



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8**

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JUL 27 2016

Ref: 8P-W-UIC

Robert Koehler, Ph.D.
Underground Injection Control Program
Colorado Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801
Denver, Colorado 80203

Re: Underground Injection Control (UIC) Program Aquifer Exemption Approval
Windy Hill Water Operations, LLC, Windy Hill #3-17D, Morgan County, Colorado

Dear Dr. Koehler:

The U.S. Environmental Protection Agency Region 8 Water Program office has reviewed your aquifer exemption request which was received January 19, 2016, and the updated request dated April 8, 2016, for the designation of a limited portion of the aquifers listed below as exempted aquifers.

This request is in conjunction with the Class II disposal well permit proposed by Windy Hill Water Operations, LLC, for the injection of up to 25,000 barrels per day (bpd) of oil and gas production water into the J-Sandstone. The water source will be off-site wells (to be identified), and the water will be transported to the site by commercial operators (to be identified). It is the EPA's understanding that the Colorado Oil and Gas Conservation Commission (COGCC) is permitting the project as a Commercial Disposal Well Facility with a Dedicated Injection Well. The first public comment period for the permit and proposed aquifer exemption ended on February 18, 2016, with no public comments received. The second public comment period for the updated aquifer exemption area ended on May 8, 2016, with no actionable public comments received.

APPROVAL OF PROPOSED AQUIFER EXEMPTION: Based on the review of the supporting information provided by the COGCC, and pursuant to 40 CFR § 144.7(b)(3), the EPA hereby approves a non-substantial program revision (40 CFR §§ 144.7 and 145.32) to exempt portions of the J-Sandstone of the Lower Cretaceous Dakota Group. The depth and extent of the aquifer exemption are as follows:

Approximate depth to top of exempted aquifer: 5,110 feet
Approximate depth to bottom of exempted aquifer: 5,300 feet
Area: N½ of 17-3N-55W; N½ SW¼ and N½ SE¼ of 17-3N-55W; W ½ NW ¼ and NW¼ of SW ¼ of 16-3N-55W 6th P.M., in Morgan County, Colorado.

Based on our review of the information provided, the EPA concurs with the COGCC's conclusion concerning the aquifer exemption criteria listed below:

- It does not currently serve as a source of drinking water (40 CFR § 146.4(a))
- It has total dissolved solids more than 3,000 and less than 10,000 mg/l and it is not reasonably expected to supply a public water system (40 CFR § 146.4(c))

The exempted aquifer is confined above by approximately 85 feet of the immediately overlying Dakota D unit, which is composed of shale in this area, and above that by 4,925 feet of Dakota Group and Pierre shales. The exempted aquifer is confined below by approximately 121 feet of the immediately underlying Skull Creek Shale.

This approval applies to the location and the injection activity described herein. Additional approvals may be required for additional injection activities.

Please find enclosed the Record of Decision (ROD) which supports this decision by the EPA. The ROD includes additional background information, detailed analysis and discussion of any public comments. If you have questions or concerns, please contact Valois Shea of my staff at (303) 312-6276.

Sincerely,



Darcy O'Connor
Acting Assistant Regional Administrator
Office of Partnerships and Regulatory Assistance

Enclosure

cc: Robert Smith, EPA Headquarters



**U.S. EPA Region 8
Underground Injection Control Program**

AQUIFER EXEMPTION RECORD OF DECISION

This Record of Decision provides EPA's aquifer exemption (AE) decision, background information concerning the AE request, and the basis for the AE decision.

Regulatory Agency: Colorado Oil and Gas Conservation Commission (COGCC) 1425 Program

Date of Aquifer Exemption Request: original request: January 19, 2016; updated request: April 8, 2016

Substantial or Non-Substantial Program Revision: Non-Substantial

Basis for Substantial or Non-Substantial Determination: This AE request has been determined to be a non-substantial revisions to the approved State primacy program. This determination is based on the fact that the total dissolved solids (TDS) in the portion of the aquifer proposed for exemption is between 3,000-10,000 mg/L and the AE is associated with the issuance of a site-specific Class II UIC permit action, consistent with EPA's Guidance 34.

Operator: Windy Hill Water Operations, LLC (Windy Hill)

Well Class/Type: Class II SWD Well

Well/Project Name: Windy Hill #3-17D

Well/Project Permit Number: N/A

Well API number: 05-087-08145

Field: Unnamed

Tribal Reservation: N/A

Well/Project Location: Qtr: SENE Section: 17 Township: 3N Range: 55W 6th P.M.

Footage Call: 1974 feet from N line 715 feet from E line

County: Morgan **State:** CO

Latitude: 40.22797 **Longitude:** -103.5493

DESCRIPTION OF PROPOSED AQUIFER EXEMPTION (depths are approximate values at the well bore)

Aquifers to be Exempted: J Sandstone **Top:** 5,110 feet **Bottom:** 5,300 feet **Lithology:** Sandstone

Water Quality – TDS (mg/L): 6,600 mg/L to 10,000 mg/L

Source of WQ Data: Analysis of 4/15/2015 sample from Windy Hill #3-18WSW well and 2/7/2005 sample from Windy Hill #1-17D well

Areal Extent and Description of Exempted Aquifer (i.e. radial distance, encompassed TSR)

Total Area of Aquifer to be Exempted: 600 Acres

Description: N½ of 17-3N-55W; N½ SW¼ and N½ SE¼ of 17-3N-55W; W ½ NW ¼ and NW¼ of SW ¼ of 16-3N-55W 6th P.M., in Morgan County, Colorado.

Confining Zone(s):

Upper Confining Zone

| Formation | Lithology | Top (Feet below ground surface) | Bottom (Feet below ground surface) |
|-----------------------------------|-----------------------------|---|--|
| The Colorado Group & Pierre Shale | Shale, siltstone, limestone | ~100 | 5,025 |
| Dakota D Unit | Shale in this location | 5,025 | 5,110 |

Lower: Skull Creek Shale **Lithology:** Shale **Top:** 5,310 feet **Bottom:** 5,433

The confining zones are shown in stratigraphic column in Figure 1. The proposed exempted aquifer is the J Sandstone of the Dakota Group.

The Dakota Group is composed of a basal marine sandstone (the Plainview-Lytle Formations in the Denver Basin), that is overlain by a widespread marine shale unit (the Skull Creek Shale) that is in turn overlain by a series of erratically-distributed, near-shore-marine, deltaic, and distributary sandstones. The lower sandstones are known as the J Sandstone and the upper sandstone is known as the D Sandstone. In Morgan County, as many as four distinguishable sandstone beds (the J-1, J-2, J-3, and J-4) make up the J Sandstone, with the J-1 being the uppermost and the J-4 being the deepest. This stratigraphic sequence is shown in Figure 1.

At the location of the Windy Hill #3-17D well, the top of the J Sandstones is encountered at a depth of 5,110 feet below ground surface (bgs) and the base of the J Sandstones (top of the Skull Creek Shale) is at 5,310 feet bgs according to geophysical well logs. Only the J-1, J-2, and J-4 Sandstones are present; the J-3 Sandstone is absent. The geophysical logs for Windy Hill #1-17D well indicate that the D-1 Sandstone and the D-2 Sandstone are actually shale in this location. The J-1 and J-2 Sandstone are intersected by the well at 5,110 to 5,130 feet bgs. The thickness of the J-4 Sandstone is approximately 180 feet, extending from 5,130 to 5,310 feet bgs. The Windy Hill #3-17D well is perforated from 5,130 to 5,300 feet bgs. However, there is no evidence to indicate that the J Sandstones are not one hydrologic unit. Therefore, the vertical extent of the exempted aquifer is 200 feet from 5,110 feet to 5,310 feet bgs.

BACKGROUND

The project proposes using the Windy Hill #3-17D well as a Class II underground injection control (UIC) well to dispose of up to 25,000 barrels per day (bpd) of oil and gas production water into the J Sandstone through the perforated interval extending from 5,130 to 5,300 feet bgs. The water source would be off-site wells (to be identified), and the water would be transported to the site by commercial operators (to be identified). The Commission is permitting the project as a Commercial Disposal Well Facility with a Dedicated Injection Well. The proposed disposal well is an existing well that was previously permitted as a Class V UIC well by the EPA under a former project design. The well was constructed, but it was never operated as an injection well. Upon receipt of a Class II injection permit from the Commission, EPA will release the well from its jurisdiction.

USDW(s): The Laramie-Fox Hills USDW, which overlies the Pierre Shale over much of the Denver Basin, has been eroded away at this location. The unconsolidated Quaternary-aged deposits of alluvial and eolian sediments that form the surficial geology over large areas of the Denver Basin lie directly upon the Pierre Shale. In the Windy Hill project area, the Pierre Shale is overlain by wind-deposited silt and fine sand USDWs up to about 100 feet thick over the larger area, with about 50 feet present at the location of the 3-

17D. The Pierre Shale contains a fairly persistent lens of sandstone near its base that serves locally as a water source for private wells. The J Sandstone USDW is proposed for exemption.

Injectate Characteristics: Oil & Gas Exploration & Production wastes

BASIS FOR DECISION

Regulatory Criteria under which the exemption is approved

40 CFR § 146.4(a) *It does not currently serve as a source of drinking water*

A search in the Colorado Division of Water Resources (DWR) online water well database indicated that permits have been issued for 18 private wells within ¼ mile of the updated AE boundary. Table 1 lists information about each of these wells. The well locations are shown on Figure 2. Reported well depths range from 60 to 88 feet. All wells listed in Table 1 are vertically isolated from the Dakota J Sandstone, the aquifer requested for exemption, by several thousand feet of low-permeability shale.

| Permit # | Location | Footcalls | Depth | Perf Top | Perf Bottom |
|----------|-------------|---------------|---------------------------------------|--------------------|--------------------|
| 46051-MH | NWNE Sec 17 | 394 N 1942 E | 62 | 50 | 60 |
| 269978 | NWNE Sec 17 | 394 N 1942 E | 60 | 50 | 60 |
| 46052-MH | NENW Sec 17 | 341 N 1857 W | 74 | Info not available | Info not available |
| 269977 | NENW Sec 17 | 341 N 1857 W | 72 | 62 | 72 |
| 46053-MH | NWNW Sec 17 | 394 N 392 W | 64 | 54 | 64 |
| 269976 | NWNW Sec 17 | 394 N 392 W | 63.5 | 53.5 | 63.5 |
| 46055-MH | SENE Sec 17 | 2384 N 2200 W | 79 | 69 | 79 |
| 269980 | SENE Sec 17 | 2384 N 2200 W | 79 | 69 | 79 |
| 269981 | SENE Sec 17 | 2084 N 2463 W | 78.5 | 68.5 | 78.5 |
| 65854-F | SENE Sec 17 | 2300 N 1900 W | Permit canceled; well not constructed | | |
| 65853-F | SWNW Sec 17 | 2300 N 600 W | Permit canceled; well not constructed | | |
| 46054-MH | SWNW Sec 17 | 1555 N 378 W | 88 | 78 | 88 |
| 269979 | SWNW Sec 17 | 1555 N 378 W | 88 | 78 | 88 |
| 65856-F | NESE Sec 17 | 1900 S 2500 E | Permit canceled; well not constructed | | |
| 43892 | SWSE Sec 17 | 2640 N 400 E | 45 | Info not available | Info not available |
| 65855-F | NESW Sec 17 | 2000 S 1300 W | Permit canceled; well not constructed | | |
| 65858-F | SESW Sec 17 | 600 S 2000 W | Permit canceled; well not constructed | | |
| 65857-F | SWSW Sec 17 | 600 S 600 W | Permit canceled; well not constructed | | |

A search of the DWR water wells database indicates that the nearest drinking water well completed in the aquifer proposed for exemption, the Dakota Sandstone, is approximately 54 miles from the proposed aquifer exemption area.

40 CFR § 146.4(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.*

Two water samples were collected from the J Sandstone in two different locations within the Windy Hill project area. One sample was collected at the well with the current Division of Water Resources permit # 79176-F located in NWSW Section 18 T3N R55W, 9,700 feet from Windy Hill #3-17D. This sample had a TDS of 6,600 mg/L. An earlier sample was collected in February, 2005, from Windy Hill well #1-17D, API# 05-087-08137 in NWNW Section 17 T3N R55W, 4,000 feet from Windy Hill #3-17D. This sample had a TDS of 10,000 mg/L.

It is unlikely that the Dakota Sandstone will be tapped to supply water for municipal or domestic uses, or even stock or agricultural uses, in the area, due to the high TDS content in the Dakota Sandstone water, the high cost of drilling deep wells to access the Dakota Sandstone at depths on the order of 5,000 feet, and the high cost of treating Dakota Sandstone water to remove excess TDS. The permit applicant provided information on the cost to construct, operate and maintain a drinking water treatment plant with the treatment process equipment that would be required to treat Dakota Sandstone water to potable standards. The treatment process that would be required to treat the Dakota Sandstone water is reverse osmosis, which would create a high TDS brine. An additional expense would be incurred for the disposal of the large volume of high TDS brine that would be created by the treatment of Dakota Sandstone water.

The nearest public water supply is a well field operated by the City of Brush. The well field is approximately four (4) miles west-southwest of the Windy Hill #3-17D well and obtains water from an alluvial aquifer along Beaver Creek in Section 27, Township 3 North, Range 56 West. During a consultation for the development of this aquifer exemption request, the City indicated that it is unlikely that they would consider obtaining water from the Dakota Sandstone, given the good quality and ready availability of water from the City's current source aquifer, particularly in contrast to the poorer-quality water in the Dakota Sandstone, the high cost of drilling deep wells to access the Dakota Sandstone water, and the high cost and difficulty of treating Dakota Sandstone water to remove excess total dissolved solids. Population growth projections for the City of Brush indicate that future increased water demand could be met by the shallow source aquifer currently in use by the City.

The population of the City of Brush was 5,465 in 2013, based on records from the Colorado Department of Local Affairs, State Demographer's Office (SDO 2015a). SDO (2015b) population projections show an annual growth rate for Morgan County (projections are available only on a county level) ranging from approximately 0.9 percent to 1.3 percent and averaging approximately 1.1 percent through the year 2040. Applying the Morgan County projection rates to the 2013 population for Brush suggests that the population of Brush will grow to approximately 7,341 by 2040, for an increase of 34 percent. The municipal water demand can be anticipated to grow at a rate approximately equal to the population increase, which would result in a water demand ranging seasonally from 800,000 to 4 million gallons per day by the year 2040. This demand could be met by the shallow source aquifer currently in use by the City of Brush.

Other Considerations

The proposed Windy Hill operation will also include one to two water supply wells completed in the J Sandstone injection zone that will be used to supply J Sandstone groundwater for commercial uses, such as a component of hydrofracturing fluids. The water supply well, Windy Hill #3-18WSW, is located in the west

half of Section 18 approximately 1.9 miles away from Windy Hill #3-17D. Windy Hill submitted a request to the DWR for a nontributary determination for withdrawal of up to 25,000 barrels per day (bpd) of groundwater from the J Sandstone from the Windy Hill #3-18WSW well and potentially one other well.

The COGCC, the DWR and the EPA were concerned that the pumping of groundwater water supply well(s) would affect the flow pattern of the injectate from Windy Hill 3-17D. The three agencies requested that Windy Hill develop a groundwater flow model tracking injectate flow from the Windy Hill 3-17D during the pumping of J-Sandstone water supply well(s) in order to determine the appropriate AE boundary. The agencies agreed that Scenario 1 of the March 2016 Tetra Tech report is representative of the injectate flow path from Windy Hill 3-17D as influenced by the simultaneous pumping from the water supply well(s). This area is shown in Figure 3. In a letter dated, April 8, 2016, COGCC requested that the additional area impacted by the injectate be included in the AE area.

The water supply well, Windy Hill #3-18WSW, is already constructed. The COGCC, DWR and EPA discussed the likelihood of this well ever being used to supply drinking water from the J-Sand. The conclusion is that the cost of treatment, including construction and maintenance costs of the technology needed to treat the J-Sand aquifer to drinking water standards would be prohibitive compared to using shallower, better quality water sources available at the site.

PUBLIC COMMENT

Results of Public Comment Process: COGCC published a public notice in *The Fort Morgan Times* (Fort Morgan, Colorado) on December 22, 2015 for the originally proposed AE area. COGCC published a second public notice in *The Fort Morgan Times* on April 8, 2016 for the updated AE area. On the last day of the second public comment period, the COGCC received a letter requesting a public hearing. COGCC policy requires that public hearing requests must include a reason for the holding the hearing or a specific objection against the proposed aquifer exemption. The COGCC replied back to the commenter requesting information about the objection to the aquifer exemption and reasons for holding the hearing. The letter included a two-week deadline for replying back to the COGCC before the COGCC considered the public comment period officially closed. The commenter never responded; therefore, the public comment period officially ended without any actionable comments related to the aquifer exemption.

The DWR and Colorado Department of Public Health and Environment (CDPHE), were notified and provided the following comments:

- The DWR does not consider the injection zone formations to be potable groundwater at this location due to the depth and high TDS content. The DWR informed COGCC and EPA that Windy Hill had submitted a permit application to the DWR for a water supply well completed in the J Sandstone. The purpose of this water supply well would be to provide non-potable water for industrial use. DWR expressed concern that the originally proposed AE area did not take into consideration the effects of pumping from the water supply well. To address this concern, Windy Hill developed a groundwater flow model to determine the impact on the AE area due to pumping from the water supply well. The DWR was also concerned that Windy Hill may add an additional pumping well at some time in the future. To address this concern, the COGCC agreed to include as a permit condition that the permit would be reviewed every 5 years to determine how many pumping wells are operating at the site and revisit the groundwater flow model as necessary, if new pumping wells are added to the operation.
- The CDPHE concurred with the proposed aquifer exemption and considered the J Sandstone in the area to be eligible for classification as a Regulation 42 area. The CDPHE encouraged the other two State agencies to conduct the process to include this area under Regulation 42 at some time in the future.

The Regulation 42 designation is conferred by a COGCC/CDPHE joint rule-making action upon on oil-and-gas-bearing aquifer units within the Lower Cretaceous Dakota Group. These aquifers are usually oil-and-gas-bearing. In this case, test wells have been drilled into the J Sandstone in the Windy Hill project area but the presence of commercially producible oil and gas was not detected. To be eligible for the Regulation 42 designation, the Dakota aquifer groundwater is considered to be of "Limited Use and Quality" as a drinking water source for the following reasons:

- No drinking water wells in the area use the J-Sand as a water source.
- Because of its depth and the treatment required for TDS concentrations and petroleum hydrocarbons.

CONCLUSION AND DECISION

Based on review of the entire record, EPA finds that exemption criteria 40 CFR §§ 146.4(a) and 146.4(c) have been met and EPA approves the AE request as a non-substantial program revision.

Figure 1. Stratigraphic Column from Windy Hill #3-17D, Windy Hill Water Operations, LLC

(Figure 4 in Tetra Tech Report)

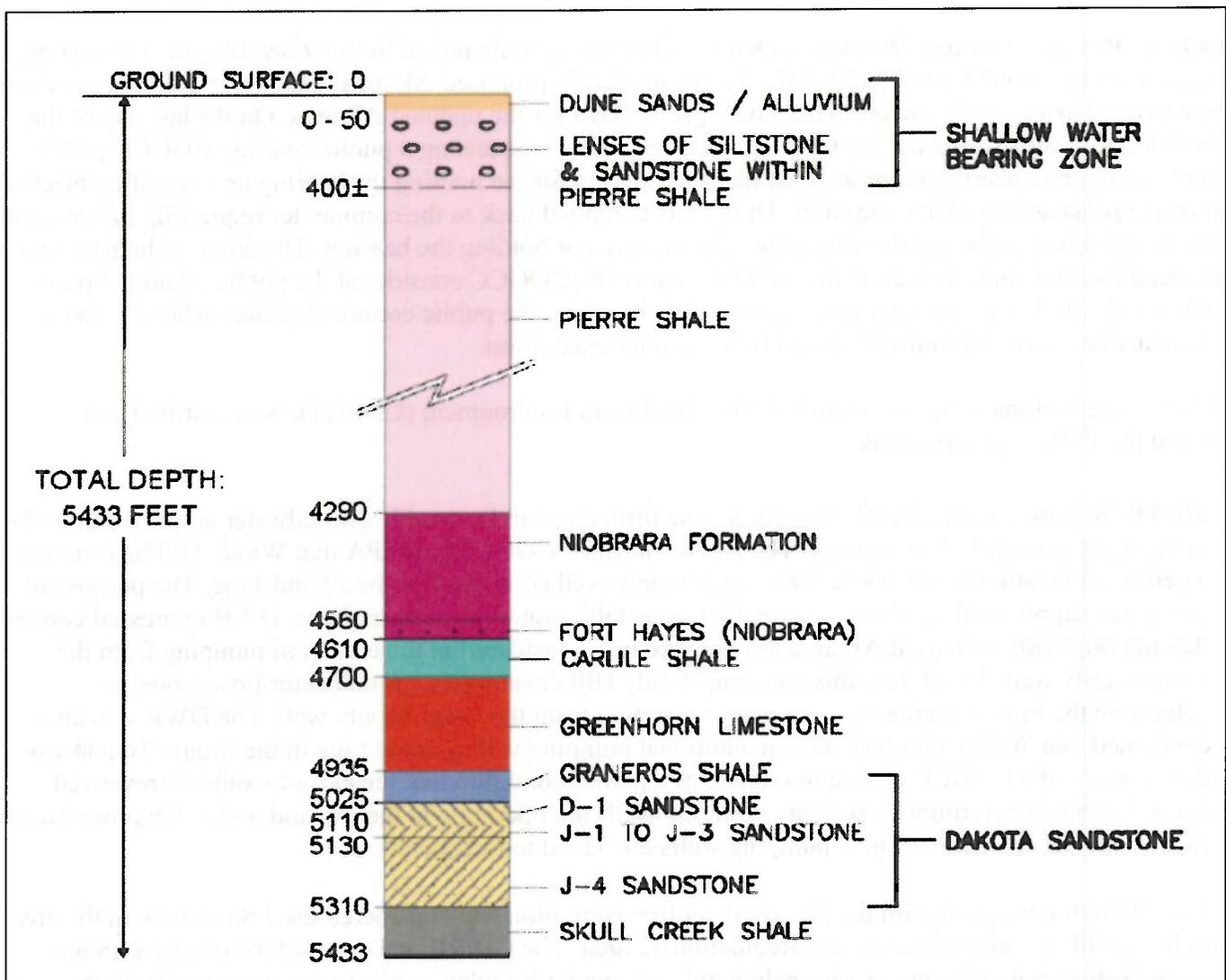


Figure 2. Locations of water wells located near the Windy Hill #3-17D Well

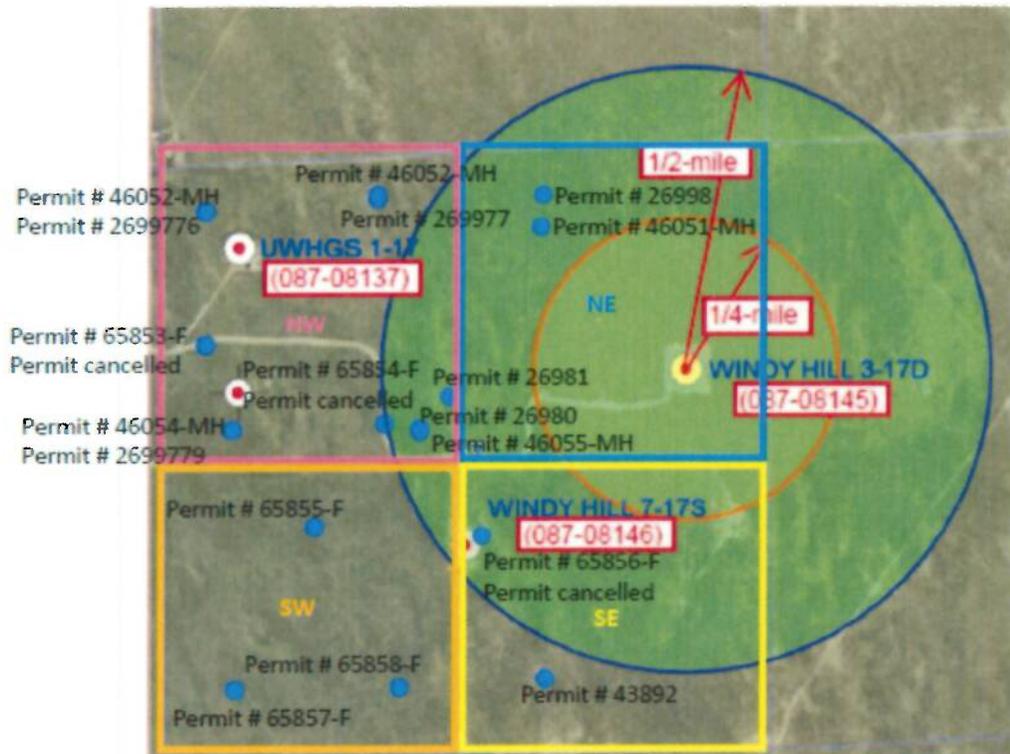


Figure 3. Expanded AE Area based on the groundwater flow model taking into account pumping of the groundwater production well completed in the J Sandstone and located east of the Windy Hill 3-17 well.

