

WATERSTONE ENVIRONMENTAL, INC.

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April 21, 2014

VIA EMAIL
mbrock@breitburn.com

Martha Brock
EH&S Manager
BreitBurn Management Company LLC, Region II &
Pacific Coast Energy Company
515 S. Flower Street, Suite 4800
Los Angeles, CA 90071

**RE: EXEMPTION FROM GROUNDWATER MONITORING PLAN REQUIREMENTS FOR
HYDRAULIC FRACTURING PER SB 4 - BREITBURN DOW CHANSLOR LEASE IN THE
NORTH AND SOUTH BELTRIDGE OIL FIELDS, KERN COUNTY, CA**

Dear Ms. Brock:

The purpose of this document is to describe the results of groundwater research including information from a 50-foot boring performed on behalf of BreitBurn Operating L.P. (BreitBurn) by Waterstone Environmental, Inc. (Waterstone) for the oil-productive area near and underlying BreitBurn's 320-acre Dow Chanslor Lease in the North and South Belridge Oil Fields near Lost Hills in Kern County, CA (Subject Property). Additionally, a description of the proposed hydraulic fracturing (fracking) project is provided. Figures 1 and 2 show the Subject Property location which consists of the S ½ of the S ½ of Section 1 and the N ½ of the N ½ of Section 12, T28S-R20E (Mount Diablo Baseline and Meridian). This document replaces the April 1, 2014 submittal based on revisions suggested by the State Water Resources Control Board (SWRCB) in a phone call with BreitBurn personnel on April 21, 2014.

BreitBurn has requested that Waterstone perform groundwater research for the area to determine whether BreitBurn's planned well stimulation of 32 wells on the Subject Property by fracking is subject to groundwater monitoring requirements described in the state of California Senate Bill SB4 approved by Governor Brown on September 20, 2013 and administered by the state of California Division of Oil, Gas and Geothermal Resources (DOGGR) and the SWRCB. In addition, per a request made by the SWRCB, Waterstone recently logged a 50-foot deep boring in the oil field to evaluate the soil column for the presence of groundwater.

The result of Waterstone's research indicates BreitBurn's planned fracking project qualifies for an exemption from the Groundwater Monitoring Plan requirements specified in Public Resource Code section 3160. This document provides a discussion of background information for the area, a description of the project and information on groundwater beneath the Subject Property.



Field History and Operating Area

The Subject Property is located in both North and South Belridge Field as shown on Figure 3. BreitBurn purchased the Subject Property in November 2012 from American Energy Operations (AEO).

Figure 3 shows the areal extent of the Belridge oil field which is located 45 miles northwest of Bakersfield. The South Belridge field covers some 4,800 productive acres while the North Belridge field covers an additional 900 acres. The light oil Diatomite Pool is overlain by the heavy oil sands of the Tulare Formation.

The South Belridge field was discovered in April 1911 by the newly-formed Belridge Oil Company. Development of the South Belridge field was active through the early 1920s and with less activity until World War II. By the early 1950s, the field had been drilled to its current boundaries, with the heavy-oil-producing sands of the Tulare Formation as the primary producing zone.

In the North Belridge Field, the Diatomite Pool was discovered in 1912 by several wells producing from the naturally fractured diatomite. During the late 1930s deeper sub-Monterey reservoirs were discovered and developed. The development history of the Diatomite Pool in North Belridge is generally similar to that in South Belridge.

During the late 1970s, hydraulic fracturing techniques were tested in the diatomaceous Opal-A to make Diatomite development commercially viable. Mobil completed the first successful hydraulically fractured diatomite well in 1977. Subsequently, the Diatomite pool was actively developed by all operators, completing wells with multiple hydraulic fractures.

By 1984, reservoir compaction and the resulting surface subsidence had begun to impact producing operations because of wellbore damage and well failures. Full-scale water injection pressure maintenance operations were therefore implemented in South Belridge in 1986 and were ultimately expanded throughout North and South Belridge from the late 1980's to the late 1990's. Since acquiring the lease, BreitBurn has continued developing the diatomite and managing the necessary water injection and pressure maintenance to minimize subsidence of the formation.

Project Description

BreitBurn is pursuing approval from DOGGR to complete and frack 32 wells in North and South Belridge as listed on the attached Table 1 and shown on Figure 4. This project is a continuation of the ongoing development of the diatomite reservoirs in Belridge. Other operators are performing similar procedures including Aera Energy who reportedly plans to drill and frack approximately 500 wells per year in the two oil fields. This information is



contained in an Aera Energy report¹ to the RWQCB dated February 5, 2014 entitled *Groundwater Monitoring Exemption Justification for Hydraulic Fracturing Well Stimulation Treatments, North and South Belridge Oil Fields – Kern Count, California* that describes groundwater in the area of Aera’s leases some of which adjoin the Subject Property to the north and south (Aera’s Submittal).

The Subject Property has over 120 active producers and 60 active injectors and has been operated by stimulating the reservoir since development began in the late 1970’s. Both fracking and subsidence mitigation are critical to economically operate the field. The procedures used to mitigate wellbore subsidence have vastly improved since waterflood injection began in the field in the 1980’s and the most up-to-date methods are used by BreitBurn. Last year, 16 production wells were drilled by BreitBurn, completed, and successfully stimulated by fracking.

The field is being developed in a line-drive pattern and with an approximate 2:1 producer to injector ratio. A typical completion will consist of 14” conductor cemented in at ± 50’, 9-5/8” casing set at ± 1000, and a 7” long string cemented in at ±2400 – 3100’ depending on the deepest target interval. All strings are cemented to the surface.

Fractures typically have short half-lengths of 150 feet or less which has been demonstrated by fracture modeling, tracers, and the current development well spacing. Fracture height is largely dictated by stress, but generally is less than 200 feet. Model stresses, logs, and experience indicate a good upper boundary at the top of the Opal diatomite isolating it from the San Joaquin, Etchegoin, or Tulare formations.

The typical fracture treatment is freshwater base fluid, with guar-based cross-linked fracturing fluid serving as the proppant carrying mechanism. A slick-water pad is typically followed by cross-linked proppant laden stages with concentrations as high as 10 ppg, concluded by flushing the wellbore with freshwater. All flowback water is processed and re-injected into the waterflood using the same procedures used to manage produced water from the field’s oil production. The proposed depth of well stimulation for each well to undergo fracking is as follows:

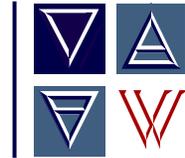
Opal A wells : 1400’ – 2200’
Opal CT wells : 1400’ – 2900’

The source of the water to be used for well stimulation is from the West Kern Water District.

Groundwater beneath the Subject Property

Based on Waterstone’s research, discussed in this Section, BreitBurn’s planned fracking project on the Subject Property qualifies for an exemption from the Groundwater Monitoring Plan requirements specified in Public Resource Code section 3160 which states:

¹ Aera’s Submittal: p. 2, Section 3, para. 1



“Monitoring is not required for oil and gas wells where the wells do not penetrate groundwater of beneficial use, as determined by a regional water quality control board, or do not penetrate exempt aquifers pursuant to Section 146.4 of Title 40 of the Code of Federal Regulations.”²

Section 146.4 of Title 40 of the Code of Federal Regulations defines an exempt aquifer as follows:

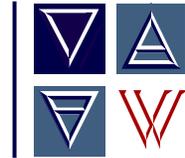
- (a) It does not currently serve as a source of drinking water; and
- (b) It cannot now and will not in the future serve as a source of drinking water because:
 - (1) It is mineral, hydrocarbon or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible.
 - (2) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical;
 - (3) It is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or
 - (4) It is located over a Class III well mining area subject to subsidence or catastrophic collapse; or
- (c) The total dissolved solids content of the ground water is more than 3,000 and less than 10,000 mg/l and it is not reasonably expected to supply a public water system.

The SWRCB requested that BreitBurn submit additional information by performing a 50-foot boring in the fracking area, logging any encountered groundwater, and sampling any encountered groundwater with analysis for total dissolved solids. The 50-foot deep boring was performed on March 24, 2014 using a solid stem auger (location is shown on Figure 4). The boring was observed and supervised by a Waterstone Principal Hydrogeologist, Richard Vogl, who is registered in the State of California as a Professional Geologist, Certified Engineering Geologist, and Certified Hydrogeologist. Mr. Vogl collected samples at frequent intervals and produced the log of the boring that is included in Attachment A.

No groundwater was encountered at any depth through the entire 50-feet of the boring. All soil from surface to 43 feet was noted to be slightly moist and the final 7 feet were dry. Therefore, no water sample was collected for analysis.

Groundwater information is also available that describes subsurface characteristics in the vicinity of the Subject Property from an ExxonMobil lease located 2 miles to the south (see

² The absence of protected water as described in CFR Title 40 Section 146.4 is viewed as a condition for exemption from the Groundwater Monitoring Plan in SB 4 when agreed to by the Regional Water Quality Control Board. (Source: <http://www.conservation.ca.gov/dog/Documents/Final%20Interim%20Regulations%20with%20Highlights.pdf>)



location shown in Attachment B-Figure 3). Following are excerpts regarding geologic setting and groundwater for this nearby lease as stated by the RWQCB in Order R5-2013-0061 entitled *Waste Discharge Requirements For ExxonMobil Production Company for Post-Closure Maintenance And Corrective Action, Hill Lease Surface Impoundments, South Belridge Oil Field, Kern County*:

9. The South Belridge Oil Field is on the west side of the San Joaquin Valley, approximately 45 miles west-northwest of Bakersfield, in Kern County.

10. The field is on the Antelope Plain, an alluvial piedmont with coalescing alluvial fans from the Tumbler Range to the west. The region slopes east towards the San Joaquin Valley.

11. The land on the Hill Lease is used exclusively for oil and gas production. Adjacent land to the north, south, and east is used for oil and gas production.

12. Adjacent land to the west is primarily used as a commercial oilfield disposal facility permitted by Kern County. Non-hazardous oilfield production wastewater is injected at the facility into Class II disposal wells permitted by the California Division of Oil, Gas, and Geothermal Resources (CDOGGR). Solids temporarily stockpiled on concrete drying pads at the facility are transported to permitted landfills.

13. The Lease is in the South Valley Floor Hydrologic Unit, Antelope Plain Hydrologic Area (No.558.60), as depicted on interagency hydrogeologic maps, prepared by the Department of Water Resources in August 1986.

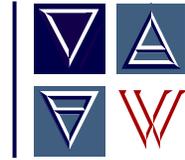
17. The Lease is in the Kern County Basin Hydrologic Unit, Detailed Analysis Unit 259. The designated beneficial uses of the groundwater, as specified in the Basin Plan, are municipal and domestic supply (MUN), agricultural supply (AGR), and industrial service supply (IND).

21. At the Lease and adjoining section to the north the stratigraphy consists of the following geologic units. The youngest unit is Alluvium consisting of alternating sand, silt, and clay. Within and at the base of the Alluvium is a sand layer designated as the 22K Sand. Above the 22K Sand is the Alluvial Clay. Below the 22K Sand is the Corcoran Clay Equivalent (CCE), which was unconformably deposited on the underlying Tulare Formation of Pleistocene age....

23. Groundwater is present in the Tulare Formation, 22K Sand, and overlying Alluvium as shallow perched groundwater, and part of a regional aquifer system. The regional aquifer system is unconfined to semi-confined above the CCE, and confined below the CCE.

In addition, Aera Class II disposal wells in the Tulare zone exist in the area, shown as yellow triangles along the eastern margin of South Belridge in Attachment B, Figure 3.

The location of cross section A-A' on the Subject Property is shown on Figure 4 and included as Figure 5. Figure 5 shows the logs for the selected wells indicating the presence of "air sands" (unsaturated) above the Tulare formation. Other cross sections of the Belridge oil fields



that are part of Aera's Submittal and are representative of the conditions across the oil-productive anticline are included in Attachment B.

Conclusions

BreitBurn's planned fracking project on the Subject Property qualifies for an exemption from the Groundwater Monitoring Plan requirements specified in Public Resource Code section 3160 which states:

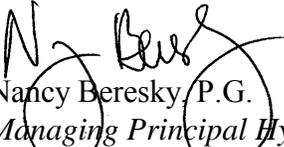
"Monitoring is not required for oil and gas wells where the wells do not penetrate groundwater of beneficial use, as determined by a regional water quality control board, or do not penetrate exempt aquifers pursuant to Section 146.4 of Title 40 of the Code of Federal Regulations."

There is no groundwater beneath the Subject Property as evidenced by the following information previously discussed:

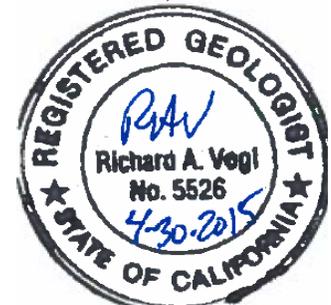
- There is no groundwater between the surface and 50 feet in depth in the project area per the boring log provided in Attachment A.
- The first encountered fluid-bearing unit above the productive limits of the Diatomite zone is the hydrocarbon-bearing segment of the Tulare Formation.
- Figure 5 shows the logs for wells on the Subject Property indicating the presence of "air sands" (unsaturated) above the Tulare formation on the Subject Property.

If you have any questions, please call Nancy or Richard at (714) 414-1122.

Sincerely,


Nancy Beresky, P.G.
Managing Principal Hydrogeologist
Waterstone Environmental, Inc.


Richard A. Vogl, P.G; C.E.G; C.Hg.
Principal Hydrogeologist
Waterstone Environmental, Inc.





Attachments: Table 1 – Wells to be Hydraulically Fractured
Figure 1 – Site Location Map
Figure 2 – BreitBurn Dow Chanslor Lease Location
Figure 3 – North and South Belridge Oil Field Structure
Figure 4 – Well Locations to be Fracked
Figure 5 - Cross Section A-A' on the Subject Property
Attachment A – Boring Log for 50-Foot Boring
Attachment B – Index Map and Aera Cross Sections
A-A' through D-D'

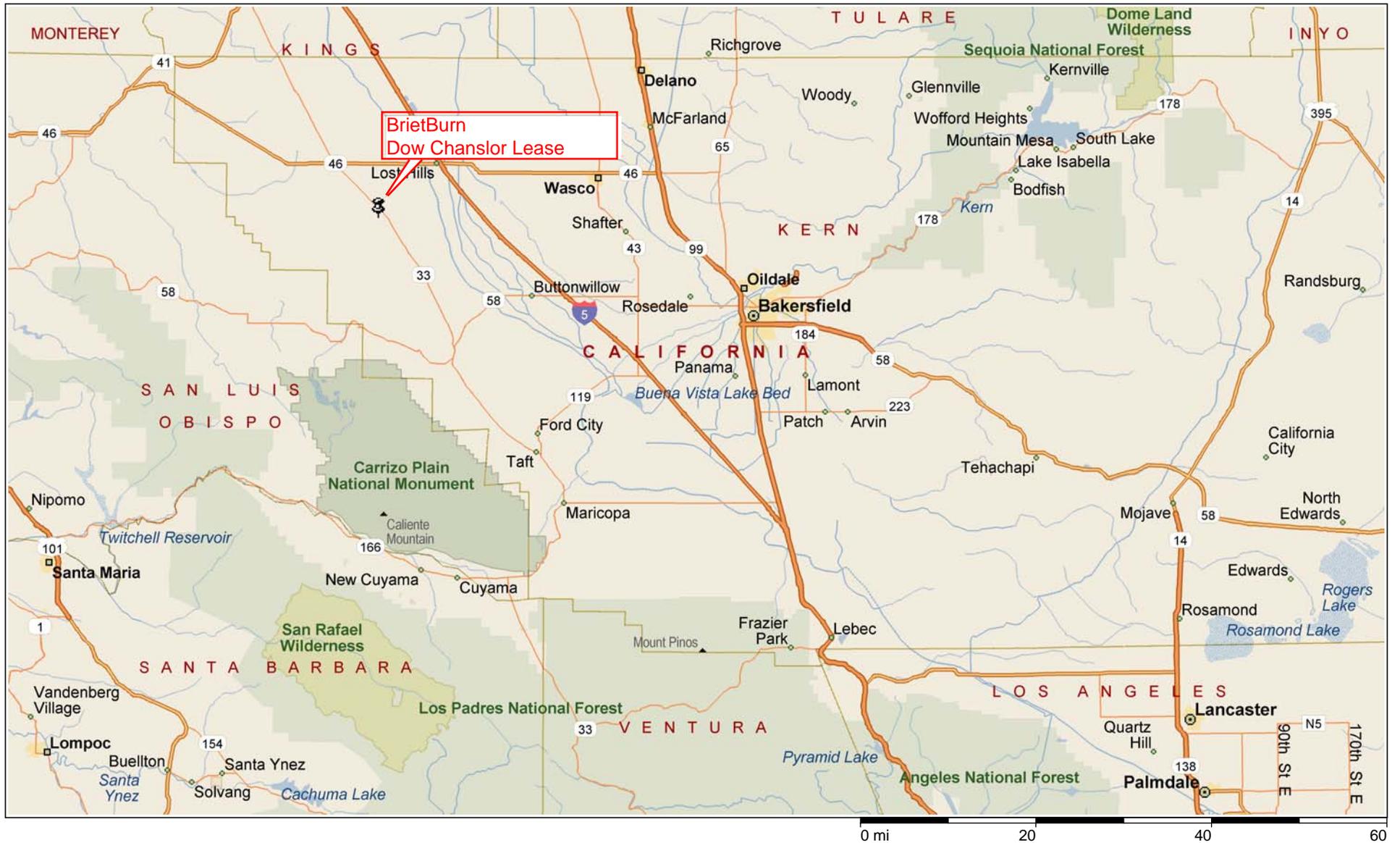
Table 1
Proposed Order of Wells for Hydraulic Fracture
BreitBurn Dow Chanslor Lease, Kern County, CA

IP Rates for Opal A				
Month	Fluid, bfpd	Oil, bopd	Water, bwpd	Gas, mcf/d
0	455	78.169	376.831	78.169
IP Rates for Opal CT				
Month	Fluid, bfpd	Oil, bopd	Water, bwpd	Gas, mcf/d
0	152	26	126	5

	Well Name	Zone
1	K-8A	CT
2	GGG-9	CT
3	G-4	CT
4	EE-5A	CT
5	D-4A	CT
6	AA-6A	CT
7	AA-8A	A
8	BB-5	A
9	A-4	A
10	A-3	A
11	A-2	A
12	B-3	A
13	BB-13	A
14	BBB-14	A
15	CC-12	A
16	CC-11A	A
17	DD-12	A
18	C-4	A

	Well Name	Zone
19	C-2	A
20	E-3	A
21	F-3	A
22	H-5	A
23	G-3A	A
24	H-4A	A
25	HH-4	A
26	I-13A	A
27	I-5A	A
28	KKK-8	A + CT
29	KK-5A	A
30	KK-4	A
31	K-4	A
32	L-4	A

Figure 1- Site Location Map



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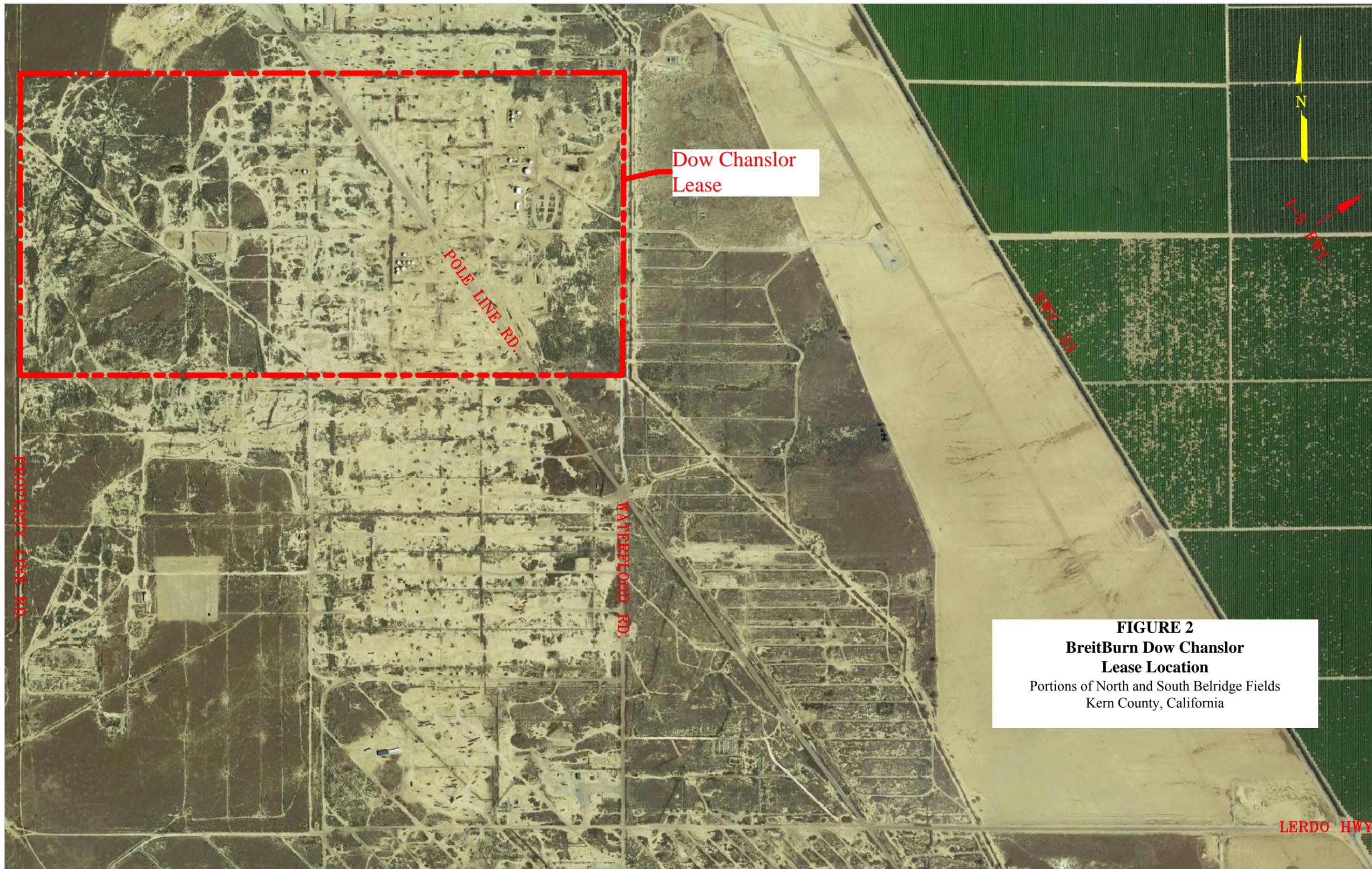
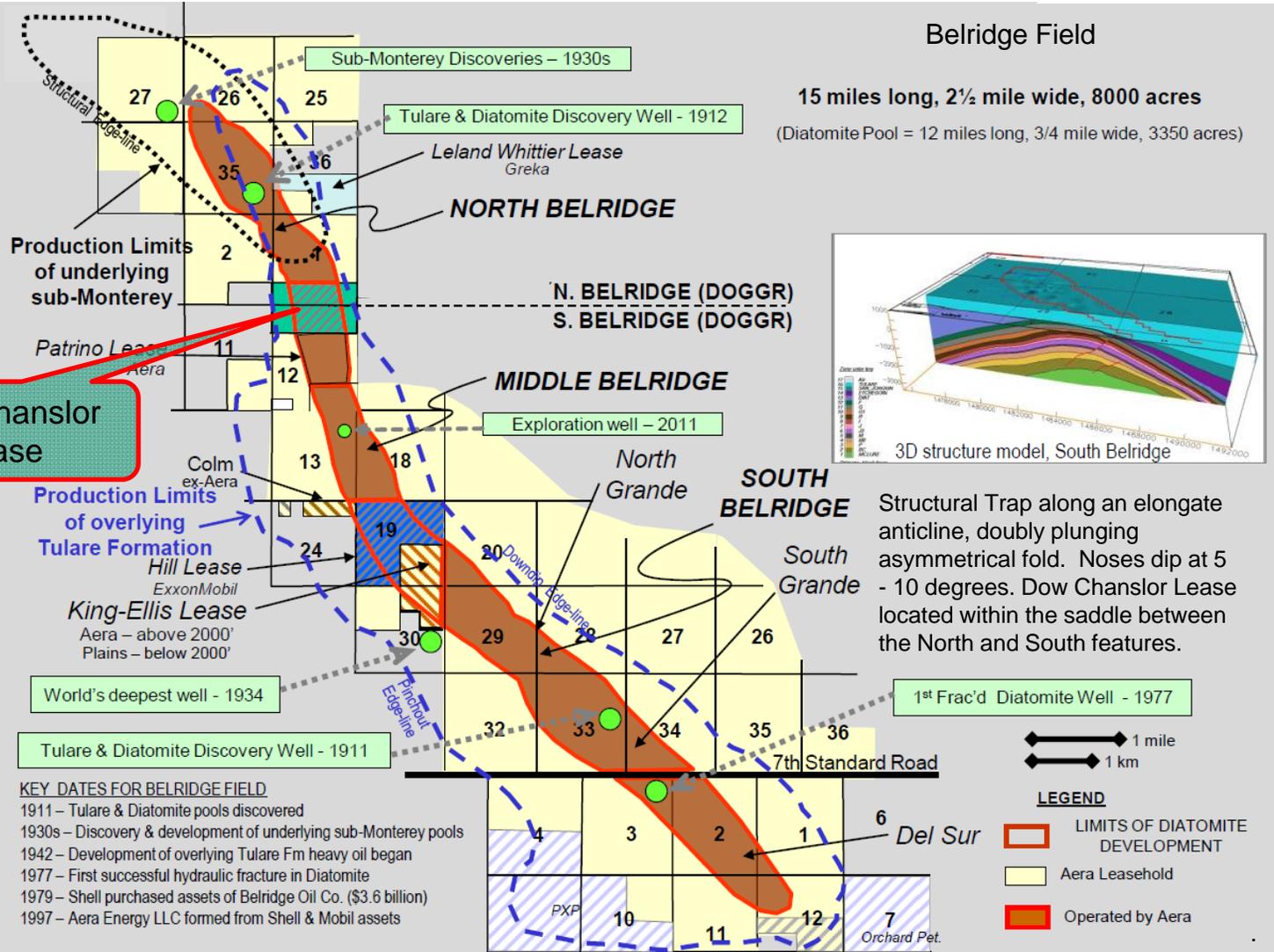


FIGURE 2
BreitBurn Dow Chanslor
Lease Location
Portions of North and South Belridge Fields
Kern County, California

Figure 3
North and South Belridge
Oil Field Structure
BreitBurn
Dow Chanslor Lease
Kern County, CA

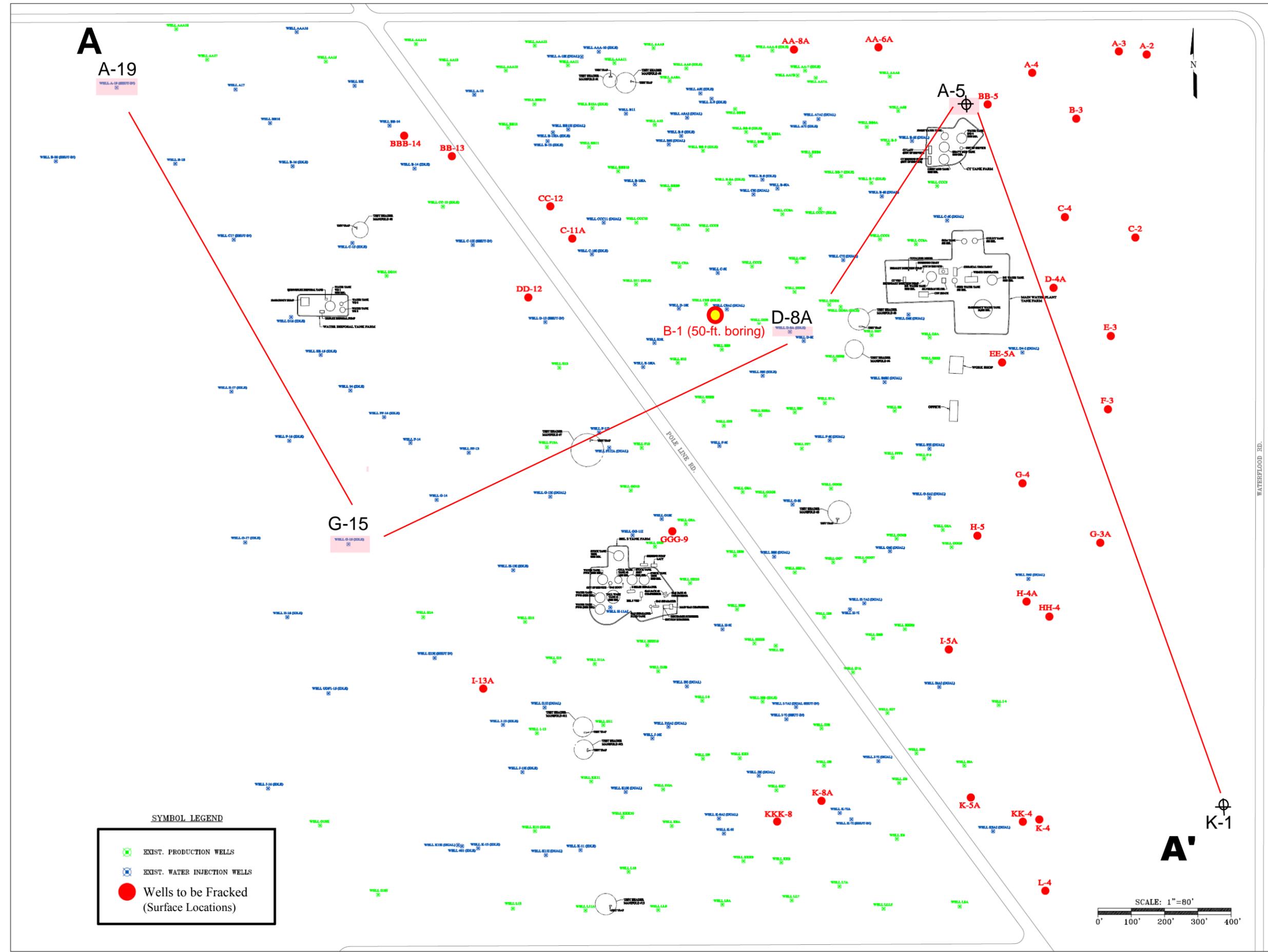


Dow Chanslor Lease

Figure 4
Well Locations to be Fracked
(and other BreitBurn
Facilities and Wells)

Dow Chanslor Lease,
 North and South Belridge
 Oil Fields
 Kern Co., CA

Cross Section A-A' is shown on Figure 5.



SYMBOL LEGEND

- ⊗ EXIST. PRODUCTION WELLS
- ⊗ EXIST. WATER INJECTION WELLS
- Wells to be Fracked (Surface Locations)

SCALE: 1"=80'
 0' 100' 200' 300' 400'

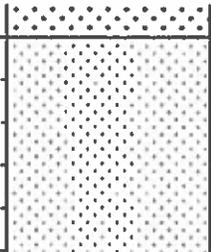
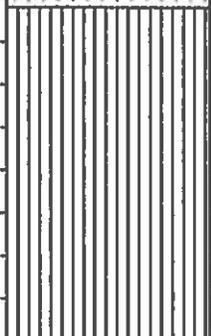
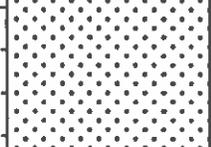
ATTACHMENT A

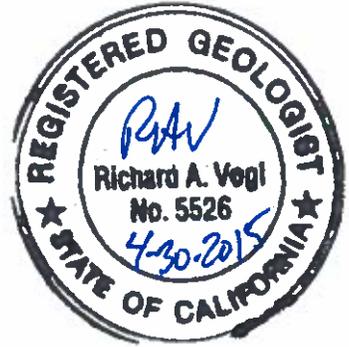


PROJECT INFORMATION	DRILLING INFORMATION
PROJECT: BreitBurn - Belridge Fracking LOCATION: Belridge Oil Field - Kern County JOB NO.: 14-119 PROJECT MANAGER: Nancy Beresky, P.G. LOGGED BY: Richard A. Vogl, P.G., C.Hg. DATES DRILLED: March 24, 2014	DRILLING CO.: Richard Heely Construction DRILLER: RIG TYPE: Solid Stem Auger Rig METHOD OF DRILLING: Solid Stem Auger SAMPLING METHODS: Continuous Grab Sampling TOTAL DEPTH: 50 Feet

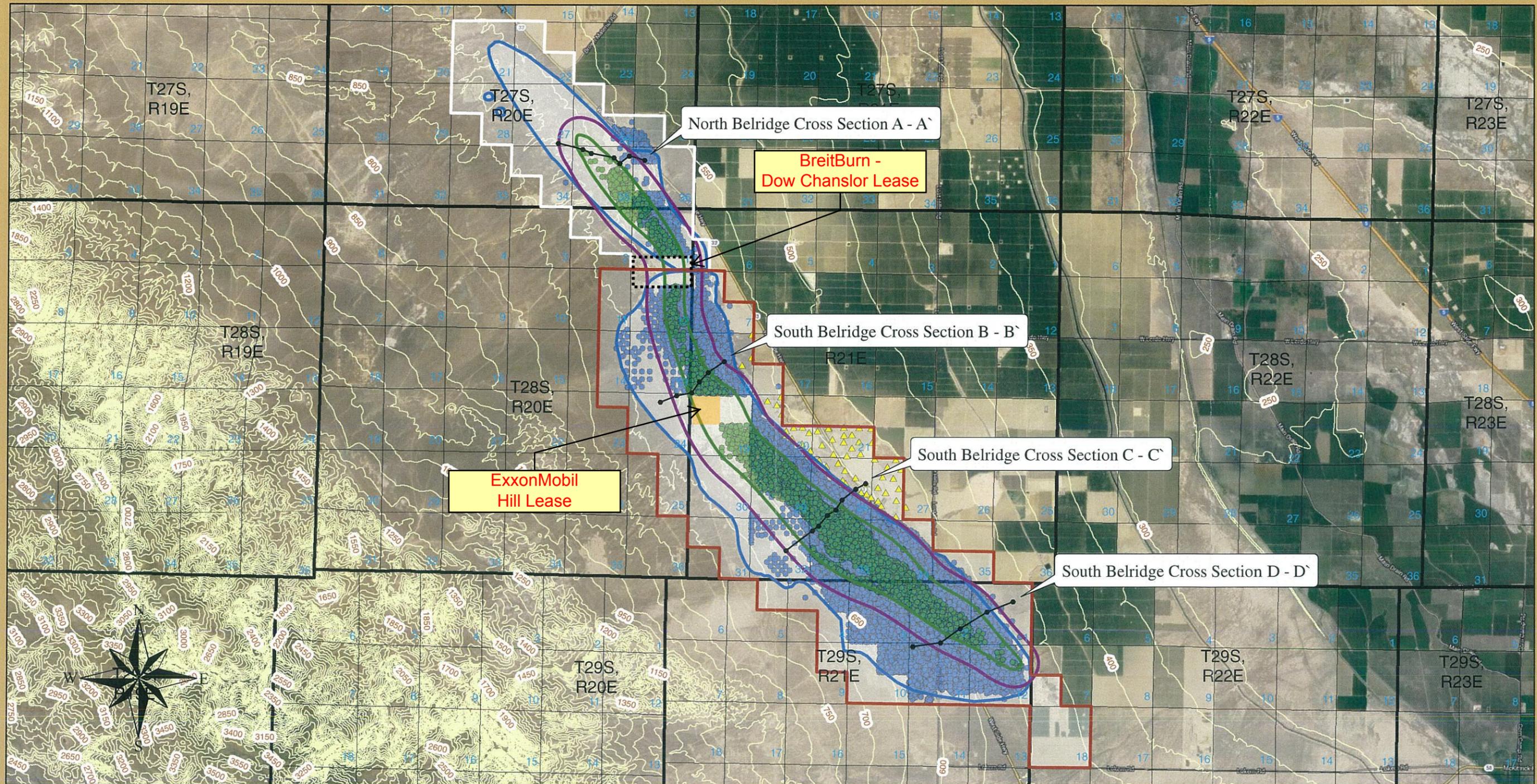
LITHOLOGY

Depth feet bgs	Graphic Log	Water	USCS	Est. Grain Size % (gravel, sand, silt, clay)	Soil Description (and other remarks)	Collected	PID ppm
0			ML		SILT - Brown (10YR, 5/3), slightly moist, low plasticity		
-5			ML		SILT - Brown (10YR, 5/3) , slightly moist, low plasticity		
-10			ML		Trace very fine sand		
-15			ML		SILT - Brown (10YR, 5/3), slightly moist, low plasticity		
-20			ML		SILT - Brown (10YR, 5/3), slightly moist, non-plastic		
-22			SP		SAND - Pale brown (10YR, 6/3), very fine sand, poorly graded, slightly moist, trace silt		
-24			SM		SILTY SAND - Pale brown (10YR, 6/3), very fine sand, slightly moist, 30% silt		
-26			SP		GRAVELLY SAND - Brown (10YR, 5/3), very fine to coarse sand, well graded, slightly moist, semi-rounded gravel up to 4" in diameter, 15% silt, 20% gravel		

Depth (feet)	Graphic Log	Water	USCS	Est. Grain Size % (gravel, sand, silt, clay)	Soil Description (and other remarks)
-30			SP		GRAVELLY SAND - Pale brown (10YR, 6/3), very fine to coarse sand, well graded, slightly moist, semi-rounded gravel up to 1" diameter, occasional rounded cobbles up to 6" diameter, 10% silt, 10% gravel
-35			SP ML		GRAVELLY SAND - Pale brown (10YR, 6/3) very fine to medium sand, moderately graded, slightly moist, 20% silt and 20% gravel GRAVELLY SILT - Very pale brown (10YR, 7/3), slightly moist, non-plastic, gravel up to 1" diameter, 20% gravel, trace very fine sand
-40			ML		GRAVELLY SILT - Very pale brown (10YR, 7/4), dry to slightly moist, gravel up to 1" diameter, 10-15% gravel, no sand
-45			SP		GRAVELLY SAND - Very pale brown (10YR, 7/3), very fine sand, trace medium sand, poorly graded, dry to slightly moist, trace silt, 1/2" diameter gravel, 5-10% gravel 10-15% silt, dry
-50			ML		GRAVELLY SILT - Brown (10YR, 7/3), very fine sand, poorly graded, non-plastic, dry, 30-50% sand, gravel up to 1" diameter, 20% gravel
-55					Total Depth: 50 feet.
-60					
-65					



ATTACHMENT D



ExxonMobil Hill Lease

BreitBurn - Dow Chanslor Lease

North Belridge Cross Section A - A'

South Belridge Cross Section B - B'

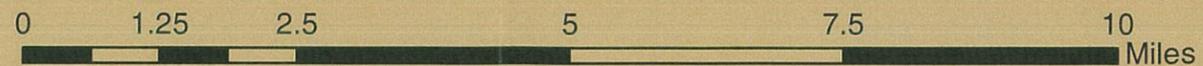
South Belridge Cross Section C - C'

South Belridge Cross Section D - D'

Legend

— Cross Sections	▲ Class II Disposal Wells
▭ South Belridge Field Boundary	● Diatomite Wells
▭ North Belridge Field Boundary	● Tulare Wells
▭ Diatomite Productive Limit	▭ Sections
▭ Diatomite Outer 1500 ft Boundary	▭ Elevation Contours (50 ft)
▭ 1973 & 1974 DOGGR Productive Areas	

North & South Belridge Oil Fields



1 in = 2 miles

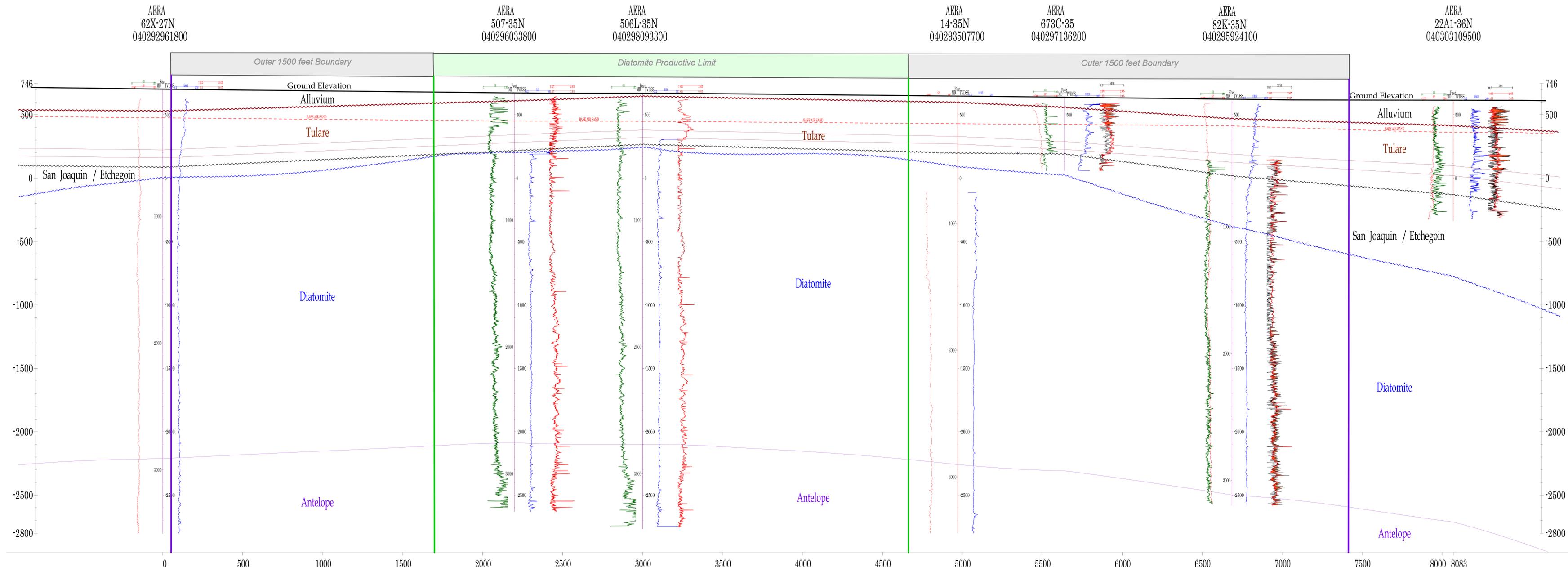
AERA

Figure 3

A

NORTH BELRIDGE - Cross Section A - A'

A'



AERA ENERGY LLC			
Figure 12			
NORTH BELRIDGE - Cross Section A - A'			
Production: 12800	Injection: 12800	VE = 1	
Depth Meter: FEET	FEET		
SEALED			
GEO JANUARY 15, 2014			
NORTH BELRIDGE LEASE S 27, 35, 36 T2S R2E			
NORTH BELRIDGE DIP SECTION: A-A'			
GEOLOGISTS: Belridge Asset			

B

SOUTH BELRIDGE - Cross Section B - B'

B'

AERA
7-24
040297515500

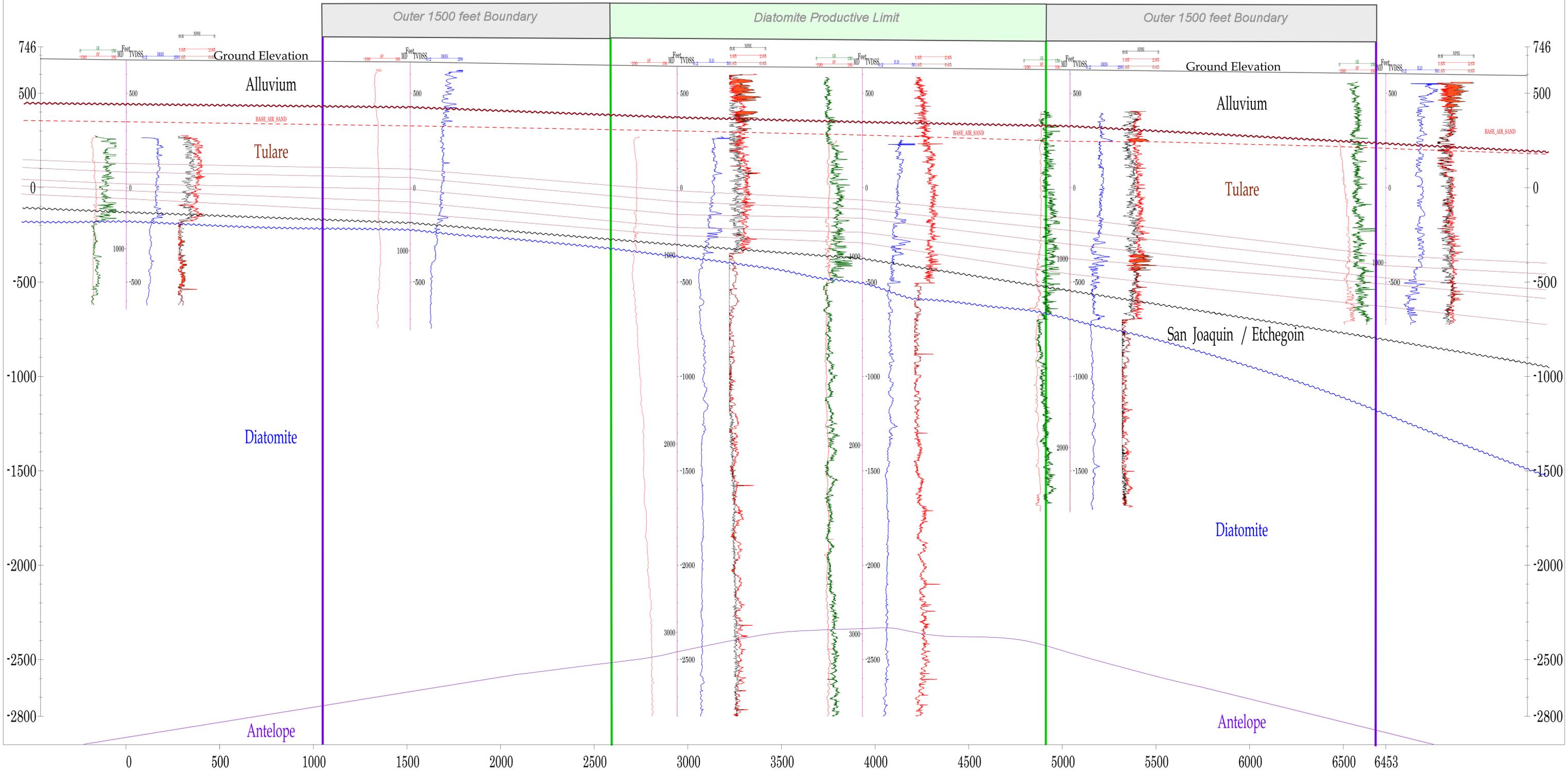
AERA
90-24
040295866700

AERA
519E-18
040296742200

AERA
527L-18
040297105200

AERA
536C-18
040303221900

AERA
654AR-18
040298783900



AERA ENERGY LLC			
Figure 13			
SOUTH BELRIDGE - Cross Section B - B'			
Vertical Scale: 1:2400	Horizontal Scale: 1:2400	VE = 1	
Depth Units: FEET	Distance Units: FEET		
SEALLEVEL			
GEO		DATE: JANUARY 15, 2014	
SOUTH BELRIDGE LEASE 524,18 T27S R20E			
SOUTH BELRIDGE DIP SECTION: B - B'			
GEOLOGISTS: Belridge Asset			

C

SOUTH BELRIDGE - Cross Section C - C'

C'

AERA
55-32
040294399400

AERA
12R-33_ST1
040297760801

AERA
522E-33
040297240700

AERA
438M-28
040296070700

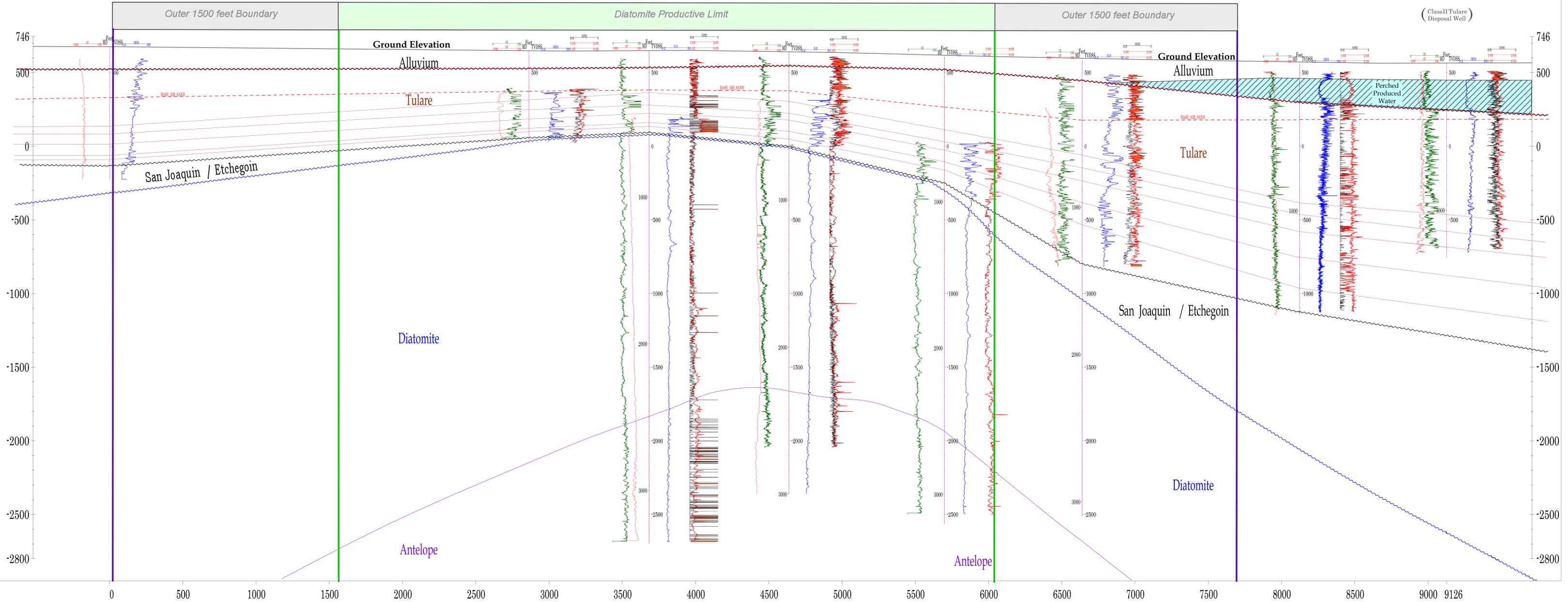
AERA
547N-28
040297137500

AERA
446-28
040297517800

AERA
365G-28
040301995600

AERA
WWD1-28
040304306800

(Class II Tulare
Disposal Well)



AERA ENERGY LLC		
Figure 14		
SOUTH BELRIDGE - Cross Section C - C'		
Horizontal Scale: 1"=400'	Vertical Scale: 1"=100'	VE = 1
Units: FEET	Units: FEET	
Author: GEO	Drawn: SHELBY	Date: JANUARY 15, 2014
SOUTH BELRIDGE LEASE Sec 32,33,28 T28S R21E		
SOUTH BELRIDGE DIPSECTION C-C'		
GEOLOGISTS: Belridge Asset		

D

SOUTH BELRIDGE - Cross Section D - D'

D'

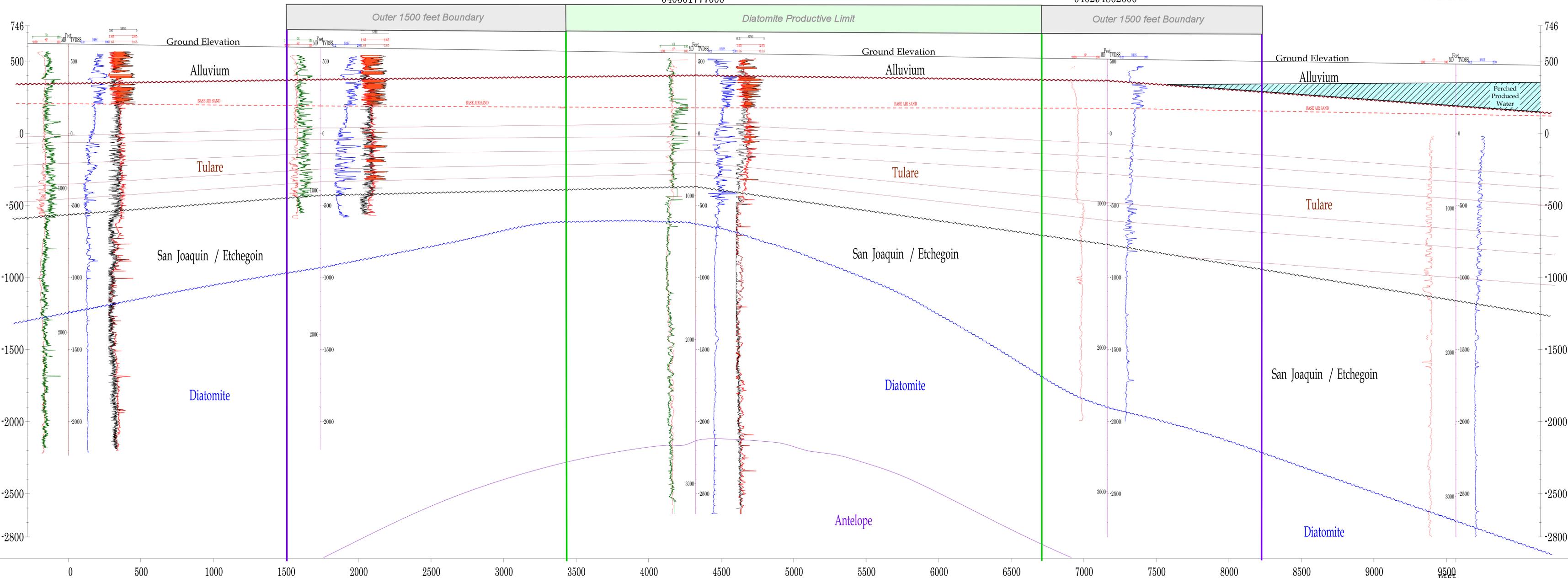
AERA
5049A-11
040303030400

AERA
5016-11
040302346100

AERA
7480-2
040301777000

AERA
525R-1
040294862600

AERA
17-1
040291588900



AERA ENERGY LLC			
Figure 15			
SOUTH BELRIDGE - Cross Section D-D'			
Scale:	1:2400	Scale:	1:2400
Unit:	FEET	Unit:	FEET
		VE =	1
SEAL/EVL			
GEO: FEBRUARY 06, 2014			
SOUTH BELRIDGE LEASE S 1, 2, 11 T29S R21E			
SOUTH BELRIDGE DISSECTION D-D'			
GEOLOGIST: Belridge Asset			