NON CONFIDENTIAL

SFOGI Exploration & Production

SFOGI Frontier Oil & Gas Inc.
3737 Bellaire Blvd.
Houston, TX 77025

FED EX Tracking # 7986 9177 7293

August 2, 2012

Mr. Travis Marshall
Colorado Department of Natural Resources
Division of Reclamation, Mining and Safety
101 South 3rd Street, Suite 301
Grand Junction, CO 81501

SUBJECT: Response to Notice of Deficiency – July 24, 2012
NOI NO. P-2012-013, Private Land Well Pad Discharges to Groundwater

Dear Mr. Marshall:

Shell Frontier Oil & Gas Inc. (SFOGI) is providing the following responses to a Notice of Deficiency issued by the Colorado Division of Reclamation Mining and Safety (CDRMS). On July 6, 2012, SFOGI submitted a Notice of Intent (NOI) to conduct prospecting application to CDRMS requesting authorization to discharge produced groundwater generated through well installation, pumping tests or groundwater monitoring to infiltration pits. On July 24, 2012, CDRMS responded to SFOGI with a letter of deficiency requesting additional clarifications to the application materials. This letter provides SFOGI's responses to CDMRS' request for additional clarification.

Request for Clarification 1: Please explain the rationale of infiltrating water with a higher Total Dissolved Solids (TDS) value than the receiving Uinta Aquifer:

Response: 1A Uinta Aquifer

SFOGI notes that the types of discharges being requested are discrete events that will occur infrequently and be of relatively short individual duration (occurring for a few hours for well sampling up to 4 weeks in case of drilling a multi-well pad). To evaluate the potential effects of discharging produced waters from the various water bearing intervals to the Uinta, SFOGI considered several conservative cases. The following cases are considered by SFOGI to representative of discharging conditions:

1. Drilling a new well pad with up to 6 wells (Uinta, L7, L6, L5, L4, and L3) followed by pumping testing and 5 quarters of sampling = Max volume discharge for drilling.
2. Conducting pumping tests on a 6 well pad = Max volume discharge for pumping test case.
3. Conducting monitoring of wells on a 6 well pad = Max volume discharge for monitoring case.

Discharges from well installation, pumping tests, and monitoring will discharge varying quantities of water overtime with the majority of water being discharged over a 450 day period when new wells are installed, tested and initial quarterly monitoring is conducted (See Table 1 below).

Table 1 New Well Pad Discharge Schedule

Discharge Activity	Start Day
Drilling	0
Pumping Test	73
Sampling Event #1	90
Sampling Event #2	180
Sampling Event #3	270
Sampling Event #4	360
Sampling Event #5	450

Tables 2 and 3 below provide estimated water production volumes and cumulative volume weighted TDS concentrations for the produced waters that will be infiltrated.

Table 2 Typical Drilling Water Production Volumes for a 6 Well Pad

Unit	Average Saturated Thickness	Drilling Time	# times unit is produced	Discharge Rate	Development Purge Time	Purge Rate	Total Produced Water	TDS
	(ft)	(min)		(gpm)	(min)	(gpm)	(gallons)	(mg/L)
Uinta	400	300	6	57	120	25	105,600	1,270
L7	100	75	5	114	120	25	45,750	1,110
L6	200	150	4	135	120	25	84,000	952
L5	200	150	3	163	120	25	76,350	915
L4	400	300	2	192	120	25	118,200	10,000
L3	100	75	1	222	120	200	40,650	10,000
Cumulative							470,550	4,087 (1)

(1) Cumulative TDS Concentration is a volume weighted average.

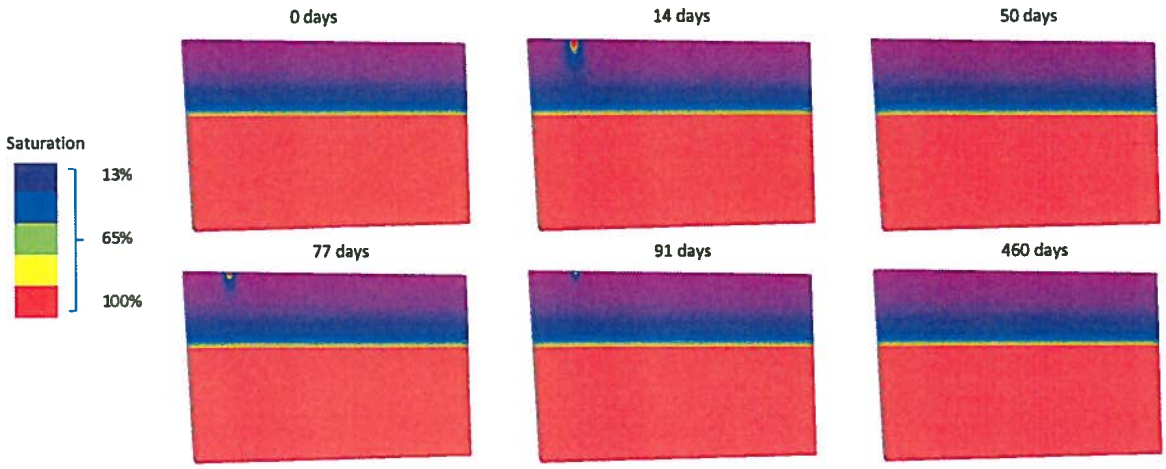
Table 3-Typical Water Production Volumes,6 Well Pad Pumping Tests and Well Sampling

Unit	8-Hr Pumping Test (gallons)	TDS (mg/L)	Sampling with 3 CV Purge (gallons)	TDS (mg/L)
UT	15,000	1,270	1,000	1,270
L7	15,000	1,110	1,440	1,110
L6	15,000	952	1,875	952
L5	10,000	915	2,250	915
L4	20,000	10,000	3,075	10,000
L3	24,000	10,000	3,365	10,000
Cumulative	99,000	5,042 (1)	13,005	5,468 (1)

(1) Cumulative TDS Concentration is a volume weighted average.

Using the discharge schedule in Table 1, typical water production data provided in Tables 2 and 3 for a 6 well pad site and using unsaturated, vadose zone thickness of 200 feet for the Uinta formation (which is conservative as the average is approximately 260 feet), SFOGI simulated the infiltration of produced water from an infiltration pit at a 6 well pad into the Uinta formation. This simulation is represented by Figure 1. The unsaturated portion of the Uinta is represented by purple and the groundwater (100% saturation) is represented as red on the figure. As shown, this simulation shows that under the maximum discharge volume scenario that represents drilling 6 wells, followed by pumping tests and sampling over a 460 day period that produced water does not fully saturated the vadose column under the pit and reach the water table in the Uinta. Figure 1 shows, that as drilling initiates on day 0 and continues, water is discharged to the infiltration pit and begins to saturate a portion of the vadose zone (as illustrated at day 14 on Figure 1 and as shown by the red color intruding into the purple color) of the Uinta formation under the pit. When drilling is completed (after approximately 30 days), the saturated zone under the pit caused by the well drilling discharge, dissipates back to background saturation levels at about day 50. Following the drilling, the pumping tests represented as day 77 and sampling represented as day 91 are also shown on Figure 1. Because these two discharges are volumetrically considerably smaller than the drilling discharge volume, their effects are smaller. This simulation represents the highest volume discharge case under conservative conditions and shows that produced water discharged to a pit will not reach the groundwater table in the Uinta. As such, discharges of water with TDS concentrations greater than the TDS background concentration of the Uinta will have no noticeable effect on the receiving water and can be authorized.

Figure 1 –Simulation of Maximum Discharge Volume to Infiltration Pit



At concentrations less than 10,000 mg/L TDS, Underground Sources of Drinking Water (USDW) are considered potable. Although no negative impact is anticipated, SFOGI will utilize 10,000 mg/L TDS as a threshold value as to when produced water for wells and pads discharging to the Uinta would be shipped off site for disposal.

Response: 1B Alluvial Aquifer

In addition to the Uinta Aquifer, SFOGI has some existing well pads that are located in areas where a shallow alluvial aquifer is present. In the initial NOI application, SFOGI inadvertently did not include a discussion of produced discharges to pits located where alluvial aquifers are present. Where present,these alluvial aquifers are encountered at approximately 20 feet below the ground surface and are approximately 30 feet thick. Based on data collected previously by SFOGI, the background concentration for TDS is 1,880 mg/L for the alluvial aquifer based the 85th percentile concentration of the existing data. Using a factor of 1.25 times the background value yields a 2,350 mg/L threshold that groundwater must meet at the point of compliance. SFOGI has assumed that the point of compliance point would be set 15 meters down gradient of the discharge point.

SFOGI predicts that for cases where future wells would be installed (either a total of 6 wells representing a maximum volumetric discharge or a scenario where only an L3 and L4 well is installed representing the highest concentration discharge scenario) and the alluvial aquifer is present that TDS concentrations greater than 1.25x the background could occur at a point of compliance well at TDS discharge values less than 10,000 mg/L. Based on simulations, SFOGI determined that for scenarios where 6 wells including an L4 and L3 were installed or where 2 wells consisting of an L4 and L3 well were installed that the TDS discharge concentrations that would not cause the background concentration to be exceeded at a point of compliance well 15 meters away would need to be 7,600 mg/L and 4,160 mg/L or less respectively. For future drilling operations SFOGI conservatively proposes an alternate threshold value of 4,000 mg/L TDS (for L3 and L4 water bearing zones) for discharges associated with well drilling operations at well pads located in areas where an alluvial aquifer is present and a L3 and/or L4 well will be installed. Figure 2 illustrates the simulation for a 2 well L4 and L3 installation scenario and

shows that a discharge concentration of less than 4,160 mg/L would not cause the background threshold concentration at the point of compliance well to be exceeded. If no L3 and/or L4 well will be installed, the TDS concentrations of the discharge water will be less than the TDS concentration of the Alluvial Aquifer (see Table 4 below).

In the case of conducting pumping tests or well sampling to existing wells (where drilling has already been previously completed), simulations completed by SFOGI show that TDS concentrations less than 10,000 mg/L will not cause a well located 15 meters down gradient of the discharge point to exceed 1.25 times the TDS background concentration. Figure 3 illustrates this simulation.

Figure 2 – Two Well Pad with L3 and L4 Well, TDS 4,160 mg/L

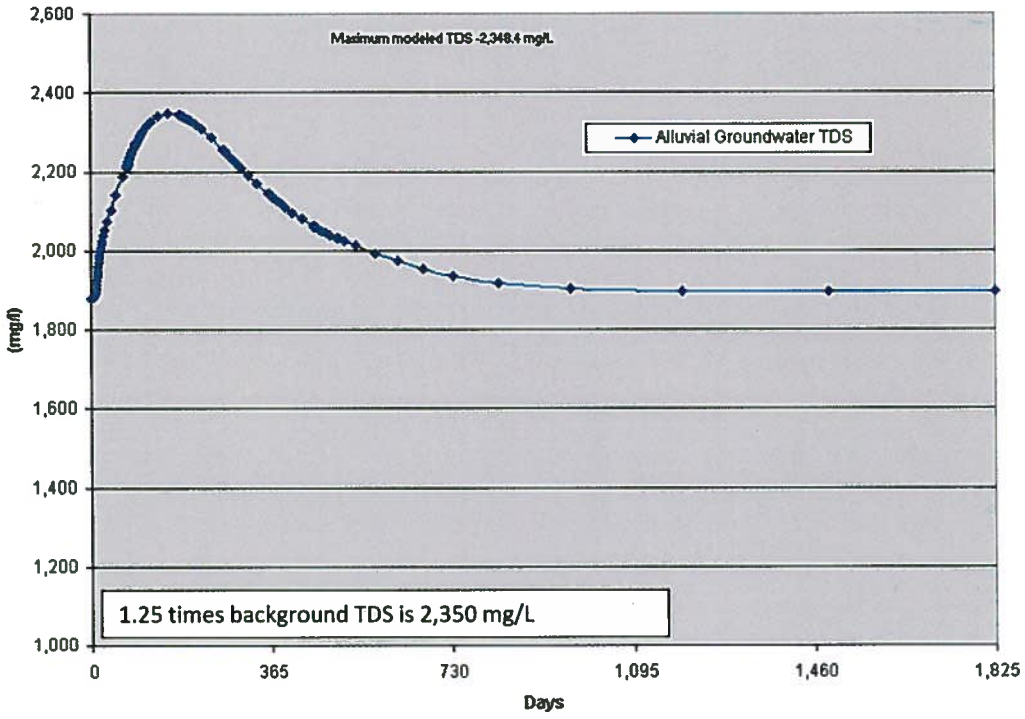
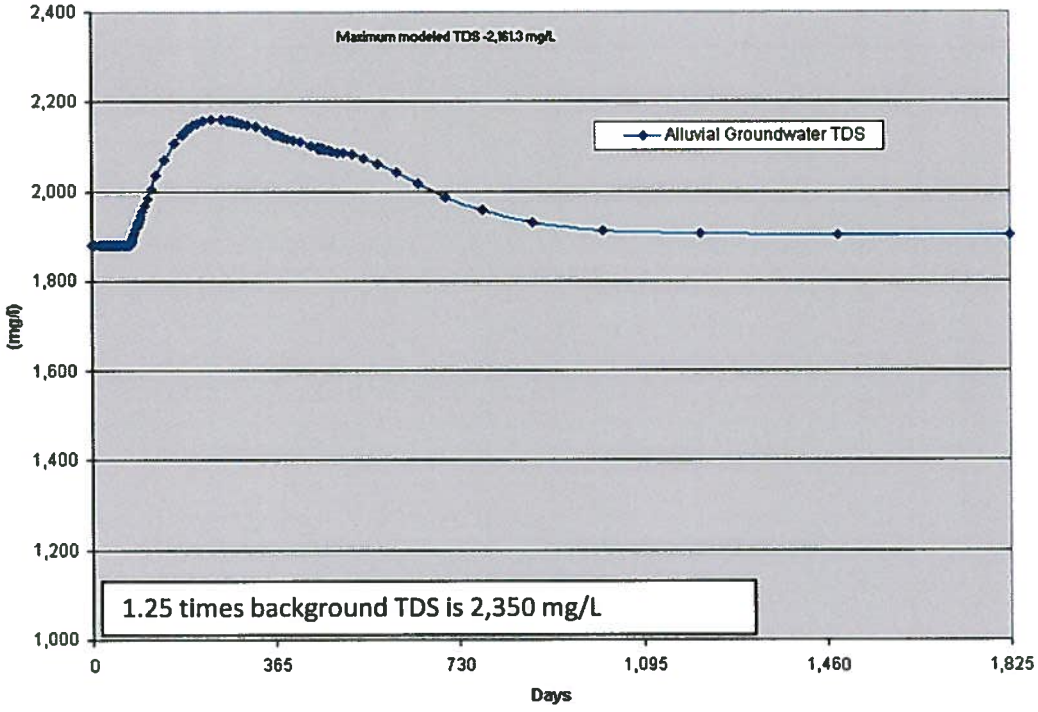


Figure 3 – Well Testing and Sampling Discharges, 6 Well Pad, TDS 10,000 mg/L



Request for Clarification 2: Water with a TDS higher than 1.25 times background values shall not be applied to road surfaces in order to protect existing soil and surface water qualities that exist in the Yellow Creek drainage basin.

Response 2: On a technical basis, SFOGI does not anticipate that periodic and infrequent spraying of limited quantities of produced water at concentrations greater than 1.25 times the TDS background values directly on to road surfaces or well pads for the purpose of dust suppression would be of sufficient quantity to adversely affect the existing soil quality. With regard to surface water quality, SFOGI understands that any direct or indirect discharges to surface waters would be required to be permitted by Colorado Division of Public Health and Environment. As such, any dust suppression activities would be conducted at sufficient distances from surface water bodies to assure that no discharges occur. Although SFOGI believes little to no risk to soil or surface water quality exists, SFOGI agrees not to utilize water with more than 1.25 times the TDS background concentration produced during monitoring well installation, pumping tests or routine monitoring for dust suppression.

Request for Clarification 3: Please supply information that characterizes the water quality of the receiving aquifer (Uinta) along with the general water quality of the water intended to be disposed of for TDS, Oil & Grease and alkalinity or acidity (pH).

Response 3: As CDRMS is aware, SFOGI has compiled and provided extensive groundwater quality data for wells located in the Piceance Creek Basin geographic area. SFOGI has generated more than 1,500 TDS samples and 1,700 pH data points to represent the water quality of the respective water bearing intervals in the Yellow Creek and Piceance Creek drainage basins. As requested, Table 4 provides the 85th Percentile concentration representative of the respective water bearing interval for TDS (mg/L) and pH (s.u.). This table also provides the calculated 1.25 times the 85th percentile value for TDS for the Uinta.

Table 4 – TDS and pH Water Quality Characteristics for Water-Bearing Intervals

Unit	85th Percentile TDS (mg/L)	1.25 Times 85th Percentile TDS (mg/L)	85th Percentile pH (s.u.)
Alluvium	1,880	2,350	7.49
Uinta	1,270	1,588	8.01
L7	1,110	n/a	8.41
L6	952	n/a	8.70
L5	915	n/a	8.84
L4	5,375	n/a	8.02
L3	4,177	n/a	8.03

The request for clarification also asks for information pertaining oil and grease data. SFOGI has not historically collected oil and grease data from monitoring wells located in the Yellow Creek or Piceance Creek Drainage Basins. Previous CDPHE discharge permits only required visual monitoring for visible sheens during discharges and if a visible sheen was observed then sampling for oil and grease with an effluent limit of 10 mg/l was required. Review of discharge monitoring reports (DMRs) submitted to CDPHE from 2006 until the permits for Yellow Creek and Piceance Creek Drainages were terminated revealed either no discharges occurred or no visible sheens observed. As such, no oil and grease data is available. Oil and grease is not anticipated to be a constituent of concern based the types of discharges being requested. Any future, drilling activities conducted by SFOGI will not use hydrocarbon based drilling mud and existing wells are completed in formations that contain insoluble kerogen and not oil. As with previous discharge permits, SFOGI is willing to accept visual monitoring for sheens with a condition to collect an oil and grease sample if a visible sheen is observed. As with CDPHE permits, SFOGI would propose that the applicable effluent limit be 10 mg/L for the conditional sampling of oil and grease from authorized discharges with an observed visible sheen.

If you have any questions regarding the information in this letter, please contact me at (713) 245-7732.

Sincerely,

Jeffrey D. Stevenson
Staff Environmental Engineer