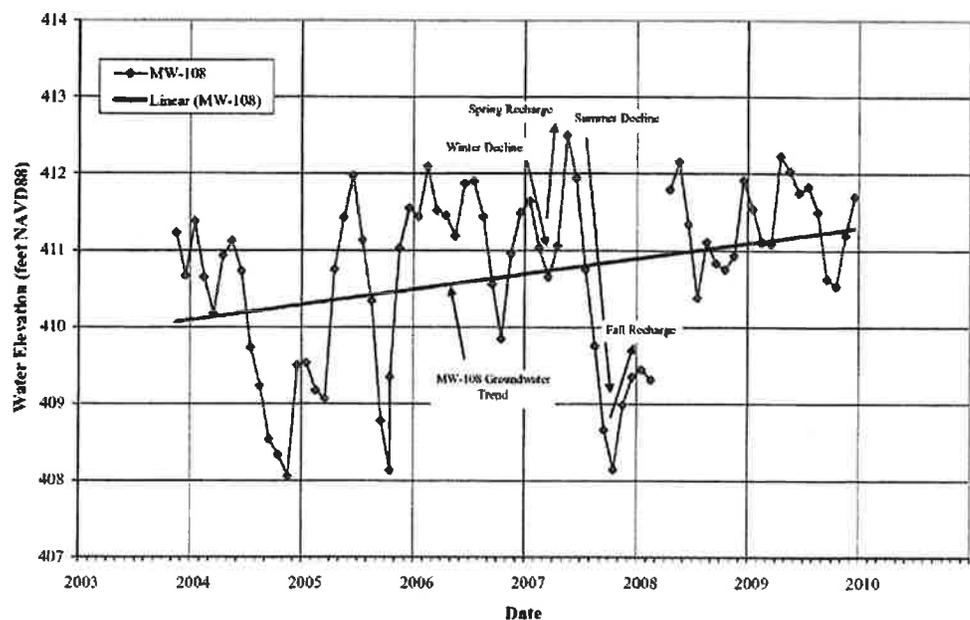
- The brook in this section has many boulders, which can have confusing effects as they emerge at times of low flow;
- The Brook has sloping sandy banks that result in a changed flow profile during low flows;
- Woody debris is washed downstream during high flows and tends to collect on stranded logs on the large boulders that mark the former location of the Grist Mill dam. This debris has been shown to change the calibration, and must be removed periodically.

Nevertheless, we are reasonably confident that a calibration curve can be constructed that allows the determination of flow in the Brook from measurements of water level on a staff gauge.

Climatic Variations

We have all noticed tremendous variations in precipitation over the past decade. The period 1999-2002 was a period of drought, with 2001 being its peak, whereas the last few years have been years of very high rainfall and/or snowfall. The middle years of the decade had more or less normal precipitation. As a

result of this natural variation in precipitation and natural recharge to the aquifer, groundwater levels have increased by over one foot over the last six years, despite the greater rises and falls due to seasonal changes and storm events. Both the natural variation and upward trend are clearly shown in the Figure above (from the LGS 2009 monitoring report for Nestle).



Years of normal or higher than normal precipitation should be of no concern to the Town of Fryeburg, in respect to a healthy flow through Wards Brook because in those years springs flow

at higher rates than average, and the base (low) flow in the Brook is also higher than average as a result.

Conclusions

The Town of Fryeburg has come a long way in its ability to manage its excellent water resources since Pure Mountain Springs transformed the operation of the Fryeburg Water Company into a utility that also supplied spring water for bottling under the Poland Spring label, and other entities also showed interest in making large withdrawals for similar purpose. The following points should be borne in mind in consideration of Fryeburg's current position:

1. Production Wells installed in portions of the aquifer (such as the Fryeburg Water Company's three wells, the WE Corporation well and others) are capable of very high yields;
2. If pumped to capacity, these wells are capable of over-drafting the aquifer such that Wards Brook could go dry if the many springs were to cease flowing;
3. Such drying of springs is not in the interest of either Nestle or the WE Corp, as they are selling "spring water", the definition of which requires that springs in hydraulic connection with the wells continue to flow;
4. A numerical computer model of groundwater flow through the aquifer was constructed and calibrated. It estimated that an average withdrawal of 603,000 gallons per day for bottled water to be trucked out of the watershed was probably acceptable for maintenance of spring flow and healthy streamflow, even during dry years;
5. A certain measure of doubt is inherent in the above statement. It is for that reason that we urged that flow in the Brook be measured routinely;
6. We recommended in our 2005 report that *"The Planning Board or Code Enforcement Officer can use water flows across a weir to regulate withdrawals from wells that service bottled water facilities in order to protect natural resources in the Wards Pond/Brook drainage. We recommend that the minimum flow across the Wards Brook weir (at the Old Mill site) be set at 800 gallons per minute. This regulatory trigger should be considered as preliminary and "for guidance only" as more data is collected in the future, and reassessed based upon the advice of the consulting biologist, and on long term measurements at these weirs."* We are at that stage in the process now.
7. Current average daily withdrawals by Nestle and the WE Corp are about half (about 300,000 gpd) of the recommended maximum withdrawals (603,000 gpd). As a result we anticipate minimum flow in the Brook will be considerably above the preliminary trigger value of 800 gpm, especially as we are still apparently in a wet weather cycle.

I trust that this information is useful to the Town of Fryeburg, and look forward to continuing as the Town's advisor on matters related to water resources.

Yours Sincerely,

Peter Garrett, Ph.D., Senior Vice President
Maine Certified Geologist #169

Cc Dick Krasker and Board of Fryeburg Water District