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.

Primacy Agency: Environmental Protection Agency, Region 8

Date of Aquifer Exemption Request: June 30, 2020

Substantial or Non-Substantial Program Revision: Non-Substantial

While the action before the EPA is not a state program revision, but rather an approval of an AE in a federally-administered program, the process is treated similarly and requires the EPA to determine whether the proposed AE is major or minor (i.e. substantial or non-substantial) exemption. The process is discussed in a Federal Register Notice Preamble at 48 Fed. Reg. 40098, 40108 (September 2, 1983); see also 49 Fed. Reg. 20138, 20143 (May 11, 1984). The review process differs depending on whether the EPA treats the decision as a major or minor exemption. The EPA has determined this proposed AE is a minor exemption because it is associated with the issuance of a site-specific UIC Class II permit action, not a state-wide programmatic change or a revision with implications for the state-wide or national UIC program. The decision to treat this AE as a minor exemption is also consistent with the corresponding state program revision process detailed in EPA Guidance 34: Guidance for Review and Approval of State Underground Injection Control (UIC) Programs and Revisions to Approved State Programs. Guidance 34 explains that the determination as to whether an exemption is substantial or non-substantial is made on a case-by-case basis, and with the exception of AEs associated with certain Class I wells or exemptions not related to action on a permit, AE requests are typically treated as minor actions/non-substantial decisions.

Operator: BP America Production Company

Well Name: Barnes WDW #1
Well API Number: 05-067-08758
Well Class /Type: Class II Salt Water Disposal Well
Well Location:
Surface Location:
Latitude: 37.128716 **Longitude:** -107.829904
Qtr: SWSE **Section:** 4 **Township:** 33N **Range:** 9W
Footage Calls: 1105' FSL 2210' FEL
County: LaPlata **State:** Colorado

Background Information: BP America Production Company (BP) currently operates a Class II Water Disposal Well Permit for the purpose of disposing of produced water from Coal Bed Methane wells drilled to the Fruitland Formation in the Ignacio Blanco Field. The disposal well was originally drilled on November 23, 2002 and completed to a depth of 8,931 feet to near the base of the Entrada Formation. An aquifer exemption was approved for the Entrada Sandstone in the Permit of November 19, 2002 with a volume limit of 79,354,840 barrels.

Subsequently, in the modified permit of October 14, 2004, both the Bluff and Entrada Sandstones were permitted as injection zones with allowable injection volumes of 105,949,400 barrels (Bluff Sandstone) and increased volume limitation of 85,789,010 barrels for the Entrada Formation. A second aquifer exemption was issued in conjunction with this permit modification to include the Bluff Sandstone.

Since the Lower Morrison Formation immediately above the upper injection zone (Bluff Sandstone) is a recognized USDW from 8,060-8,190 feet (130 feet), another aquifer exemption is necessary. The Morrison Formation was permitted as an injection zone in the original permit and is not perforated but is in contact with the underlying perforated injection zone (Bluff Sandstone) and may receive injection fluids in the future.

The injection zones in the Barnes WDW #1 well consists of approximately 130 feet of Lower Morrison Formation and 247 feet of the Bluff Sandstone that is a massive medium-grained eolian sandstone. These two units make up the upper injection zone. The Bluff Sandstone is above the Wanakah Sandstone and the Todilto Limestone, that are considered tight, low porosity rock. Combined these two units are 147 feet thick. The lower injection zone is the Entrada Sandstone that occurs below the Todilto Limestone. The Entrada Sandstone consists of 200 feet of also a massive medium-grained eolian sandstone.

As of April 1, 2019, approximately 9,976,858 barrels of approved Class II fluids have been injected into this well. Analytical results of injected fluids reported in October 2018 indicated a Total Dissolved Solids concentration of 3,760 mg/l and a Specific Gravity of 1.003.

DESCRIPTION OF PROPOSED AQUIFER EXEMPTION

Aquifers to be Exempted: Lower Morrison **Lithology:** sandstone

Water Quality –TDS: 4,000 mg/L

Source of WQ Data: Barnes WDW #1

Depth and Thickness of the Lower Morrison Formation
True Vertical Depth: **Top:** 8,060 feet **Bottom:** 8,190 feet

The entire Morrison Formation is 478 feet thick at the location of the Barnes WDW #1. Only the lower part of the Morrison Formation, which consists of a permeable sandstone unit from 8,060 feet to 8,190 feet in depth, is proposed for exemption. The injection well is not perforated in the Lower Morrison Formation and no additional volume limitation is included in this Aquifer Exemption. A 225-foot thick confining zone consisting of relatively impermeable shales and sandstones (Middle Morrison Formation) occurs above the Lower Morrison Formation sandstone unit. This lower sandstone unit is in contact with and hydrologically connected with the Bluff Sandstone injection zone that supports this action.

Approved AE Area: A ½ mile radius AE from the Barnes WDW #1 wellbore has already been approved for the Bluff and the Entrada Sandstone. The proposed exemption is for ½ -mile radius AE for the Lower Morrison. The total injection volume allowable for the Bluff is 105,949,400 barrels and Entrada Sandstones is 85,789,010 barrels. No additional approved volume is proposed for the Lower Morrison as part of this Aquifer Exemption.

Areal Extent of Aquifer: 496.6 Acres

Confining Zone(s):

Upper Confining Zone: Middle Morrison Formation
Lithology: Fine to medium-grained sandstones, siltstones, shale and mudstones
True Vertical Depth Top: 7,835 feet **Bottom:** 8,060 feet

Lower Confining Zone: Wanaka - Todilto Formations at the base of the Bluff Sandstone
Lithology: Shale, Sandstone, Limestone, Anhydrite
True Vertical Depth Top: 8,437 feet **Bottom:** 8,584

Injectate Characteristics: Produced water, flowback, workover fluids and drilling fluids.

Underground Sources of Drinking Water:

Multiple potential USDWs were encountered by the Barnes WDW #1 injection well. Several of the formations noted in the table below are hydrocarbon bearing as noted. The potential groundwater sources are protected by surface, first intermediate and second intermediate casing and cement to a depth of 7,561 feet into the Dakota Sandstone. A liner and cement isolate the potential water bearing formations from 7,561 to PBTD at 8,888 feet with perforations into the Bluff and Entrada Sandstones. The USDWs encountered within the Barnes WDW #1 well are as follows:

Formation Name or Stratigraphic Unit	Top (ft)*	Base (ft)*	TDS (mg/l)	Lithology
Alluvium	0	100	300-1,000 #	Silt, sand, gravel, and boulders
San Jose Formation	100	1,500	800-1,600 #	Sandstone, shale and conglomerate
Farmington Sandstone	1,610	2,225	1,120-4,450	Sandstone
Fruitland Formation	2249	2660	7,150	Carboniferous Shale and Coal – CBM producing
Pictured Cliffs Sandstone	2660	2823	3,285-4,660	Sandstone – Hydrocarbon Producing
Cliff House Sandstone	4480	4961	1,120-4,450	Sandstone – Hydrocarbon Producing
Menefee+	4961	5,173	210-3,350	Silty Shale
Dakota	7,494	7,678	5,297-7,361	Sandstone
Burro Canyon	7,678	7,712	5,960	Sandstone
Lower Morrison	**8,060**	**8,190**	**4,000**	**Sandstone**
Bluff Sandstone	**8,190**	**8,437**	**7,580**	**Sandstone**
Entrada Sandstone	**8,584**	**8,784**	**4,580-18,735**	**Sandstone**

*Formation top and bottom depths at the Barnes WDW #1
#Groundwater Resources of the Florida Mesa Area, La Plata County, Colorado
+Groundwater Atlas of Colorado, San Juan Basin, Colorado Geological Survey, Special Publication 53

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*

According to records on file with the Colorado Division of Water Resources, no wells have ever been drilled or are currently producing as a water source from the Morrison Formation. The deepest

penetration for a water source well within 2 miles of the Barnes WDW #1 is ~295 feet, which would be completed in the alluvium, a primary source of freshwater in the area. A shallow domestic well (recorded as 12 feet in depth) is located within the ½ mile AOR.

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

The top of the Lower Morrison is 8,054' TVD. The depth of 8054'TVD is substantially deeper than freshwater aquifers sourced by water wells (as noted by the water source well drilled to 293'). To drill a water source wells to a depth of 7,494'TVD and then complete the well would cost over $1M (based on internal British Petroleum Scoping Approval for Expenditure). In addition to drilling and completion costs, monthly operating expenses would further make the project economically unfeasible. It is extremely unlikely that area inhabitants would drill to these depths when there is adequate freshwater in shallow alluvium. These shallow water wells can provide 1-75 gal/min depending on which reservoir is drilled (Robson and Wright, 1995, Groundwater Resources of the Florida Mesa Area La Plata County, Colorado, US Geological Survey, Water Resources Investigation 4190). Water quality also varies depending on which formation is drilled (Robson and Wright, 1995). It should also be noted that these shallow water wells are most common in more rural areas as the Florida and Animas Rivers are the source of water in Durango and Ignacio (City of Durango, 2017). This is discussed in greater detail below.

Water analysis for these formations show Total Disolved Solid (TDS) levels greater than 4,000 mg/L, which is unfit for human consumption without treatment. Therefore, these formation waters would require treatment for drinking water purposes, which is not economical due to the availability of shallower freshwater sources in the area.

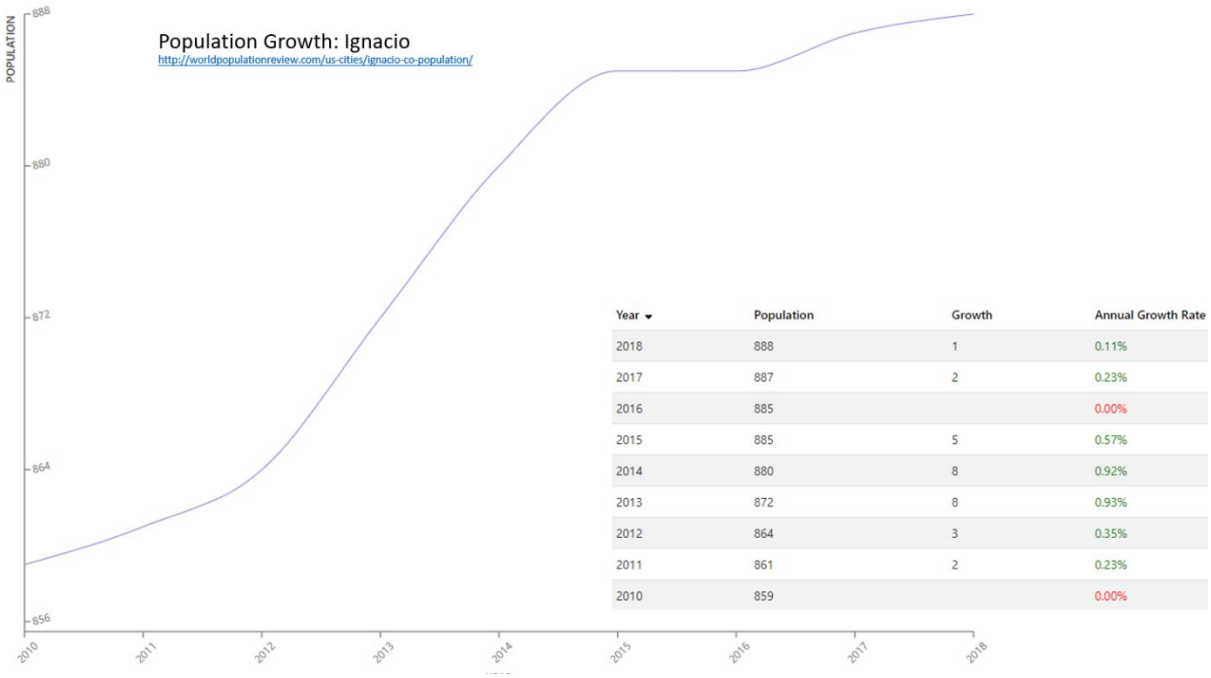
1. Total Dissolved Solids (TDS) in the Morrison formation were calculated to be ~4,000 mg/l based on open hole logs, and thus is not reasonably expected to supply a public water system.
2. Additionally, the nearest major towns are Durango (~9 miles NW) and Ignacio (~10 miles E) would not use the Morrison formation for drinking water due to reasons below:

The depth and associated drilling cost would make these formations economically unfeasible.

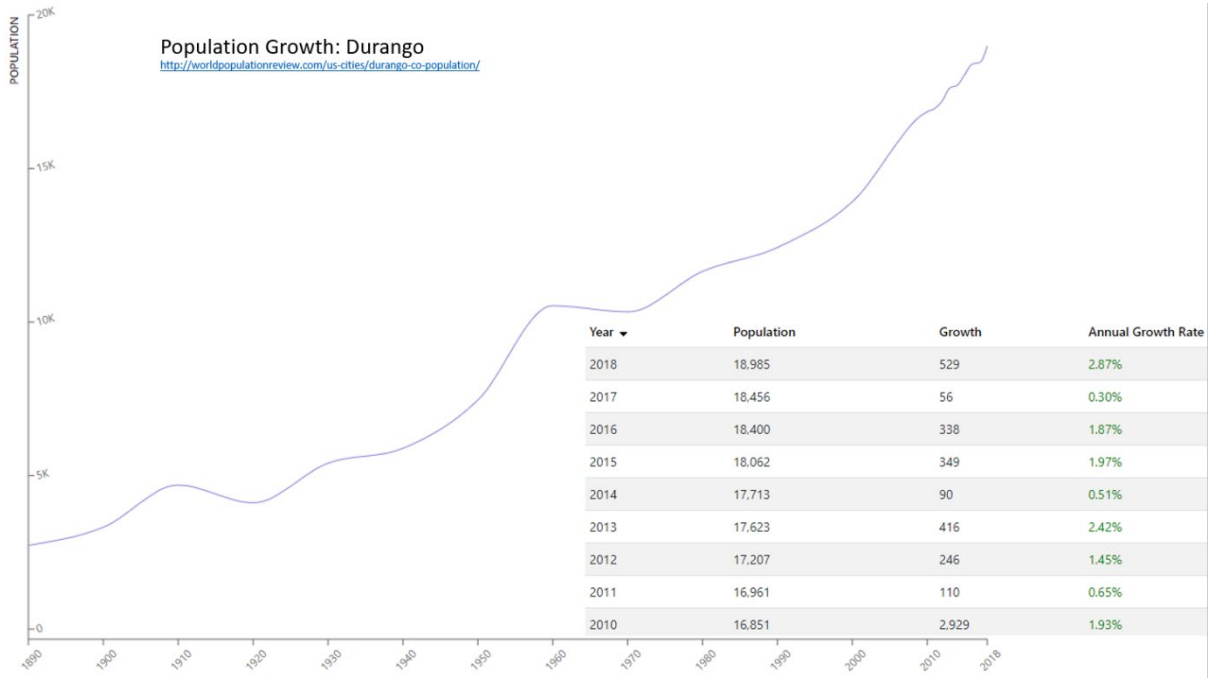
The inhabitants of these towns utilize the Animas River and Florida Rivers. According to the Durango Comprehensive plan, the city of Durango pumps 1.5 billion gallons of water to Durango Water Treatment Plant every year and pump an additional 200 million gallons of raw water for irrigation purposes. Additionally, the Vallecito Reservoir is located nearby and is a significant source of fresh water.

The quality of the water from the Morrison formation is unfit for human consumption. De-mineralization of this source would be impractical in considering its use in a public supply system.

Since 2010 the largest year over year population increase in the town of Ignacio and Durango was 0.93% (8 people) and 2.87% (529 people) respectively. The water demand due to population increases can be met with existing resources, rather than developing more costly resources.



Year	Population	Growth	Annual Growth Rate
2018	888	1	0.11%
2017	887	2	0.23%
2016	885		0.00%
2015	885	5	0.57%
2014	880	8	0.92%
2013	872	8	0.93%
2012	864	3	0.35%
2011	861	2	0.23%
2010	859		0.00%



Year	Population	Growth	Annual Growth Rate
2018	18,985	529	2.87%
2017	18,456	56	0.30%
2016	18,400	338	1.87%
2015	18,062	349	1.97%
2014	17,713	90	0.51%
2013	17,623	416	2.42%
2012	17,207	246	1.45%
2011	16,961	110	0.65%
2010	16,851	2,929	1.93%

The Dakota and Burro Canyon formations are hydrocarbon bearing within 1.5-2 miles of the Barnes Water Disposal Well No. 1. Both formations are producing formations in the Smith Ute 1 well. Also, these formations are not likely hydrologically connected to the Bluff sandstone due to an impermeable, ~250' thick shaley interval of the Middle Morrison Formation which can be correlated over two (2) miles in all directions.

PUBLIC COMMENTS

Public notice of the 30-day public comment period for the proposed aquifer exemption area will be provided on the EPA website along with the Draft Permit and Statement of Basis.

Date 11/13/2020

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Signed by: SARAH BAHRMAN

Sarah Bahrman, Chief
Safe Drinking Water Branch
Water Division