

Wyoming Department of Environmental Quality
Water Quality Division
Underground Injection Control Program
Class I Non-Hazardous Injection Well Application
Fact Sheet

In accordance with Wyoming Water Quality Rules and Regulations, Chapter 27 Section 2 (t), this fact sheet is an explanation of the principal facts and the significant factual, legal, methodological, and policy questions considered in preparing the draft permit.

1. Project Name: Lost Creek ISR, LLC Permit Modification
2. Draft Permit Number: 16-145
 - a. New: Not applicable
 - b. Renewal: This is a permit modification.
 - i. Reference Permit Number(s): 13-409
 - c. Duration: The duration of the permit is ten (10) years. The expected duration of the operation is twenty (20) years.
3. Name and Mailing Address of Applicant: Mr. John Cash, Lost Creek ISR, LLC, 5880 Enterprise Drive, #200, Casper, WY 82609
4. Description of Operation: The operator proposes to operate these wells as industrial in-situ recovery (ISR) non-hazardous waste disposal wells.
5. Injection Well Location:

Well Name	Legal Description	Latitude	Longitude
DW No. 1 (existing)	NE¼ of SW¼ Section 25; T25N; R93W	42.10696	-107.88607
DW No. 2 (proposed)	NE¼ of SE¼ Section 19; T25N; R92W	42.12115	-107.85636
DW No. 3 (existing)	SE¼ of SW¼ Section 13; T25N; R93W	42.13335	-107.88443
DW No. 4 (existing)	NW¼ of SE¼ Section 18; T25N; R92W	42.13545	-107.85915

DW No. 5 (proposed)	NW¼ of SE¼ Section 17; T25N; R92W	42.13900	-107.83840
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NOTE: Latitude and Longitude are using North American Datum 83

6. Well History: Lost Creek ISR, LLC (Lost Creek) has five (5) permitted Class I injection wells originally authorized in May 2010 (Underground Injection Control (UIC) permit 09-586). A permit modification was subsequently authorized in December 2013 (UIC permit 13-409). This permit modification updated the groundwater classification, requested a United States Environmental Protection Agency (USEPA) aquifer exemption for a portion of the Fort Union Formation (Total Dissolved Solids [TDS] between 3,000-10,000 milligrams per liter [mg/L]), updated the Area of Review (AOR) and injection pressures, and brought the permit into conformance with other recently issued Class I ISR permits. The Lost Creek Class I wells are located in Sweetwater County, Wyoming, and of the five (5) Class I injection wells authorized under 13-409, three (3) have been constructed (DW No.1, DW No. 3, and DW No. 4). The 16-145 permit modification proposes to authorize the injection of non-hazardous wastewater associated with ISR operations at the Lost Creek ISR, LLC mine in Sweetwater County into the Lower Battle Spring Formation, in addition to the previously authorized discharge zone in the Fort Union Formation covered under the 13-409 permit. The 16-145 permit modification will only add the Lower Battle Spring Formation as an authorized discharge zone for the three (3) existing injection wells DW No. 1, DW No. 3, and DW No. 4. The authorized discharge zone for proposed (i.e., unconstructed) injection wells DW No. 2 and DW No. 5 will remain the same as in the 13-409 permit and, the 16-145 permit modification will renew authorization for the construction of injection wells DW No. 2 and DW No. 5 for a period of ten (10) years.

7. Geologic Setting

a. Injection Formation/ Member Name: The authorized discharge zone is the Fort Union Formation and Lower Battle Spring Formation in existing DW No. 1, DW No. 3, and DW No. 4 wells, and the Fort Union Formation is the authorized discharge zone for the proposed DW No. 2 and DW No. 5 wells within the intervals specified in the table below:

Well Name	Surface Elevation (ft above mean sea level)	Depth to Top of Perforated Interval (feet below ground surface (ft bgs))	Depth to Bottom of Perforated Interval (ft bgs)	Net Sand Thickness (ft) within Perforated Interval	Well Depth (ft bgs)
DW No. 1	6,816	5,622	9,561	598	9,978

Well Name	Surface Elevation (ft above mean sea level)	Depth to Top of Perforated Interval (feet below ground surface (ft bgs))	Depth to Bottom of Perforated Interval (ft bgs)	Net Sand Thickness (ft) within Perforated Interval	Well Depth (ft bgs)
DW No. 2	6,873	5,954	8,700	400	8,800
DW No. 3	6,984	5,680	8,324	504	8,426 ₁
DW No. 4	6,964	5,752	8,532	423	8,601 ₁
DW No. 5	6,995	5,954	8,700	400	8,800

NOTE: ₁ Plug back well depth

- b. Upper Confining Zone Formation/Member Name: The upper confining zone for existing wells DW No. 1, DW No. 3, and DW No. 4 consists of shale interbedded with sandstone and siltstone beds at the interface between the Upper and Lower Battle Spring Formation with thicknesses of 278 feet, 171 feet, and 208 feet, respectively. The interbedded sandstone and siltstone beds have thicknesses of up to 10 feet in DW No. 1, 39 feet in DW No. 3, and 24 feet in DW No. 4. The upper confining zone for proposed wells DW No. 2 and DW No. 5 consists of approximately 306 feet of shale interbedded with minor sandstone, siltstone, and coal beds less than 20 feet thick at the base of the Lower Battle Spring Formation (formerly described as the Wasatch formation in UIC permit 13-409).
- c. Lower Confining Zone Formation/Member Name: The lower confining zone consists of approximately 1,900 feet of low permeable shales and siltstones of the Lance Formation.
- d. Faults and Seismicity Concerns: There are no known faults penetrating the upper and lower confining zones and there are no seismicity concerns in the vicinity of these wells.

8. Operations

- a. Injection rate: maximum 1,714 barrels per day
- b. Injection pressure: The limiting surface injection pressure is 572 psi for DW No. 1, 579 psi for DW No. 2, 820 psi for DW No. 3, 796 psi for DW No. 4, and 579 psi for DW No. 5.
- c. Injectate characteristics: See Section 6 of Draft Permit 16-145.

- d. Monitoring and reporting requirements: See Section 9 of Draft Permit 16-145.
- e. Plugging and abandonment: The financial assurance instrument for reclamation and facility restoration resides in Table 6 of Appendix B in the Permit to Mine #788 annual report to the Land Quality Division. The total abandonment cost for the three constructed wells (DW No. 1, DW No. 3, and DW No. 4) is three hundred thirty eight thousand, two hundred seventy four dollars (\$338,274.00).

9. Basis for New Class VI Groundwater Classification

- a. Excessive concentration of total dissolved solids: Not Applicable
- b. Excessive concentrations of specific constituents:
 - i. Fort Union: Yes, see the Draft Permit 16-145. The groundwater classification for the Fort Union Formation was made in both the 09-586 and 13-409 permits.
 - ii. Lower Battle Spring: Not applicable
- c. Depth and location: Yes, see Draft Permit 16-145 and “Statement of Basis for Aquifer Exemption” for permit 16-145.

10. Is a US EPA authorized Aquifer Exemption (AE) Request being submitted?

- a. Yes, See attached Statement of Basis for Aquifer Exemption: Yes, aquifer exemption requested for injection zones in the Lower Battle Spring Formation for DW No. 1, DW No. 3, and DW No. 4. An aquifer exemption request was made for injection zones in the Fort Union Formation for DW No. 2 and DW No. 5 as part of the 13-409 permit, and is pending a final decision from the USEPA after submittal and review of representative water quality sample results after the wells are constructed.
- b. Not required, pre-existing AE (date of approval): Yes, pre-existing AEs were approved for injection zones in the Fort Union Formation for DW No. 3 and DW No. 4 on October 22, 2014 and December 12, 2013, respectively.
- c. Not required, excessive total dissolved solids (source of data): Yes, AE not required for injection in the Fort Union Formation for DW No. 1 because sample results exhibited concentrations of total dissolved solids greater than 10,000 milligrams per liter (mg/L).
- d. Not required, low aquifer yield (source of data): No

11. Underground Sources of Drinking Water (USDW) Evaluation

A USDW is defined by the Wyoming Water Quality Rules and Regulations (WQRR), Chapter 27 as those aquifers or portions thereof which have a total dissolved solids content of less than 10,000 mg/L, and are classified as either Class I, II, III, IV (a) or Special (A).

A summary of each potential USDW from surface to Pre-Cambrian basement follows:

a. Potential USDWs Above the Receiver

Overlying the Lower Battle Spring Formation, the Upper Battle Spring Formation meets the USEPA definition of an USDW based on known TDS concentrations. **The lowermost USDW is in the Upper Battle Spring Formation.**

b. Receiving Formation as a Potential USDW

Regional data indicate the receiving zone, the Lower Battle Spring Formation, will likely have TDS concentrations between 3,000 mg/L and 10,000 mg/L. A confirmation sample will verify the need for an aquifer exemption.

c. Potential USDWs Below the Receiver

The Fort Union Formation below the Lower Battle Spring Formation received an aquifer exemption for TDS concentrations between 3,000 mg/L and 10,000 mg/L at existing injection wells DW No. 3 and DW No. 4. An AE was not required for the Fort Union Formation below the Lower Battle Spring Formation at existing injection well DW No. 1 due to a TDS concentration in excess of 10,000 mg/L.

Below the Fort Union Formation, the units which the Wyoming Water Development Council (WWDC) considers to be major aquifers are: the Lance Formation, Fox Hills Sandstone, Mesa Verde Group, Frontier Formation, Muddy Sandstone, Cloverly Formation, Sundance Formation, Nugget Sandstone, Tensleep Formation, Madison Formation, and Flathead Formation. None of these units are considered USDWs due to TDS concentrations in excess of 10,000 mg/L. Detailed analysis prepared by Wyoming Department of Environmental Quality (WDEQ) staff for the above listed major aquifers is included in the supplemental report prepared for UIC permit 09-586 and can be obtained at <http://gem.wqd.apps.deq.wyoming.gov/default.aspx>.

12. Area of Review Process

Pursuant to WQRR, Chapter 27, the AOR is the area for which information and analyses shall be submitted as part of a UIC permit application, and reviewed for issuance of a permit. The AOR must include all portions of an aquifer that will be affected in a measurable way within ten (10) years of the granting of a permit, assuming that the permit is complied with. The AOR is the largest of the following three: radius of the

cone of influence (COI), the radius of the Area of Emplaced Waste (AEW), or the minimum required ¼-mile (1,320 ft) radius.

a. Cone of Influence

The COI represents the area in which hydraulic heads in the receiver (including initial heads and head increases caused by injection activities) exceed those of the lowermost USDW. Thus, it is the area that fluid could move from the receiver to the lowermost USDW if a direct conduit were present. For this permit, the calculations for the COI is based on the critical pressure rise between the top of the discharge zone and an assumption of a hypothetical artificial penetration represented by a mud-filled borehole with an assumed 9.0 pound per gallon mud density. This COI calculation approach was previously utilized in the 13-409 permit modification due to the similar pressure gradient between the Fort Union Formation, Lower Battle Spring Formation, and Upper Battle Spring Formation.

i. Discussion, radial distance, well interference: The combined Fort Union and Lower Battle Spring COI is estimated to have a radius of 2,170, 2,920, and 3,840 feet for DW No. 1, DW No. 3, and DW No. 4, respectively. The Fort Union COI is estimated to have a radius of 1,630 feet for DW No. 2 and DW No. 5, previously calculated in the 13-409 permit. Well interference is expected to be minimal as the wells are located at distances of greater than a mile apart.

ii. PLSS Table and map: See the attached Figure.

Legal Description(s) of the Area(s) of Review

Well Name	Quarter-Quarters or Lots	Section	Township/Range
DW No. 1	All of SW ¼	25	T25N; R93W
	S ½ of NW ¼		
	W ½ of SE ¼		
	SWNE		
	E ½ of SE ¼	26	
	SENE		
	N ½ of NW ¼	36	
	NWNE		

Legal Description(s) of the Area(s) of Review

Well Name	Quarter-Quarters or Lots	Section	Township/Range
DW No. 2	All of SE ¼	19	T25N; R92W
	S ½ of NE ¼		
	E ½ of SW ¼		
	W ½ of SW ¼	20	
	SWNW		
	NWNW	29	
	N ½ of NE ¼	30	
DW No. 3	All of SW ¼	13	T25N; R93W
	All of SE ¼		
	S ½ of NW ¼		
	SWNE		
	All of SE ¼	14	
	SENE		
	E ½ of NE ¼	23	
	All of NW ¼	24	
	W ½ of NE ¼		
	NENE		
DW No. 4	All of SW ¼	17	T25N; R92W
	S ½ of NW ¼		
	NWNW		
	All of NW ¼	18	
	All of NE ¼		
	All of SW ¼		

Legal Description(s) of the Area(s) of Review

Well Name	Quarter-Quarters or Lots	Section	Township/Range
	All of SE ¼	19	T25N; R93W
	All of NE ¼		
	All of NW ¼		
	NENE	24	
	E ½ of SE ¼	13	
	SENE		
DW No. 5	SWNW	16	T25N; R92W
	NWSW		
	All of NE¼	17	
	SENW		
	NESW		
	All of SE¼		

b. Area of Emplaced Waste (AEW)

- i. Discussion, radial distance, well interference: The AEW radius in the Fort Union is estimated to be 666, 475, 772, 876, and 475 feet for DW No. 1, DW No. 2, DW No. 3, DW No. 4, and DW No. 5, respectively. The AEW radius in the Fort Union for DW No. 1, DW No. 3, and DW No. 4 incorporates the net sand thickness in the injection zone, the volume of waste injected into the Fort Union for each existing well reported through the end of March 2017, 20 years of continued injection into the Fort Union, and a 10% dispersion factor. The AEW radius in the Lower Battle Spring is estimated to be 614, 669, and 730 feet for DW No. 1, DW No. 3, and DW No. 4, respectively. Well interference is expected to be minimal as the wells are located at distances of greater than a mile apart.

PLSS Table: Not Applicable.

c. Final Area of Review

- i. Discussion: Final AOR is the COI.

- ii. PLSS Table & map: See COI above.
- iii. Wyoming Oil and Gas Conservation Commission permitted wells penetrating confining layer above AOR (discussion): There are no wells penetrating the upper confining layer within the AOR

13. Public Participation

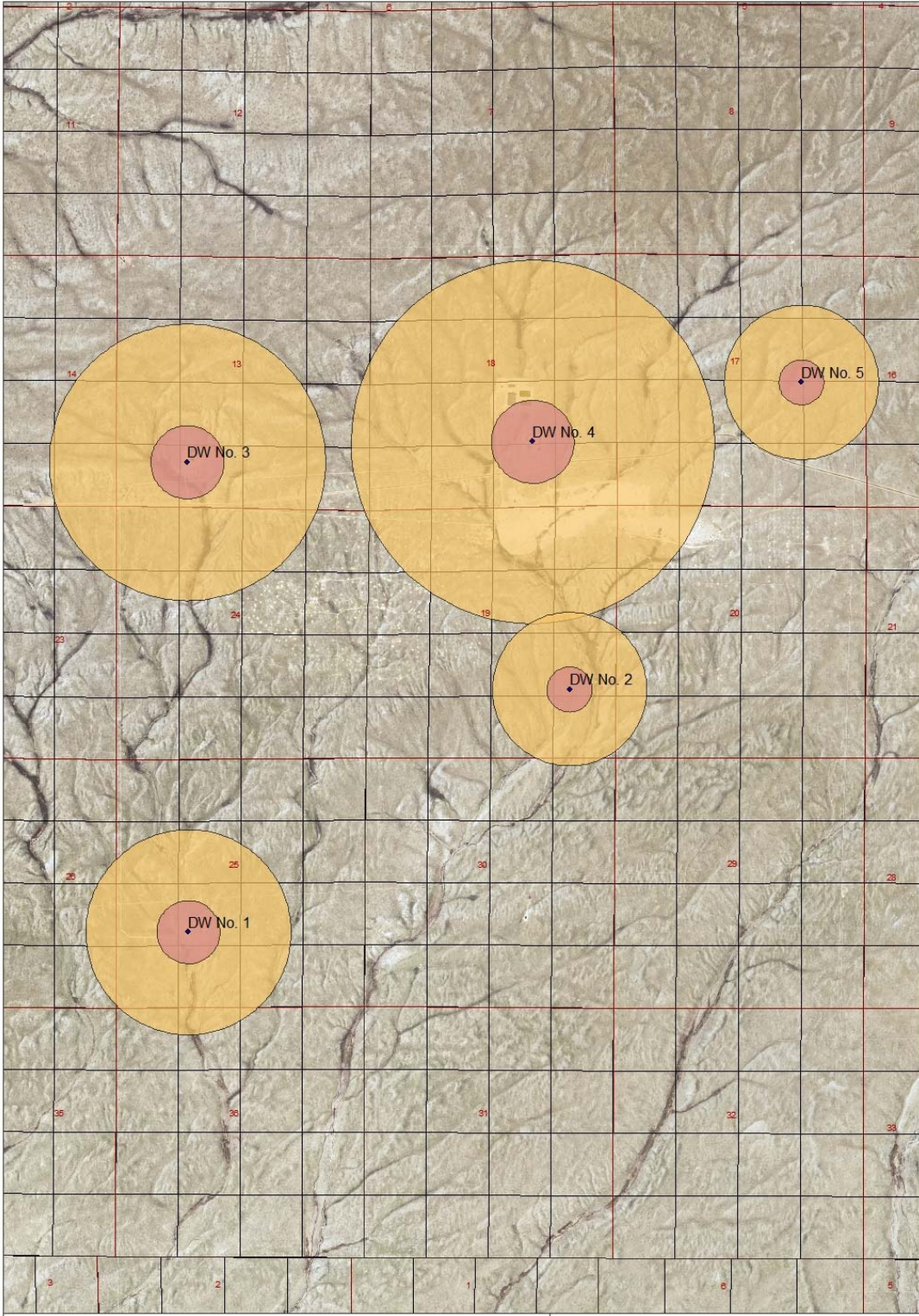
- a. The applicant has been provided with a draft permit prior to the permit being issued.
- b. A Public Notice has been issued with a public notice period starting December 9, 2017 and ending on January 8, 2018 (30 day notice as required by WQRR, Chapter 27). This notice was published in the Rocket-Miner and WDEQ website on or before the start of the public comment period.


14. Basis for issuing a permit: Review of application materials indicates proposed facility will be in compliance with applicable regulations pursuant to WQRRs, Chapters 8, 11, and 27.

15. Documentation of Fact Sheet: The archives file for this permit will include adequate documentation of all sections of this Fact Sheet.

16. Certification: The issuance of this permit is based upon a review of the application materials submitted in accordance with the UIC Program requirements of WQRR Chapter 27. This review was performed by Chris Brown, Project Geologist, Groundwater Section, PG#3975 and completed on November 22, 2017. Permit issuance is recommended based upon statements, representations, and procedures presented in the permit application and supporting documents, permit conditions, and the items identified in this Fact Sheet.

End of Fact Sheet



<p>Legend</p> <ul style="list-style-type: none"> ◆ Class 1 Wells ■ Area of Emplaced Waste ■ Cone of Influence <p>0 3,250 6,500 Feet</p>	<p>N</p> 	<p>UIC Facility No.: WYS-037-00122</p> <p>Facility Name: Lost Creek ISR, LLC</p> <p>Permit No.: Draft Permit 16-145</p> <p>Date: 11-22-2017</p>
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