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MEMORANDUM

Date: November 28, 2010
To: Water Utility Board
Tom Heikkinen, Water Utility Manager
Subject: Water Utility Pumping Doctrine

The Madison Water Utility has commissioned a large contract to evaluate the need for of an additional water well(s) on the east side of the city. This work was conceived initially to replace UW 3 and broadened to address water quality issues at UW 7, UW 8, and UW 15.

I believe that this work should also review the Water Utility's Pumping Doctrine of its well system. When I use the term "Pumping Doctrine", I do not wish to convey any implication that the Water Utility has a written, approved doctrine for well pumping. I do not believe that there is one. However, there is a general practice for pumping its wells that can be described as follows:

With the exception of the newest well (UW 29), wells are either off or on. That is, they are pumped at maximum capacity or shut off. Wells with the best water quality are used throughout the year. Wells with water quality issues, such as visible iron or manganese, are only employed during the higher demand summer months or when other wells are taken out of service for repairs.

I believe that the existing pumping doctrine is the result of the historic limitation of the pumps and control systems. In the past, a well could only be pumped at less than maximum capacity by "throttling down" the valves, which increased the head losses in the system and increased the power consumption. UW 29 has more recent technology (variable frequency drives or VFDs) which allows for the well to be pumped at one-half its rated capacity.

The existing Pumping Doctrine does result in some problems for the Water Utility. Those problems include:

- Localized lowering of the ground water level, which increases the hydraulic gradient;
- Increased power for pumping water from the lower ground water elevation; and,
- Most importantly, greater potential for moving pollutants from documented or undocumented contaminated sites.

Unfortunately, the Water Utility has several examples of moving pollutants to the well sites. UW 3, which was located at Johnson and First Street, was located in close proximity to a number of contaminated sites, including the Demetral Landfill. There is a belief that pumping from UW 3 and pumping from the Oscar Mayer Company's privately owned wells created a stable situation regarding the movement of pollutants. When the Oscar Mayer Company's wells were taken out of service, UW 3's water quality declined.

UW 15 is another well threatened by pollutants. This well, located in the vicinity of E. Washington Avenue and Lien Road has been pumped steadily to make up for lack of UW 3, and water quality issues at UW 7 and 8.

On a more positive note, UW 29 has been operated at one-half its capacity to reduce the risk of pollutants being drawn from the Sycamore Landfill, which lies to the northwest of the well. UW 29 was also retrofitted with iron and manganese filter technology. As I understand it, the Water Utility has determined this procedure has also resulted in less lowering of the groundwater table and a resultant diminished use of power for pumping.

In evaluating the need for additional wells and capacity for wells on the city's east side, I urge the Water Utility to consider revising the current Pumping Doctrine to minimize the flow of pollutants to its wells. This work should be done prior to modeling the hydraulic capacity of the system in the east side project. The work flow would be as follows:

- 1) Determine the water supply needs and fire flows for geographic areas;
- 2) Determine the optimum flow capacity of existing wells based upon the maximum capacity and with reductions to minimize the flow of contaminants to the well;
- 3) Determine the hydraulic capacity of the system based upon various scenarios including the failure of equipment and unanticipated contamination; and,
- 4) Determine scenarios to best address the water quality issues.

I certainly recognize that my direct experience with the Utility's water supply mission is minimal. However, my past professional experience as City Engineer managing the city's retired landfills provided a perspective regarding the impact of documented and undocumented contamination sources on the public drinking water supply. As part of the environment work on landfills, the City Engineering Division conducted pump testing of UW 3, 16, 17, 18, and the Oscar Mayer Wells in conjunction with the Demetral, Truax, Greentree, Mineral Point, and Olin Landfills. Engineering also conducted pump tests for the environment review of the Madison Convention Center project.

It was during the tests of UW 16/Mineral Point Landfill, Joe DeMorett, the present Water Supply Manager, postulated the "leaking confining" shale deposit which substantially changed the way we look at the impact of pollutants on groundwater and the operation of the Water Utility wells.

Engineering also conducted pump tests for the environmental review of the Madison Convention Center project. During that work, the relationship between the water flow to the well and Lake Monona was studied and the age of the water was determined. (There is a connection between the surface water and UW 17 but the flow takes considerable time.)

Sincerely,



Larry D. Nelson, P.E.