

# Additional Information

Berdan Fed SWD#1  
(SWD-2570)

Cisco Production Potential and Seismicity Analysis  
Rec'd Feb 6, 2024



February 5<sup>th</sup>, 2024

Oil Conservation Division  
1220 South St. Francis Dr.  
Santa Fe, New Mexico 87505

Subject: WaterBridge Stateline LLC – Berdan Fed SWD # 1  
Application for Authorization to Inject

To Whom It May Concern,

On behalf of WaterBridge Stateline LLC (Waterbridge), ALL Consulting, LLC (ALL) is submitting the enclosed amendments to the Berdan Fed SWD #1 application, originally submitted on August 29<sup>th</sup>, 2023 (application number: pMSG2325249180). These amendments include a Cisco production analysis and a seismic analysis letter.

Should you have any questions regarding the enclosed application, please contact Oliver Seekins at (918) 382-7581 or [oseekins@all-llc.com](mailto:oseekins@all-llc.com).

Sincerely,

A handwritten signature in black ink, appearing to read "Oliver Seekins", is written over a horizontal line.

ALL Consulting  
Oliver Seekins  
Consultant / Project Manager

## **Cisco Production Analysis:**



## ALL CONSULTING ASSESSMENTS AND ANALYSIS OF THE CISCO FORMATION IN THE DAGGER DRAW AREA

ALL Consulting (ALL) has analyzed and assessed the Cisco Formation in the Dagger Draw area in Eddy County, New Mexico, for the potential for commercial hydrocarbon production. There are a total of 20 wells that penetrate into and/or through the Cisco Formation in this area, that have either been perforated and tested the Cisco Formation, conducted drill stem tests (DSTs) on the Cisco Formation, or attempted to commercially produce hydrocarbons from the Cisco Formation after completion.

The Cisco Formation is Pennsylvanian in age and is composed of carbonate rocks typically deposited in a reef-type environment. In the area of the Dagger Draw, the Cisco Formation ranges from approximately 500 to 700 feet in thickness. The Cisco Formation is typically non-productive due to its unfavorable diagenetic history, and out of the 20 wells that were tested for hydrocarbon potential, only two of these wells have attempted to be produced. The first well (API No. 015-23090) is located far north and outside the boundary of the Dagger Draw property. This well was drilled and completed in May of 1980, and in 1982, this well was assigned a "New Pool" designation of McMillian Upper Penn Gas Pool by OCD. No production records are available for this well; it was plugged and abandoned in 1983. The second well (API No. 015-31365), was drilled and completed in December 2000 in the Atoka Formation. This well was plugged back and perforated in the Cisco Formation in April of 2007 and was subsequently plugged and abandoned in 2009. In the two years of production, the total production was 1,363 Mcf of gas and 48,618 barrels of brine water, indicating that this well was non-commercially viable.

This assessment and analysis of the Cisco Formation by ALL clearly demonstrates the lack of historically commercially viable hydrocarbons in the Dagger Draw area. However, Waterbridge Stateline LLC understands the limited potential for encountering commercially viable hydrocarbons and the subsequent impacts on their proposed Salt Water Disposal Wells if commercial production is encountered.

Attached are a series of maps, cross-sections, and Cisco Formation Isopach and Structure Maps depicting some of the data analyzed in this review.

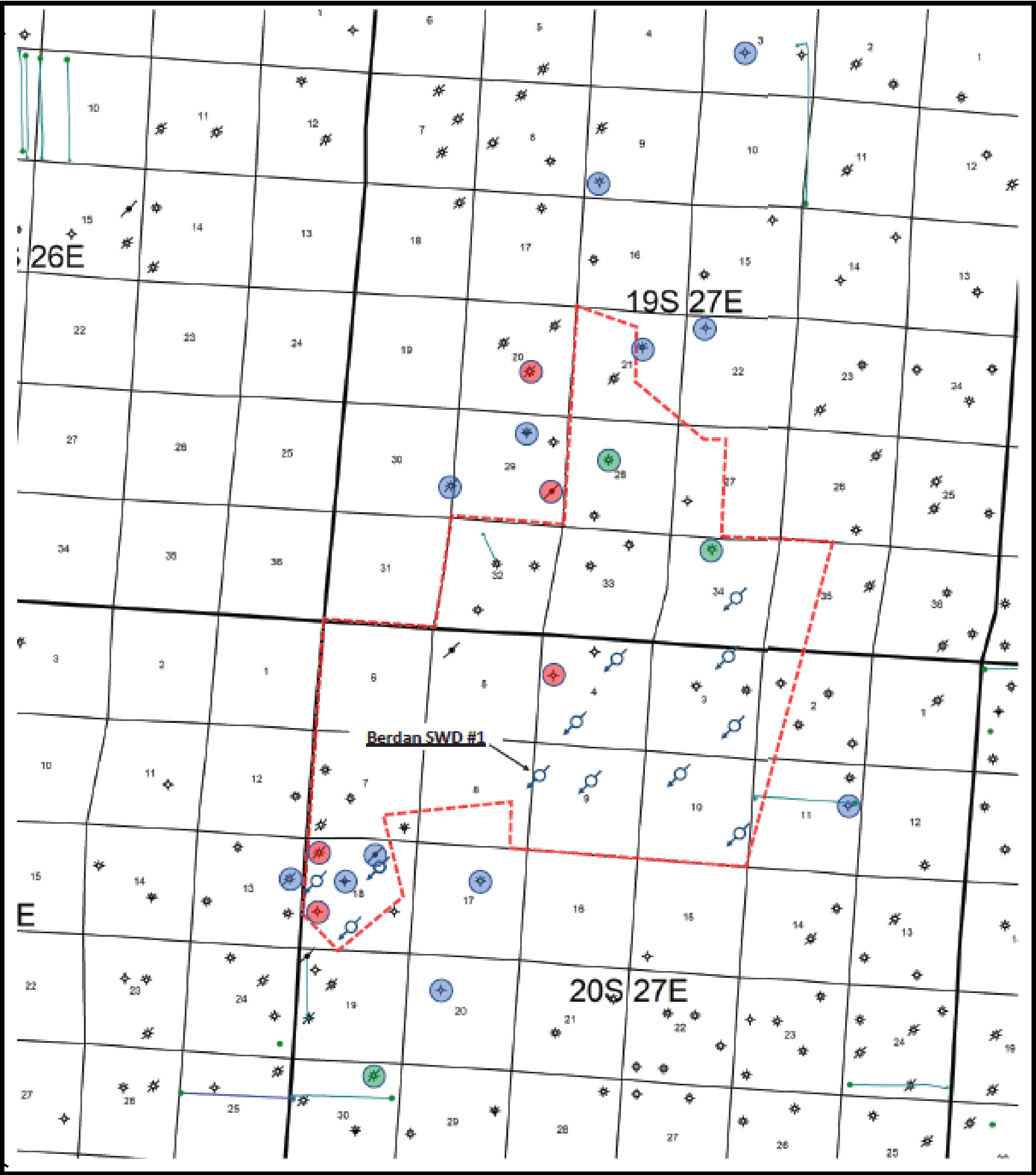
Thomas E. Tomastik

February 5, 2024

Date







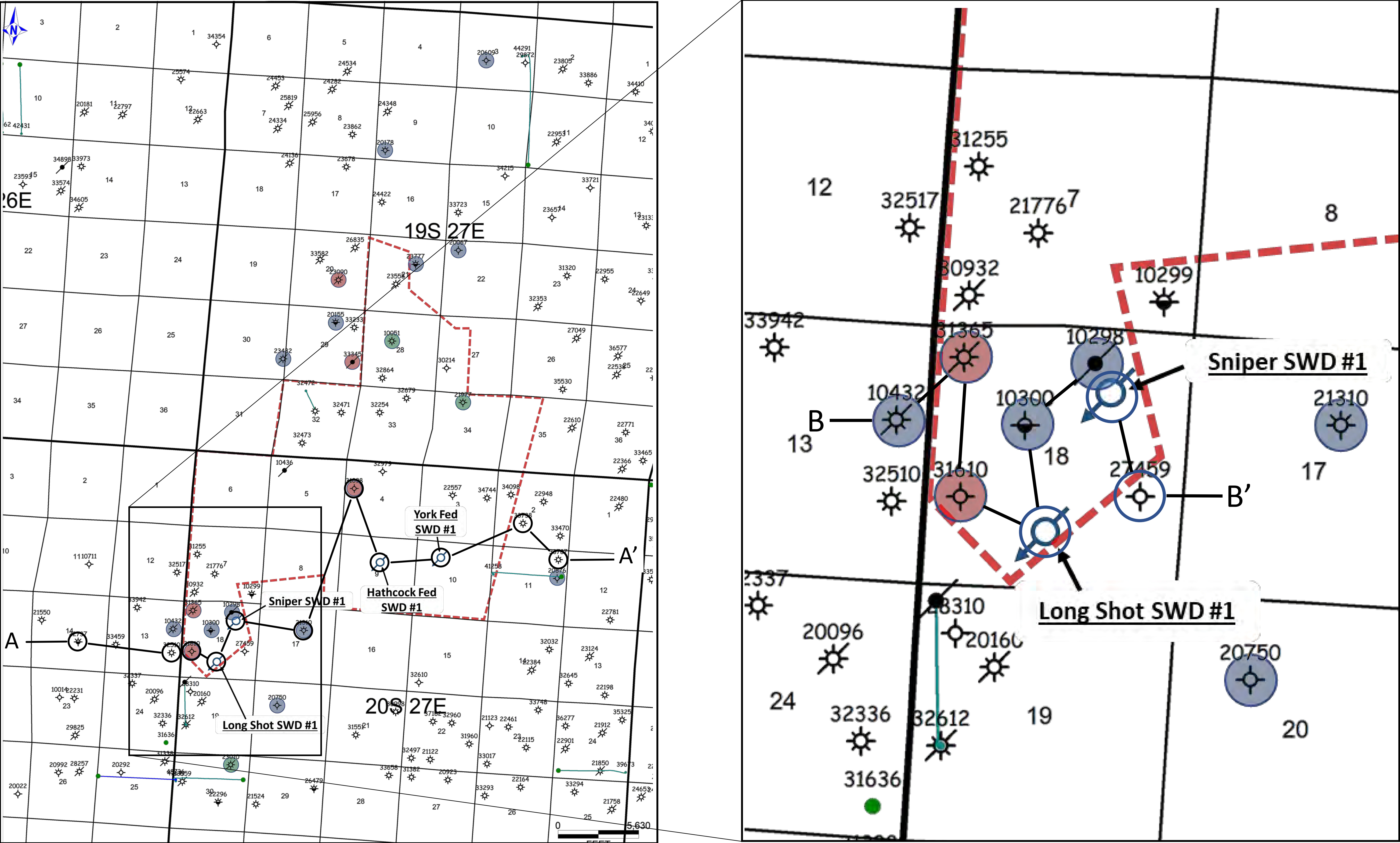
**WaterBridge Stateline LLC** (OGRID # 330129)

**Berdan Fed SWD #1:** Application Number - pMSG2325249180

- Perf'd Cisco – No Production (5 Wells)
- DST Cisco (12 Wells)
- IHS reported perfs or DST's – Not present or illegible @ NMOCD
- ♂ Pending WaterBridge Cisco Disposal Permits

Representative Cross-Section Depicting the Cisco  
Formation in the Dagger Draw Region.



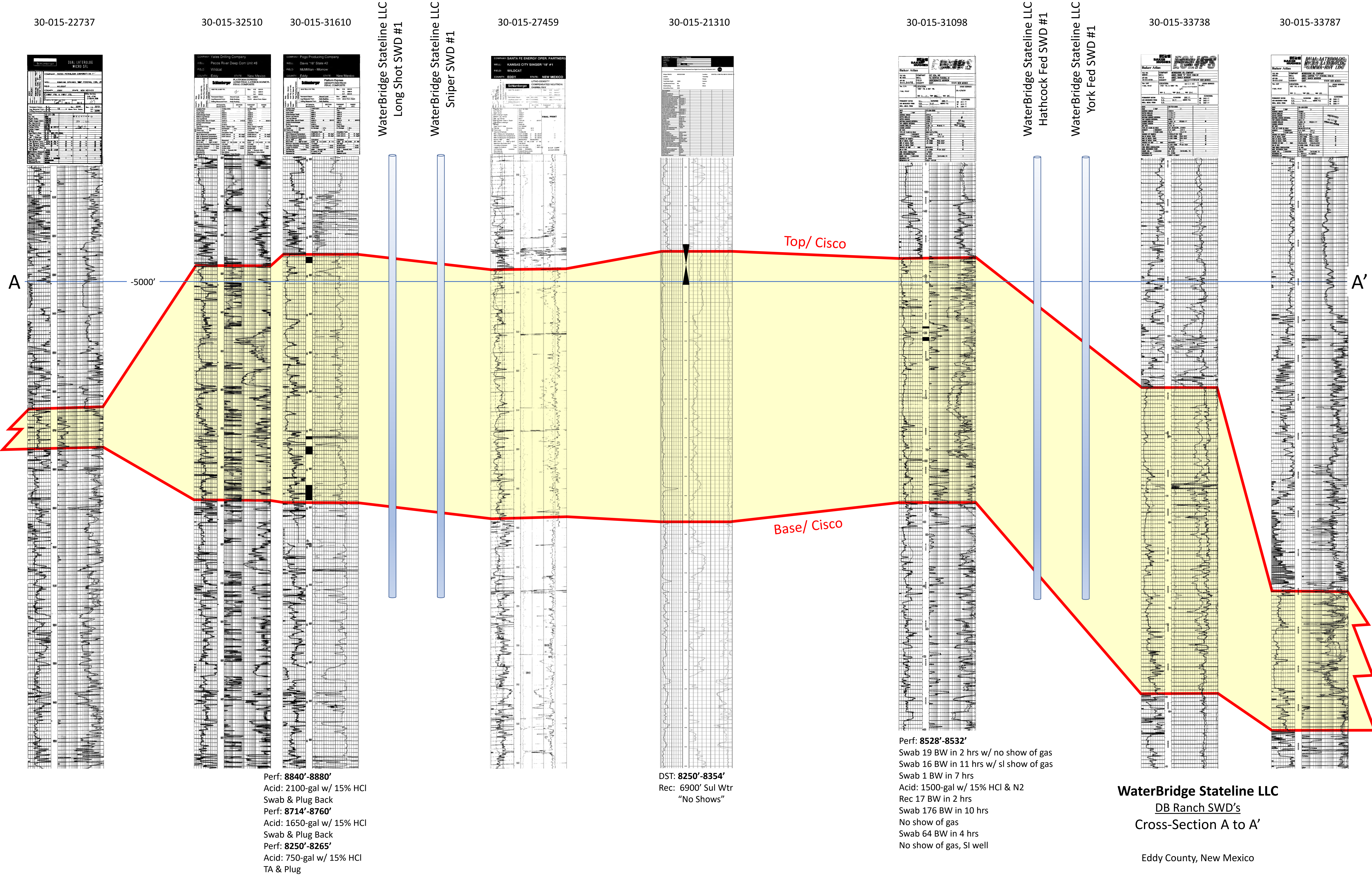


- Perf'd Cisco – No Production
- DST Cisco
- IHS reported perfs or DST's – Not present or illegible @ NMOCD

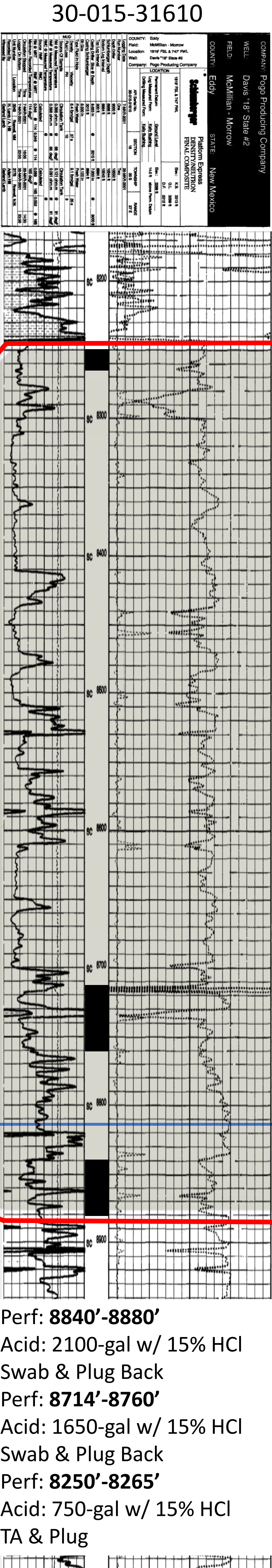
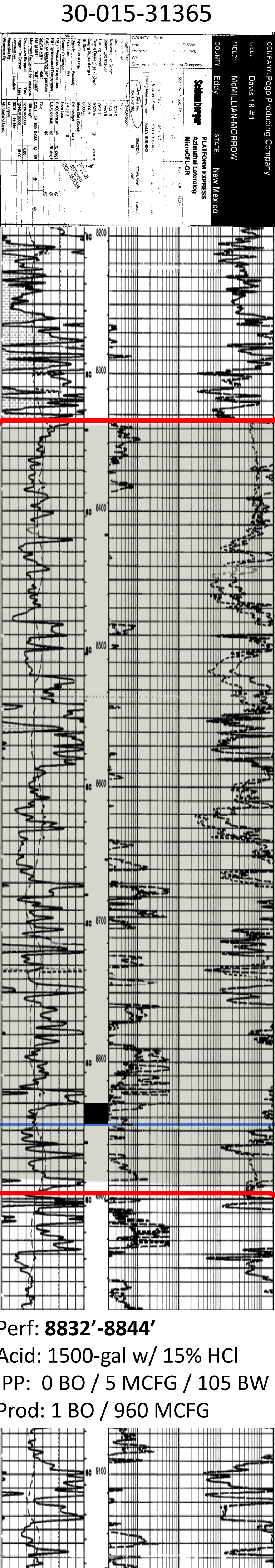
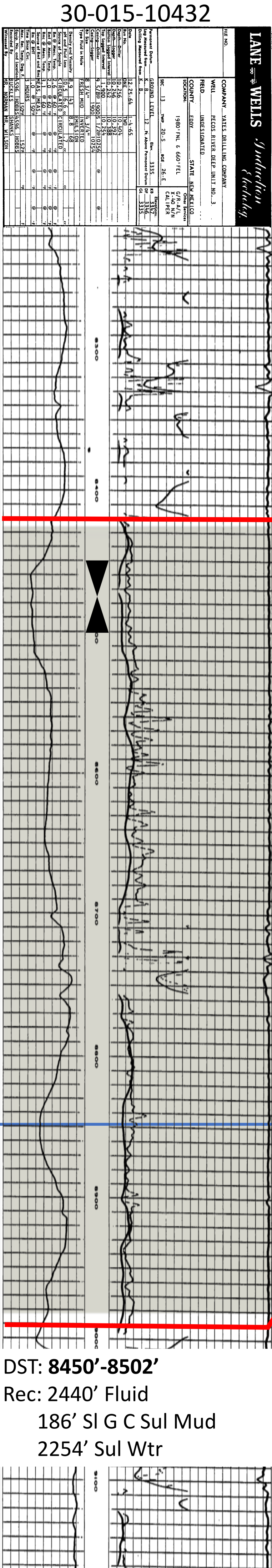
WaterBridge Stateline LLC  
DB Ranch SWD's  
Cross-Section Maps

Eddy County, New Mexico

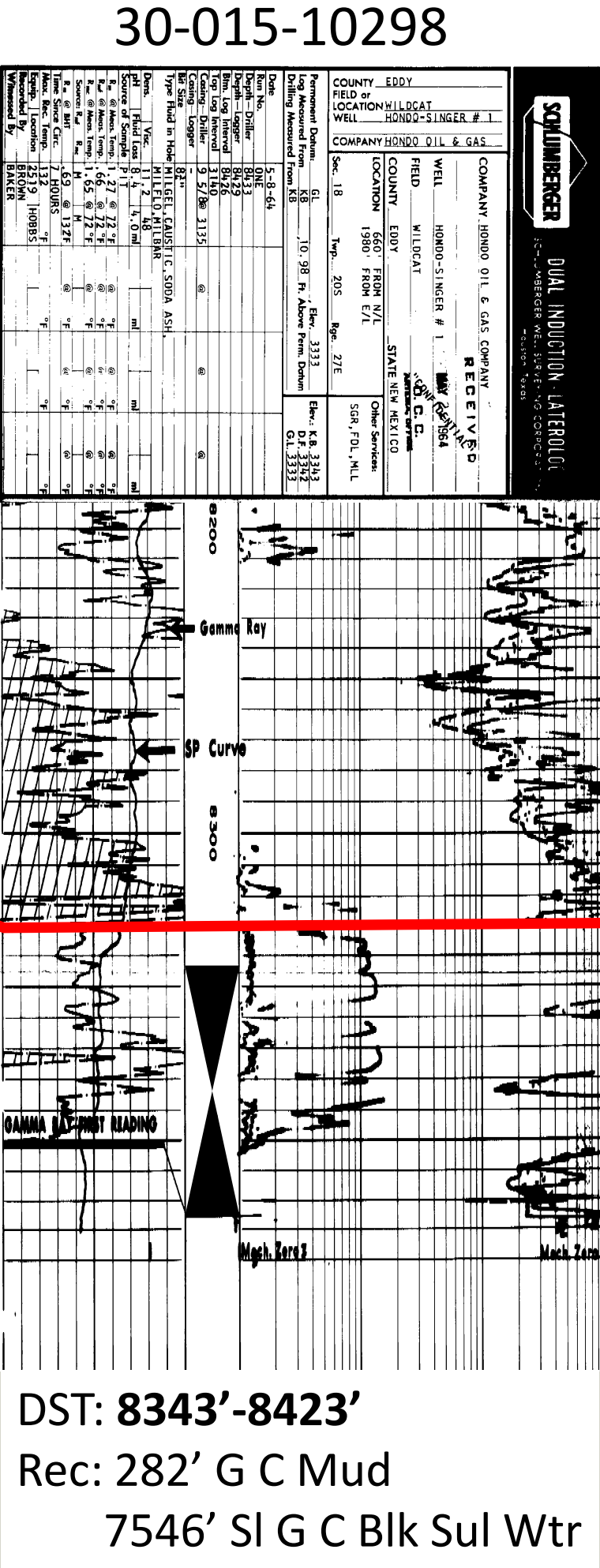
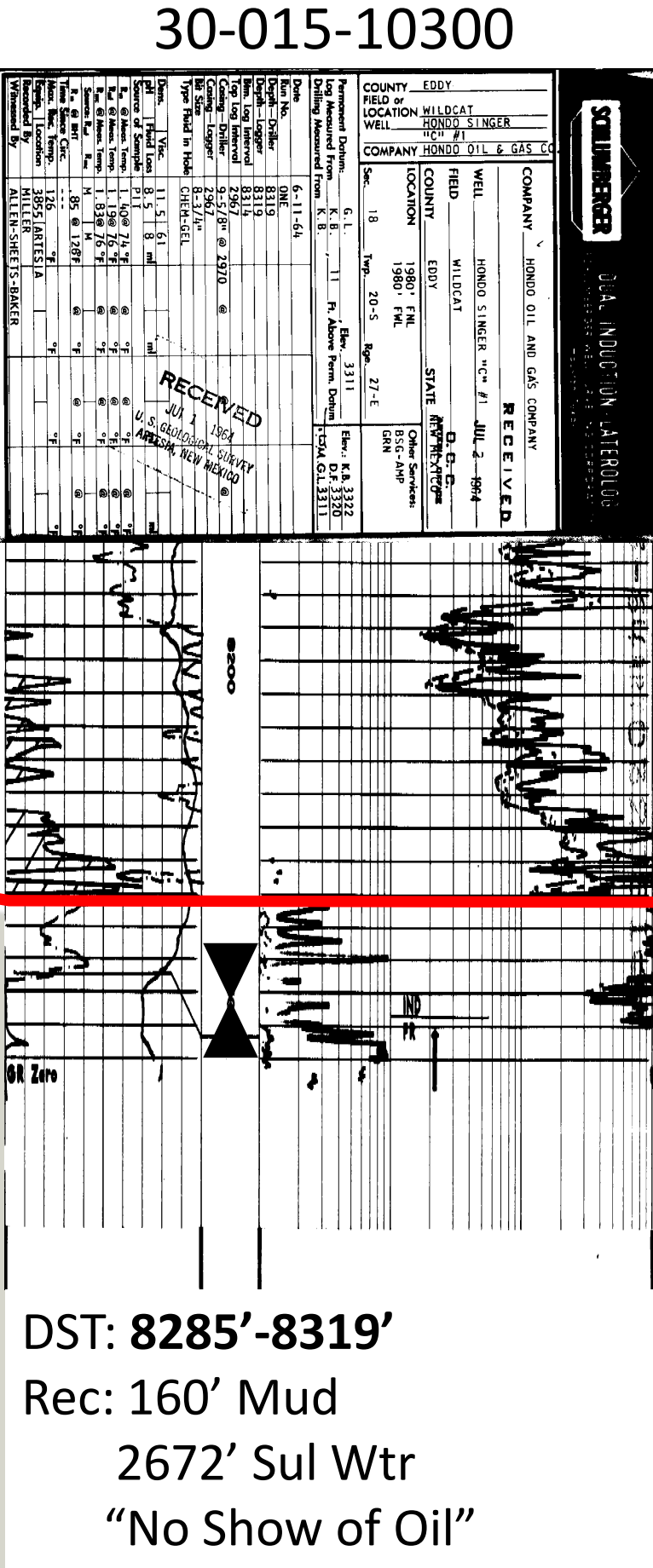




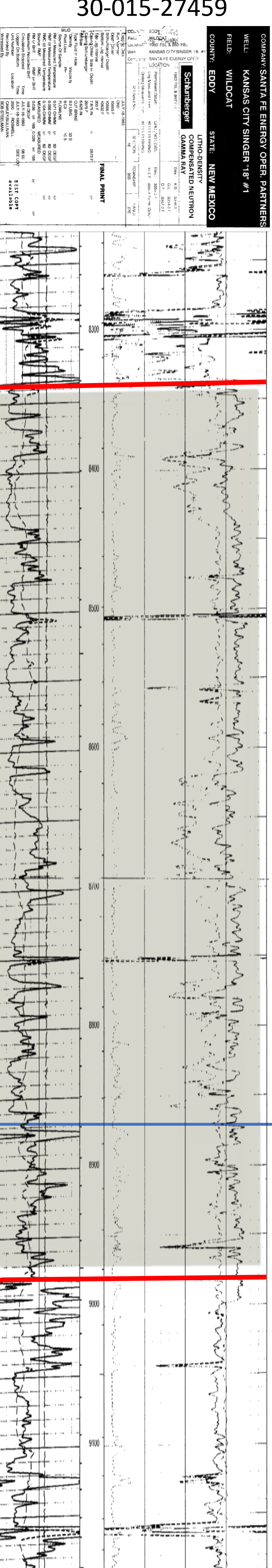




WaterBridge Stateline LLC  
Long Shot SWD #1



WaterBridge Stateline LLC  
Sniper SWD #1



WaterBridge Stateline LLC  
DB Ranch SWD's  
Cross-Section B to B'  
Eddy County, New Mexico



## Regional Cisco Completions and Drill Stem Test Map

DST: Upper Cisco **8060'-8130'**  
Rec: 1000' Mud  
6384' SulWtr

Perf: **8186'-8190'**  
@ 1550 MCFGPD  
**No Prod Reported**

DST: Upper Cisco **8235'-8270'**  
Rec: GTS TSTM  
Perf: Upper Cisco **8308'-8336'**  
No reported production  
Plug back and abandon Cisco

DST: Upper Cisco **8295'-8339'**  
Rec: 7875' Form Wtr  
DST: Upper Cisco **8300'-8339'**  
Rec: GTS in 7 min  
2557' GasCutFluid  
No completion in Cisco

Perf: Upper Cisco **8382'-8398'**  
Acid: 4000 gals 20% HCl  
Plugged Back

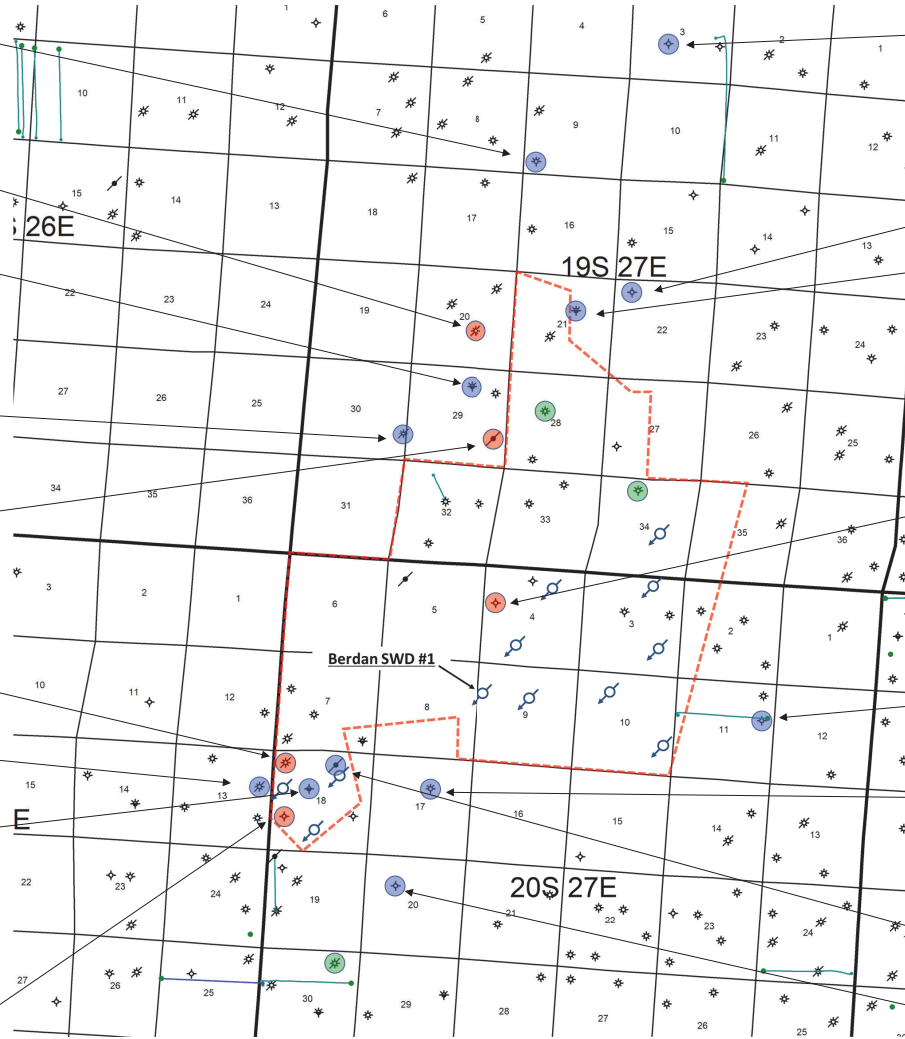
Perf: Lower Cisco **8832'-8844'**  
Acid: 1500-gal w/ 15% HCl  
IPP: 0 BO / 5 MCFG / 105 BW  
**Prod: 1 BO / 960 MCFG**

DST: Upper Cisco **8450'-8502'**  
Rec: 2440' Fluid  
186' SIGCSulMud  
2254' SulWtr

DST: **8285'-8319'**  
Rec: 160' Mud  
2672' SulWtr  
"No Show of Oil"

Perf: **8840'-8880'**  
Acid: 2100-gal w/ 15% HCl  
Swab & Plug Back  
Perf: **8714'-8760'**  
Acid: 1650-gal w/ 15% HCl  
Swab & Plug Back  
Perf: **8250'-8265'**  
Acid: 750-gal w/ 15% HCl  
TA & Plug

- Perf'd Cisco – No Production
- DST Cisco
- IHS reported perfs or DST's – Not present or illegible @ NMOCD
- ⊕ Pending WaterBridge Cisco Disposal Permits



DST: Upper Cisco **8189'-8218'**  
Rec: GTS in 13" @ 25mcf  
60' Oil&GasCutMud  
30' Oil

DST: Upper Cisco **8195'-8278'**  
Rec: GTS in 42" TSTM  
60' Sul&GasCutMud  
3800' SW

DST: Upper Cisco **8355'-8360'**  
Rec: 360' VrySIGasCutMud  
6384' SulWtr

DST: Upper Cisco **8100'-8230'**  
Rec: 3000' GasCutFormWtr w/TrOil  
DST: Upper Cisco **8100'-8192'**  
Rec: 5' OilCutMud  
590' SIOilCutMud

Perf: Middle Cisco **8528'-8532'**  
Swab 19 BW in 2 hrs w/ no show  
of gas  
Swab 16 BW in 11 hrs w/ sl show  
of gas  
Swab 1 BW in 7 hrs  
Acid: 1500-gal w/ 15% HCl & N2  
Rec 17 BW in 2 hrs  
Swab 176 BW in 10 hrs  
No show of gas  
Swab 64 BW in 4 hrs  
No show of gas, sl well

DST: Upper Cisco **9320'-9374'**  
Rec: 3400' Gas  
5380' SaltWtr w/ SulfOdor

DST: **8250'-8354'**  
Rec: 6900' Sul Wtr  
"No Shows"

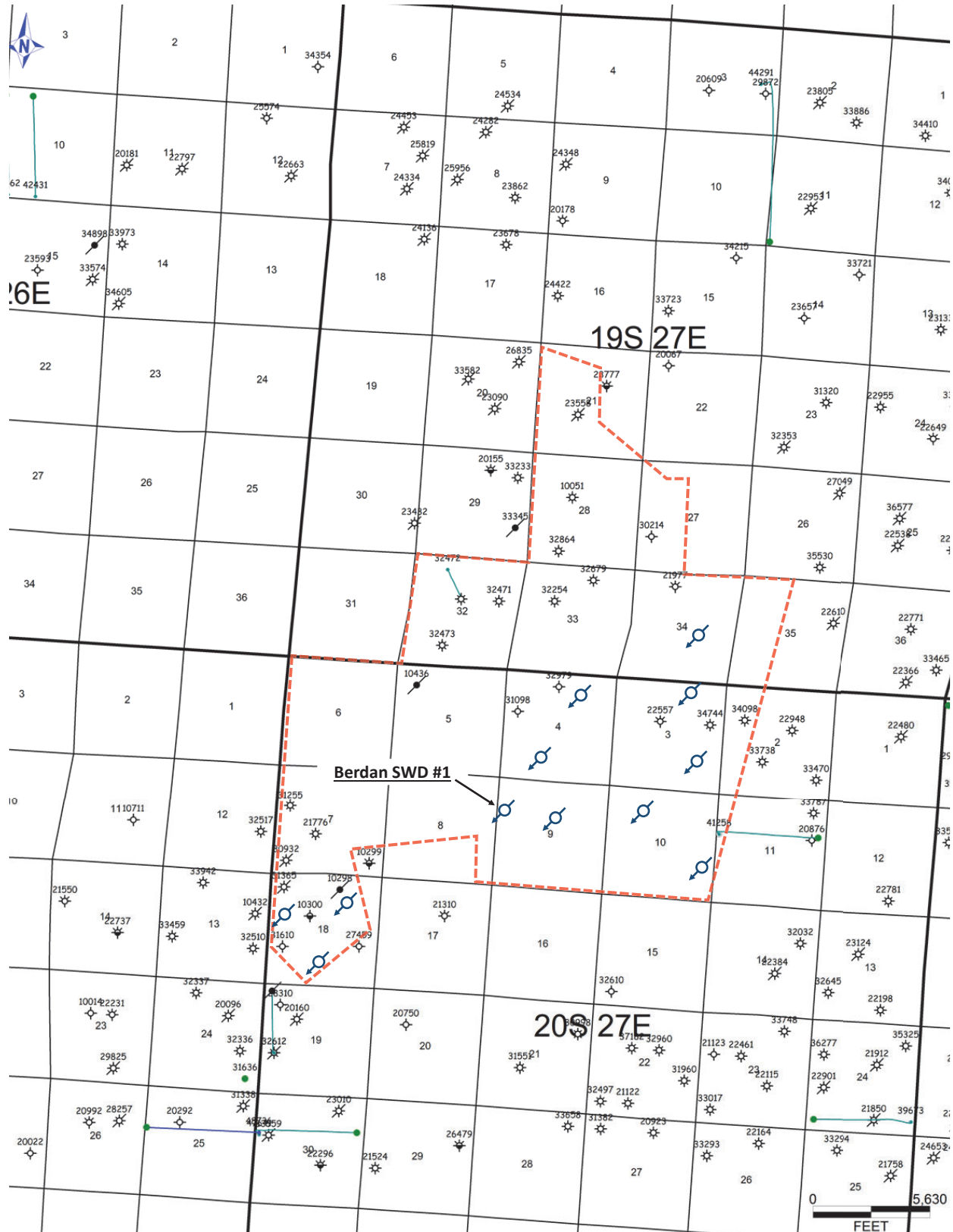
DST: **8343'-8423'**  
Rec: 282' GCMud  
7546' SIGCBikSulWtr

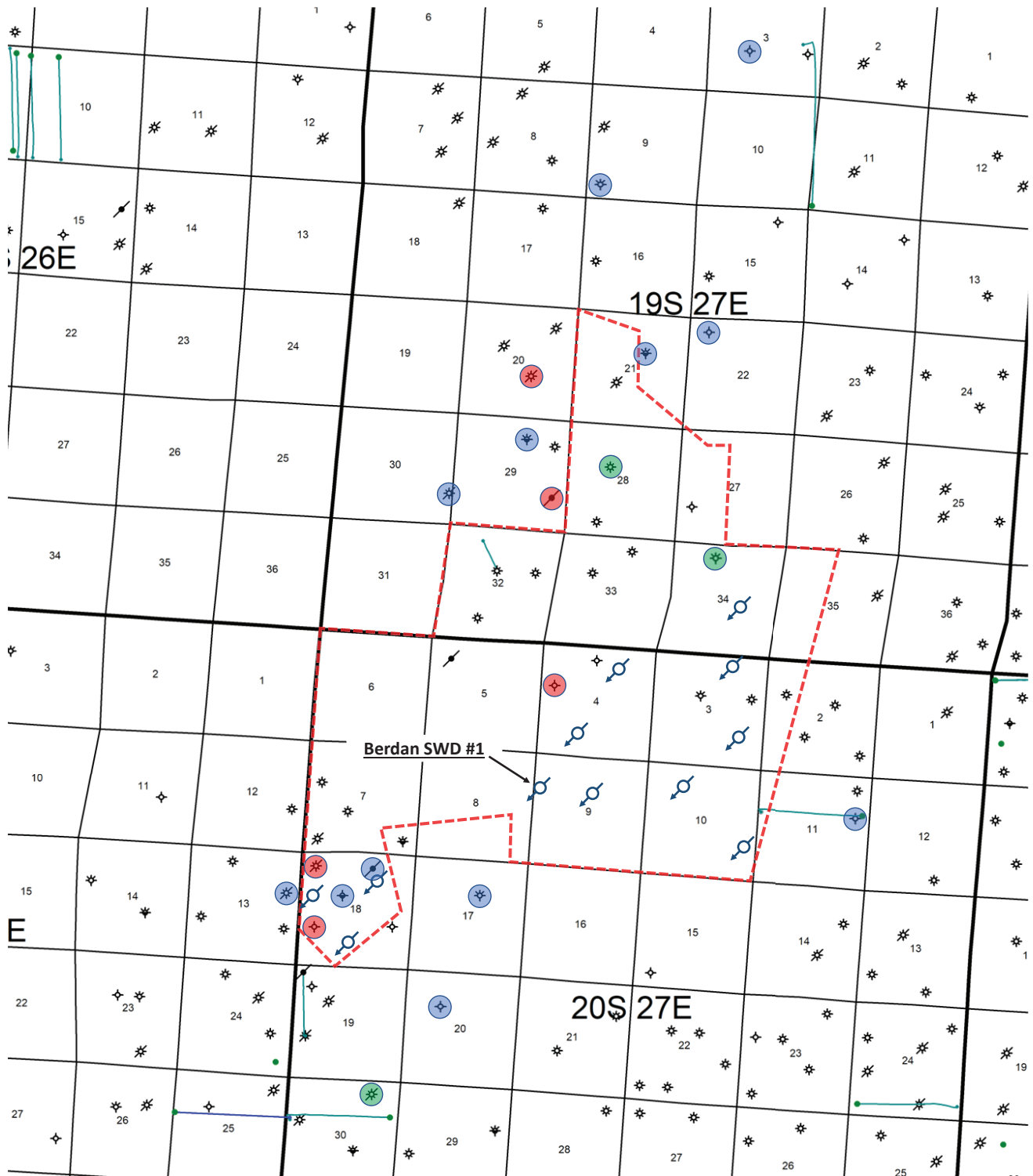
DST: Middle Cisco **8685'-8750'**  
"No Shows"

**WaterBridge Stateline LLC**  
Berdan SWD #1  
Cisco DST & Perf Results

Eddy County, New Mexico

## Cisco Formation Isopach & Structure Maps





- Perf'd Cisco – No Production
- DST Cisco
- IHS reported perfs or DST's – Not present or illegible @ NMOCD
- ⊗ Pending WaterBridge Cisco Disposal Permits

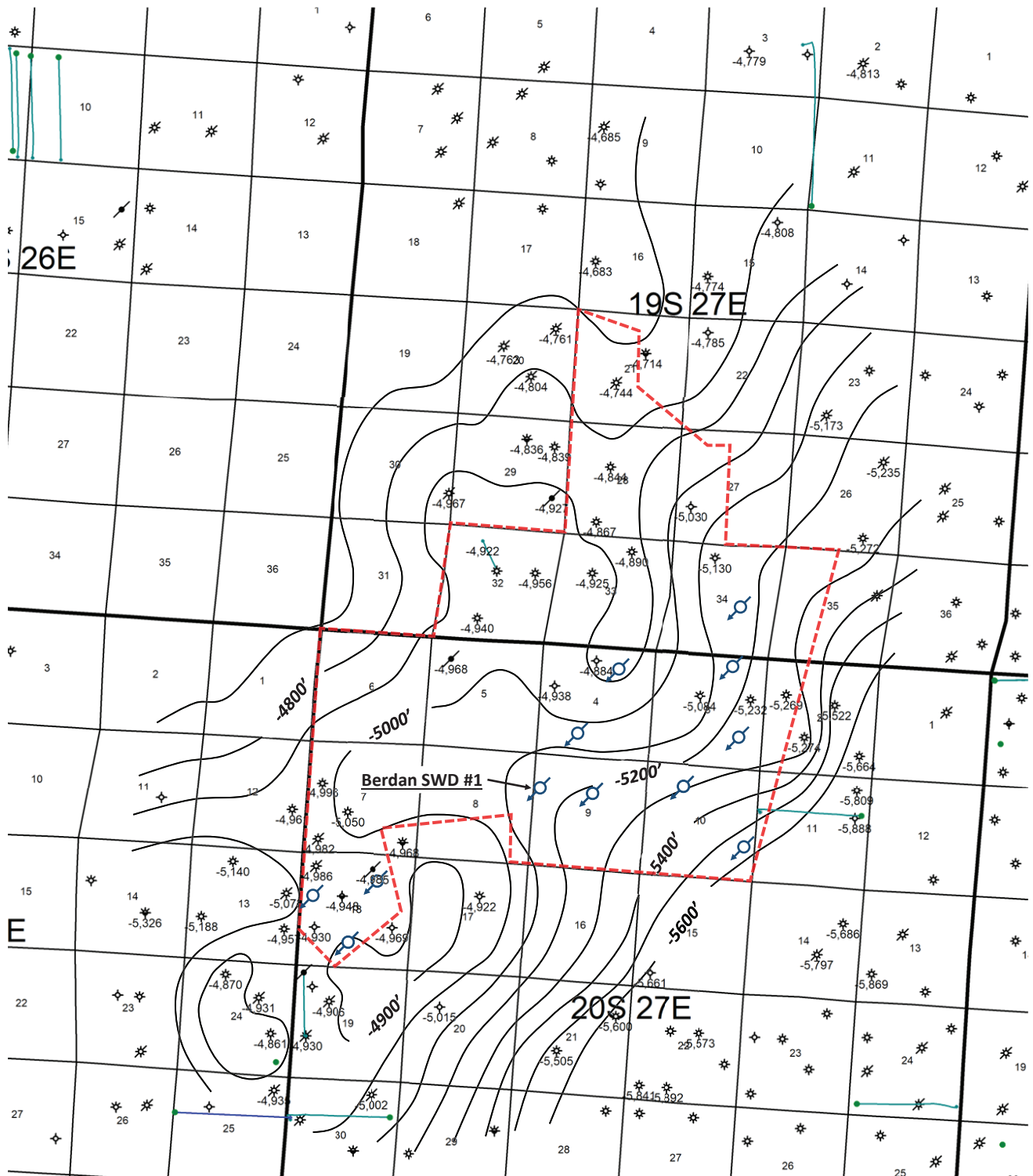
**WaterBridge Stateline LLC**

**Berdan SWD #1**

**Cisco DSTs and Perfs**

**Eddy County, New Mexico**





--- Property Outline

Pending WaterBridge Cisco Disposal Permits

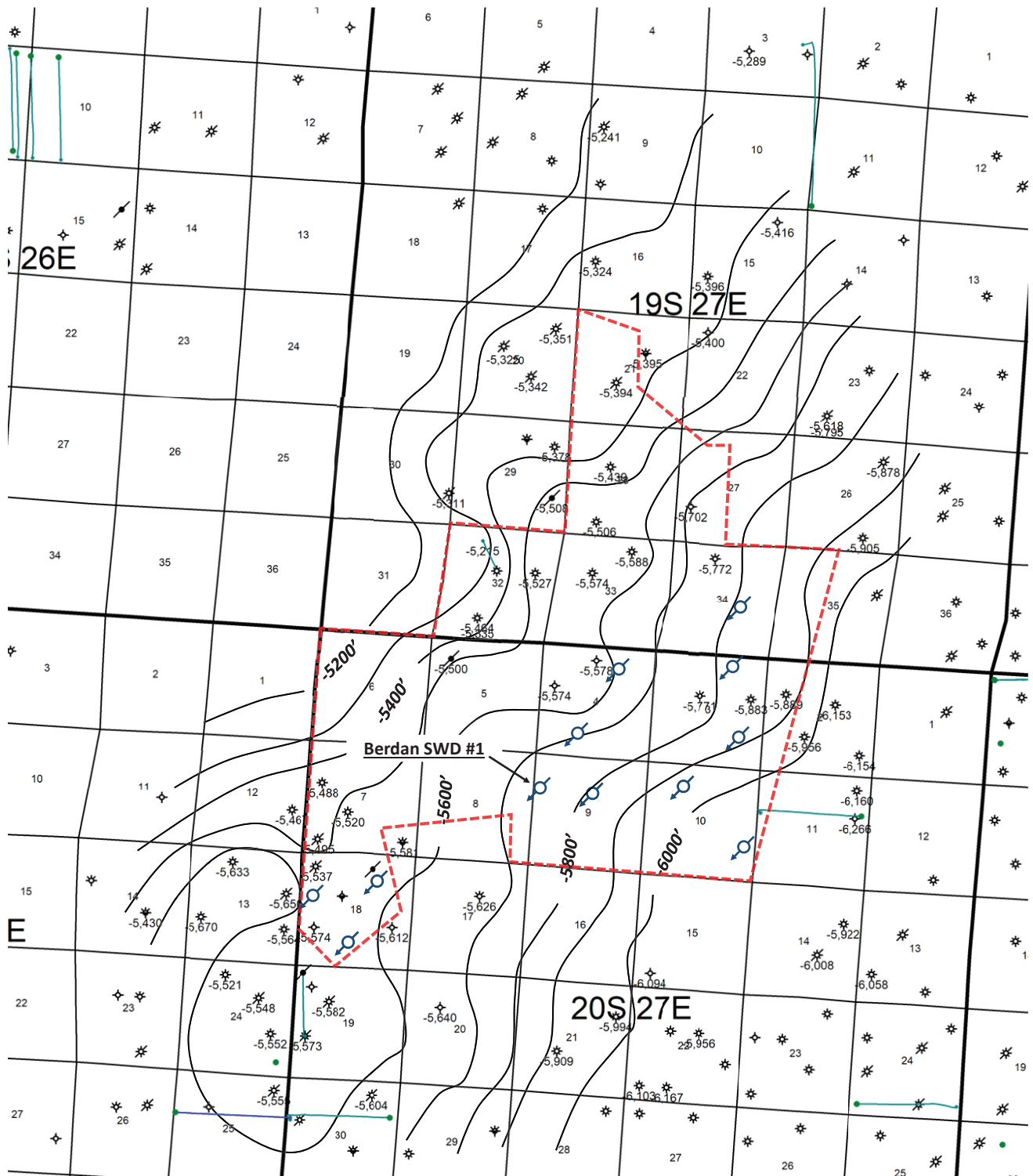
**WaterBridge Stateline LLC**

**Berdan SWD #1**

Structure Map – Top/ Cisco

Contour Interval = 100'

Eddy County, New Mexico



--- Property Outline

 Pending WaterBridge Cisco Disposal Permits

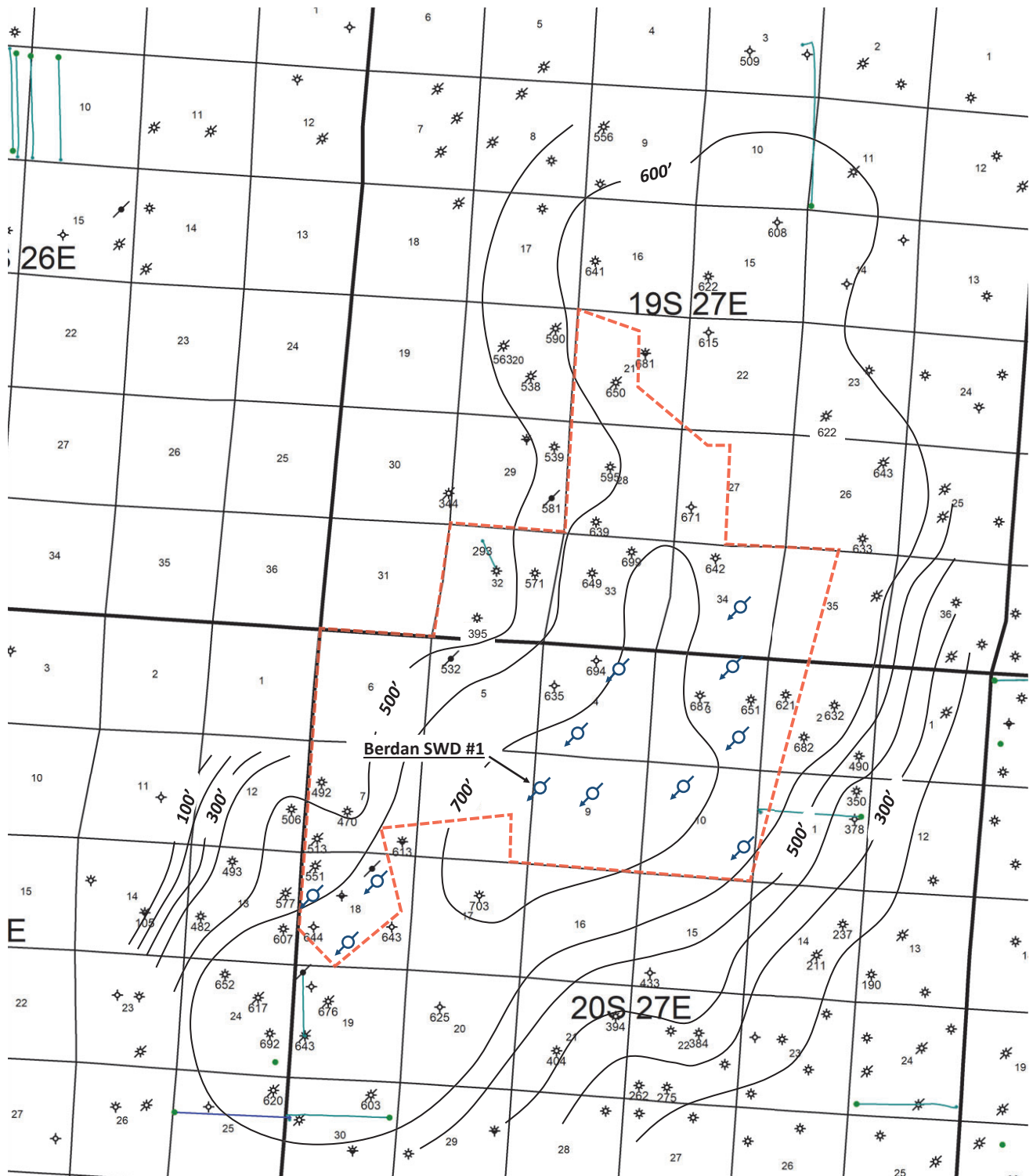
**WaterBridge Stateline LLC**

**Berdan SWD #1**

Structure Map – Base/ Cisco

Contour Interval = 100'

Eddy County, New Mexico



--- Property Outline

⊕ Pending WaterBridge Cisco Disposal Permits

**WaterBridge Stateline LLC**

**Berdan SWD #1**

Isopach Map – Cisco Formation

Contour Interval = 100'

Eddy County, New Mexico

## **Seismic Analysis Letter:**



February 5, 2024

PN 1703.SWD.02

Mr. Phillip Goetze, P.G.  
NM EMNRD – Oil Conservation Division  
1220 South St. Francis Drive  
Santa Fe, NM 87505

Subject: **WaterBridge Stateline, LLC**  
**Berdan Fed SWD #1 - Seismic Potential Letter**

Dear Mr. Goetze,

At the request of Water Bridge Stateline, LLC (WaterBridge), ALL Consulting, LLC (ALL) has assessed the potential injection-induced seismicity risks in the vicinity of WaterBridge's Berdan Fed SWD #1 (Subject SWD), a proposed saltwater disposal (SWD) facility in Eddy County, New Mexico, and summarized the findings in this letter. This assessment used publicly available data to identify the proximity and characteristics of seismic events and known faults to evaluate the potential for operation of the Berdan Fed SWD #1 to contribute to seismic activity in the area.

## Geologic Evaluation

The Subject SWD is requesting a permit to inject into the Pennsylvanian Cisco Formation at a depth of 8,450-9,200 feet below ground surface (bgs). The Cisco consists of various Pennsylvanian-age carbonates and is overlain by approximately 40 feet of shale beds with low porosity and permeability development that prevent the upward migration of injection fluid and serve as the upper confining layer (see **Attachment 1**). Additionally, approximately 80 feet of interbedded low porosity and low permeability shales and other carbonate rocks lie in the lower Cisco Formation and upper Strawn Formation and act as a lower confining zone by prohibiting downward migration of injected fluids into the underlying Strawn Formation (see **Attachment 1**). A stratigraphic chart depicting the geologic setting is included as **Figure 1**.<sup>1</sup>

## Seismic Events and Fault Data

A review of United States Geological Survey (USGS) and New Mexico Tech Seismological Observatory (NMTSO) earthquake catalogs determined that four (4) seismic events have been recorded within a 100 square mile area [9.08-kilometer (km) radius] around the Subject SWD. The closest recorded seismic event was a M1.1 that occurred on September 20, 2023 and was located approximately 2.03 miles south of the Subject SWD (see **Attachment 2**).

<sup>1</sup> Ball, Mahlon M. 1995. "Permian Basin Province (044)." In *National Assessment of United States Oil and Gas Resources—Results, Methodology, and Supporting Data*. U.S. Geological Survey.  
<https://certmapper.cr.usgs.gov/data/noga95/prov44/text/prov44.pdf> (accessed June 18, 2018).



WaterBridge Stateline, LLC  
Berdan Fed SWD #1 Seismic Information  
February 5, 2024

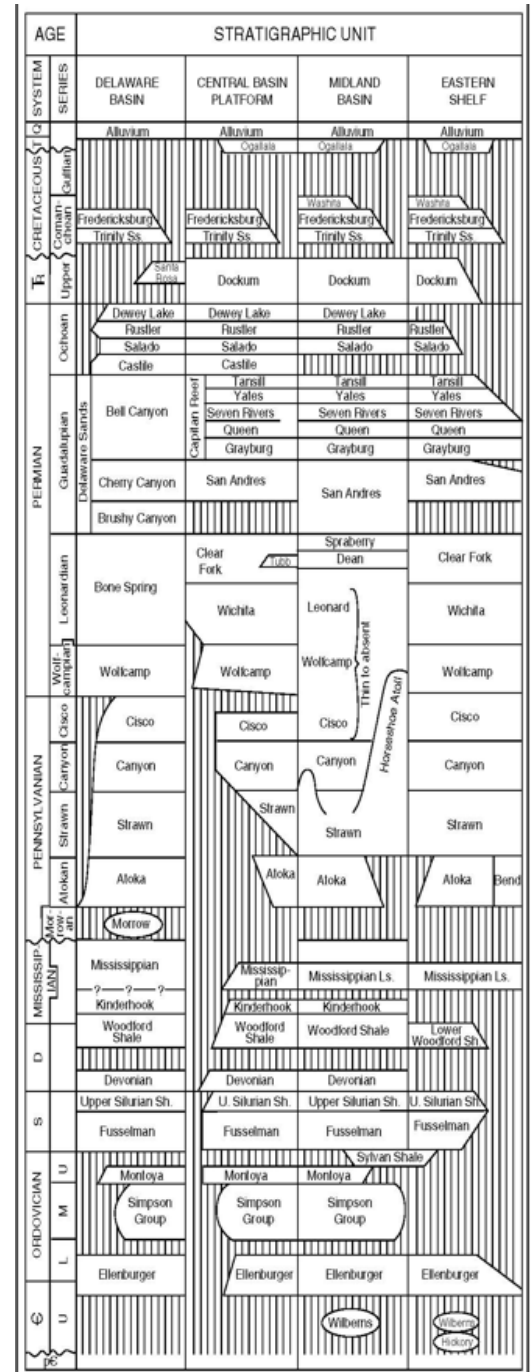
Fault data from USGS and the Texas Bureau of Economic Geology (BEG)<sup>2</sup> indicates that the closest known fault is located approximately 2.02 miles east of the Subject Well (See **Attachment 2**). This identified fault is within the Precambrian basement, which is approximately 7,000 feet below the injection interval<sup>3</sup>. A map of the seismic events and faults within 9.08 km of the Subject SWD is included as **Attachment 2**.

## Seismic Potential Evaluation

Experience in evaluating induced seismic events indicates that most injection-induced seismicity throughout the U.S. (e.g., Oklahoma, Ohio, Texas, and Colorado) occurs as a result of injection into Precambrian basement rock or into overlying formations that are in hydraulic communication with the Precambrian basement rock, or as a result of injection near critically stressed and optimally oriented faults. Seismicity at basement depths occurs because critically stressed faults generally originate in crystalline basement rock and may also extend into overlying sedimentary formations.<sup>4</sup>

Injection into either the Precambrian basement rock or its overlying formations that are hydraulically connected to the basement rock through faulting or fracture networks can increase the pore pressure and may cause the fault to slip, resulting a seismic event.<sup>4</sup> Because of this, the vertical distance between the injection formation and Precambrian basement rock as well as the presence or lack of faulting within the injection interval are major considerations when determining the risk of injection-induced seismicity. Geophysical logs from nearby well records show at least 7,000 feet of vertical separation between the injection interval and the Precambrian basement.<sup>1</sup> Injection-induced seismicity is not typically associated with shallow disposal wells, such as the Berdan Fed SWD #1.

**Figure 1 – Delaware Basin Stratigraphic Chart (Ball 1995)**



<sup>2</sup> Horne E. A. Hennings P. H., and Zahm C. K. 2021. Basement structure of the Delaware Basin, in The Geologic Basement of Texas: A Volume in Honor of Peter Flawn, Callahan O. A., and Eichubl P., The University of Texas at Austin, Bureau of Economic Geology.

<sup>3</sup> G. Randy Keller, J. M. Hills & Rabah Djeddi, A regional geological and geophysical study of the Delaware Basin, New Mexico and West Texas, Trans Pecos Region (West Texas) (1980).

<sup>4</sup> Ground Water Protection Council and Interstate Oil and Gas Compact Commission. *Potential Injection-Induced Seismicity Associated with Oil & Gas Development: A Primer on Technical and*

WaterBridge Stateline, LLC  
Berdan Fed SWD #1 Seismic Information  
February 5, 2024

For injection into the Cisco Formation to contribute to seismic activity, one of two hypothetical geologic scenarios must exist:<sup>5</sup>

1. Earthquake hypocenters would need to be significantly shallower (several kilometers) than initially identified by the USGS and NMTSO seismic monitoring networks, and thus placing seismic activity high in the sedimentary column, rather than in the Precambrian basement.
2. High permeability and transmissive conduits from fault-damaged zones would need to be present below the Cisco Formation, allowing fluid to migrate through the Strawn Formation shale and carbonate units and through significantly deeper confining intervals, and eventually into the Precambrian basement. Additionally, this hypothesis would need to assume that the injection fluids and bottom hole pressures in the Cisco Formation would need to exceed existing hydrostatic pressures within the deeper geologic formation in order for injection fluids to migrate downward.

There are no publications or data that suggest either of these scenarios to be true for the area around the Subject SWD.

## Conclusion

As an expert on the issue of induced seismicity, seismic monitoring and mitigation, it is my opinion that the potential for the Subject SWD to cause injection-induced seismicity is expected to be minimal, at best. This conclusion is based on (1) the presence of numerous confining layers above and below the injection interval and (2) the significant vertical distance between the injection zone and Precambrian basement rock in which the nearest fault is located.

Sincerely,  
ALL Consulting



Reed Davis  
Geophysicist

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*Regulatory Considerations Informing Risk Management and Mitigation*. 2015. 141 pages.

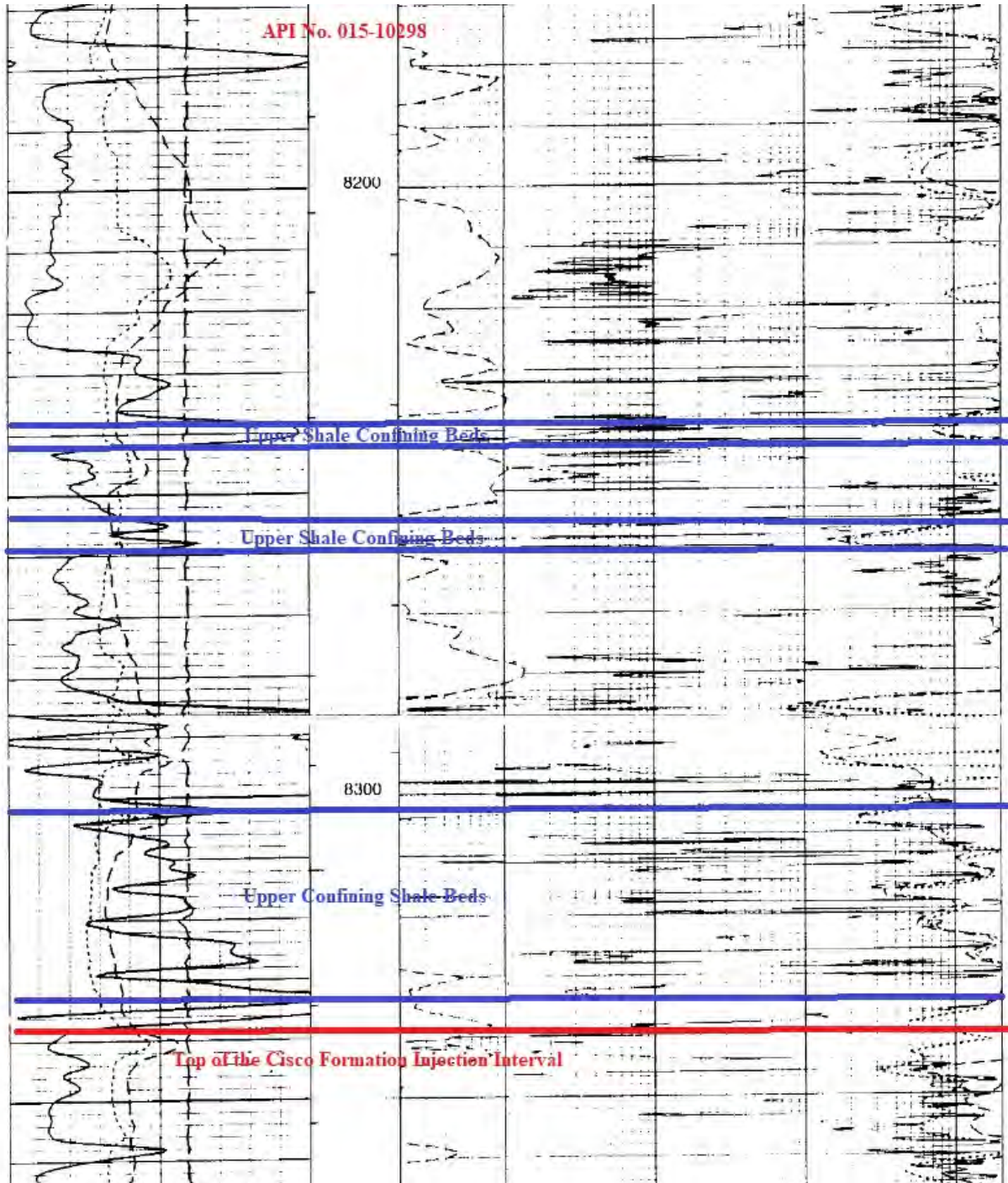
<sup>5</sup> Skoumal, Robert J., et al. "Induced Seismicity in the Delaware Basin, Texas." *Journal of Geophysical Research: Solid Earth*, vol. 125, no. 1, 2020, doi:10.1029/2019jb018558.

WaterBridge Stateline, LLC  
Berdan Fed SWD #1 Seismic Information  
February 5, 2024

**Attachment 1**  
**Upper and Lower Confining Zones**

WaterBridge Stateline, LLC  
Berdan Fed SWD #1 Seismic Information  
February 5, 2024

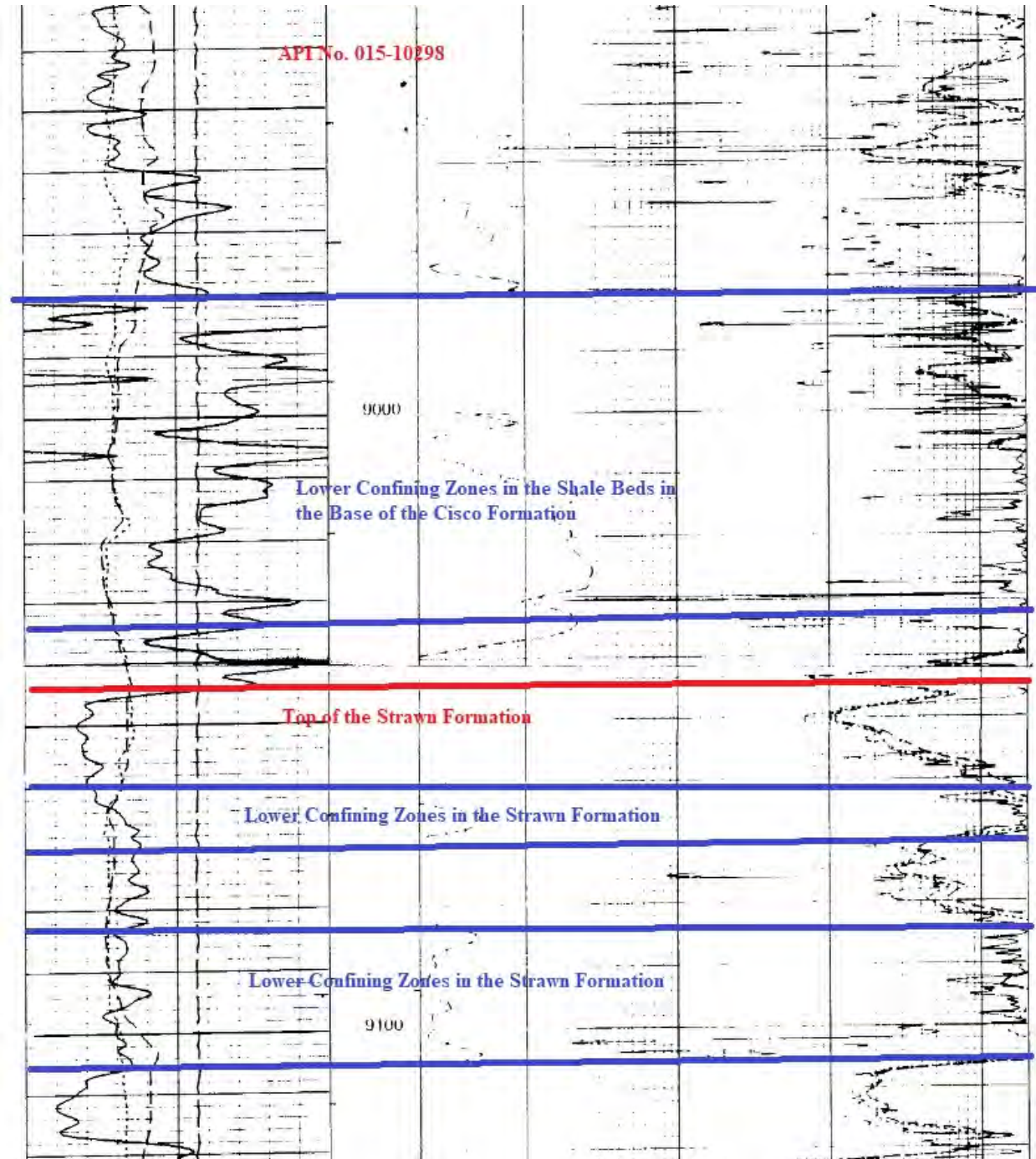
### Upper Shale Confining Zones from API No. 015-10298





WaterBridge Stateline, LLC  
Berdan Fed SWD #1 Seismic Information  
February 5, 2024

### Lower Shale Confining Zones from API No. 015-10298



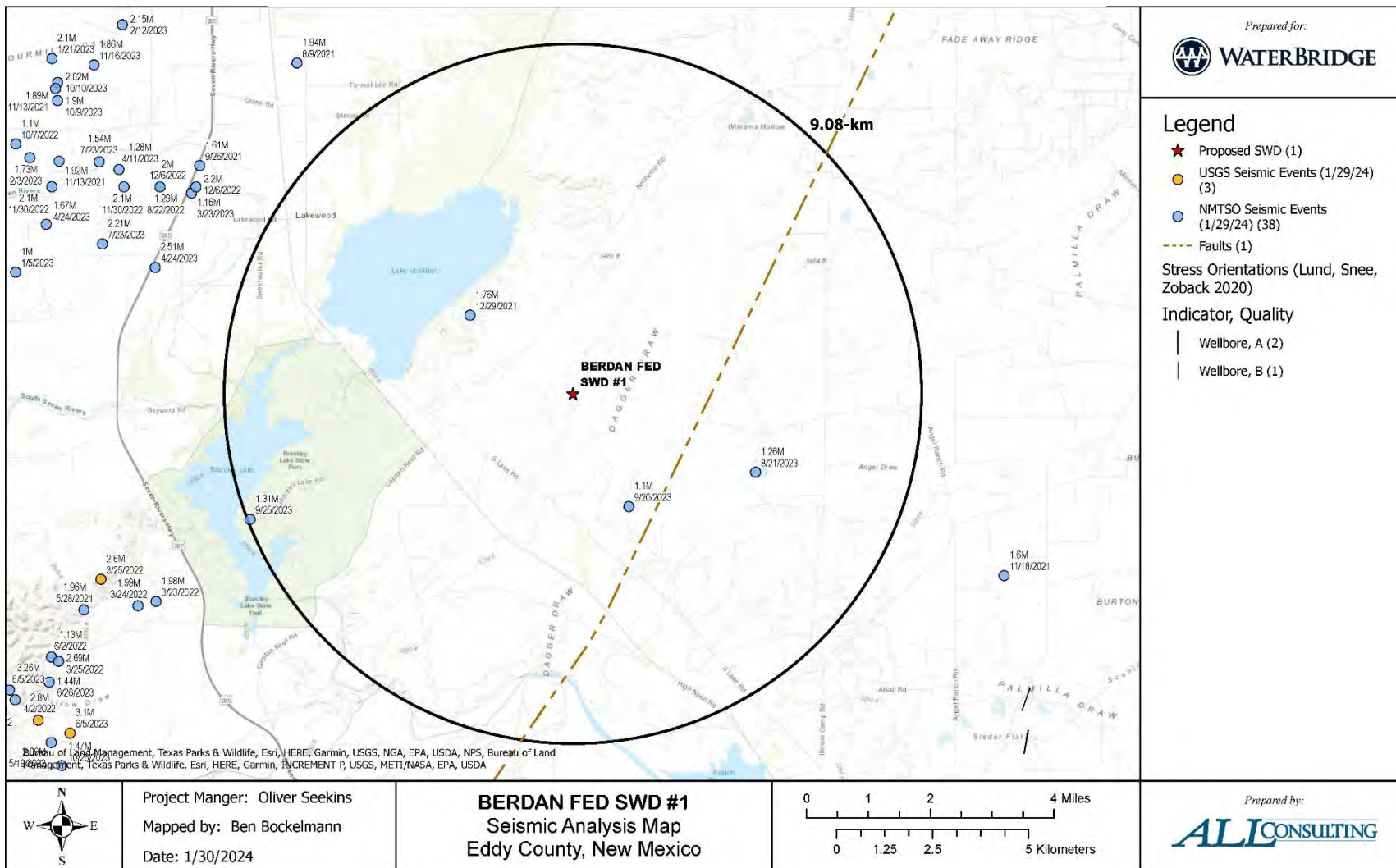


WaterBridge Stateline, LLC  
Berdan Fed SWD #1 Seismic Information  
February 5, 2024

**Attachment 2**  
**Seismic Event Map**

WaterBridge Stateline, LLC  
Berdan Fed SWD #1 Seismic Information  
February 5, 2024

### Berdan Fed SWD #1 Nearby Seismic Events and Faults



**District I**  
1625 N. French Dr., Hobbs, NM 88240  
Phone:(575) 393-6161 Fax:(575) 393-0720  
**District II**  
811 S. First St., Artesia, NM 88210  
Phone:(575) 748-1283 Fax:(575) 748-9720  
**District III**  
1000 Rio Brazos Rd., Aztec, NM 87410  
Phone:(505) 334-6178 Fax:(505) 334-6170  
**District IV**  
1220 S. St Francis Dr., Santa Fe, NM 87505  
Phone:(505) 476-3470 Fax:(505) 476-3462

State of New Mexico  
Energy, Minerals and Natural Resources  
Oil Conservation Division  
1220 S. St Francis Dr.  
Santa Fe, NM 87505

CONDITIONS  
  
Action 327232

CONDITIONS

Operator: WaterBridge Stateline LLC 5555 San Felipe Houston, TX 77056	OGRID: 330129
	Action Number: 327232
	Action Type: [IM-SD] Admin Order Support Doc (ENG) (IM-AAO)

CONDITIONS

Created By	Condition	Condition Date
anthony.harris	None	3/27/2024