November 2014

Norwest Corporation (Norwest) maintains three gaging stations for Pioneer Natural Resources USA Inc. (PNR) in the headwaters of the Apishapa River in northern Las Animas County, Colorado. The Apishapa River is a tributary of the Arkansas River. The gaging stations acquire "continuous" data on 15-minute intervals for pressure, temperature, conductivity, calculated SAR, and calculated flow using an In-Situ Aqua Troll. Communication of the near real-time continuous data is accomplished using Iridium satellite telemetry and is available online at www.apishapawatershed.org. Norwest visits the stations every two weeks to download the data, calibrate the equipment, acquire instantaneous flow measurements, collect field parameters of pH, temperature, conductivity and salinity, and collect water quality samples. All monitoring conducted at each station is voluntary and is not required by any regulatory agency.

The three stations on the Apishapa are shown on **Figure 1**. The Belarde station is furthest upstream and has a contributing watershed of 59.3 square miles. The Eichler station is located downstream, and has a contributing watershed of 72.9 square miles. The Lisonbee station is located further downstream, southwest of Aguilar, slightly upstream of the historic USGS gage 07118000, and has a contributing watershed of 141.7 square miles. The Eichler and Lisonbee stations are located downstream of the Apishapa's confluence with tributaries potentially influenced by coalbed methane discharge waters.

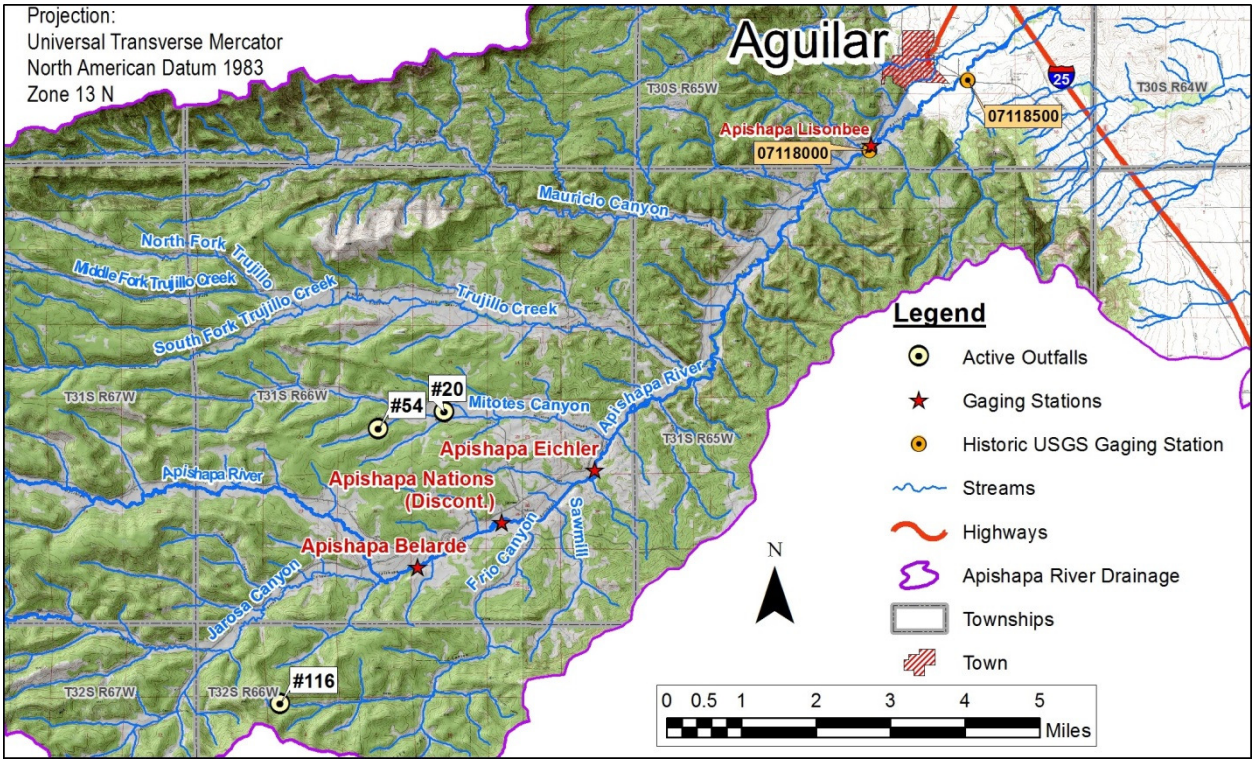

FIGURE 1
APISHAPA WATERSHED

The U.S. Drought Monitor prepares maps weekly for drought conditions throughout the contiguous United States. The U.S. Drought Monitor is produced in partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln (NDMC-UNL), the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration. **Figure 2** depicts drought conditions in Colorado for data received as of 7 a.m. EST on October 28, 2014. **Figure 3** depicts drought conditions in Colorado for data received as of 7 a.m. EST on December 2, 2014. Drought conditions in Las Animas County remained the same throughout the month of November with D0 and D1 drought conditions in the western portion of the county, D1 drought conditions in the central part of the county, and a combination of D1 and D2 drought conditions in the eastern part of the county (Drought Monitor, 2014).

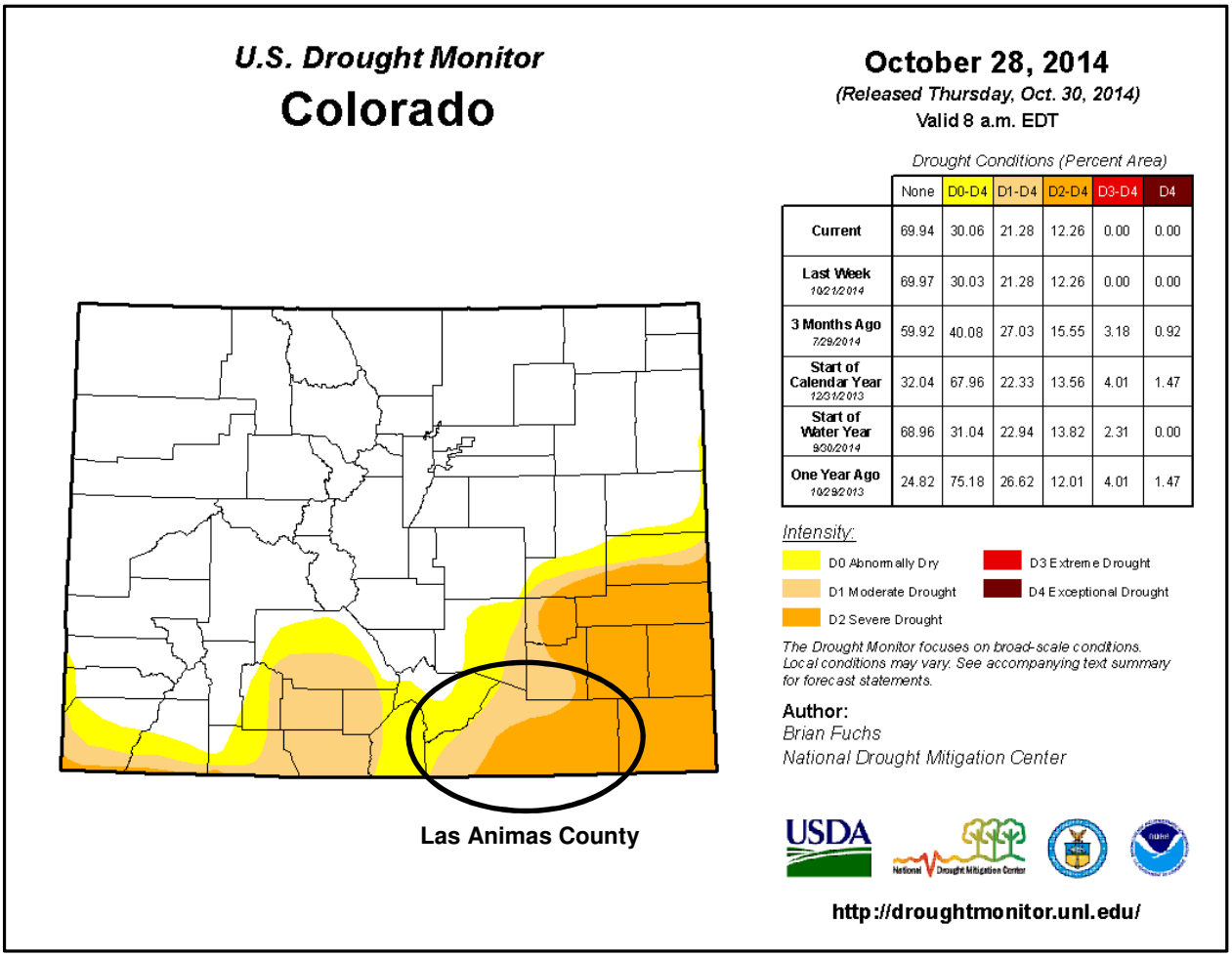

FIGURE 2
U.S. DROUGHT MONITOR COLORADO – OCTOBER 28, 2014

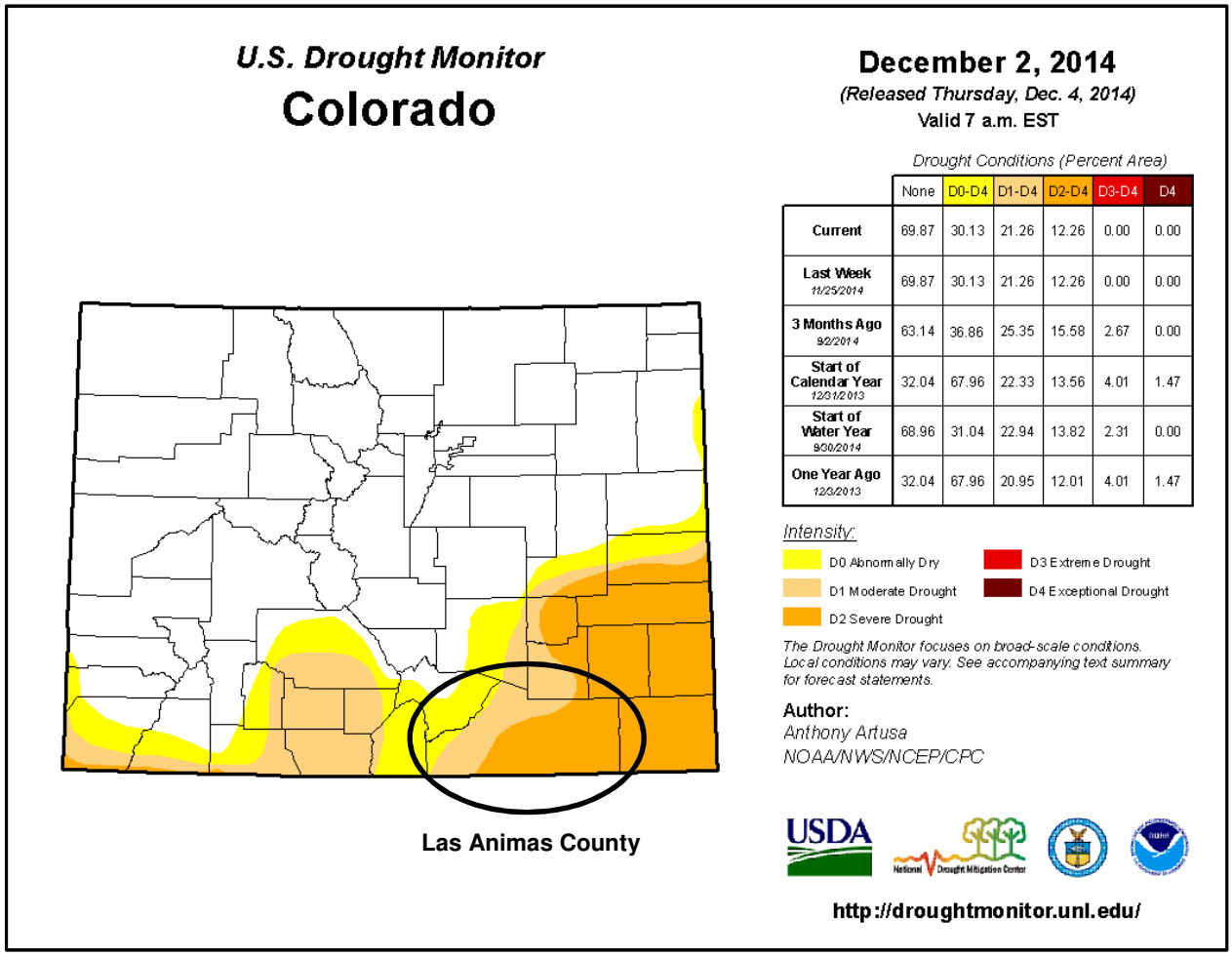

FIGURE 3
U.S. DROUGHT MONITOR COLORADO – DECEMBER 2, 2014

The three gaging stations on the Apishapa River discussed in this report are located in the southwest part of the county with the D0 and D1 drought conditions mentioned above. Recordable flow was present at all three stations the entire month of November 2014. Laboratory water quality samples were collected at all three stations during both November 2014 site visits. Streamflow was measured at all three stations during the November 7, 2014 visit and at the Lisonbee station during the November 18, 2014 visit. Streamflow was not measured at the Belarde and Eichler stations on November 18, 2014 due to frozen conditions.

November 2014 data exhibited a calculated daily average flow of 1.81 cfs at Belarde, 0.36 cfs at Eichler, and 1.24 cfs at Lisonbee. Temperatures were seasonal. The daily average specific conductance at Belarde ranged from 289 µs/cm to 367 µs/cm, with a median value of 322 µs/cm (**Table 1**). The daily average specific conductance at Eichler ranged from 501 µs/cm to 523 µs/cm, with a median value of 508 µs/cm (**Table 1**). The daily average specific conductance at Lisonbee ranged from 554 µs/cm to 620 µs/cm, with a median value of 605 µs/cm (**Table 1**). The calculated daily average sodium adsorption ratio (SAR) values in November 2014 ranged from 0.56 to 0.66 at Belarde, 1.07 to 1.12 at Eichler, and 1.70 to 1.90 at Lisonbee (**Table 1**).

TABLE 1
NOVEMBER 2014 DAILY AVERAGE GAGE DATA

	Average Daily			
	Minimum	**Median**	**Average**	**Maximum**
Belarde - (30 days of flow data)				
Water Level (ft)	0.47	0.56	0.56	0.64
Flow[1] (cfs)	0.84	1.88	1.81	2.62
Temperature (°C)	0.05	1.69	2.92	8.22
Conductivity (µs/cm)	289	322	323	367
TDS[2] (mg/l)	188	210	210	238
Sodium Adsorption Ratio[3] (SAR)	0.56	0.60	0.61	0.66
Eichler - (30 days of flow data)				
Water Level (ft)	0.42	0.47	0.48	0.56
Flow[1] (cfs)	0.09	0.25	0.36	0.90
Temperature (°C)	0.37	1.79	3.06	8.64
Conductivity (µs/cm)	501	508	509	523
TDS[2] (mg/l)	326	330	331	340
Sodium Adsorption Ratio[3] (SAR)	1.07	1.08	1.09	1.12
Lisonbee - (30 days of flow data)				
Water Level (ft)	0.27	0.31	0.31	0.35
Flow[1] (cfs)	0.65	1.15	1.24	2.15
Temperature (°C)	0.24	3.09	4.00	9.38
Conductivity (µs/cm)	554	605	595	620
TDS[2] (mg/l)	360	393	387	403
Sodium Adsorption Ratio[3] (SAR)	1.70	1.86	1.83	1.90

[1] Calculated from pressure data

[2] Calculated from conductivity data with a conversion of 0.65 mg/l TDS per µs/cm specific conductance

[3] Derived from a historic multivariate regression analysis of conductivity and flow

The mainstem of the Apishapa River has been classified by the Colorado Water Quality Control Commission (WQCC) as supporting aquatic life, recreation, water supply, and agriculture (CDPHE WQCC, 2014). During the month of November 2014, the water type at the Belarde and Eichler stations was a calcium bicarbonate water, with a sodium-calcium bicarbonate water type at Lisonbee.

November 2014 field measured SC values and laboratory measured SAR values at the Eichler and Lisonbee stations are illustrated in **Table 2** and **Figure 4**. Both stations were below the SC threshold limit of 1300 µs/cm and the SAR threshold limit of 6.8 (**Figure 4**). These SC and SAR threshold limits have been identified by the Colorado Department of Public Health and Environment (CDPHE) for protection of downstream alfalfa crops (CDPHE, 2010).

TABLE 2
NOVEMBER 2014 SAR AND SPECIFIC CONDUCTANCE

Location	Sample Date	SAR	Specific Conductance (µs/cm)
Belarde	11/7/2014	0.69	322
Belarde	11/18/2014	0.63	379
Eichler	11/7/2014	1.28	425
Eichler	11/18/2014	1.32	821
Lisonbee	11/7/2014	2.10	492
Lisonbee	11/18/2014	2.03	644

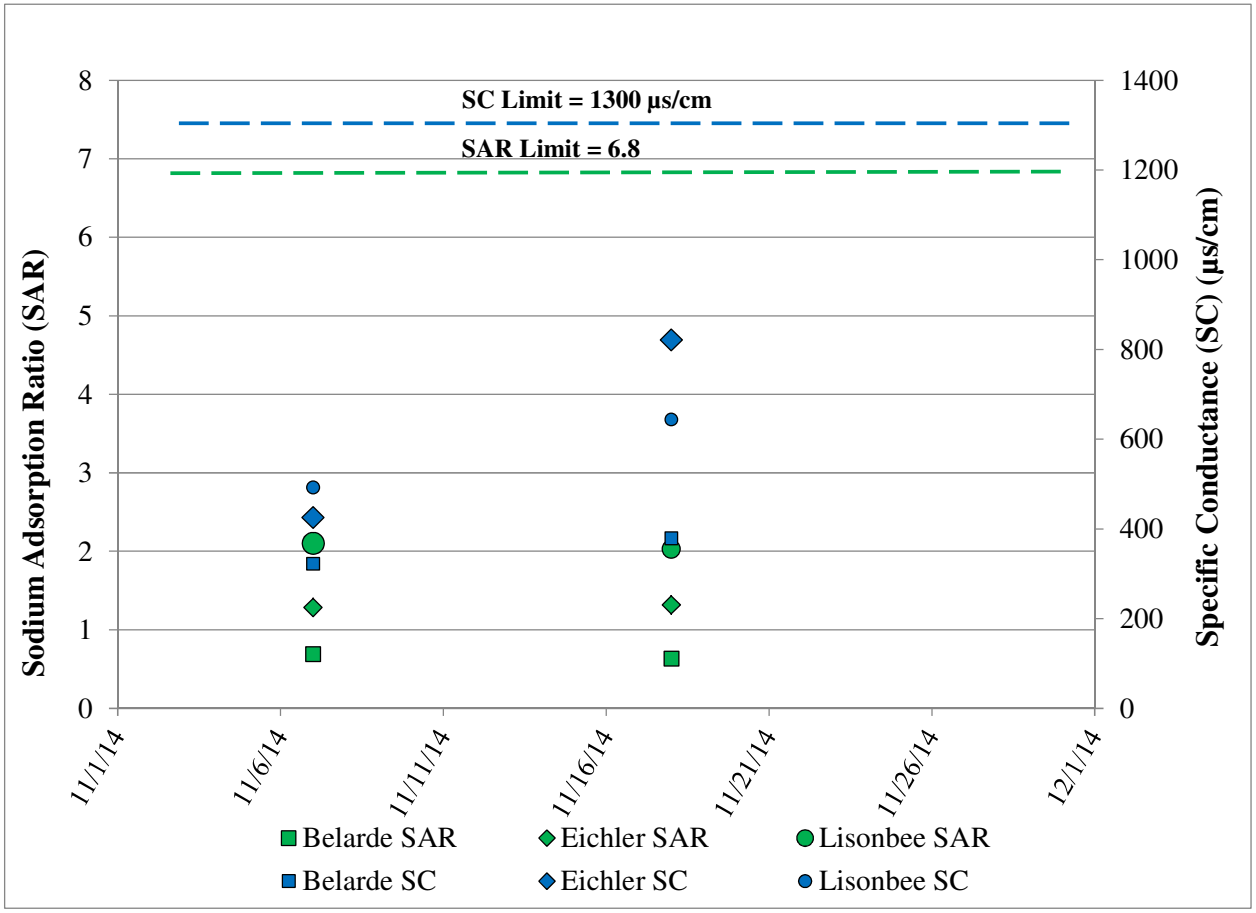

FIGURE 4
NOVEMBER 2014 SAR AND SPECIFIC CONDUCTANCE

The water in November exhibits a range of hardness with Belarde ranging from 134 mg/l $CaCO_3$ to 143 mg/l $CaCO_3$ hardness, Eichler at 304 mg/l $CaCO_3$ hardness during both sampling events, and Lisonbee ranging from 201 mg/l $CaCO_3$ to 214 mg/l $CaCO_3$ hardness (**Table 4**). Based on toxicity testing, aquatic species protection from elevated heavy metal concentrations increases as hardness increases (CDPHE WQCC, 2013). Lower hardness values, closer to 25 mg/l $CaCO_3$, have lower hardness based metal

standards to provide aquatic life protection and higher hardness values, closer to 400 mg/l $CaCO_3$, can afford higher hardness based metal standards to provide aquatic life protection (CDPHE WQCC, 2013).

Stream water quality is affected by the quantity of sediment in the stream. Sediment concentrations increase during storm events or snowmelt runoff. Analyses of the total recoverable forms of metals typically increase with increased sediment concentrations, as the laboratory analytical digestions dissolve the sediment. Total suspended solids (TSS) in November 2014 ranged from <4 mg/l to 8.8 mg/l at the Belarde station, ranged from <4 mg/l to 9.6 mg/l at the Eichler station, and was 5.2 mg/l during both sampling events at the Lisonbee station (**Table 3** and **Figure 5**). TSS values less than the detection limit of 4 mg/l are plotted as ½ the detection limit in **Figure 5**. Total recoverable iron concentrations were 0.520 mg/l to 0.730 mg/l at Belarde, 0.089 mg/l to 0.282 mg/l at Eichler, and 0.277 mg/l to 0.691 mg/l at Lisonbee (**Table 3** and **Figure 5**).

TABLE 3
NOVEMBER 2014 INSTANTANEOUS TOTAL RECOVERABLE IRON (MG/L) AND TOTAL SUSPENDED SOLIDS (MG/L)

Location	Sample Date	Iron (T-Rec.) (mg/l)	Total Suspended Solids (TSS) (mg/l)
Belarde	11/7/2014	0.730	8.8
Belarde	11/18/2014	0.520	<4.0
Eichler	11/7/2014	0.282	9.6
Eichler	11/18/2014	0.089	<4.0
Lisonbee	11/7/2014	0.277	5.2
Lisonbee	11/18/2014	0.691	5.2

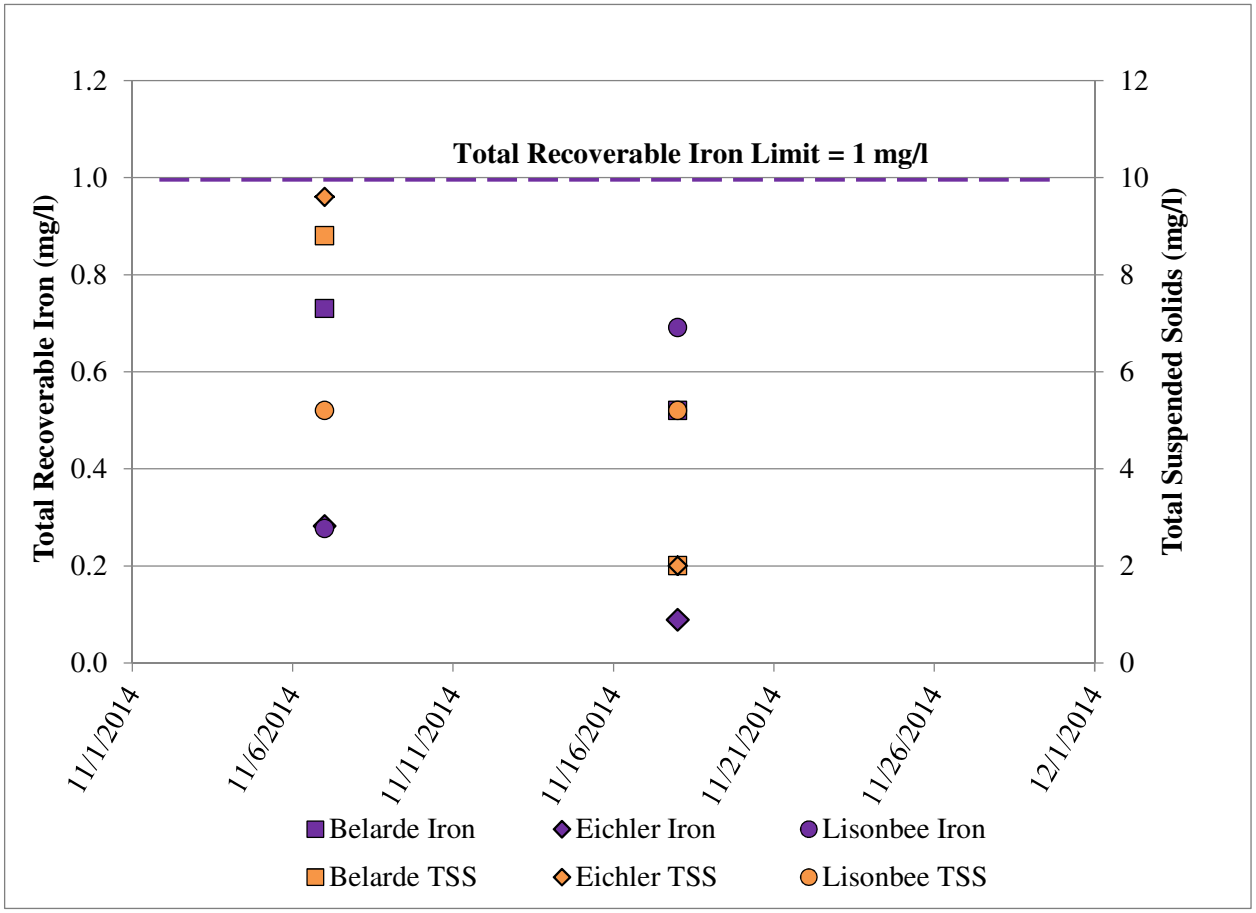

FIGURE 5
NOVEMBER 2014 INSTANTANEOUS TOTAL RECOVERABLE IRON (MG/L) AND TOTAL SUSPENDED SOLIDS (MG/L)

Constituents below the detection limit at all three stations in November 2014 include arsenic, boron, chromium, copper, and selenium. Measured concentrations of potentially dissolved copper were below the detection limit of 15 µg/l at all three stations (**Table 4**). However, the hardness adjusted stream standard for chronic potentially dissolved copper at Belarde in November was lower than the 15 µg/l detection limit (**Table 4**). Measured concentrations of potentially dissolved manganese and potentially dissolved zinc were lower than the hardness adjusted stream standards established by the WQCC (**Table 4**). Chloride and sulfate were below the stream standards at all three stations (**Table 5**). The field pH values in November 2014 were within the stream standard of between 6.5 and 9.0 at both stations (**Table 5**).

TABLE 4
HARDNESS BASED STREAM STANDARDS ASSOCIATED WITH APISHAPA RIVER INSTANTANEOUS SAMPLING, NOVEMBER 2014 (CDPHE WQCC, 2013)

Site	Sample Date	Stream Segment	Calculated Hardness[1] (mg/l $CaCO_3$)	Acute Copper (Pot. Diss.) (µg/l)	Chronic Copper (Pot Diss.) (µg/l)	Chronic Iron (T-Rec.) (mg/l)	Acute Manganese (Pot. Diss.) (µg/l)	Chronic Manganese (Pot. Diss.) (µg/l)	Acute Zinc (Pot. Diss.) (µg/l)	Chronic Zinc (Pot. Diss.) (µg/l)
Belarde Hardness Based Standards	11/7/2014	3a	134	17.7	11.5	1	3291	1819	209	158
Belarde Hardness Based Standards	11/18/2014	3a	143	18.8	12.2	1	3363	1858	222	168
Belarde Maximum November Results			**NA**	**<15**	**<15**	**0.730**	**135**	**135**	**<20**	**<20**
Eichler Hardness Based Standards	11/7/2014	3a	304	38.3	23.2	1	4324	2389	440	333
Eichler Hardness Based Standards	11/18/2014	3a	304	38.3	23.2	1	4324	2389	440	333
Eichler Maximum November Results			**NA**	**<15**	**<15**	**0.282**	**355**	**355**	**20**	**20**
Lisonbee Hardness Based Standards	11/7/2014	3a	214	27.5	17.2	1	3847	2125	320	242
Lisonbee Hardness Based Standards	11/18/2014	3a	201	25.9	16.3	1	3767	2081	302	229
Lisonbee Maximum November Results			**NA**	**<15**	**<15**	**0.277**	**37.7**	**37.7**	**<20**	**<20**

[1] A hardness value of 400 mg/l CaCO3 is used to calculate the metal standards when the measured hardness values are greater than 400 mg/l CaCO3

TABLE 5
STREAM STANDARDS ASSOCIATED WITH APISHAPA RIVER INSTANTANEOUS SAMPLING, NOVEMBER 2014 (CDPHE WQCC, 2013)

Site	Sample Date	Stream Segment	Arsenic (Total) (µg/l)	Boron (Total) (mg/l)	Acute Chromium (Total) (µg/l)	Chronic Chromium (Total) (µg/l)	Chloride (mg/l)	Acute Selenium (T-Rec.) (µg/l)	Chronic Selenium (T-Rec.) (µg/l)	Sulfate (mg/l)	pH-low (s.u.)	pH-High (s.u.)
Belarde Standards	11/7/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Belarde Standards	11/18/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Belarde Maximum November Results[1]			**<15**	**<0.05**	**<10**	**<10**	**9.07**	**<4**	**<4**	**40**	**7.80**	**8.01**
Eichler Standards	11/7/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Eichler Standards	11/18/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Eichler Maximum November Results[1]			**<15**	**<0.05**	**<10**	**<10**	**59.8**	**<4**	**<4**	**28.4**	**7.93**	**8.33**
Lisonbee Standards	11/7/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Lisonbee Standards	11/18/2014	3a	0.02	0.75	16	11	250	18.4	4.6	250	6.5	9
Lisonbee Maximum November Results[1]			**<15**	**<0.05**	**<10**	**<10**	**8.37**	**<4**	**<4**	**59.1**	**8.28**	**8.36**

[1] Minimum result identified for pH-low

References

Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Commission (WQCC), 2013. 5 CCR 1002-31, Regulation No. 31 The Basic Standards and Methodologies for Surface Water, Amended September 11, 2012, Effective January 31, 2013.

Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Commission (WQCC), 2014. 5 CCR 1002-32, Regulation No. 32 Classifications and Numeric Standards for Arkansas River Basin, Amended March 11, 2014, Effective April 30, 2014.

Colorado Department of Public Health and Environment (CDPHE), 2010. Apishapa CBM Facility, Water Quality Assessment, Draft Discharge Permit CO0048313, Pioneer Natural Resources, USA, Inc.

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