Pilot Study Report

for

Z-92® Uranium Treatment Process

conducted at

City of Grand Island, Nebraska
South Basin Water Supply

October 22, 2009

WATER REMEDIATION TECHNOLOGY, LLC
9500 W. 49th Avenue, Suite D100, Wheat Ridge, Colorado 80033 · 303-424-5355 · FAX 303-425-7497

Executive Summary

A uranium and gross alpha radionuclide removal pilot study was conducted for the City of Grand Island, Nebraska on their South Basin water supply. Naturally occurring radionuclides in the Grand Island's raw water source exceed the current Maximum Contaminant Levels (MCL's) for uranium and gross alpha.

The City of Grand Island selected Water Remediation Technology's (WRT) Z-92® Uranium Treatment Process as a possible cost effective solution to their uranium and gross alpha problem. WRT provided a 1.5 GPM (gallons per minute) treatment system, which was delivered and installed on June 30, 2009.

The purpose of this pilot study is to document the effectiveness of the WRT system on high uranium and gross alpha water and to provide information necessary to meet regulatory compliance.

The treatment system has successfully met uranium and gross alpha compliance at all times during the pilot study. The system was in operation for 93 days prior to writing this report and effectively reduced the level of uranium (Figure 1) and gross alpha (Figure 2) to less than the MCL.

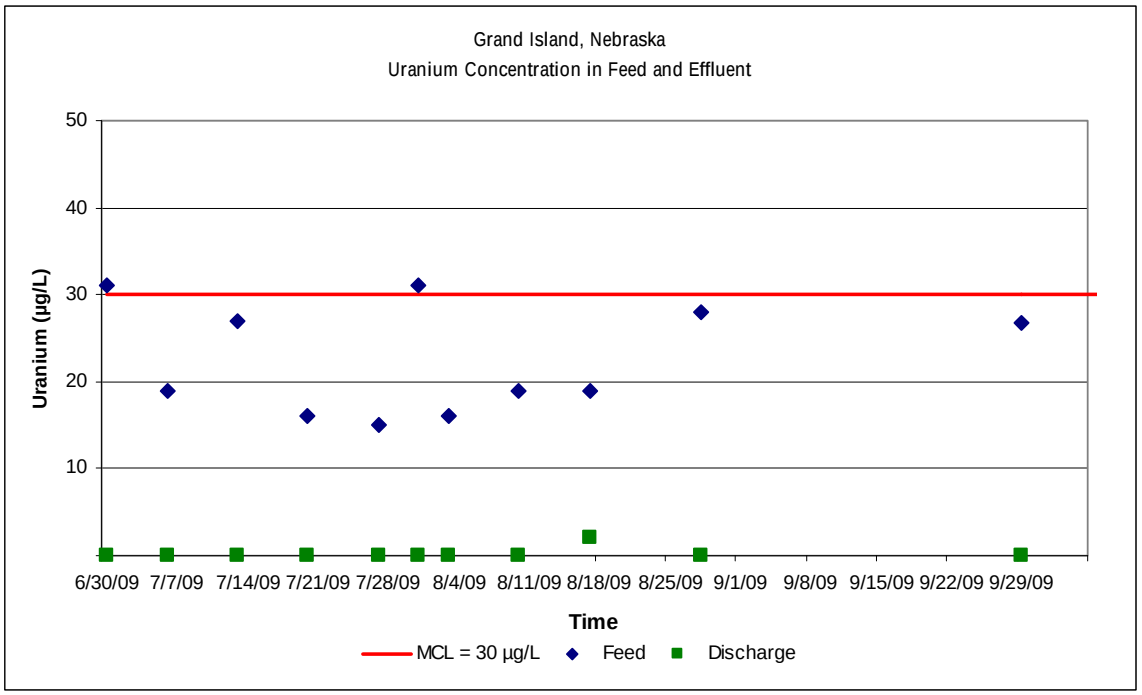

Figure 1

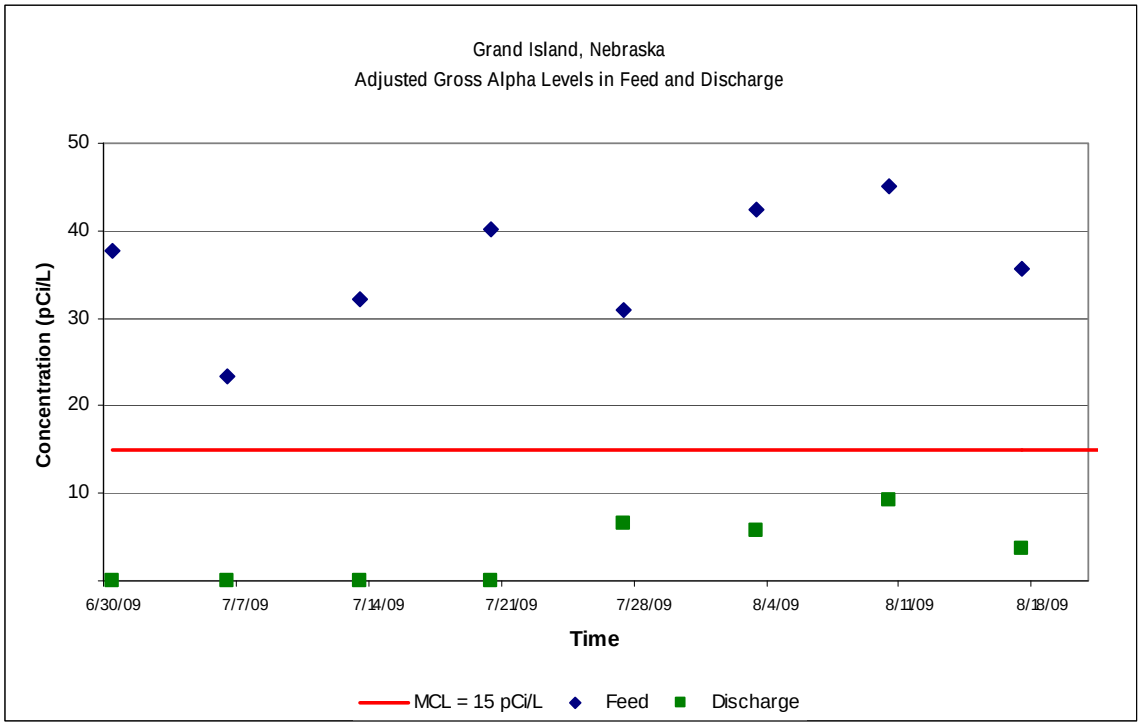

Figure 2

The results are also shown in Table 1. The average feed concentration of uranium, 22.5 µg/L, was reduced to an average of 0.2 µg/L after column 3 and has yet to exceed 2.0 µg/; well below the MCL. The average feed concentration of gross alpha, 35.9 pCi/L was reduced to 3.2 pCi/L after column 3 and never exceeded 9.3 pCi/L.

Table 1. Uranium and Gross Alpha levels in feed and discharge water.

Uranium	Feed (µG/L)	Discharge @ Column 3 (µG/L)
Uranium MCL	—	**30.0**
Average	22.5	0.2
Highest value	31.0	2.0
Lowest Value	15.0	0.0
Gross Alpha	**Feed (pCi/L)**	**Discharge @ Column 3 (pCi/L)**
Gross Alpha MCL	—	**15.0**
Average	35.9	3.2
Highest value	45.0	9.3
Lowest Value	23.4	0.0

Application Information

The City of Grand Island is located in Hall County in central Nebraska, approximately 100 miles west of Lincoln. Grand Island is the fourth largest city in Nebraska, with an estimated population of 45,000. There are approximately 10 wells that comprise the South Basin water supply. These wells, along with the North Basin water supply serve the community of Grand Island. The pilot study was conducted at the Platte Generating Station, where water from the South Basin is connected to the generating station. The South Basin well field pumps an average of 10,000 gallons per minute to supply the community of Grand Island. The water source for these wells is the Ogallala Aquifer.

Technology Overview

Water Remediation Technology's (WRT) Z-92® Uranium Treatment Process utilizes proprietary adsorptive ion exchange media in a series of upflow treatment vessels to remove uranium and reduce gross alpha from drinking water. The water is moved through the treatment system using the water pressure generated from the well source. No chemicals are added to the water for the treatment process. After the media is loaded with uranium and other radionuclide contaminants, it is removed from the circuit and permanently disposed of in a licensed facility. WRT designs, manufactures and provides the equipment and media used in the facility. The handling and exchange of new media to replace spent media, as well as the shipping and disposal into licensed disposal sites, is handled by WRT. The treatment media is ANSI/NSF Standard 61 certified for use in drinking water.

Equipment Overview

The pilot equipment was installed in the City of Grand Island's South Basin treatment facility. The treatment system used consisted of three 6-inch diameter by 40-inch vertical height treatment vessels, each containing 36-inches of process media. The source water entered the unit through a control valve and enters the bottom of the first treatment vessel. All three columns were operated in an up-flow mode, with the flow exiting the top of the first column, then following the same flow path through columns 2 and 3 (see Figure 3). The last component in the system was a safety filter. Sample ports were located prior to the first vessel, and after the second vessel.

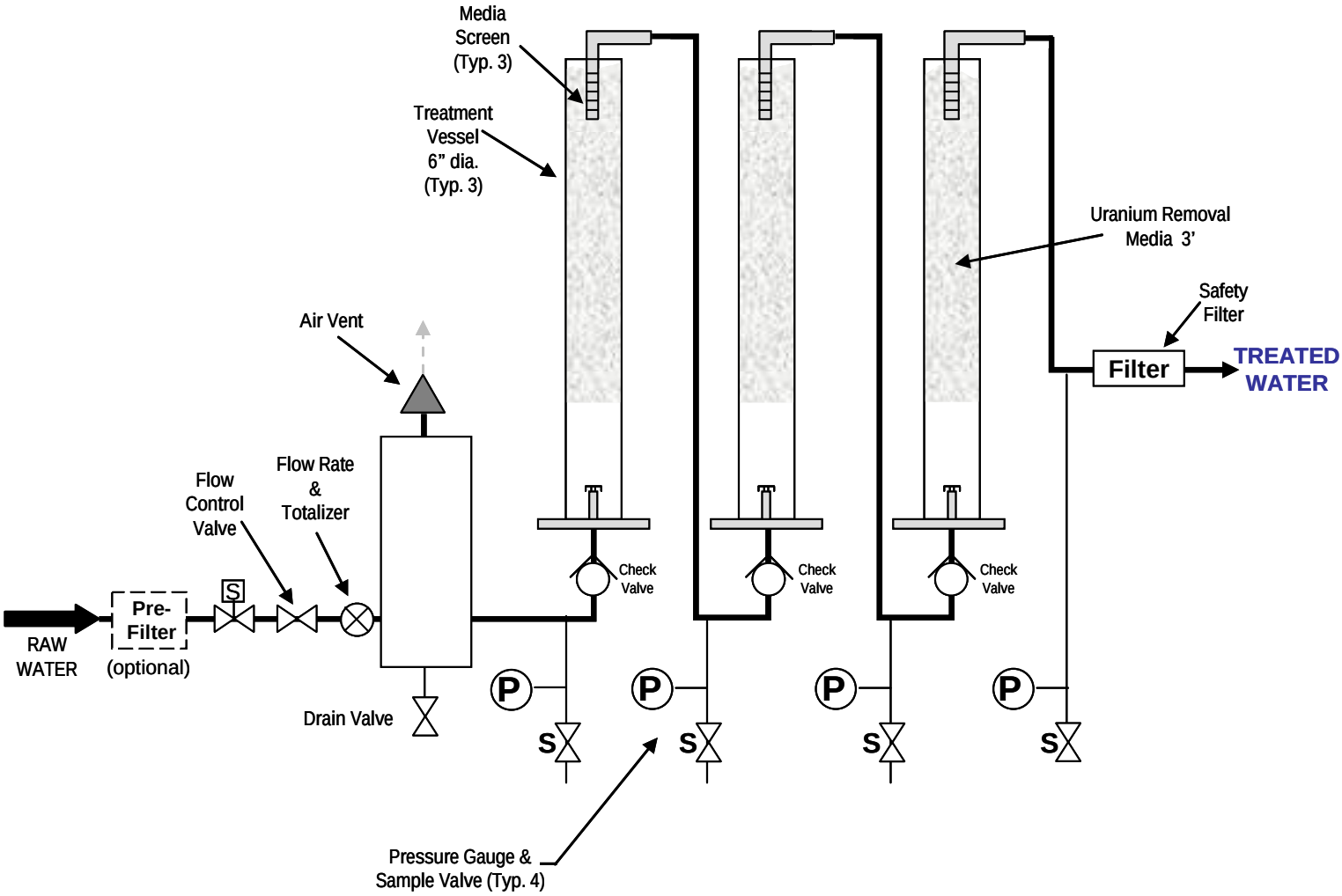

Figure 3. Simplified Process Flow Diagram

The City of Grand Island's
Z-92® treatment system.

Statement of Purpose

The uranium levels in the raw water during the pilot study were as high as 31.0 µg/L, and the gross alpha as high as 45.0 pCi/L. The Environmental Protection Agency (EPA) mandated MCL for uranium is 30 µg/L and 15 pCi/L and for gross alpha.

The purposes of this pilot study are:

- Demonstrate the ability of the WRT Z-92® Uranium Treatment Process to consistently and effectively reduce the uranium and gross alpha content to below the MCL on this specific water.
- Demonstrate the reliability and ease of operation of the WRT Process.
- Comply with regulatory requirements.
- Develop Design Criteria for the Full-Scale System.

Delivery and Installation of the Treatment System

The treatment system was delivered at the City of Grand Island's South Basin treatment facility on June 30, 2009. Due to the self-contained design of the pilot trailer, set up consisted of securing the trailer and connecting the water source and discharge line. The pilot study began the same day. Data was collected for 93 days prior to the writing of this report.

Operator training for system operation, monitoring and sampling was conducted on the day of installation and a schedule for sampling was established. Samples were collected by the City of Grand Island's personnel from sample valves located in the feed line and after discharge from each respective treatment vessel, at pre-determined sample intervals.

Analytical

The samples for uranium, gross alpha and inorganic water quality were delivered to the Nebraska Public Health Environmental Laboratory in Lincoln, Nebraska and Evergreen Analytical Laboratory in Wheat Ridge, Colorado for analysis. Samples for radium were delivered to Energy Laboratories, Inc. in Casper, Wyoming. All three laboratories are National Environmental Laboratory Accreditation Program certified laboratories. Methods for analysis were:

Gross Alpha	EPA 900.0
Uranium	EPA 200.8
Radium 226	EPA 903.0
Radium 228	RA-05
Metals	EPA 200.8
Anions	EPA 300.0

Results

The sampling results are shown in Table 2 and 3. Feed samples were collected immediately prior to the first treatment vessel. Intermediate column samples were collected immediately after column 1 and column 2 and the final discharge sample was taken after column 3. Analytical laboratory certificates are attached as Appendix A. Figure 4 and 5 shows uranium and gross alpha levels in the feed water entering the treatment system, and treated water exiting the system. The graphs clearly show that the system consistently and successfully reduced the uranium and the gross alpha in the treated water to levels below the required MCL.

Table 2. Uranium Test Results

Uranium	Column Concentrations (µG/L)				
Date	Feed	C1	C2	C3	MCL
6/30/09	31.0	<	<	<	30.0
7/6/09	19.0	<	<	<	30.0
7/13/09	27.0	<	<	<	30.0
7/20/09	16.0	<	<	<	30.0
7/27/09	15.0	<	<	<	30.0
7/31/09	31.0	<	<	<	30.0
8/3/09	16.0	<	<	<	30.0
8/10/09	19.0	2.0	<	<	30.0
8/17/09	19.0	<	<	2.0	30.0
8/28/09	28.0	<	<	<	30.0
9/29/09	26.7	<	<	<	30.0

Note: < is below detection levels.

Figure 4 below, presents in graph format, the data in Table 2.

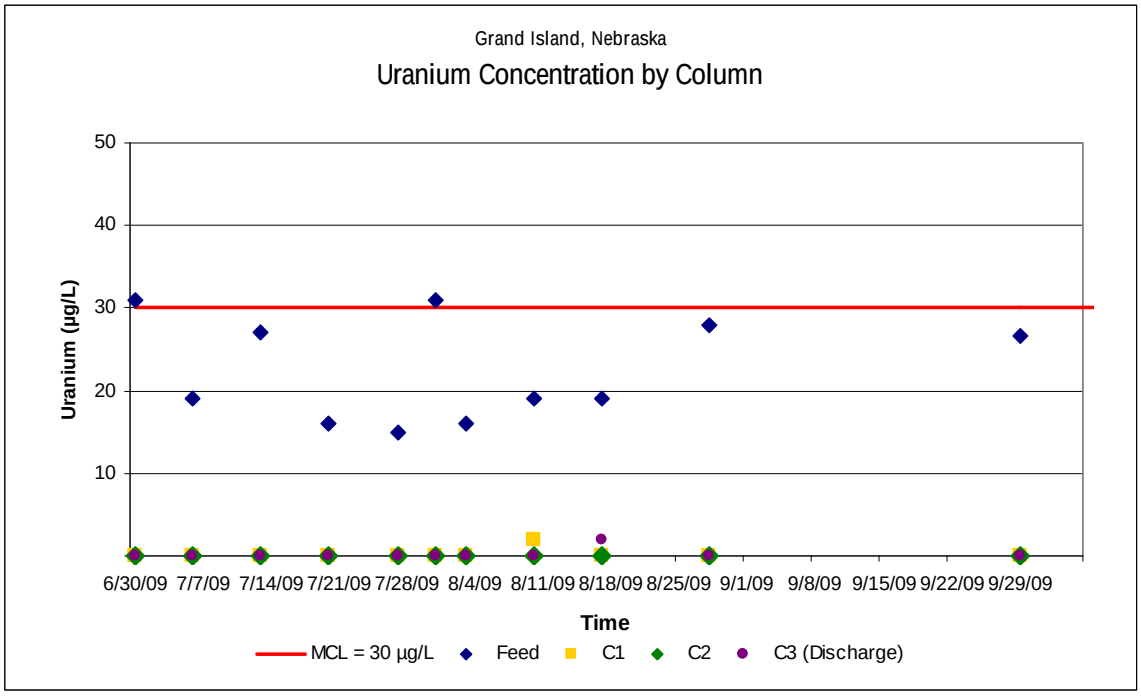

Figure 4

Table 3. Gross Alpha Test Results

Gross Alpha	Column Concentrations (pCi/L)				
Date	Feed	C1	C2	C3	MCL
6/30/09	37.8	-3.0	-1.0	-1.0	15.0
7/6/09	23.4	0.0	0.0	0.0	15.0
7/13/09	32.1	0.0	0.0	0.0	15.0
7/20/09	40.1	0.0	0.0	0.0	15.0
7/27/09	30.9	8.6	9.0	6.5	15.0
8/3/09	42.5	9.1	6.9	5.8	15.0
8/10/09	45.0	8.4	8.0	9.3	15.0
8/17/09	35.6	0.0	2.8	3.6	15.0

Figure 5 below, presents in graph format, the data in Table 3.

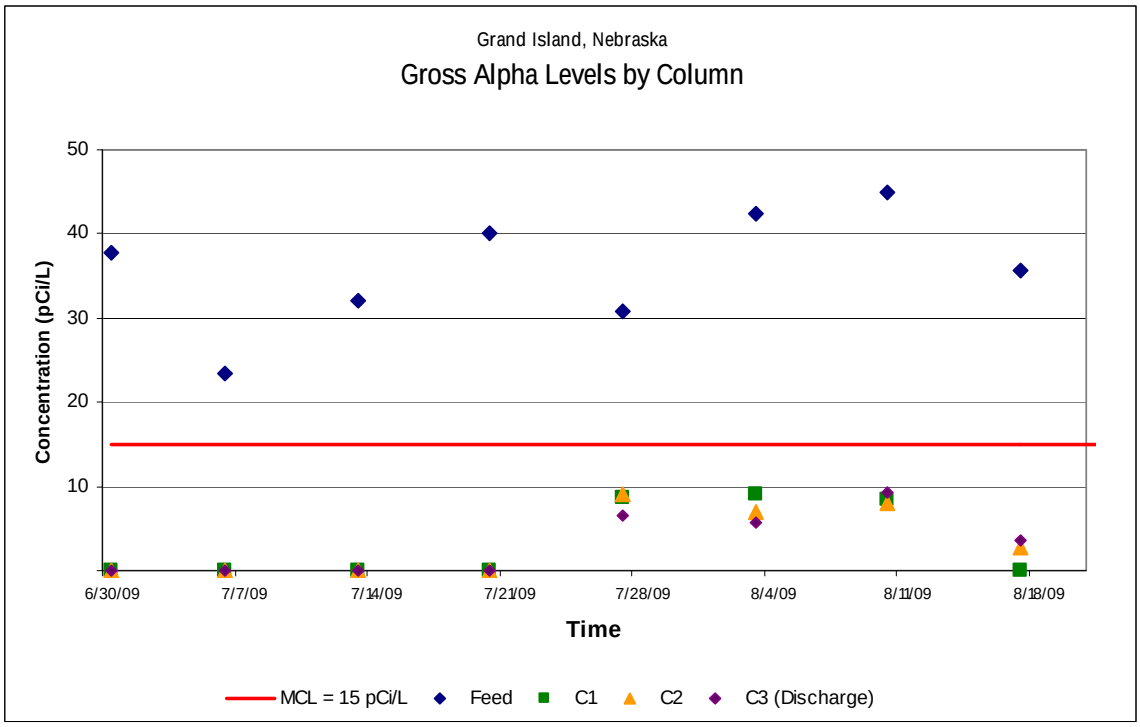

Figure 5

Radium Results

The radium sampling results are shown in Table 4. Samples from the feed water source for radium testing were collected once at the installation of the pilot unit. The analytical laboratory certificate is attached as Appendix B. The results for radium sampling shows the feed water average combined RA-226 and Ra-228 concentration is within compliance of the radium MCL. Of the radium isotopes normally found in ground water, Ra-226 will contribute to the measured gross alpha of the water sample.

Table 4. Radium 226, 228 Raw Water Test Results

Date	Radium 226 Feed (pCi/L)	Radium 228 Feed (pCi/L)	Combined Radium Feed (pCi/L)	MCL
6/30/09	0.1	1.0	1.1	5.0

Water Quality

A water quality analysis was performed on the feed water to the treatment system and on the treated water exiting the WRT system to document any changes in water quality through the treatment process. The results of those tests are shown in Table 5. Other than the reduction of uranium and adjusted gross alpha, there is no significant change to the water quality. Some removal of metal contaminants such as vanadium will occur early in the service run and may not continue throughout the expected uranium removal service period. Support documentation for Table 5 is attached as Appendix C.

Table 5. Water Quality Test Results

Grand Island, Nebraska Water Quality Data			
Item	**Pre WRT Process**	**units**	**Post WRT Process**
Alkalinity	192	mg/L	196
Antimony	<	µg/L	<
Arsenic	2.59	µg/L	2.20
Barium	101	µg/L	101
Beryllium	<	µg/L	<
Calcium	81.6	mg/L	82.5
Carbon, Total Organic	2.20	mg/L	1.00
Chloride	33.1	mg/L	32.5
Chromium	1.64	µg/L	1.71
Copper	<	µg/L	<
Fluoride	0.521	mg/L	0.522
Hardness	290	mg/L	290
Iron	50.9	µg/L	<
Lead	<	µg/L	<
Magnesium	21.2	mg/L	21.4
Manganese	14.8	µg/L	15.6
Mercury	<	µg/L	<
Nickel	3.02	µg/L	5.00
Nitrite	<	mg/L	<
Potassium	10	mg/L	10
Selenium	<	µg/L	<
Silica	24.0	mg/L	23.0
Sodium	74.2	mg/L	74.7
Strontium	0.800	mg/L	0.600
Sulfate	230	mg/L	220
Thallium	<	µg/L	<
Total Dissolved Solids	594	mg/L	584
Uranium	24.9	µg/L	<
Vanadium	4.41	µg/L	4.38
Zinc	<	µg/L	<

Note: < is non-detectable levels.

Hydraulic Loading Rate, EBCT

The treatment unit operates only when the deep well is providing water to the distribution system. The average flow rate through the treatment unit, when operating, was 1.50 GPM. The HLR at this flow rate is 7.6 GPM per square foot. The total gallons treated during the pilot study are summarized in Table 6 and Appendix D.

The EBCT at this HLR through three treatment vessels, each containing 36-inches of media, is 2.9 minutes each, for a cumulative EBCT of 8.8 minutes.

Table 6. Cumulative treated flow in gallons

Sample Data	Treated Flow in Gallons
6/30/09	26
7/6/09	14,560
7/13/09	27,963
7/20/09	43,202
7/27/09	58,210
8/3/09	73,196
8/10/09	87,311
8/17/09	101,484
8/28/09	124,559
9/29/09	193,110

Radiation Safety

The treatment system is designed to collect uranium, a naturally occurring radioactive material, while in operation. Because of this action, it gradually becomes radioactive during normal operation. WRT both predicts and monitors the level of radiation present in the treatment system.

The total amount of radiation that members of the public can be exposed to is 2 mrem per hour and 100 mrem over the course of a year. WRT's maximum measured activity is less than half of the hourly exposure limit. Due to the limited amount of operator attention necessary for the pilot test, the annual exposure limit is also readily met.

WRT has prepared a safety plan for its tests that includes radiation level monitoring, logging time spent in proximity to a test unit, emergency procedures to be followed and an introduction to radiation safety for operators. Operators are instructed in radiation safety before the pilot test is started.

Any full scale system will include appropriate equipment, radiation level monitoring, and a corresponding safety plan approved by regulatory authorities.

Operational Results

An operation log was maintained during the pilot study, and is attached as Appendix D. The treatment system operated throughout the course of this test without any operational problems.

Conclusion

The WRT Z-92® Uranium Treatment Process consistently reduced the adjusted gross alpha and uranium in the system discharge to levels well below the required MCL's. The treatment system operated easily and reliably during the study. There was no equipment or operational problems of any kind.

WRT would like to thank the personnel and staff of the City of Grand Island for their assistance, cooperation and participation in this study.

Appendices available upon request