AQUIFER EXEMPTION EVALUATION

Project Officer: Craig Boomgaard Date: 3/14/14

Agency: Environmental Protection Agency-Region 8

Operator: Slawson Exploration CO, INC.

Well/Project and Location: Big Bend 1-5 SWD SENW Sec.5-T151N-92W; Mountrail County, ND

Injection Characteristics: Fluids proposed to be injected would come from liquid waste generated by production from both the Bakken and Three Forks Formations. Both the Bakken and Three Forks Formation waters contain high concentrations of chlorides, sodium and some calcium, making the physical characteristics of the two waters very similar with total dissolved solids (TDS) up to 344,000 PPM in this area as published in the Catalog of North Dakota Water Chemistries. These waters have no secondary use and can be disposed of in Class II wells. Permitted wastes also include fluids produced during the drilling, completion, testing, or stimulation of wells or test holes related to oil and gas operations.

Description of Proposed Aquifer Exemption Area

Aquifer to be Exempted: Inyan Kara Formation of the Dakota Group

Aquifer Water Quality: Swab Volume 300 bbls: TDS = 6,510 mg/L,
Swab Volume 400 bbls: TDS = 9,170 mg/L,
Swab Volume 500 bbls: TDS = 8,790 mg/L,
Swab Volume 600 bbls: TDS = 8,676 mg/L,
Swab Volume 715 bbls: TDS = 7,769 mg/L

Aquifer Depth: At the wellbore, the Inyan Kara Formation occurs from 4,845-5,261 feet below ground surface.

Aquifer Exemption Area: Inyan Kara Formation: 1,900 foot radius from the surface location of the Big Bend 1-5 SWD well.

Confining Zone(s): The upper confining zone is the Mowry Formation (shale), located from 4,488-4,845 feet (357 feet thick). The lower confining zone is the Swift formation (shale), located from 5,261-5,707 feet (446 feet thick). The confining zones and cement through these zones have been determined by the EPA to be adequate to prevent the movement of fluid from the injection zone to any known or potential underground sources of drinking water (USDWs) above or below the injection zone. A cement bond log was reviewed to determine adequate cement exists behind pipe through the confining zones. To determine that the geologic confining zones are continuous, eighteen (18) gamma ray logs were reviewed along the north-south and east-west trending axis covering a five (5) mile radius.

USDW(s): There are no known USDWs below the injection zone. The nearest USDW above the Inyan Kara is the Fox Hills Formation. In this area, it is located 3,132 feet above the proposed injection zone (Inyan Kara Formation). Note the Hell Creek and Fox Hills Formations are connected hydrologically and are therefore considered to be a single aquifer. The Hell Creek Formation sits above the Fox Hills Formation. This combined aquifer system underlies the entire reservation and ranges from 100 to 350 feet in thickness. The principal USDWs in the area of the

proposed aquifer exemption are the New Town Aquifer and Sanish Aquifer. Both of these aquifers sit above the Fox Hills Formation and have many confining shale formations separating them from the proposed injection zone.

Regulatory Criteria under which the exemption is requested
40 CFR 146.4

(x) (**a)** Not currently used as a drinking water source **and**:

Based on the North Dakota State Water Commission public records, there are no drinking or stock wells completed into the Inyan Kara Formation in Townships 150N, 151N and 152N for Ranges 91W, 92W, and 93W. The deepest well on the New Town Peninsula is 960 feet deep and located at NESE Township 151N Range 93W Section 3. The nearest wells are approximately 3.5 miles north of the Big Bend 1-5 SWD and serves as public water supply or the city of New Town, ND. The New Town city water supply consists of three (3) ground water wells penetrating the New Town Aquifer. Other segments, including Four Bears, Mandaree, Parshall, Twin Buttes, and White Shield use Lake Sakakawea has the primary source of drinking water for the public water systems.

( ) (**b)(1)** It is mineral, hydrocarbon, or geothermal energy producing, or

(x) **b(2)** It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical, or

( ) **b(3)** It is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption, or

( ) **b(4)** It is located over a Class III well mining area subject to subsidence or catastrophic collapse, or

(x) **c.** TDS is more than 3,000 and less than 10,000 mg/l and it is not reasonably expected to supply a public water system.

Explanation for b**(2)** and **c:**

Based on the Mountrail County (and peninsula) population trends and the amount of available water in the Sentinel Butte, Tongue River, Fox Hills/Hell Creek Formations, New Town and Sanish Aquifers, there is sufficient quantity of ground water in these resources to serve the current and future population of Mountrail County and the peninsula without the development of the exempted portion of the Inyan Kara Formation. Also, the Missouri River/Lake Sakakawea is the primary source of drinking water for most of the reservation. The lake holds a permanent pool of 4,980,000 Ac-Ft with a top range of 23,821,000 Ac-Ft with a useable volume up to 18,841,000 Ac-ft. Lake Sakakawea currently provides drinking water for Four Bears, Mandaree, Parshall, Twin Buttes and White Shield.

The estimated costs to develop the proposed exempted aquifer as a water supply source including any treatment costs and costs to develop alternative water supplies is discussed below. It includes costs for well construction, transportation, and water treatment for each source.

The primary factor controlling the cost of developing the proposed exempted aquifer as a water supply source is depth and water quality. As shown above, the Inyan Kara Formation is found at approximately 4,898 feet below land surface, with a total depth of 5,444 feet. In contrast, the better quality Fox Hills/ Hell Creek Formation is available at approximately 1,413 feet below land surface and an approximate TD of 1,710 feet, with several other acceptable formations at shallower depths.

Slawson recently drilled, cased, and partially perforated the Big Bend 1-5 SWD for a cost of $1,085,900. A phone conversation with Rex at Backman Drilling (701) 734-6667 located in Wilton, ND provided verbal information for 5" cased domestic wells of $31.00/foot. Agri Industries Inc. (Williston, ND) provided verbal information for 100-200 gallon per minute industrial wells for 200 foot 10 inch casing of approximately $40,000, a 900 foot Fort Union well around $60,000 and a 1600 foot Fox Hills well approximately $150,000. Dennis Water Well Service located in New Town, ND (701) 627-2390 provided a verbal quote of $280,000 to drill a Fox Hills well. These costs represented do not include location construction or surface equipment, as it is assumed that these additional costs would be the same for each formation.

Aquifer	Depth (Feet)	Estimated well cost (Total Depth)
New Town	200	$ 40,000
Ft. Union	900	$ 60,000
Fox Hills	1,805	$280,000
Inyan Kara	5,444	$1,085,900

As can be observed above, drilling cost varies by depth, size of hole, and contractor. The estimated total depth drilling cost to drill an Inyan Kara water supply well exceeds the cost of drilling a Fox Hills water supply well by an estimated $805,900, with additional savings and shallower depths. Therefore, based on cost, the quantity, and quality of the water available in the Fox Hills/Hell Creek aquifers and other supplies located at shallower depths, this suggests that the proposed exempted aquifer is situated at a depth which makes recovery for USDW purposes economically impractical.

Public Process

This aquifer exemption request will be announced in both the Minot Daily News and New Town News newspapers. The Final Permit and Statement of Basis, and the aquifer exemption application will be posted on the EPA-Region 8 UIC webpage for the public to review.