Responses to Scott Korom – University of North Dakota

Comments on the Draft Report on the Red River Valley Water Supply Project Needs and Options

UNIVERSITY OF UND NORTH DAKOTA

GEOLOGY AND GEOLOGICAL ENGINEERING
P.O. BOX 8358
GRAND FORKS, NORTH DAKOTA 58202-8358
(701) 777-2811; FAX (701) 777-4449
www.geology.und.edu
www.und.edu/dept/sem/

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Red River Valley Water Supply Project
Bureau of Reclamation
Dakotas Area Office
P.O. Box 1017
Bismarck, ND 58502-1017

To whom it may concern:

Below are my comments on the draft Needs and Options report. They all pertain to Appendix B. I have comments on two major issues and a list of suggested revisions to improve the readability of the text.

Comment 1 On page B-33 there is a paragraph on the geochemical influences of ASR, but I do not think it adequately addresses the potential problems of ASR in our region. It is well-established that some of our aquifers have reactive components in them. As pointed out on page B-34, there are shale "layers" in the Moorhead Aquifer, which are "of interest." I believe the writer of this section should more clearly state the possible influences of the shale on groundwater quality during ASR.

For example, we know that shale fragments exist in the Elk Valley Aquifer and we believe they are at least partially responsible for the relatively high concentrations of sulfide (as pyrite) and organic carbon in these sediments. On adding nitrate to groundwater at a site in the Elk Valley Aquifer, which makes the water more oxidizing, sulfate concentrations from the apparent oxidation of pyrite increased over 350% (Korom et al., 2005). There was also the apparent precipitation of magnesian calcite (Korom et al., 2005). It is unlikely that water with high nitrate concentrations would be used for ASR; however, that does not solve potential problems caused by geochemical changes during ASR in our aquifers. If reduced water is added to the Moorhead Aquifer it may encourage further production of ferrous iron and increased populations of iron bacteria. The latter are notorious for plugging up groundwater conveyance systems.

Comment 2 Are the maintenance costs of cleaning out iron bacteria considered in the estimates of cost of the various alternatives?

My second and last major issue has to do with the subsection titled *Water Removed under Confined Conditions*, starting on page B-38. This section concludes that water taken from the confined portion of the Moorhead Aquifer is relatively insignificant compared to that potentially available from the unconfined portion, assuming a successful ASR program is possible. I agree, but I believe

Comment 3 the major reason why the confined aquifer has little potential to store water can be made clearer.

The writer correctly calculates the range of the amount of water produced from storage due to compressibility of water and compression of the aquifer matrix by the change in head over history. However, once this water is extracted the water produced by aquifer compression, which is probably more than that produced by the

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Response to Comment 1

Currently, there are inadequate geochemical data for the West Fargo and Moorhead Aquifers. Additional field data collection and analysis would be required to verify and refine assumptions prior to pilot-scale tests of the aquifer response to ASR (aquifer storage and recovery). Geochemical modeling will be undertaken to determine if the mixing of ASR water and native groundwater will lead to adverse chemical reactions, if an alternative is selected for construction that uses an ASR feature.

Response to Comment 2

Although this issue was not specifically addressed, costs such as these would be considered part of operation and maintenance costs associated with Project features.

Response to Comment 3

This section was clarified in the Final Needs and Options Report.

compressibility of water, is not fully replaceable during an ASR program. In other words, once water is removed from a confined aquifer, the resulting compression is not fully elastic. Some of the storage capacity of the confined aquifer is lost forever. A good reference for this is USGS (1999). As a remedy for this section, I recommend that the amount of water produced over history from the confined aquifer be estimated. This should be followed by a statement that the amount of water that could now be stored in the confined portion of the aquifer would be even less with an explanation as to why. Furthermore, storativity on page B-38 is the volume of water produced per unit area of aquifer per unit change in head of the potentiometric surface.

Comment 4

Comment 5 Below are several suggestions that may be useful:

Page B-36, ¶ 2, line 2: add "after extraction" between "water" and "with surface water." It may not be readily apparent that the mixing of aquifer water and surface water discussed here is not natural, but apparently a result of blending the two waters before treatment.

Page B-39, line 7: add "the" between "as" and "lower." Comment 6

Comment 7 Page B-39, after "Porosity": use "average" for "in the middle"

Page B-39, end of page: All of these variable definitions seem to be out of place. Comment 8

Page B-39, S_y: I would not say that specific yield is analogous to specific storage.

Comment 9 Specific yield is water that is produced by gravity drainage; however, specific storage is water produced by compression of the aquifer matrix and water compressibility (not drainage). For an unconfined aquifer $S = hS_s + S_y$ and usually $S_y >> hS_s$. For a confined aquifer, bS_s is analogous to hS_s for an unconfined aquifer, not S_y.

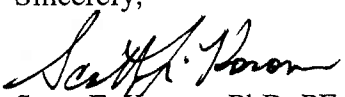
References

Korom, S.F., A.J. Schlag, W.M. Schuh, and A.K. Schlag. 2005. In situ mesocosms: Denitrification in the Elk Valley Aquifer, *Ground Water Monitoring and Remediation* 25(1): 79-89.

United States Geological Survey. 1999. Land Subsidence in the United States. *Circular* 1182, 177 pgs.

Please feel free to contact me with any questions or comments (701-777-6156, scottkorom@mail.und.nodak.edu).

Sincerely,



Scott F. Korom, PhD, PE

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Response to Comment 4
This section was clarified in the Final Needs and Options Report.

Response to Comment 5
This has been added to the Final Needs and Options Report

Response to Comment 6
This has been added to the Final Needs and Options Report

Response to Comment 7
This has been added to the Final Needs and Options Report

Response to Comment 8
Your comment is noted.

Response to Comment 9
The suggested corrections have been made in the Final Needs and Options Report.