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April 6, 2015

VIA HAND DELIVERY

Ms. Janet Kieler
Water Quality Control Division
4300 Cherry Creek Drive South
Denver, CO 80246

RE: Pioneer Natural Resources USA, Inc. Comments on Draft Public Notice for Permit Nos. CO-0047767, CO-0047776, and CO-0048003,

Dear Janet:

On February 6, 2015 the Water Quality Control Division ("Division" or "WQCD") issued Draft Renewal Permits for Pioneer Natural Resources USA, Inc. ("Pioneer") discharges of produced water from coalbed methane wells ("CBM") in the Purgatoire Watershed; specifically, Discharge Permit Nos. CO-0047767, CO-0047776 and CO-0048003 ("Draft Permits"). This document, including all attachments, exhibits, materials incorporated by reference, and all filings in connection with the prior or existing permits, constitute the comments on the Draft Permits submitted by, or on behalf of, Pioneer.

I. Introduction

XTO Energy, Inc. ("XTO") and Pioneer (collectively the "Companies") request to maintain the status quo – so gas operations are productive and the community continues to benefit from our produced water.

In this arid region of southeastern Colorado, XTO and Pioneer produces gas and also significant quantities of water – water which has been beneficially used for livestock watering, wildlife ponds and irrigating crops. The water is of good quality, as evidenced by monitoring and its actual use. To assure the water quality is consistently acceptable, the Companies have funded a robust water quality monitoring program for the receiving waters, particularly the Purgatoire River. In a unique effort to be transparent about the quality of water produced, the Companies have real-time water quality data downloaded to a public website so those using the water could check its quality. Many Las Animas landowners not only value, but even rely upon the produced water.

> We wait as patiently as possible for the snow or rain to come but the amount it will take to moisturize these drought-stricken grounds will be huge. We have however, been lucky in on aspect, we have had the benefit of gas production in our area which has given us the use of "extra water" from the discharges. This discharge water has been used for the past 12+ years and we have only had positive effects, no negative effects from the water have been found.
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> . . .
>
> Making our living off of this land we would never want bad water, and we would never stand by if bad water were being put into the Purgatoire River. However, it is just as important that we fight to keep the good water. We have been using this water for over 12 years with absolutely no negative effects. Injecting this water that we know and can prove is good water, without any evidence that it is bad would be devastating to landowners and the country as a whole.

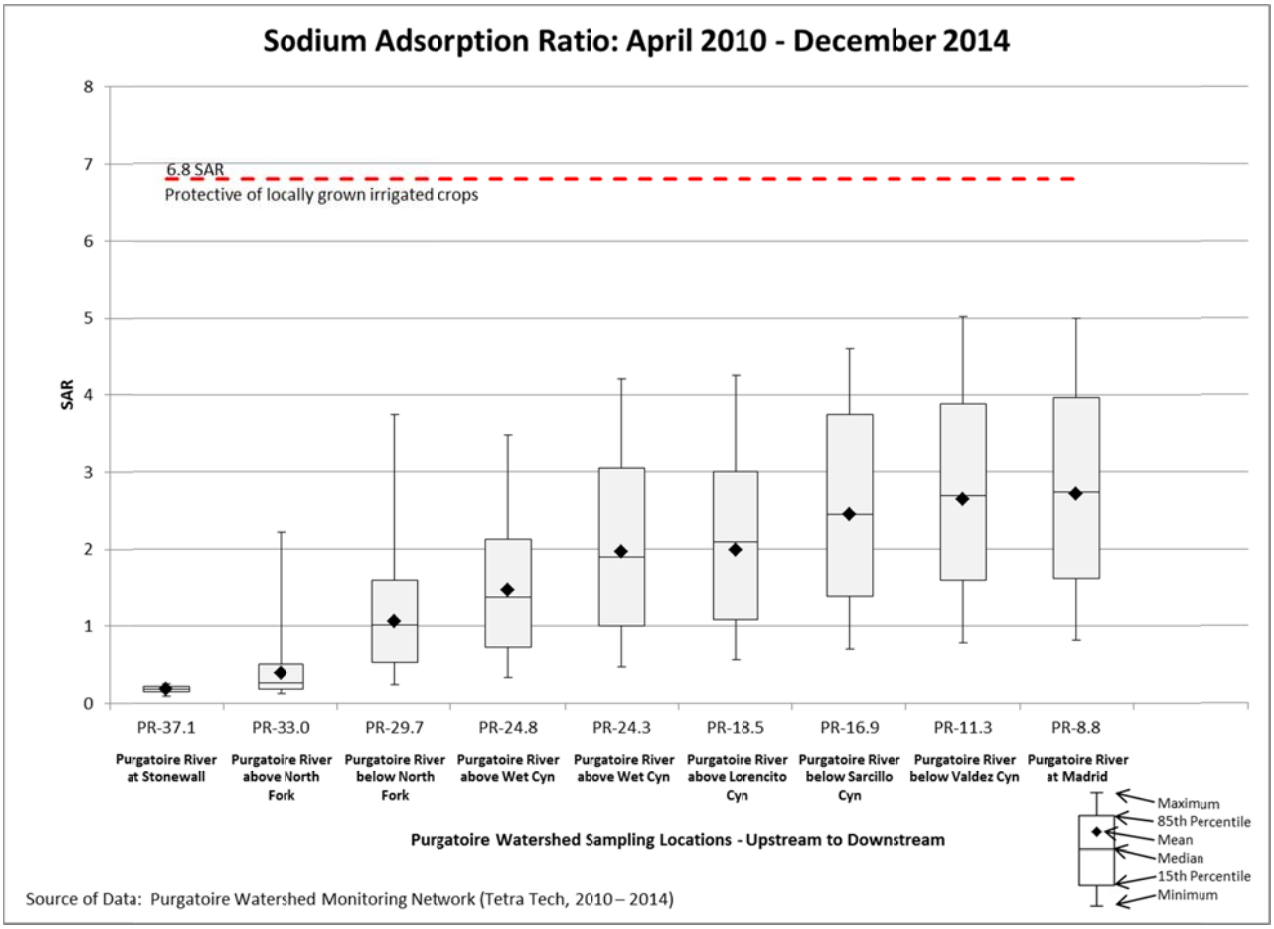
Excerpts from letters and verbal testimony to Water Quality Control Commission ("WQCC") from Las Animas landowners (F. and M. Eichler, C. Healey, G. and J. Salapich, B. and S. Brunelli, D. Taylor, M. Mesta, F. Martinez, G. and D. Mestas, B. Tamburelli, C. Garcia, T. Hoosich, T. and K. Kosoich, A. Zerone, E. Shaun, A. and A. Martinez, D. J. Baros, and P. and T. Tamburelli) (submitted June 2013) (attached as Exhibit 1). *See also* Written Comments of Hill Ranch Ltd., et al. to WQCC re: Revised Water Quality Classifications, Standards, and Designations for Multiple Segments in the Arkansas Basin, Regulation #32 (received June 26, 2002) (attached as Exhibit 2).

Las Animas County's communities and economies depend upon the Purgatoire River watershed, which flows into the Arkansas River. Annual flows in the Purgatoire River can vary widely from year to year; since the year 2000, flows have ranged between about 9,412 acre-feet ("AF") to 76,400 AF per year, with an annual average of about 43,000 AF over that period. On an annual basis, lower flows often occur in the summer and early fall seasons. The communities rely upon livestock, crops and tourism as the main stays of their economies . Each of these sectors substantially benefits from the additional water produced by oil and gas operations. Collectively, the companies discharge between 4,150 and 8,000 AF of water per year, based upon production levels for the past three years. This water comes from very deep aquifers; absent the pumping by the Companies this water would not reach the Purgatoire watershed. Because many of the gas wells are located near tributaries in the upper reaches of the watershed, some produced water does not reach the Purgatoire River or even the closest tributary.

Irrigators have used the produced water for over 15 years, primarily irrigating forage crops such as alfalfa and pasture grass. A potential concern is whether sodium levels in the produced

water adversely affect crop production. The Purgatoire River monitoring program has reported that the sodium absorption ratio ("SAR"; an evaluation of sodium availability) in the Purgatoire River has consistently been below the SAR trigger level of 6.8, protecting the water diversions for the most sensitive crops in the basin – alfalfa (Figure I-1).

Figure I-1. Sodium Adsorption Ratio: April 2010 – December 2014.



Additionally, recent monitoring of alfalfa and pasture grass fields that have used Purgatoire River water (containing produced water) demonstrates no harmful accumulations of sodium in the soils. Crops produced in Las Animas County generate $3.17M dollars in sales for the area; about $63,500 of that is attributable to crops using produced water.

Livestock operations rely on the produced water for watering livestock. This was particularly true during the droughts in 2012/2013. During the WQCC hearings in 2013, Tammy Taburrelli testified about the importance of the produced water. As a cattle rancher, she testified that their livestock herd had been reduced by 50% due to water shortages and, but for the produced water, the herd would have been completely eliminated. Over $1.0M of livestock sales in Las Animas County are attributable to produced water. CBM water production results in about

$1.1M in direct agricultural sales per year and about 21 agricultural jobs. The total impact of produced water used for agriculture amounts to over $2.0M in sales, $365,000 in income and 41 jobs.

Produced water is collected by landowners and the state in ponds for wildlife watering. That water supports a diverse and healthy wildlife community on private lands and the State's Bosque Del Oso Wildlife Refuge ("Bosque"). These areas in turn support hunting and wildlife watching activities. The total economic impact of big game hunting in the Purgatoire watershed is approximately $4.4M; the existence of produced water supports that activity to a certain degree. Colorado Parks and Wildlife uses produced water at Bosque, which is a popular big game hunting location; over 700 AF of produced water was discharged onto the Bosque in 2014.

Figure I-2. Deer feeding near outfall in Bosque Del Oso Wildlife Refuge.

Landowners also fill their ponds with produced water to provide water sources for various wildlife species. Wildlife is a key aspect of the local tourism economy; together, hunting and wildlife watching activities generate about $19.9M in total economic activity in Las Animas County each year.

Visitation to Trinidad Lake State Park is partially dependent on reservoir levels; produced water adds to the total volume in Trinidad Lake. About $240,000 in direct visitor expenditures and

over $390,000 in total economic activity can be attributed to the availability of produced water each year.

However, the benefits from produced water will end if the Draft Permits are issued – these Draft Permits would impose more restrictive discharge limits—limits that are not necessary because current water already supports the beneficial uses of the water—crops, livestock watering and wildlife ponds. New limits on electrical conductivity ("EC") and SAR are not warranted because the EC/SAR levels in the river, and for diversions to crops, are significantly below the State's threshold levels for these constituents. *See* Figure I-1, above; for EC, *see* Figure XII-2). Water quality standards for livestock or wildlife, which are less restrictive than standards for crops, are met.

Additionally, the protection of aquatic life in the river is important. Because of the arid conditions, many drainages are dry or ephemeral; the flows in those drainages are effluent dependent. Therefore, no aquatic life thrives and reproduces in these drainages. Aquatic life may only be present intermittently during high flow conditions. Whole Effluent Toxicity ("WET") testing is conducted to test the toxicity of the discharges to the resident aquatic species. Testing for survivability and reproductivity of aquatic life should occur at the confluences of the drainages and the river where aquatic communities are present. Acute WET testing in the tributaries at the outfalls already provides early indicators of potential problems.

Lastly, iron levels are naturally high in the Purgatoire River and they remain elevated from naturally occurring erosive soils and geology in the region (Figure I-3). Iron is difficult to remove from the produced water and economically infeasible to treat or inject due in great part to the widely dispersed locations of 127 outfalls throughout the 600 square mile rugged terrain. The iron concentrations discharged by the Companies are less than what was historically measured by the U.S. Geological Survey ("USGS") in 1978-1981 (pre-CBM operations), yet river flows are still in exceedance of the iron standards.

Figure I-3. Existing stream bank erosion along South Fork Purgatoire, approximately 5 miles upstream of the confluence – 10 foot drops and vertical side slopes. Erosive soils, measures as total suspended sediment ("TSS") are known sources of elevated iron in the watershed.

Instead of restrictive iron limits, the Discharge Permits should adopt iron limits based upon an alternatives analysis presented herein (Attachment B), which identifies modified iron limits to be incorporated into the permits. These proposed limits provide iron levels below historic background iron concentrations for this watershed.

Notwithstanding the many benefits of the produced water to the state, local government, and communities, the Division has ignored the water quality data and water benefits and proposed discharge limitations for XTO and Pioneer, which would force deep well injection of the produced water. The Companies have previously demonstrated, and demonstrate again, that water treatment at remote locations is infeasible. If deep well injection were to occur, the water would no longer be available for irrigation, livestock or wildlife and the flows in the Purgatoire watershed would be reduced. Moreover, deep well injection is very expensive – an estimated capital cost of $111-$184M and annual operating costs of $1.8M for injection of 5.0 – 8.6 million gallons per day ("MGD"). <u>These costs are so high that Raton Basin CBM production may no longer be economically feasible</u>.

Additionally, the analytical work required under these Draft Permits would cost $2.4M during the Draft Permits' five year term. This does not include the additional labor, vehicle or shipping costs that would be required. Such costs are unprecedented, especially considering that the intent is to maintain the status quo in the receiving waters. The analytical requirements result in costs that are many magnitudes greater that the existing monitoring costs for these discharges.

Excessive analytical costs are not warranted given the good water quality conditions in the receiving waters. And, since the Division already contended that parameters with 600 data points were too large to evaluate, it is likely that most of the data collected would never be reviewed or used for future permit decisions.

The more stringent water quality limits proposed by the Division are not necessary to protect the uses or water quality.

Our comments herein provide detailed information on the proposed discharge limits contained in the Draft Permits.

II. CBM Economic Benefits to Las Animas Communities of $1.4B Will Be Eliminated

In addition to the agricultural and recreational benefits that can be directly attributed to the use of produced water, the CBM industry itself provides a number of economic benefits to the communities of Las Animas County. In fact, this industry supports a substantial portion of the County's economy. The benefits of CBM industry activity include employment, income, property tax revenues, company purchases from local businesses, sales tax revenue, generation of severance and Federal Mineral Lease ("FML") revenues and royalty payments to private land owners. Table II-1 summarizes the local economic benefits generated by the CBM industry in 2014, including direct employment of about 345 people, with associated incomes of about $38.7M. *See* Harvey Economics, "Economic Benefits of CBM Industry Activity and Produced Water in Las Animas County, Colorado, 2015" ("Harvey 2015") (attached hereto as Attachment C).

Table II-1. Impact of CBM Activity on Local Employment, Income and Retail Sales (Harvey Economics, 2015).

	CBM Industry-Related	**County Totals**
Direct Employment	$345	NA
Total Employment	$871	$7,860
Annual Average Wage	$79,400	$37,500
Direct Income	$38.7 M	NA
Total Income	$54.5 M	$297M
Direct Sales of Goods and Services	$59.5M	NA
Total Sales of Goods and Services	$85.6M	$332M
Sales Tax Revenue	$340,000	$4.2M
Property Tax Revenue	$4.3M	$14,036,000
TOTAL	**$243,020,616**	**$1,433,273,500**

Severance tax revenue and FML revenues together provided an additional $976,000 to local jurisdictions and school districts in 2014 and royalty payments to local landowners totaled almost $4.0M. The economic benefits provided by the industry depend on a number of factors that affect company operations and therefore, these benefits vary over time. For example, with higher natural gas prices and increased production levels in 2011, industry employment was almost 600 people and total tax revenues amounted to over $7.8M.

III. Regulatory and Procedural History Related to Draft Permits

Pioneer holds Discharge Permit Nos. CO-0047767, CO-0047776, and CO-0048003, which authorize the discharge of produced water from Pioneer's CBM operations to ephemeral drainages and tributaries of the Purgatoire River. The discharge of produced water from Pioneer's CBM outfalls was originally authorized under General Permits, and then individual permits issued on December 30, 2009, effective February 1, 2010. Those individual permits were set to expire on January 31, 2015. Although the normal course of business would be to submit permit renewal applications six months prior to expiration in accordance with 5 C.C.R. § 1002-61.4(1)(D), the Division required that Pioneer submit early renewal applications for its permits on or before December 31, 2013. As such, on December 23, 2013, Pioneer timely filed applications for renewal of its Discharge Permits, Nos. CO-0047767, CO-0047776, and CO-0048003 with the Division. Permit Renewal Applications for Pioneer Natural Resources USA, Inc. in the Raton Basin; CDPS Permit Nos. CO-0047776, CO-[00]47767, and CO-0048003 (Dec. 23, 2013). Over 13 months later, on February 6, 2015, the Division published Draft Discharge Permit Nos. CO-0047767 ("Draft 47767 Permit"), CO-0047776 ("Draft 47776 Permit"), and CO-0048003 ("Draft 448003 Permit") (collectively, the "Draft Permits"). In addition to the Draft Permits, the Division published the Water Quality Assessment ("WQA") and Fact Sheets ("47767 Fact Sheet", "47767 Fact Sheet" and "48003 Fact Sheet") associated with the Draft Permits, each of which are collectively considered portions of the Draft Permits.[1]

[1] Pioneer incorporates by reference its prior submissions, correspondence, materials, data, reports, and all other documents provided to the Division; current and prior permits, including applications, drafts, fact sheets, appendices and Water Quality Assessments, comments, data; all submissions, correspondence, materials, data, reports, and all other documents related to all of Pioneer's permit modification requests; all submissions, correspondence, materials, data, reports, and all other documents provided the Division under Pioneer's compliance schedules; all submissions, correspondence, materials, data, reports, and all other documents submitted to the Division's Enforcement Section; Pioneer's Notice of Appeal, Request for Adjudicatory Hearing, and Request for Stay (and attachments thereto) (filed Mar. 9, 2015); all materials in the proceedings by the WQCC regarding Revised Water Quality Classifications, Standards and Designations for the Arkansas River Basin, Regulation # 32 (5 C.C.R. § 1002-32) for the June 2013 Hearing and specifically those materials related to Purgatoire River; all materials in the proceedings by the WQCC for Consideration for the Adoption of New Temporary Modifications and Revisions to Current Temporary Modifications for Multiple Segments, including Segments in

This letter and Attachment A set forth in detail our analysis and requested revisions to the Draft Permits, Water Quality Assessment, and Fact Sheets. This letter first sets forth our general comments on issues of general applicability to all of the permits and Attachment A sets forth permit-specific comments. We welcome the opportunity to meet with the Division to discuss these matters further, to respond to any questions you may have, and to resolve these issues.

IV. Draft Permits Are Not Consistent with the State Water Plan

Governor Hickenlooper directed the Colorado Water Conservation Board, Department of Natural Resources, in concert with other agencies such as CDPHE, to develop a state water plan. That plan addresses the needs and shortfalls for each river basin, including the Arkansas River Basin. Colorado Water Conservation Board, "Colorado's Water Plan" (draft dated Dec. 10, 2014) ("State Water Plan").

The draft Arkansas River Basin Implementation Plan (draft July 31, 2014) ("Arkansas River BIP"), which is a component of the draft State Water Plan, recognizes that the water supply gap in the Arkansas River basin will widen without successful completion of creative plans and projects. The Arkansas Basin has significant inter-basin and interstate obligations. As such, it must "maximize the use of existing water supplies" and "take all actions required to maintain current water supplies and prevent future water supply gaps from increasing." Arkansas BIP at 8, 43.

1. Agriculture.

Agriculture is the largest water use in the Basin; agricultural use accounts for about 87 percent of total water withdrawals. The Basin contains 428,000 irrigated acres, with about one million AF of crop water demand annually. Current irrigation shortages exceed 450,000 AF per year. Given the projected decrease in future irrigated acres, shortages are anticipated to be approximately 370,000 AF per year by 2050. The State Water Plan and the Arkansas River BIP identify an augmentation gap of up to 50,000 AF by 2050.

2. Municipal and Industrial ("M&I") use.

The population of the Arkansas Basin is expected to grow from just over 1 million people in 2013 to between 1.58 million and 1.84 million people by 2050; an increase of between 53 and 79 percent. M&I water use is currently a small portion of Basin demand (about 10 percent of total water withdrawals). However, due to future population growth, M&I demands are projected to reach between 298,000 AF and 352,000 AF by 2050, an increase of up to 170,000 AF. Shortages of at least 45,000 AF, and possibly as much as 94,000 AF, are anticipated by 2050.

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the Arkansas River Basin, Regulation # 32 (5 C.C.R. § 1002-32) for the December 2014 Hearing, and specifically those materials related to the Purgatoire River; and all correspondence and materials submitted by Pioneer to the Executive Director of CDPHE, Director of the Water Quality Control Division, the Permits Section and their staff.

3. Environmental and recreational use.

The State Water Plan and the Arkansas River BIP identify a number of goals for non-consumptive water uses in the Basin; these goals include maintaining and improving fish and wildlife populations and habitats, boating and other recreational opportunities, and wetland areas.

Environmental needs in the Basin include water for wetlands, birding areas, and threatened and endangered species. Numerous wetlands are present throughout the Basin. Recreational needs include water for boating, fishing and hunting. Recreational boating includes both whitewater and flatwater boating for commercial and private purposes. Fishing is a popular activity, which occurs at numerous reservoirs, lakes, rivers, streams and smaller tributaries throughout the Basin. The Arkansas Basin also includes prime waterfowl hunting areas and habitat for other commonly hunted large and small game species.

4. Water quality decisions must consider and further State Water Plan goals.

The Division's decisions on the Draft Permits must consider the value, and need, for the water produced by XTO and Pioneer. Every drop of water in the Arkansas Basin is potentially part of the solution to address existing shortfalls in the basin, which are estimated to increase to 36,000-110,000 AF by 2050.

Water produced from CBM operations in the upper Purgatoire watershed tributaries have provided between 4,500 and 8,000 AF of water per year. Produced water discharged into the Purgatoire watershed presently supports stock watering, wildlife habitat, and downstream river calls for agricultural uses. This is an important resource that should remain available to reduce the water gap for local and regional uses.

Therefore, all available or potential water sources must be considered for suitability in meeting the Basin's water gaps, including CBM water. CBM-produced water is an existing source of water supply available to Basin water users to help meet a portion of current and future water needs; this source of water should be included in the evaluation of water management for the Arkansas Basin.

CBM water discharged into Purgatoire River tributaries adds to the Purgatoire mainstem flow and annually provides water for agricultural and recreational activities that alleviates the pressure on other water supply sources.[2] CBM water becomes even more important in dry years when it represents a greater portion of total supply. CBM water is generally available throughout the year; its value increases in low flow periods of the growing season. The loss of CBM water

[2] Collectively, the Draft Permits allow the discharge of up to 8.57 MGD, or approximately 9,600 AF annually of CBM-produced water into the upper Purgatoire watershed, including the North and South Forks of the Purgatoire River, and more significantly in tributary canyons that flow into the mainstem of the Purgatoire River.

would result in a reduced volume of water in the Purgatoire for all uses and associated benefits. In fact, any reduction in the amount of CBM water discharged to surface water would further exacerbate the estimated water demand gap for beneficial uses within the Basin, including M&I, agriculture, environmental, and recreational uses.

When issuing permits, such as these Draft Permits, the Division should balance water quality with consideration for physical water supplies and their attendant water rights and values to downstream users. A balance between water supplies and water quality is achieved by maintaining the status quo with discharges and produced water at historic levels. Unbalanced permitting decisions, such as the effluent limits proposed in these Draft Permits, will cause produced water to be injected or the Companies will consider limiting or curtailing gas operations that produce this water.

V. "Current Conditions" Should Reflect Status Quo, Not More Restrictive Water Quality Limits

The produced water benefits many sectors of the local economy and also fish, wildlife, and aquatic communities. *See above* at Section I (Introduction), and Section IV (State Water Plan). In preparing the Draft Permits, the Division frequently references the "current condition." Presumably, that would be the status quo, but as applied in the Draft Permits, the current condition would require the Companies to implement additional pollutant reduction measures, water flow restrictions and significant and expensive monitoring. This is <u>not</u> status quo. These proposed requirements would alter the "current condition" as that term has been defined and applied by the Division. The Division's very description of "current condition" in the regulations typically describes a process by which:

> [T]he Division will assess the current effluent quality, recognizing that it changes over time due to variability in treatment plant removal efficiency and influent loading from industrial, commercial, and residential sources. One necessary element of an approach to maintain the current condition would be a requirement that <u>the total loading from commercial and industrial contributors be maintained at that level as of the date of adoption of the temporary modification</u> and that neither the concentration nor the frequency of high concentration shall increase over historic levels and frequency.

See 5 C.C.R. § 1002-38.66 (emphasis added).

Although "current condition" is most frequently used for temporary modifications, it is not unreasonable to expect that when the same agency uses the same term in another context, the same definition and parameters are intended to apply.

One example states: "The Commission's intent of using this notation is to preserve the status quo during the term of the temporary modification. Discharges to those segments shall continue to be authorized to discharge the subject pollutant at their current permitted concentration and flow levels." *Id*. § 1002-38.74(M). Similarly:

> Where the Commission has adopted a narrative temporary modification of "current condition", the Commission intends that, when implementing the temporary modification in a CDPS permit, the permit conditions will reflect the current effluent quality, recognizing that it changes over time due to seasonal variability, change in the effluent flow and the concentration over time.

Id. § 1002-33.52(J).

In implementing more stringent EC/SAR limits, the Division repeatedly stated that it established these limitations based on an effort to maintain the "current conditions" within the watershed. The Division explained:

> The current condition approach used for both the 2014 modification and for this renewal permit is to establish effluent limits that characterize the water quality of the discharge for the period of record January 1, 2010 through September 30, 2012. Effluent limits are intended to hold the current condition in place from a water quality standpoint, which allow the permittee operational flexibility to change the quantity and quality of water from each outfall, to the extent that these changes do not result in a significant departure from the characterized condition. The Division agrees that these changes in quality can be attributed to a number of operational factors, including reductions and increases in flow from existing sources within the piping network to each outfall, changes in chemistry in groundwater formations from which produced water is currently withdrawn, changes in formations from which groundwater is withdrawn within existing wells, and changes in sources (wells) to the outfall piping network.[3]

[3] *See* 47767 Fact Sheet at 11; 48054 Fact Sheet at 11; 48062 Fact Sheet at 11 (emphasis added). *See also* 47776 Fact Sheet at 6 ("One objective of the establishment of effluent limits set to represent the current condition characterized from January 2010 through September 2013, was to allow these operational and discharge changes to occur only to the extent that they do not result in a decrease in water quality)."); 48003 Fact Sheet at 6 (same language); 48054 Fact Sheet at 8 (same language); 48062 Fact Sheet at 8 (same language).

Allowing for operational and discharge changes that do not result in a decrease in water quality is consistent with the Division's past practices in developing limitations to maintain "current conditions." As noted above, "current condition" is typically used in the context of temporary modifications. *See, e.g.*, 5 C.C.R. § 1002-38.82 ("the Division will assess the current effluent quality, recognizing that it changes over time due to variability in treatment plant removal efficiency and influent loading from industrial, commercial, and residential sources. One necessary element of an approach to maintain the current condition would be a requirement that the total loading from commercial and industrial contributors be maintained at that level as of the date of adoption of the temporary modification and that neither the concentration nor the frequency of high concentration shall increase over historic levels and frequency.").

However, the Division erred by defining the period for "current condition" as January 2010 through September 30, 2012, because the period of CBM operations is significantly longer and considering data before 2010 and after 2012 will more accurately reflect the variability in conditions that are truly the "current condition." The data record and the historic uses of produced water support that the "current condition" for at least 15 years has been relatively consistent.

Despite espousing that the new limits would allow the Companies' operational flexibility, the Draft Permits imposed flow limits to specific outfalls that restrict the location and combination of outfalls, which negates the flexibility the Division highlighted in imposing new limits based on "current conditions."[4] The Division's explanation for imposing new, more stringent limits while also imposing flow limits flies in the face of the Division's past practice in applying limits that maintain "current conditions."

The purpose of the "current condition" approach is to maintain current environmental standards in the receiving body, allowing the permittee some flexibility in the details of its operations so long as the ultimate outcome is satisfactory. Imposing per-outfall limits, however, with no regard for the actual condition of the receiving body or operational realities, contradicts the very purpose of the "current condition" approach. Years of real-life experience with the Companies' operations in the Raton Basin show that the current condition of the Purgatoire River is clean and healthy and that the Companies' continued CBM operations will not adversely impact the River. Such a backward application of the Division's stated methodology is arbitrary and capricious.

Current condition is equivalent to status quo—i.e., no major changes—it recognizes the variability in flows, effluent concentrations that have been historically evidenced in the natural

[4] Draft 47767 Permit at 4-5; Draft 47776 Permit at 5-10; Draft 48003 Permit at 5-7; Draft 48054 Permit at 4-5; Draft 48063 Permit at 4-5. The Division explained that because the new EC/SAR "permit limitations were revised to ensure that the 'current condition' was retained, flow limits were added to each outfall." 47767 Fact Sheet at 5; 47776 Fact Sheet at 4; 48003 Fact Sheet at 4; 48054 Fact Sheet at 5; 48062 Fact Sheet at 6.

system. The Division must implement "current conditions" in these permits as it is defined; which will result in the status quo for discharges under these permits.

VI. Risk-Based Permit Renewal

A common sense approach to permit renewals is incorporated in the permitting process but it has not been used by the Division in preparing the Draft Permits. The Division could issue these permits with minimal or no change after performing a risk-based evaluation. The risk-based evaluation is completed – the extensive watershed information data demonstrates that discharges at current levels produce water that is beneficial for crops, livestock, wildlife, aquatic life and recreation.

Regulation 61 states that the Division has the obligation to reissue discharge permits with minimal or no change after performing a risk-based evaluation. 5 C.C.R. § 1002-61. Specifically, Regulation 61.1(5) reads:

> For any permit, at the time of permit renewal, the Division shall use a risk-based approach applied to the receiving water(s) that considers the most recent water quality/quantity information, information in the renewal application, and any other relevant information, to determine whether the permit can be reissued with minimal or no change.

In their December 2013 Permit Renewal Applications, the Companies provided the Division with extensive water quality data collected throughout the watershed from the Purgatoire River Watershed Monitoring Network. The Division is also in receipt of more recent data collected under the Level 1 and Level 2 monitoring programs in the current permits. These data demonstrate that applicable water quality standards for boron, chloride, EC, SAR and WET are met throughout the watershed. And, although iron levels in the Purgatoire River exceed standards, those exceedances have been consistent for many years, even pre-CBM operations.[5] No increase in iron concentration has occurred, or been attributable to produced CBM water. Thus, the "current condition" of the surface water quality in the Purgatoire watershed continues to be protective of designated uses after over 15 years of CBM operations.

Notwithstanding the water quality data, the Division has issued draft permits which have major, significant changes to terms and limits.

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[5] Total recoverable iron concentrations routinely exceed standards in applicable stream segments during highflow events following rainstorms and snowmelt. Pre-CBM era data (USGS 1978-1981) and Purgatoire River Watershed Monitoring Network data (2010 to present) indicate that elevated iron levels are directly correlated to the amount of sediment conveyed in the streams. The source of this sediment (and iron) is streambank erosion, runoff from burn areas, etc. within the area the Companies operate, but also from areas upstream of the current CBM operations.

The time and expense that the Division has expended to develop these significantly changed permits, with their many inaccuracies and errors, has been a waste. If the Division followed Regulation 61.1(5), the permit renewal process could have been expedited. The Division must consider the complete data record and scientific evidence submitted by the Companies in their December 2013 Permit Renewal Applications and conduct a risk-based evaluation. The permits for these discharges should be issued with minimal or no changes.

VII. Economic, Environmental, Energy, and Public Health Costs and Impact of Draft Permits Are Not Reasonable

The Colorado Water Quality Control Act mandates that water decisions by the Division are reasonable and consider the economic, environmental, energy and public health impacts and costs of those actions. C.R.S. § 25-8-102(5).

Specifically, the Division is directed when issuing permits that require treatment to protect water quality standards (and beyond technology-based requirements), that it "must determine whether or not any or all of the water-quality-standard-based effluent limits are reasonably related to the economic, environmental, public health and energy impact to the public and affected persons." C.R.S. § 25-8-503(8). The Division erred in its rudimentary, formulaic conclusion that "the water-quality-standard-based effluent limitations of this permit are determined to be reasonably related to the economic, environmental, public health and energy impacts to the public and affected persons." *See* 48054 Fact Sheet at 68; 47767 Fact Sheet at 42.

In part, the Division's conclusion is premised on its finding that "the evaluation for this permit shows that the WQCC, during their proceedings to adopt the Classifications and Variance Standards for Arkansas River Basin, Regulation 32, considered economic reasonableness." ***Id.*** The Companies submitted extensive evidence during the WQCC proceedings regarding Classifications and Numeric Standards for Arkansas River Basin, Regulation #32 (June 2013) that compliance with certain water quality standards (e.g., boron) was neither technically nor economically feasible. *See* Rebuttal Statement, "Compliance with Existing Standard is Not Technically or Economically Feasible," at 11. The Commission accepted the Companies' position on technical and economic infeasibility (and unreasonableness) and approved the modified boron standards as proposed.

However, the discussion, and conclusions, are not limited to just boron standards. Further, permit modifications for iron, WET and EC/SAR were submitted because of the impossibility—technically and economically—of meeting the proposed discharge limits (and required control measures). *See*, *e.g.*, presentation re: Five Point Plan to Dr. Urbina, CDPHE Executive Director (May 2012); meeting with Dr. Urbina (Sept. 4, 2012); Letter from R. Sandquist to WQCD re: Request for Permit Modification for Iron Limits, Permits CO-0048003, CO-0047767, and CO-0047776 at 1 (Dec. 18, 2013) ("Measures to reduce iron from coalbed methane produced water at the outfalls are not feasible to implement . . . ."); Letter from R. Sandquist to WQCD re: Whole Effluent Toxicity Testing Permit Requirements/Raton Basin, Pioneer Natural Resources USA, Inc.

Permit Nos. CO-0047776 and CO-0048003 (Dec. 16, 2013); "Ecological Evaluation of the Effects from XTO and Pioneer Discharges to Aquatic Life in Lorencito Canyon and South Fork Purgatoire River," AECOM at 3 (Feb. 2013) ("During the trial period authorized by the compliance schedules, the discharges have not consistently passed the chronic WET tests with C. dubia at these outflows.") ("WET Report"); Letter from R. Sandquist to P. Pfaltzgraff, WQCD, re: Importance of Permit Compliance (Jan. 13, 2014); Letter from R. Sandquist re: Request for Permit Modification for SAR and EC, Pioneer Natural Resources, Inc., Permits CO-0047776, CO-0047767, and [CO-]0048003 at 2 (Aug. 6, 2014) ("It is not currently feasible for [the Companies] to come into compliance with the SAR limits in the Permits . . .").

Ergo, the only feasible technical option would be to inject the produced water. Injection of produced water was central to the Commission's 2013 hearings in the Arkansas River – injection meant that the produced water would never again be available to landowners and communities in the Las Animas County and the Arkansas Basin.

> You are currently faced with the very important decision of deciding whether or not we will continue to have access to our most precious resource: the discharge water from the gas wells. Your decision will impact hundreds of ranchers and farmers who have come to depend on this discharge water to keep their operations viable.

Testimony of T. Tamberelli, WQCC Hearing re: Classifications and Numeric Standards for Arkansas River Basin, Regulation #32 (June 11, 2013). Further, at a capital cost of $111 - $184M plus annual operating costs of $1.8M, injection was not economically reasonable.

1. Additional Evidence That The Water-Quality-Standard-Based Effluent Limits Are Not Technically or Economically Feasible.

At the request of the Companies, Harvey Economics updated its 2013 economic evaluation of the Raton CBM operations. *See* Harvey 2015.

The report found:

> In Las Animas County, CBM gas has been extracted from the Raton Basin for over 15 years. CBM industry activity and the associated produced water has the potential to continue to provide real benefit to the local economy in terms of employment, income and various revenues.
>
> Changes in permit limits or other regulations affecting the discharge of produced water have the potential for increasing associated discharge costs, if treatment is required, or for the re-injection of additional water. Additional costs related to treatment of produced

> water may result in a reduction of CBM activity. Likewise, the high costs of re-injection wells may also have the potential for reducing gas extraction activities. An additional downside of re-injection is that produced water would become unavailable for any beneficial use in Las Animas County or in the Arkansas Basin, where all water supplies are sorely needed.
>
> As this report shows, CBM industry activities, including the production of water, provide valuable benefits to the residents and jurisdictions of Las Animas County. Curtailment of CBM production in Las Animas County or re-injection of produced waters would have the following economic impacts:
>
> - Reduction in water available for use by the agriculture and tourism/ recreation industries – reduced volume of agricultural activity or visitation to the area for hunting or other activities. Reduced activity in these industries will also lead to reduced employment and income in the county;
>
> - Reduction in company employment and expenditures – local employment and spending by CBM companies would be reduced, along with sales tax revenue for the City of Trinidad or others;
>
> - Reduction in royalty payments and various tax payments – royalty payments to private landowners would be reduced, as would the amount of severance taxes and FML revenues received by the county and local jurisdictions;
>
> - Lower economic activity countywide – overall, reduced CBM mining activity and water production will result in a decline in employment and personal income, reduced local spending and fiscal impacts to both state and local governments.

Harvey 2015 at 30-31.

2. Effluent Limits Imposed Are Derived From Policies, Not Standards.

Effluent limits for EC/SAR and WET testing are derived from policies – policies that purportedly interpret and apply narrative standards. These are not numeric water quality standards that were considered when the Commission adopted the narrative standards for agriculture or aquatic life. When the Commission adopted narrative standards applicable to the Arkansas River Basin, these specific policies for EC/SAR and WET were not contemplated. Similarly, the CBM

industry was still emerging in the Basin and what would be reasonable for a mature industry and a mature field in decline was not contemplated. Therefore, the Division's presumption that the Commission considered the economic reasonableness for EC/SAR effluent limits and WET testing requirements is not supported.

VIII. Request for Facilitated Discussion

The Companies request a facilitated discussion with the Division to address the terms, limits and restrictions in the Draft Permits, the permitting process and other related matters. The discussions must be fair and reasonable; the facilitator must be unbiased, have a strong background in discharge permits and water rights, be approved by the Division and the Companies, and the Division and Companies must be able to freely select their representative for the facilitation. For over five years, the Companies have engaged with the Division on the potential effluent limits for these discharges. The Companies, after conferring with the Division and other regulatory agencies, have undertaken special water quality, water quality monitoring, aquatic life and biologic monitoring and river restoration planning – all to determine suitable discharge limits.

The direct communications have not resulted in decisions that were informed by the Companies' science, available data, water quality monitoring or plans that were previously submitted to the Division. We request that the Division and Companies select a facilitator who can assist with the dialogue, expand the understanding between the parties, and potentially result in attainable and reasonable discharge permit limits that balance the community needs for water supply with water quality.

IX. Incorrect Flow Determinations Affect Limits in the Draft Permits

Flow determinations for the receiving waters that are not correct or not supported by monitoring data permeate the Draft Permits because flows are directly related to permit limits. For example, overestimating flow mischaracterizes streams that are ephemeral or effluent-dominated. And, underestimating flows for streams results in reduced or no assimilative capacity for the discharges. As a result, permit decisions derived from the estimated flows found in the Draft Permits are not scientifically sound.

A. Many of the Division's low flow estimates were made based on communications with local water commissioners, even though flow data collected with scientific instruments was available.

The Division did not use reliable, scientific evidence in determining flow estimates throughout the Draft Permits. The Division incorrectly states for each of these segments that *"[f]low data for the receiving stream is not available."* In fact, the Division is aware that the Companies, with the assistance of Tetra Tech, collected flow data in these segments from April 2010 – December 2014 at the locations shown in Table IX-1.

Table IX-1. Summary of Flow Data Available for Guajatoyah Creek, the Middle Fork of the Purgatoire River and the South Fork of the Purgatoire River (April 2010 – December 2014).

Stream Segment	Station No.	Data Available
Guajatoyah Creek (COARLA05a)	GUA-0.1	Instantaneous[6] (Monthly)
Middle Fork of the Purgatoire River (COARLA05b)	PR-37.1	Continuous[7] (Daily average)
	PR-24.9	Instantaneous (Monthly)
South Fork of the Purgatoire River (COARLA05b)	SFPR-12.7	Instantaneous (Monthly)
	SFPR-0.1	Continuous (Daily average)

The Companies have briefed the Division on numerous occasions about the data collection activities in the Purgatoire watershed, and even solicited input from the Division in early 2010 on the *Purgatoire River Watershed Monitoring Network Sampling and Analysis Plan* (Tetra Tech,

[6] Monthly flow data are from instantaneous flow measurements made using a current meter or portable flume.
[7] Daily average flow data are calculated from stage data collected at continuous (15-minute) intervals at instrumented stream gaging stations.

2010, as updated). The Companies also provided the Division with flow data from April 2010 through December 2012 for the stations listed in Table IX-1, along with flow data from numerous other stations, in the Permit Renewal Application that was submitted on December 23, 2013. And, updated flow data was (and is) readily available from the Purgatoire watershed website, a flow data source referenced in the Permit Renewal Application. The Division should have relied upon these actual, scientific instrument-based flow measurements to quantify the low flows in these segments. Instead, as indicated in the WQA, the Division relied upon the local water commissioner to provide unsubstantiated estimates of low flows for Guajatoyah Creek (COARLA05a), the Middle Fork of the Purgatoire River (COARLA05b) and the South Fork of the Purgatoire River (COARLA05b). WQA at 30-32.

The low flow estimates used by the Division for the Draft Permits for Guajatoyah Creek (*see* WQA, Table A-5c) and the South Fork of the Purgatoire River (*see* WQA, Table 5e) are not accurate. Flow measurements from the Purgatoire River Watershed Monitoring Network stations should be utilized, as these are accurate, actual measurements conducted with scientific instruments that provide a robust dataset for streamflows. The streamflow data provided to the Division by Tetra Tech in December 2013 will provide higher 1E3, 7E3, and 30E3 low flows for these receiving streams than the estimated low flows currently used in the Draft Permits. Although the Division could have easily accessed the data from the website, the Companies are willing to provide the Division with additional flow data for the stations listed in Table IX-1 that has been assembled since the Permit Renewal Application was submitted over a year ago at the request of the Division.

The Division ignored available data and used the incorrect low flow values to develop many of monitoring and reporting requirements for the Draft Permits for outfalls to Guajatoyah Creek and the South Fork of the Purgatoire River. Reliance on these incorrect estimates resulted in permit errors with excessive sampling and reporting that is expensive, burdensome and, importantly, provides no additional environmental benefit. Examples of how use of more accurate low flow values would impact monitoring and reporting requirements include:

1. Mixing Zone Analyses

    - Permit No. CO-0048003. Stream width and depth data from station GUA-0.1 for over 50 flow measurements performed since April 2010 are provided in the table below. Review of these data demonstrate that the mixing zone analyses requirement should be removed from this outfall under the *Application of the Mixing Zone Exclusion Tables* test in the Division's mixing zone guidance (April 2002). Using the equations in the Division's mixing zone guidance (April 2002) to calculate the velocity, physical mixing zone ("PMZ"), and regulatory mixing zone ("RMZ") values, Table I-2, *Exclusion table for montane streams*, can be extended to incorporate the stream width and depth values for the lower flows shown in the table. For these cases, the RMZ exceeds the PMZ, indicating that Guajatoyah Creek should be excluded from a mixing zone analysis. Therefore, per Regulation 5 C.C.R. § 1002-31.10(2)(a), outfall 241-A

should be exempt from the mixing zone regulations and the requirements for a mixing zone study for this outfall should be removed from the Draft Permit.

Table IX-2. Summary of Flow Data and Stream Widths and Depths for Guajatoyah Creek Station GUA-0.1.

Date	Flow (cfs)	Width (ft)	Average Depth (ft)
5/21/2014	18.72	13.6	0.72
4/14/2010	16.19	10.5	0.77
5/12/2010	13.45	10.5	0.75
6/16/2010	7.860	10.5	0.40
6/18/2014	7.618	9.0	0.53
4/16/2014	7.171	23.0	0.98
5/16/2012	6.978	11.5	0.80
8/13/2014	4.690	8.3	0.53
9/18/2013	4.687	3.8	0.92
8/18/2010	4.159	8.0	0.51
4/18/2012	4.071	9.7	0.63
6/15/2011	3.593	8.0	1.03
7/16/2014	3.014	13.1	0.33
7/21/2010	3.014	8.5	0.44
4/13/2011	2.139	5.7	0.67
5/11/2011	2.132	7.5	0.46
10/15/2014	1.987	8.0	0.40
3/16/2011	1.448	9.25	0.36
11/19/2014	1.366	7.0	0.36
3/13/2013	1.362	2.8	0.34
6/13/2012	1.251	5.0	0.52
2/16/2011	1.223	10.0	0.28
9/17/2014	1.179	7.8	0.89
12/17/2014	1.170	5.5	0.18
12/15/2010	1.164	6.7	0.51
4/17/2013	1.124	3.5	0.42
7/17/2013	1.105	3.0	0.65
1/12/2011	1.028	5.3	0.46
10/16/2013	1.014	3.6	0.55
5/22/2013	1.001	3.0	0.40

Date	Flow (cfs)	Width (ft)	Average Depth (ft)
8/21/2013	0.928	5.4	0.39
9/15/2010	0.911	7.7	0.30
10/13/2010	0.828	6.8	0.32
12/18/2013	0.670	*Flume*	
7/13/2011	0.667	5.8	0.30
9/14/2011	0.642	4.8	0.31
2/13/2013	0.585	2.0	0.29
1/18/2012	0.542	8.0	0.28
11/13/2013	0.497	*Flume*	
7/18/2012	0.491	7.3	0.66
12/12/2012	0.466	*Flume*	
2/12/2014	0.439	*Flume*	
11/16/2011	0.406	*Flume*	
3/21/2012	0.393	5.0	0.42
12/14/2011	0.392	5.5	0.42
3/12/2014	0.384	*Flume*	
1/15/2014	0.348	*Flume*	
10/12/2011	0.331	*Flume*	
2/15/2012	0.275	*Flume*	
11/17/2010	0.204	5.5	0.24
10/17/2012	0.198	*Flume*	
8/14/2012	0.169	*Flume*	
1/16/2013	0.167	*Flume*	
9/26/2012	0.122	*Flume*	
11/14/2012	0.122	*Flume*	
8/17/2011	0.061	*Flume*	
6/26/2013	0.030	*Flume*	

Note: *Flume* indicates that flow measurements were taken using a portable flume and that stream width and depth measurements are not available.

2. Flow Calculations – WET Testing Requirements

- Permit No. CO-0048003. The Division relied upon estimates from the local water commissioner to establish low flows in Guajatoyah Creek (*see* WQA Table 5c). As illustrated in Table IX-2 above, Pioneer has 57 flow measurements available from the Purgatoire River Watershed Monitoring Network station GUA-0.1, which is located

near the mouth of Guajatoyah Creek. Many of these flow data were provided to the Division as part of the permit renewal package and the Division was made aware that this data has been routinely collected. *See* Permit Renewal Application. The Division should use these actual flow measurements to develop scientifically defensible and more accurate low-flow measurements for Guajatoyah Creek in Permit CO-0048003. Use of the correct 30E3 flow value would, at a minimum, result in lower and more accurate IWC percentage values for outfall 241.

One of the impacts of using the wrong low flows and D-flow analysis is that it impacts other calculations throughout the permits and permeates error. The Division must re-perform the following analyses in the WQA to establish potential permit limitations for the Companies outfalls reporting to the South Fork Purgatoire River and Guajatoyah Creek using the available and more accurate low flow estimates discussed above:

- The water quality based effluent limitations ("WQBELs") for the South Fork Purgatoire River (*see* WQA, Tables A-7n and A-7o) and Guajatoyah Creek (*see* WQA, Tables A-7r and A-7s).

- The antidegradation based average concentrations ("ADBACs") for the South Fork Purgatoire River (*see* WQA, Table A-12c) and Guajatoyah Creek (*see* WQA, Table A-12d).

- The concentration significance tests for the South Fork Purgatoire River (See WQA Table A-13c) and Guajatoyah Creek (*see* WQA, Table A-13d).

- The selection of the antidegradation based effluent limitations (ADBELs) for the South Fork Purgatoire River (*see* WQA, Table A-14c) and Guajatoyah Creek (*see* WQA, Table A-14d).

Once the Division has re-performed these analyses, the final potential permit limitations for the South Fork Purgatoire River and Guajatoyah Creek should be re-evaluated (*see* WQA, Table A-15 series). Then, only after applying best professional judgment, appropriate permit limits and reporting requirements can be developed for those outfalls discharging to the South Fork Purgatoire River and Guajatoyah Creek.

B. Imposing limits on flow is beyond the Division's statutory authority.

The Water Quality Control Act prohibits the discharge of any *pollutant* unless the discharger obtains a permit. C.R.S. § 25-8-501(1). Pollutants are defined to include dredged materials, dirt, sewage, chemical waste, nutrients, etc. *Id.* § 25-7-103(15). The definition of "pollutant" does not include water flows. Discharge of pollutants means the "introduction or addition of a pollutant into state waters." The waters, and the flow of waters, are not regulated under the Water Quality Control Act. While the Division may impose limits for certain measure of pollutants, it is beyond the Division's authority to set limits on flow. *See Va. Dept. of Transp.*

v. U.S. EPA, No. 12-775, 2013 WL 53741 (E.D. Va., Jan. 3, 2013) (finding that the EPA exceeded its statutory authority under the Clean Water Act by establishing a permit limit on the amount of water flowing into a water body).[8] EPA did not appeal the decision. Additionally, after the Virginia court ruled that EPA could not regulate flows, EPA withdrew the flow language from its stormwater permitting guidance. *See* "EPA Withdraws 'flow' Language in New Stormwater Permitting Guidance," INSIDE EPA (March 4, 2015) (*available at* http://inside epa.com/node/176578). Colorado's Permit Regulations only state that the permittee shall *monitor* "the volume of effluent discharged from each outfall." 5 C.C.R. § 1002-61.8(4)(c)(ii). As such, numeric flow limits should be stricken from the Draft Permits.; they may be replaced with "report only" requirements for flow.

[8] The implications of the *Va. Dept. of Transp*. decision are not limited to permits issued in the Commonwealth of Virginia. *See* Complaint, *City of Rutland, Vermont v. U.S. EPA*, No. 15-cv-00035 (filed Feb. 18, 2015); "New Legal Challenge to EPA 'Flow' Limits Revives Debate Over Stormwater," InsideEPA (Mar. 3, 2015) (discussing EPA decision to amend a 2010 memorandum on stormwater to remove references to flow regulation).

X. Temperature Limits

The WQA indicates that all outfalls that discharge to water bodies with zero (7E3) low flow are exempt from temperature limitations.[9] The WQA restricts the potential application of temperature limits to 1 Pioneer outfall:

- Pioneer Permit No. CO-0048003 (West Spanish Peaks) – Outfall 241 to Guajatoyah.

This permit requires the following:

- Installation of continuous temperature monitoring equipment by September 1, 2015 to comply with the temperature monitoring "continuous" requirements. Draft 48003 Permit at 10.

- Establishment of instream monitoring stations (both labeled UST1A) in the receiving water body above the outfalls. Draft 48003 Permit at 3.

- A mixing zone analysis (presumably for temperature) in the receiving water body above the outfalls. Draft 48003 Permit at 9-10.

Even though the monitoring requirements for temperature are report only (and will remain that way through the duration of both permits), the requirements and data-to-be-collected, foretell future temperature limits.

A. Temperature is an aquatic life standard, yet the Draft Permits designate areas to be tested where there is no aquatic life.

In the WQA, the Division indicates that most outfalls do not require temperature monitoring because the discharges are to effluent dependent streams and "*[a]ll discharges to tributaries are expected to normalize by the time the discharge water reaches the Purgatoire River.*" In contrast, the WQA indicates that temperature monitoring is required at one outfall for the following reasons:

- "*Outfall 241 for Pioneer West Spanish Peaks [Permit No. CO0048003]* ***directly discharges to Guajatoyah Creek***." (**emphasis** added).

As illustrated below, Pioneer Outfall No. 241 does *not* discharge directly to Guajatoyah Creek. Rather, this outfall discharges to a small ephemeral tributary at a location approximately 0.34 miles above the confluence with Guajatoyah Creek, as illustrated below:

---

[9] Pioneer and XTO discharge to Segments 4b, 5a, 5b and 6a (*see* WQA, Table A-1a). With the exception of Segment 5a, these segments have Type B Temporary Temperature Modifications set to "current conditions". These temporary modifications are set to expire on June 30, 2016. Table value standards (TVS) for temperature (CS-I) are currently in effect for Segment 5a.

Figure X-1. Discharge of outfall 241A.

The temperature of this water is expected to normalize by the time it flows 0.34 miles to Guajatoyah Creek. Consequently, all temperature monitoring requirements in Draft Permit No. CO-0048003 (West Spanish Peaks) should be eliminated because the Division has not established that such requirements are warranted.

B. The Draft Permits impermissibly impose temperature monitoring stations with locations "to be determined" above permitted outfalls.

The Water Quality Control Act limits the monitoring that is required of dischargers, "to any facility, process or activity from which a discharge of pollutants is made into state waters." C.R.S. § 25-8-304(1). In listing the specific requirements, the statute requires the discharger to "sample discharges." *Id*. § 25-8-304(1)(e); *see, also* § 1002-61.8(4)(b). Monitoring upstream temperature data does not measure the discharges from Pioneer's outfalls. Ambient water quality sampling, especially upstream of discharges, should not be required in the Draft Permits. Further, it is the Division's responsibility to monitor and determine the water quality of state waters ("the Division shall take such samplings as may be necessary to enable it to determine the quality of every reasonably accessible segment of state waters whenever practical."). C.R.S. § 25-8-303(1). The Division cannot delegate its monitoring responsibilities, through permits, to third parties.

Last, no additional temperature monitoring is necessary. Pioneer has supported extensive, ongoing data collection for the Purgatoire River. And Pioneer is participating in a temperature data collection program, as part of its temporary modifications for temperature, a plan submitted and accepted by the Commission and Division in June 2013 (hearing on June 11, 2013, reviewed and affirmed December 2014). *See* Temporary Modification Temperature Request in the Purgatoire Watershed Las Animas County, Colorado, Lower Arkansas River Segments 3A, 3B, 4B, 5A, 5B, 6A, 6B, 16, and 17 (April 19, 2013) (submitted as Exhibit 6 to Responsive Prehearing Statement of Pioneer and XTO in WQCC Hearing re: Classifications and Numeric Standards for Arkansas River Basin, Regulation #32 (April 23, 2013) (attached as Exhibit 3).

Draft Permit No. CO-0048003 imposes an instream (ambient) monitoring requirement in Gujatoyah Creek *upstream of the discharge*. *See* Draft 48003 Permit at 3. The Division has not even approached or discussed with Pioneer the possible availability of such data or a site for such monitoring. Notably, the Draft Permits do not identify a location for such monitoring. As such, Pioneer is unable to adequately comment on the suitability or feasibility of such monitoring, because a location has not been determined by the Division. Pioneer would not have permission to freely access this to-be-identified monitoring location unless it is granted by the private landowner. Should the Division identify a monitoring location on private property, the final permits should provide for a compliance schedule to allow Pioneer a timeline for negotiating free access and, if approved by the private landowner, establishing a permanent site for a continuous monitoring station. It is also unreasonable for the Division to expect Pioneer to pay whatever payment is demanded by the landowner for the privilege of such access. Pioneer cannot reasonably comment on these provisions of the Draft Permits when the Division has not even made a determination itself as to where it believes such monitoring should take place.

In addition, the Division has not established the basis for this additional monitoring location, particularly in light of all of the data that has been previously collected by the company at its expense. The Division has not provided any legal or other analysis explaining why it believes an additional monitoring location is necessary. The Division has not attempted to consult with the private landowner or Pioneer regarding the availability of surface water and other data that may address whatever concerns the Division may have that prompted the inclusion of these provisions in the Draft Permits. At this juncture, Pioneer has no way of knowing what information the Division may need because it has provided no legal opinions, memoranda, or the like that provide a rationale or basis for the proposed upstream monitoring requirements on property Pioneer does not own or control.

XI. WET Testing Requirements Must Consider Present Aquatic Life Conditions

On December 18, 2013, Pioneer filed Permit Modifications requesting modification to the existing Permit Nos. CO-0047776 and CO-0048003 permits to implement "alternative approaches for determining compliance with [WET] chronic testing for outfalls in the Raton Basin." *See* 47776 WET Permit Modification Form at 2 (filed Dec. 18, 2013); 48003 WET Permit Modification Form at 2 (filed Dec. 18, 2013); 48003 WET Permit Modification Form at 2 (amended Jan. 14, 2014) and all supporting documents and data included with these permit modifications. These WET modification requests were encouraged by and developed in cooperation with the EPA. The request explained that "[b]iological monitoring has found that aquatic life communities are only sustained in the Purgatoire River, not the upgradient tributaries," and therefore proposed that "acute WET testing at discharge outfalls in the tributaries will be protective." Sandquist Letter at 1 (Dec. 16, 2013).

A. Denial of WET permit modification ignore studies, scientific analyses and technical report and findings provided by the Companies.

The Companies proactively met with the Division and EPA early on in the process, with a workgroup meeting with EPA, the Division, and the USGS in 2012 to discuss alternate WET approaches. *See* Joint Letter from Pioneer and XTO to EPA, the Division, and USGS re: WET/Alternative Testing Procedure Meeting (Feb. 22, 2012) (attached as Exhibit 4). Prior to the meeting, Pioneer had recommended using an alternative test species for WET testing. However, EPA determined that the appropriate strategy was not to use an Alternate Test Procedure ("ATP") (species), but to conduct WET testing at the confluence of the tributaries and Purgatoire River, where the aquatic life warranting protection were present. The EPA indicated that CDPHE has the discretion to set the point of compliance for its aquatic life and toxicity testing policy. A letter from Pioneer and XTO regarding these discussions documents EPA's seminal role in Pioneer's modification request. *Id*.

Subsequent to the February 2012 work group meeting, the Companies, through the research and expertise of Dr. Rami Naddy, took the time and expense to identify the toxicant (TDS ions, primarily as sodium bicarbonate), and conduct studies, bioassays, and report findings describing an alternate WET approach. The results of these studies are contained in a comprehensive study by Dr. Naddy that was submitted to the Division. *See* WET Report. Additionally, GEI Consultants provided benthic macroinvertebrate and fish surveys on the aquatic life community in these reaches (June 2002, June 2012, and August 2012). Using the approach advocated by Pioneer and EPA, chronic WET tests resulted in findings of no lethal effects at different locations in the Lorencito Canyon and South Fork Purgatoire River tributaries. *See* WET Report at 11-12.

The executive summary of the WET Report lays out the framework for the requested approach. *See generally* Executive Summary to WET Report ("WET Executive Summary"). The summary notes that, in many locations, no flow or aquatic life would exist but for the outfall's

discharge. *See id*. at 2. When measured at the outfall, some of the outfalls could not comply with the required chronic WET testing, which used the species *C. dubia*. *Id*. at 1. This arose, in part, because of *C. dubia*'s sensitivity to total dissolved solids ("TDS") compared to other test species, such as *D. magna*. *Id*. at 2-3; *see also* WET Report at 22.

Pioneer therefore proposed a revised, two-part WET testing approach. First, Pioneer proposed acute WET testing at the outfalls prior to the discharge entering state waters using *D. magna*, which is less susceptible to TDS toxicity and more representative of the aquatic species in the areas. *See* Sandquist Letter (Dec. 16, 2013); WET Executive Summary at 4. Second, to assure that no toxicities other than TDS were affecting aquatic species, there would be chronic WET testing using *C. dubia* at the confluences with the Purgatoire River where aquatic life is found. *See* Sandquist Letter at 1 (Dec. 16, 2013); WET Executive Summary at 4.

However, it appears there is no recognition by the Division of this work and study effort in the Draft Permits. Pioneer takes exception to statements from the draft Fact Sheets that state insufficient work has been completed or data provided. For example, in the Fact Sheet to Permit No. CO-0047776, the Division states:

> The results of these toxicity investigations identify Total Dissolved Solids (TDS) as the cause. However, TDS chronic toxicity is widely known, and the information provided does not further investigate and affirm specific ions or parameters causing toxicity (e.g. ionic balance study, chloride, sulfate, etc.). No effort to eliminate or reduce chronic toxicity has been proposed by the other facilities and, even though the permittee has made a good faith effort to investigate toxicity, the casual identification is inadequate and no progress has been made towards reducing or eliminating toxicity.

47776 Fact Sheet at 41 (emphasis added). The Division found that, regardless of whether aquatic life actually exist in the relevant watersheds, the WQCC's aquatic life standards for the segmentation applied. 47776 Fact Sheet at 12-13; 48003 Fact Sheet at 12. Under the Division's policy, "Implementation of the Narrative Standard for Toxicity in Discharge Permits Using Whole Effluent Toxicity (WET) Testing" (Sept. 30, 2010) (the "WET Policy"), acute WET testing is only permissible where an instream wastewater concentration ("IWC") is 9.1% or less. 47776 Fact Sheet at 12; 48003 Fact Sheet at 12; *see also* WET Policy at 3-4. The Division found that, for Draft Permit Nos. CO-00- 47776 and CO-0048003, the IWC significantly exceeds 9.1% due to the ephemeral nature of the respective watershed, making acute testing inappropriate. 47776 Fact Sheet at 12; 48003 Fact Sheet at 12. This interpretation effectively makes it more likely for a chronic test to be applied to a dry arroyo than a flowing stream with aquatic life.

The Division separately rejected the proposal to perform chronic WET testing at the confluences due to its interpretation of Section 25-8-501, C.R.S., and 5 C.C.R. § 1002-61.8(2)(e),

which it found to require permit limitations "at outfall locations, prior to entering a state water" (emphasis in original). 47776 Fact Sheet at 13; 48003 Fact Sheet at 13.

The Division's rationale for rejecting the proposal is not supported by the law or regulation referenced by the Division. Neither Colo. Rev. Stat. 25-8-501 nor 5 C.C.R. § 1002-61.8(2)(e) requires permit limitations "prior to entering state water." Regulation 61.8(2)(e) only requires limitations, standards and prohibitions to be established for each outfall. It does not dictate that compliance and testing cannot occur downstream. Although discharge permits must include effluent limitations for each permitted outfall or discharge point (*see* 5 C.C.R. § 1002-61.8(2)(e)), neither the WQCA nor the Division's regulations specify that the concentration of a pollutant at the outfall must satisfy the receiving stream's water quality standards where, like here, the discharge is effectively treated further (by dint of its attempted journey across otherwise dry stream beds) before reaching waters where the protected use actually exists. Regulation 1002-61.8(4)(c) provides that "[t]o assure compliance with permit limitations," the permittee shall monitor "(i) the concentration (or other measurement specified in the permit) for each pollutant limited in the permit; and (ii) the volume of effluent discharged from each outfall," as well as "(iii) [o]ther measurements as appropriate." 5 C.C.R. § 1002-61.8(4)(c). Although this provision requires monitoring of the "volume of effluent discharged from each outfall," the provision does not specify where the permittee must measure the concentration of a pollutant to determine compliance with water quality standards (i.e., at "each outfall" or somewhere else). *See id*. By further allowing for "other measurements as appropriate," the regulation indicates that permittees have the ability to monitor pollutant concentrations at a location other than, or at least in addition to, the outfall as proposed by the Companies. *See id*. Accordingly, the CDPHE has the discretion to set the point of compliance for its aquatic life and toxicity testing policy. This is also the interpretation of the EPA, which recommended that Pioneer request a modified approach to testing WET. *See* joint letter from Pioneer and XTO to EPA, the Division, and USGS (Feb. 22, 2012).

Furthermore, the Division is already in possession of a significant body of data—collected at Pioneer's expense for over four years under the existing permit's report-only requirement and submitted to the Division—that shows why the new chronic WET limitations cannot be met. *See* Discharge Monitoring Reports ("DMRs") re: WET Compliance Monitoring Data (2009 – present). *See also* WET Report and attachments. The Division has chosen to implement requirements that can only be met at the end of the pipe, with the installation of at least 50 water treatment facilities – one for each outfall where WET cannot be achieved. The Division is already aware of the infeasibility of treating water at different locations in the field, as this was addressed in the alternatives analysis previously submitted to the Division for chloride. Letter from R. Sandquist to A. Neuhart re: Alternatives Analysis for Chloride (Nov. 28, 2012).

B. The Draft Permits change the WET testing species with no explanation.

One of the most critical WET testing changes in the Draft Permits is the difference in acute testing species. No longer are *Daphnia magna* ("*D. magna*") the invertebrate used in acute

samples; the invertebrate species proposed in the Draft Permits is *Ceriodaphnia dubia* ("*C. dubia*"). There is a significant difference between the existing and Draft Permits with the switch in these two organisms with no explanation or rationale stated. No acute WET tests have been conducted at outfalls with *C. dubia*. Under the previous General Permit (COG-900002), acute WET testing using *D. magna* was performed by both Pioneer and XTO and they consistently passed the acute WET testing requirements. *D. magna* is an approved acute WET test species that is more tolerant of TDS. The acute test species should remain *D. magna*, particularly in light of the fact that *C. dubia* is a Midwestern U.S. species not found in Colorado. *C. dubia* is not an appropriate test species in this area; *D. magna* was approved by the Division for acute WET tests and has been used for over ten years.

The Division failed to consider and apply Regulation 61.8(2)(b)(1)(B) requiring the Division to employ "procedures, including appropriate water quality modeling, which account for existing controls on point and nonpoint sources of pollution, the variability of the pollutant or pollutant parameter in the effluent, the sensitivity of the species to toxicity testing (when evaluating whole effluent toxicity), and where appropriate, the dilution of the effluent in the receiving water." Specifically, the Division's decision fails to consider "sensitivity of the species to toxicity testing," as required by Regulation 61.8(2)(b)(i)(B). The Division's decision is also inconsistent with EPA regional policy, which states that the permitting authority "should select the appropriate species to be tested based on taxonomic diversity, type of facility, types of potential toxicants, and effluent seasonal and temporal effects." EPA Regions 8, 9, and 10 Toxicity Training Tool at 42 (Jan. 2010)). EPA is clear that "[t]his recommendation is based upon the fact that there are species sensitivity differences among different groups of organisms to different toxicants." *Id.* at 43. For this reason, EPA states that "the Permitting Authority should evaluate any existing toxicity data provided by the permittee." *Id.* at 42. The Division has ignored the toxicity data provided as part of Pioneer's Permit Renewal Application and has failed to consider alternative test species, in direct contradiction of the applicable regulations and EPA guidance. Further, by using *D. magna*, WET testing would be more likely to detect unknown or unidentified toxics in CBM-produced water; whereas TDS-caused mortality to *C. dubia* could obscure a real toxin. Pioneer requests that the Division revise the permits such that *D. magna* remains the test species for acute testing.

If *C. dubia* is required in the final permits, then an appropriate compliance schedule (i.e., a minimum of five (5) years) is required to conduct the WET testing. 5 C.C.R. § 1002-31.14(4) and 1002-61.8; *see also* WQCD, Permit Compliance Schedules, Clean Water Policy No. 3 (March 4, 2014). While we recognize that the Division normally specifies *C. dubia* and *Pimephales promelas* ("*P. promelas*") when a permittee has requested use of an alternate species, the Division's WET guidance allows for the use of six different organisms in acute WET testing, including *D. magna* and *P. promelas* (which were in the prior permit). *See*, *e.g.*, Authorization to Discharge, Evergreen Operating Corp., Permit No. CO-0043940 (eff. Feb. 1, 1995); Amendment No. 5 – Rationale, Permit No. CO-0043940, Evergreen Operating Corporation, Coal Degasification Facility at 4 (Dec. 21, 1998) ("Although the state guidance defaults to *Ceriodaphnia* sp. for acute WET tests, it allows change to other identified species with Division

approval. The guidance states that it is permissible to change to *Daphnia magna* when total dissolved solids toxicity is suspected of causing WET failures. This change from *Ceriodaphnia* sp. to *Daphnia Magna*, with respect to TDS issues, has been previously made for a number of other discharge permits, including those for oil and gas production facilities."). Given that invertebrates used in previous versions of the permit were *D. magna*, and that the Companies have conducted significant acute WET testing, TIE/TRE with *D. magna* under the prior permits, the Companies request continued use of *D. magna* for all related permits requiring acute WET testing.

C. The Draft Permits arbitrarily increase WET testing frequency from once per year to quarterly.

The Division has not considered the technical and economic feasibility of conducting hundreds of chronic WET tests on the quarterly schedule outlined in the Draft Permits. The Division has not consulted with commercial laboratories available to the companies to determine the feasibility of meeting such a demanding schedule, nor did it consult with field personnel who have decades of experience collecting such samples to see if it was even physically possible. Because each WET test requires the collection of multiple field samples at remote locations hundreds of miles from any available laboratory, the requirement has a high probability of being logistically infeasible. Had the Division evaluated the real-world implications of such a testing schedule, it would not have accelerated the WET testing frequency from annually to quarterly.

To date, over five years of WET data has been compiled along with the special investigations to support the Companies' requests for WET permit modifications. The historic data shows consistent, predictable WET results – no increase in testing is warranted. The Division retains authority to vary the frequency as warranted by site-specific circumstances, and the Companies have collected an abundance of data which should be taken into consideration to reduce monitoring frequency, not increase it. The monitoring frequency should not increase at this juncture and should remain an annual requirement.

Furthermore, the Draft Permits specify that "failure to obtain a valid test result during a monitoring period [e.g., quarterly, in the case of WET], shall result in a violation of the permit for failure to monitor." Draft 47767 Permit at 26; Draft 47776 Permit at 15; Draft 48003 Permit at 12. This requirement, and potential violation, could result even if, due to weather, snow cover and the remote location of the outfall, it is neither feasible not safe to collect WET samples. The Division is requiring that TIEs be performed on outfalls where a WET test failure occurs. "In the event of a permit violation or when two consecutive reporting periods have resulted in failure of one of the two statistical endpoints, the permittee must provide written notification to the Division" documenting the failure or violation and also indicating whether accelerated testing or TIE/TRE is being performed, unless otherwise exempted in writing by the division. *Id*. This requirement will impose an additional and redundant responsibility on the permittees given the abundance of historical work that has documented the observed toxicity is driven by TDS for these discharges. Therefore, mandating accelerated testing and additional TIE/TRE requirements

in these permits is unreasonable and unnecessary to ensure that the toxicity is not changing and is primarily from TDS.

Further, the Division is already in possession of information submitted by the Companies' WET expert that identifies the source of the toxicity in the CBM-produced water. The Companies have demonstrated through many TIE/TRE results that the primary toxicant is TDS (mostly as sodium bicarbonate). As such, the Division should take this into account and reduce monitoring frequency to annual reporting. This is an approach the Division has followed in other permitting actions. *See*, *e.g.*, Authorization to Discharge Under The Colorado Discharge Permit System for London Mine, LLC, Permit No. CO-0038334 (issued Aug. 31, 2009); CDPS Major Amendment No. 1, London Mine, LLC (eff. July 1, 2007) (allowing conditional relief from quarterly WET testing based on test results indicating *C. dubia*'s sensitivity to zinc discharged from facility).

Despite this, the Draft Permits require costly and duplicative work associated with chronic WET testing and TIEs. Requiring Pioneer to perform a TRE and prepare a Plan is simply a requirement to identify how the company intends to treat produced water prior to discharge – a requirement the Division already knows is infeasible based on analyses previously submitted to the Division. *See* letter from R. Sandquist to A. Neuhart re: Alternatives Analysis for Chloride (Nov. 28, 2012).

The last permit term required WET testing annually. Given the remoteness of these outfalls and the sheer number of outfalls, the general frequency of WET testing should continue annually. Furthermore, for any sites where the WET limit stayed the same, the frequency should stay the same, again given the historic data collected at these outfalls, the remoteness and sheer number of outfalls, as well as the economic impact on the Companies.

D. The proposed WET testing requirements are economically unreasonable.

The increased frequency of WET testing (from annual to quarterly) and the possibility of more frequent TIE/TREs, creates significant economic challenges to both Companies. Moreover, the proposed WET testing changes are more costly with little or no net environmental benefit given the amount of historic data collected at these sites. Table XI-1 below summarizes the increased costs anticipated with the Draft Permits for WET testing alone. The proposed WET testing permit activities are a significant increase from current permits, with projected annual WET costs in the Draft Permits totaling $2.52M annually - over $1.85M more per year from current annual WET costs. As shown below, analytical testing costs are projected to increase four times from what is currently spent on the Companies' WET analytical testing. The accelerated level of TIE/TREs required in the Draft Permits will increase annual WET costs significantly. The projected cost estimates for TIE/TREs provided herein are conservatively low, as this estimate assumes a designed Phase 1 suite of tests focused on TDS interference. In order to conduct the quarterly sampling at XTO and Pioneer outfalls, labor will need to double (from one (1) full time employee ("FTE") to two (2) FTE). These full time staff will be necessary in order to

collect multiple samples as required by the protocol from a myriad of remote outfalls.[10] Vehicle costs will double and shipping costs will quadruple. The sheer quantity of samples that will need to be tested will require laboratory staff increases.

Table X-1. Estimated Increase in Costs of WET Testing Proposed in Pioneer and XTO Draft Permits.

Item	Current Annual WET Costs ($)	Projected Annual WET Costs of Draft Permit ($)
Analytical WET tests	$130,000	$520,000
TIEs and TREs	$380,000	$1,520,000
Labor	$80,000 (1 FTE)	$160,000 (2 FTE)
Vehicles	$9,600 (1 vehicle, $800/mo)	$19,200 (2 vehicles, $800/month)
Samples Shipping	$75,000	$300,000
Total	**$674,600**	**$2,519,200**

E. Inaccurate low flow data was used to develop WET limits, resulting in inappropriate limits.

On behalf of the Companies, Tetra Tech conducted continuous (every 15 minutes) and monthly flow monitoring throughout the Purgatoire watershed from April 14, 2010 until December 31, 2014. The Division used the continuous stream flow data collected by Tetra Tech (April 2010 – December 2012) as part of the permit renewal to derive low flows at some locations; however, the data was not appropriately used in all locations. In other cases, the Division has ignored the data submitted by the Companies and instead relied on comments not supported by scientific data. For instance, low flow estimates from the local water commissioner were used instead of continuous stream flow data from Stations PR-37.1 (near Stonewall, CO) and SFPR-0.2 (along South Fork Purgatoire, 0.2 miles upstream from confluence). Available scientific evidence (provided in the Permit Renewal Application) should be used to determine the appropriate 30E3 chronic flows. Based on an evaluation of this data, the WET testing requirements for many outfalls should be change from chronic to acute WET limits and IWC percentages would be reduced. *See discussion supra* at Section IX (Flow).

Given the significant seasonal flow fluctuations due to spring snowmelt, specifically in Lorencito Canyon, seasonal IWCs should be used for the discharges in permit CO-0047776.

[10] The safety implications of trying to collect this number of samples during the winter and attempting to meet holding and shipping times, should not be understated.

F. There are inconsistencies between Draft Permit language and Fact Sheets regarding WET requirements.

The draft Fact Sheets for XTO and Pioneer's permits are inconsistent with the acute and chronic WET limits provided in the Draft Permits, including, for example, errors found in Draft Permit CO-0047767 at page 26 (highlighting supplied):

Chronic WET Testing -Outfall(s): 057-A, 060-A, 065-A, 094-A, 202-A, 230-A, 075-A, 096-A, 105-A, 147-A, 156-A, 228- A, 238-A, 239-A

Table of IWCs

List of Outfalls Flows (cfs), Receiving Streams, and IWC		
Outfalls	Total Contributing Flow (cfs)	IWC
Reilly Canyon– COARLA06a		
057-A, 060-A, 065-A, 094-A, 202-A, 230-A	2.19	17% - CHRONIC
Sarcillo Canyon– COARLA06a		
075-A, 096-A, 105-A, 147-A, 156-A, 228-A, 238-A, 239-A	1.45	12% - CHRONIC

But see, Draft Permit No. CO-0047767 at page 13 (highlighting supplied):

Permitted features: 057-A, 065-A, 094-A, 147-A, 156-A, 238-A

ICIS Code	**Effluent Parameter**	**Effluent Limitations Maximum**				**Monitoring**	
		30-Day	**7-Day**	**Daily**	**2-Year**	**Frequency**	**Sample**
	WET, acute						
TAN6C	LC50 Statre 96Hr Acute *Pimephales promelas* Until December 31, 2016			LC50 ≥ IWC		Quarterly	Grab
TAM3B	LC50 Statre 48Hr Acute *Ceriodaphnia dubia*			LC50 ≥ IWC		Quarterly	Grab
	WET, chronic						
TKP6C	Static Renewal 7			NOEC		Quarterly	

	Day Chronic Pimephales promelas Starting January 1, 2017			or IC25 > IWC			3 Grabs / Test
TKP3B	Static Renewal 7 Day Chronic Ceriodaphnia dubia Starting January 1, 2017			NOEC or IC25 > IWC		Quarterly	3 Grabs / Test

The permitted limits contradict the aforementioned IWC and chronic limits. Specifically, the permitted features chart (page 13) erroneously requires acute (thru December 31, 2016) and chronic WET testing (from January 1, 2017) for these outfalls, whereas the Fact Sheet (page 26), lists an IWC only for chronic WET testing. The IWCs for these outfalls should also be updated based on the use of more accurate flow data. *See discussion supra* at Section IX (Flow). Similar inconsistencies regarding other outfalls are noted in Appendix A.

G. The Draft Permits contain contradictory requirements regarding what constitutes a failed acute WET test.

In Draft Permit No. CO-0047767, it states that:

> An acute WET test is failed whenever the LC50[[11]], . . . is found to be less than or equal to 100% effluent.

Draft 47767 Permit at 28. Elsewhere in the Draft Permit (and Fact Sheet), a failed acute test is defined as LC50 ≤ IWC% (or conversely the WET limit is LC50 > IWC. *See*, *e.g.*, Draft 47767 Permit at 29 ("there is a violation of the permit limit (the LC50 endpoint is less than the applicable IWC)"). In this Draft Permit, the definition of a failed test in Part I, section B.4.b, is both inconsistent and inaccurate. Because not all the outfalls have the same IWCs (e.g., Draft 47767 Permit at 28 (Table of IWCs)), those sentences should state that "an acute WET test is failed whenever the LC50, . . . is found to be less than or equal to the applicable IWC." This will make the information in the text consistent with the tables.

In addition, in each of the permitted features tables in the Draft Permits, the effluent limitations maximums for WET should be described as LC50 (NOEC or IC25) > IWC, not LC50 (NOEC or IC25) ≥ IWC. Draft 47767 Permit at 8-21; Draft 47776 Permit at 5-11; Draft 48003 Permit at 5-7. The Draft Permits are internally inconsistent and inaccurate on this point. Under the terms of the Draft Permits, the only way for a WET test to be considered passing is for the value to be greater than the IWC, not greater than or equal to IWC.

[11] "LC50" is the estimated effluent concentration that is lethal to 50% of the test organisms in the specific time period for that test (i.e., 48-h for invertebrates or 96-h for fish).

H. Despite new WET testing requirements, the Draft Permits do not provide adequate compliance schedules.

The Draft Permits contain many WET testing changes that are completely different and contrary to the significant WET data provided under the current permit and historical practices found in previous permits. For example, the Draft Permit requires a different species (*C. dubia*) for acute testing, testing frequency has been increased substantially from annually to quarterly, IWC concentrations have been changed, the calculation used to determine whether a chronic test passes (it now includes reproduction) and, more importantly, chronic testing requirements have been imposed instead of acute. The Division should have provided Pioneer with a compliance schedule for these broad and sweeping changes – any one of which warranted a compliance schedule. The Division also reduced compliance schedules in some cases. For example, in the case of WET testing, the Division suggested that ample time has been provided in the prior permit term to come into compliance, when in fact the proposed WET limits are different from the previous permits, new and not warranted, and erroneous. Due to the significant changes in the limits, test species, etc., the proposed WET testing limits necessitate an extended compliance schedule of four years minimum. 5 C.C.R. § 1002-31.14(4) and 1002-61.8; *see also* WQCD, Permit Compliance Schedules, Clean Water Policy No. 3 (March 4, 2014).

I. The Draft Permits impose 100% Acute WET testing for outfalls that do not reach the Purgatoire.

Outfalls that do not reach the Purgatoire and do not support aquatic communities should not require acute WET testing. The Draft Permits erroneously requires acute WET testing for outfalls that do not reach the Purgatoire. *See*, *e.g.*, Figures XI-1-A and B.

Figure XI-1-A. Upstream photo of Filbert outfall 079A (Aug. 2014). Outfall discharges directly into a landowner pond that only catches water during storm events and does not reach the Purgatoire River.

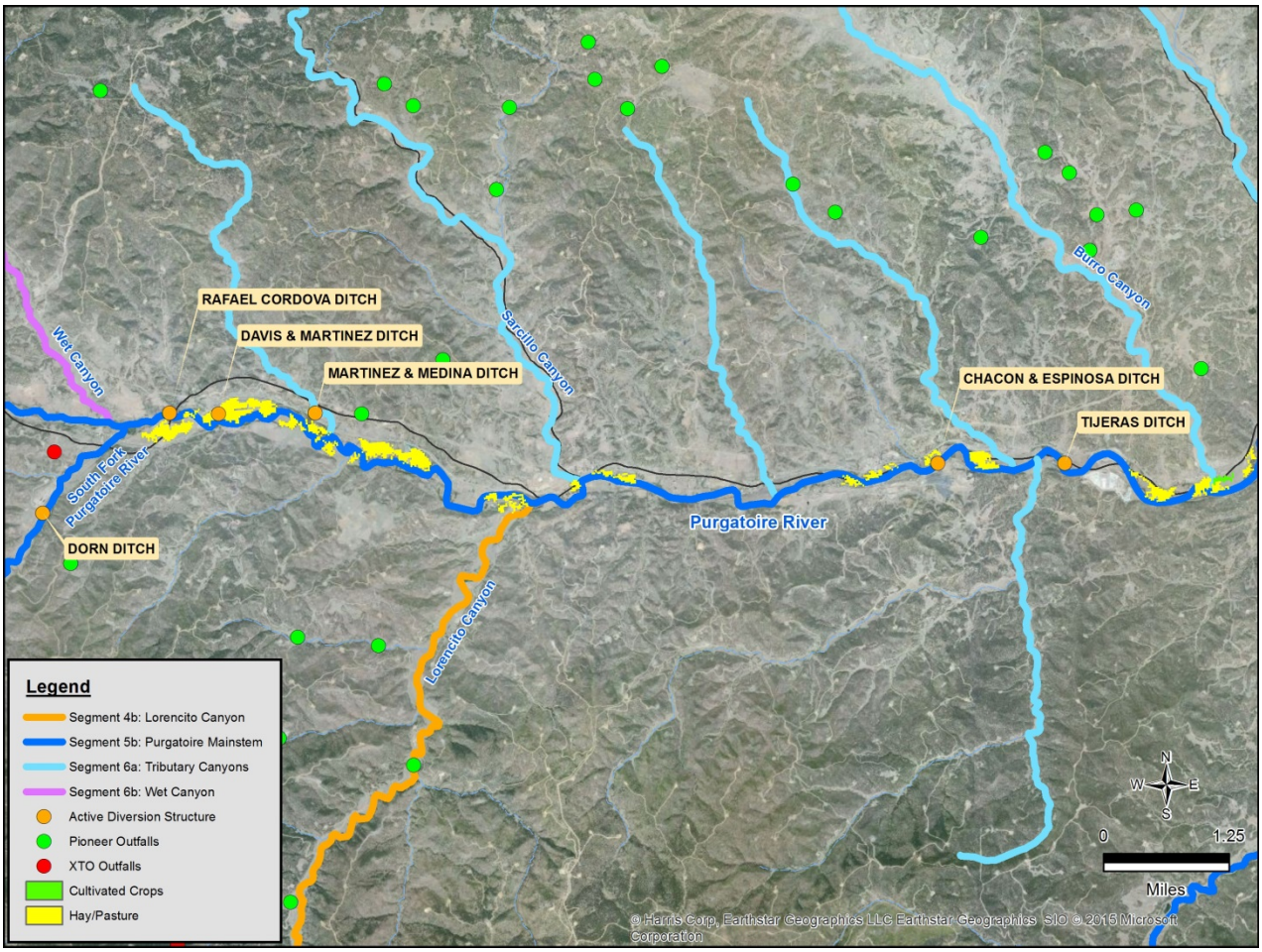
Figure XI-1-B. Downstream photo of Filbert outfall 079A (Aug. 2014).

This request for WET testing is unreasonable and will result in no environmental benefit. Notwithstanding the foregoing, if WET testing is required at these outfalls, it should be annual acute WET tests with *D. magna*.

XII. More Restrictive EC/SAR Limits Are Unnecessary

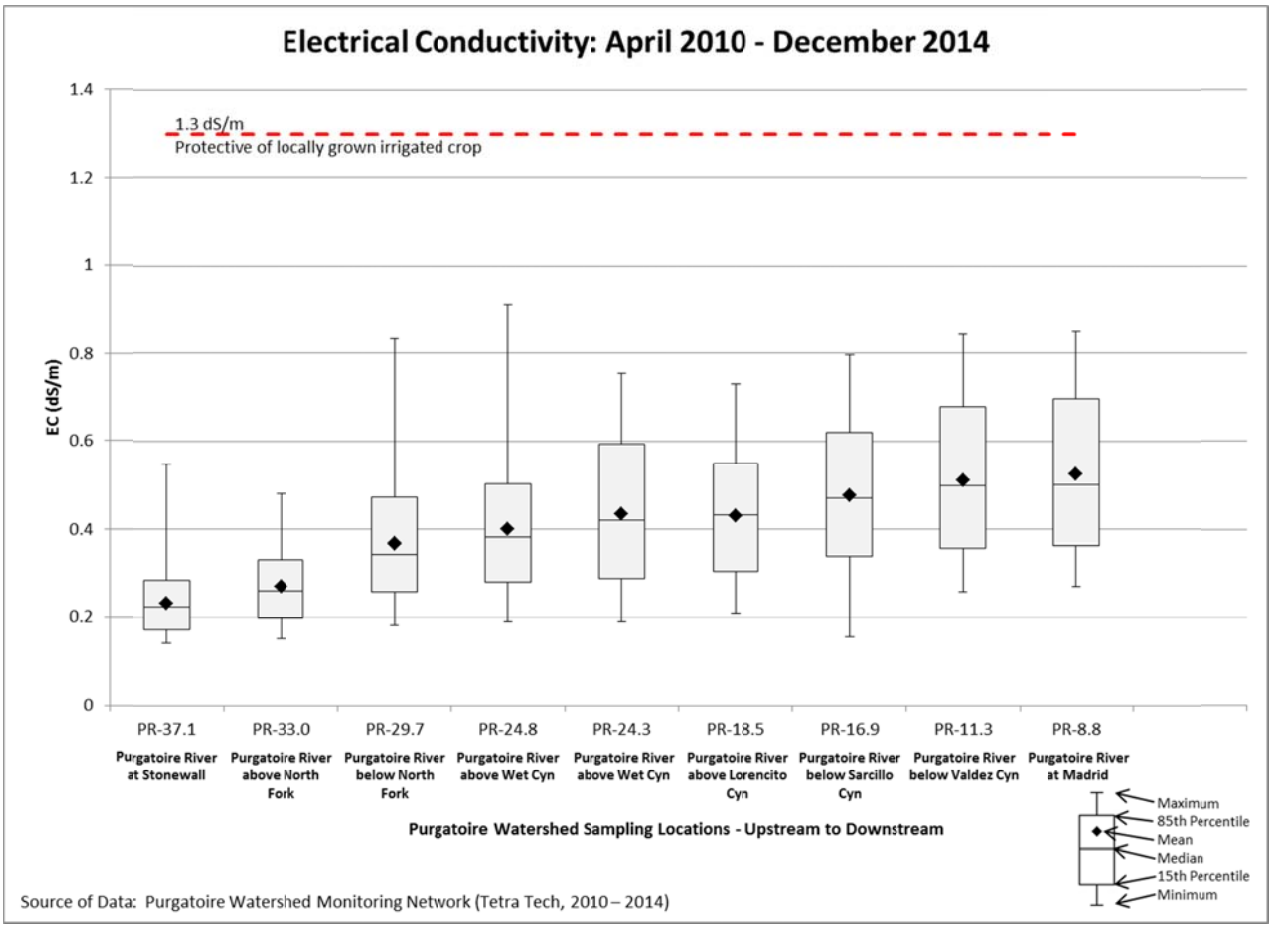
Throughout the history of CBM operations in the Purgatoire basin, levels of EC and SAR in the Purgatoire River have satisfied agricultural (irrigation) use requirements at their points of use. This is evidence that historic CBM water management practices have been protective of the water quality for agricultural uses. These findings are based upon extensive water quality monitoring in the Purgatoire River from April 2010 through the present, supported by Pioneer. Such monitoring included continuous sampling for many parameters and monthly sampling for others. EC and SAR were sampled continuously at nine locations and monthly at 27 locations in the Purgatoire River, upstream and downstream of CBM discharges. As shown in Figure XII-1, Pioneer's discharge outfalls are located in tributary canyons and agricultural irrigation uses only occur through active water diversions from the Purgatoire mainstem (Segment COARLA05b), located many miles downstream of Pioneer's discharges.

Figure XII-1. Location of Active Irrigation Diversions and CBM Outfalls.



Irrigated agriculture is protected at the River and diversions for irrigated crops. EC and SAR data have consistently been less than threshold levels protective of agriculture in the Purgatoire valley, 1.3 dS/m EC and 6.8 SAR. *See* Figure XII-2; for SAR, *see* Figure I-1.

Figure XII-2. Electrical Conductivity: April 2010 – December 2014.



Recently, Pioneer and XTO conducted soil analyses in irrigated fields. Those lands have been irrigated with Purgatoire River water, which includes CBM-produced water, for more than 20 years. Because of their senior water rights, irrigation of these fields continued during times of extreme low flow (e.g., 2002, 2011, 2012) due to drought. *See* Testimony of J. Vigil, WQCC Hearing re: Classifications and Numeric Standards for Arkansas River Basin, Regulation #32 (June 11, 2013). Even during times of extreme low-flow due to drought, some irrigation of these fields has occurred. Soil samples obtained on October 7, 2014 indicate that the soils within the irrigated fields have pH, EC and SAR levels that will not impair crop growth and development or soil structure. Soil EC was less than 1.0 dS/m at all depths in both fields with an average root zone salinity of 0.3 dS/m, a level that is protective of the most EC sensitive crop (alfalfa) grown in the Purgatoire watershed upstream of Trinidad Lake. WQCD, "Appendix A – Water Quality Assessment, Purgatoire River Canyon above Trinidad Reservoir" (rev. Dec. 7, 2009). The soil

SAR ranges from 1.2 to 1.5 and 0.9 to 1.3 in the two fields sampled and the pH ranges from 7.6 to 8.0 and 7.2 to 7.7 in the fields. The soil pH, EC and SAR are all within acceptable ranges for soils within this region and are consistent with the values for Mauricanyon soils published by the U.S. Department of Agriculture, Natural Resources Conservation Service. "Soil Survey of Las Animas County Area, Colorado, parts of Huerfano and Las Animas Counties" (2009). Moreover, in accordance with permit terms, Tetra Tech conducted soil sampling in fields irrigated for many years with waters containing CBM-produced water. Tetra Tech, "Fall 2014 Soil Sampling Results for Irrigated Soils Along the Purgatoire River Upstream From Trinidad Reservoir" (Dec. 2014). Nothing in the October 2014 soil data suggests that irrigation of these fields with a mixture of Purgatoire River water and CBM produced water discharged for almost 20 years has impacted the soil chemistry. *Id*.

To provide some historical background on the EC and SAR permitting issues, in its October 2013 permit modification request, Pioneer sought to limit EC and SAR to the 85th percentile of existing levels in the Purgatoire River upstream of Trinidad Reservoir with historical data collected by the company, with a 20% allowance for variation as accepted in laboratory duplicate analyses. The Division responded to this request by setting permit limits for flows and EC/SAR at each of Pioneer's outfalls in the permit modifications dated April 1, 2014 based upon "maximum levels" (after eliminating what the Division perceived to be "outlier" SAR values). However, there is significant variability in flows and laboratory analysis of EC/SAR that needs to be addressed in the permit limits. Upon reviewing updated data and the Draft Permit, Pioneer realized that the Division's proposed approach was infeasible. Pioneer recognized the need for caps on flow and EC/SAR, yet under the Division's modifications some outfalls would immediately exceed flow and SAR limits.

Pioneer's discharges, as demonstrated by water quality and soils salinity investigations conducted by Tetra Tech, are protective of the agricultural uses. Moreover, what is truly important are the cumulative amounts and concentrations of water (i.e., EC and SAR loads) delivered to the Purgatoire River where the irrigation use occurs. In order to address these concerns, Pioneer urged the Division to incorporate a tributary-based approach for flow, EC and SAR that would maintain "current conditions" and assure protection of these values in the Purgatoire River.

A tributary-based approach, combined with compliance points at the outfalls, is supported by the Division's statutory and regulatory authority. A primary purpose of the Water Quality Control Act's discharge permitting process is to prevent "a discharge that by itself or in combination with other pollution will result in pollution of the receiving waters in excess of the pollution permitted by an applicable water quality standard, unless the permit contains effluent limitations and a schedule of compliance specifying treatment requirements." C.R.S. § 25-8-503(4); *see also* 5 C.C.R. § 1002-61.8(1)(e) (regulatory language mirroring the statute). Effluent limitations must be based on "application of appropriate physical, chemical, and biological factors reasonably necessary to achieve the levels of protection required by the standards." *Id*.; *see also* 5 C.C.R. § 1002-61.8(2)(b) (noting that such a determination should be made on a case-by-case

basis). Caps on flow and EC/SAR for each tributary, based on historic flows and loads, would maintain historic levels of compliance while allowing for some variability (natural and operational) within and among the outfalls within each tributary.

In response to the approach Pioneer presented in October 2013, the Division issued permit modifications on February 28, 2014 (to become effective April 1, 2014). *See* 47767 Fact Sheet to Modification 2 (Feb. 28, 2014); 47776 Fact Sheet to Modification No. 3 (Feb. 28, 2014); 48003 Fact Sheet to Modification 2 (Feb. 28, 2014). The February 28, 2014 modification "set the maximum recorded SAR value for each outfall (removing outliers) as the effluent limit to maintain the 'current condition' of the Purgatoire River." 47767 Fact Sheet at 14 (Feb. 28, 2014); 47776 Fact Sheet at 11-12 (Feb. 28, 2014); 48003 Fact Sheet at 11-12 (Feb. 28, 2014). For EC, the February 28, 2014 modification set the EC limitation at the maximum recorded value. 47767 Fact Sheet at 14 (Feb. 28, 2014); 47776 Fact Sheet at 12 (Feb. 28, 2014); 48003 Fact Sheet at 12 (Feb. 28, 2014). Additionally, the modification established flow limits for each outfall, and increased the frequency of required EC/SAR sampling from quarterly to monthly. 47767 Fact Sheet at 14 (Feb. 28, 2014); 47776 Fact Sheet at 12-13 (Feb. 28, 2014); 48003 Fact Sheet at 12 (Feb. 28, 2014).

Upon implementation, however, problems with the SAR approach adopted in the permit modifications were readily apparent. Although first quarter reports on SAR compliance were not due until July 2014, Pioneer contacted the Division in June 2014 regarding compliance issues. *See* e-mail from R. Sandquist to K. Morgan, WQCD, re: SAR Issues: Pioneer Natural Resources/ Meeting with WQCD Enforcement Section (Aug. 6, 2014) (outlining investigations and studies to determine EC/SAR non-compliance and evaluations of water treatment options and closure of wells); e-mail from R. Sandquist to K. Morgan and C. Pickens, WQCD, re: Pioneer Progress Report // SAR Treatment Options (Oct. 30, 2014) (referencing July 31, 2014 meeting between Pioneer and the Division).

Later, Pioneer requested a compliance schedule. *See* 47767 EC/SAR Permit Modification Form (Aug. 7, 2014); 47776 EC/SAR Permit Modification Form (Aug. 7, 2014); 48003 EC/SAR Permit Modification Form (Aug. 7, 2014). In the requests, Pioneer noted that, since new EC/SAR limitations became effective in April 2014, Pioneer had "experienced compliance issues meeting the EC/SAR values contained in the Permits." *See* Sandquist Letter at 1 (Aug. 7, 2014). Pioneer accordingly sought "to modify the Permits to include a compliance schedule for EC/SAR with 'report only' requirements that will provide Pioneer with adequate time to assess how to comply with EC/SAR limits and to gather additional data to support revised EC/SAR limits." *Id.* Pioneer's primary rationale for requesting a compliance schedule was that the new EC/SAR protocol required monthly sampling, yet the limits were derived from quarterly data. *Id*. at 2. Pioneer and its consultants suggested that the variability of the underlying data set explained why certain outfalls reported minute exceedances under the new "current condition" limits even though there were no significant changes in field operations. *Id*. This variability was identified not only in the field, but also under laboratory conditions where duplicate analyses produced different results in terms of compliance or noncompliance with SAR limits. *Id*. Compounding the need for

additional data, Pioneer noted, was the documented fact that naturally existing geological differences in coal formations create considerable variability in the major ion compositions of groundwater. *See id*. (citing USGS, Geldon and Abbott, 1984).

The revised EC/SAR limits resulted in unpredictable, minor exceedances within outfalls. *See* Sandquist Letter at 2 (Aug. 6, 2014). However, the exceedances are classified as minor because the numeric values were within the laboratory variability for SAR testing conducted using EPA-approved analytical methods and EPA quality control guidance. In other words, as demonstrated by laboratory analyses and retesting, outfalls that met the limits one day would not on another. Accordingly, Pioneer asked for additional time to gather data to support statistically valid, revised limits, and to assess how to comply with those limits. *See id*. at 2-3.

Pioneer proposed a compliance schedule wherein Pioneer would test EC/SAR for a 24-month period and report the monthly average as "report only." *Id*. at 3. After 12 months, Pioneer would submit its sampling and testing results to the Division. *Id*. At the end of the 24-month period, Pioneer would report its EC/SAR results to the Division and provide recommended steps for EC/SAR compliance, and a schedule for compliance. *Id*. Pioneer cited 5 C.C.R. §§ 1002-61.8(3)(b) and 1002-61.8(8)(a)(i) as the regulatory basis for the imposition of a compliance schedule. *Id*. at 1-2. Pioneer sought a 24-month report-only compliance period; it did not suggest that the existing EC/SAR levels should be discarded. Importantly, during this time the Level 1 (soil salinity) and Level 2 (Purgatoire River water quality) monitoring programs in the permits would remain in effect, documenting that current conditions were maintained and agricultural uses were protected in the downstream Purgatoire (segment COARLA05b).

After reporting the SAR non-compliance, Pioneer undertook vigorous testing and re-testing to determine sources/reasons for levels above permit limits. Pioneer completed its Interim Report and submitted it to the Division on October 30, 2014. *See* e-mail from R. Sandquist to K. Morgan, WQCD, re: Pioneer Progress Report // SAR Treatment Options (Oct. 30, 2014). Pioneer also completed its analysis of SAR, bench scale testing protocols, evaluation of potential chemical additives to reduce the SAR in produced water, treatment analyses and summaries. A final report was submitted detailing the field data, data vulnerability and discrepancies and bench scale testing of potential treatment methodologies. *See* letter from R. Sandquist to K. Morgan, WQCD, re: SAR Data and Monitoring Reports, Potential SAR Exceedances Reported July 2014 (Dec. 31, 2014).

Pioneer met with the Division on multiple occasions to discuss EC/SAR permitting approaches from December 2013 until the Draft Permits were issued on February 6, 2015. *See* e-mail from R. Sandquist to P. Pfaltzgraff, re: RE: XTO Energy & Pioneer Natural Resources Meeting with WQCD Permits Section (Feb. 11, 2014).[12] The history of the Division's approach

[12] Pioneer also engaged with the Division regarding EC/SAR issues prior to filing the modification request, including on July 31, 2014. *See*, ***e.g.***, e-mail from R. Sandquist to K. Morgan, WQCD, re: SAR Issues: Pioneer Natural Resources/ Meeting with WQCD Enforcement

to addressing this issue demonstrates the arbitrary and haphazard way in which the Division has rejected Pioneer's proposals.

A. EC/SAR limitations should not apply to outfalls in Segment 6a, as there are no active diversions present and no agricultural irrigation use connections.

EC/SAR limitations should not apply to outfalls that discharge to drainages where no irrigation diversions are present. This situation exists for most of the Companies' outfalls in Lower Arkansas River Segment COARLA06a (Segment 6a), where the actual agricultural use is limited to livestock watering. EC and SAR limits were specifically developed and implemented to protect irrigated crops, not livestock.

Segment 6a is designated by the WQCC for "Agricultural Use" (5 C.C.R. § 1002-32). No active surface water irrigation diversions are present in Segment 6a.[13] As described in Table A-1a of the Water Quality Assessment, Segment 6a includes the following "receiving streams":

- Santisteven Canyon
- Sarcillo Canyon
- Burro Canyon
- Reilly Canyon
- Cow Canyon
- Smith Canyon
- Lil Bingham Canyon
- Apache Canyon and its unnamed tributary
- Ciruela Canyon
- Alamosito Canyon and its unnamed tributary
- Bingham Canyon
- Lopez Canyon

Section (Aug. 6, 2014); e-mail from R. Sandquist to K. Morgan and C. Pickens, WQCD, re: Pioneer Progress Report // SAR Treatment Options (Oct. 30, 2014) (referencing July 31, 2014 meeting between Pioneer and the Division).

[13] http://cdss.state.co.us/onlineTools/Pages/WaterRights.aspx

- Torres Canyon
- Cherry Canyon
- Left Fork of Apache Canyon
- Gallegos Canyon
- Tributaries to Lorencito Canyon, including Little Alamosa Canyon, Pancho Canyon, Alamosa Canyon, and unnamed tributaries
- Unnamed tributaries to the Purgatoire River

In the previous and current Draft Permits, the Division cites Division Policy #24, *Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops* ("Agricultural Policy"), as the basis for including EC and SAR limits in the permits for all outfalls that reach the Purgatoire River. The portion of Table 3 from the Agricultural Policy that defines the applicability of the Division's policy is reproduced in Figure XII-3, below.

Figure XII-3. Application of Agricultural Policy to Permitting Discharges to Surface Waters

Table 3. Overview of Policy Application

Site-Specific Conditions			Part A. Application of the Policy
Agricultural Beneficial Use Assigned to Receiving Water Body and Actual Use Is:	Non-agricultural		No
	Agricultural -Livestock		No
	Agricultural-Irrigated Crops	Diversion present	Yes (see Part B)
		No diversion present	No

Source: WQCD, "Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops," Water Quality Policy No. 24 (March 10, 2008).

As illustrated in Figure XII-3, the Division's policy is that when the actual use is for livestock (watering) or when no diversions for irrigation are present, then the policy should not be applied to discharges (i.e., EC and SAR limits should not be included in discharge permits for outfalls to such receiving water bodies).

Based on the Division's Policy, it is clear that none of the outfalls in Segment 6a should have EC and SAR effluent limitations.

B. The Division misinterpreted that Pioneer was requesting a removal of the new EC/SAR limitations.

The Division mischaracterized Pioneer's request for a period of report-only monitoring as a request to remove the new EC/SAR limitations indefinitely. *See* 47767 Fact Sheet; 47776 Fact Sheet; 48003 Fact Sheet. This, the Division found, did not meet the WQCA's definition of "compliance schedule," which requires "an established sequence of actions leading to compliance." 47767 Fact Sheet at 6-7; 47776 Fact Sheet at 4-5; 48003 Fact Sheet at 4-5.

Pioneer did not request that the underlying EC/SAR limits be removed for an undetermined amount of time. Instead, Pioneer asked for a 24-month period of "report only" monitoring that would allow for additional data gathering in order to determine whether the EC/SAR limits should be modified or compliance with those limits determined in another manner. *See* Sandquist Letter at 3 (Aug. 6, 2014). The modification request set forth a proposed compliance schedule, specifically outlining the sequence of actions Pioneer would take to come into compliance (Table XII-1). "SAR/EC Compliance Schedule," Sandquist Letter at Exhibit A (Aug. 6, 2014).

Table XII-1. Proposed SAR/EC Compliance Schedule.

Code	Event	Description	Date
07099	Monitoring Report	Report SAR and EC sampling and testing results as a monthly average as "Report only."	Monthly, for 24 months, beginning immediately.
50008	Study Results	Submit results of SAR and EC results to the Division, noting any seasonal and field variabilities	12 months after implementation of compliance schedule
25099	Compliance Plan	Report SAR and EC results to the Division and provided recommended steps for SAR compliance and a schedule for compliance	24 months after implementation of compliance schedule

It has been standard procedure by the Division to retain numeric discharge limits in permits subject to compliance schedules, but those limits do not take effect until the compliance schedule expires. As noted in the modification request, the outfalls exhibit considerable unpredictability under the new limits and new monthly reporting requirements. *See id*. at 2. Many outfalls would randomly demonstrate minor exceedances from test to test. This was the case for both EC and SAR. Permit-wide compliance schedules for both SAR and EC are appropriate and would address this unpredictability, not merely to bring a handful of outfalls into compliance. 5 C.C.R. § 1002-31.14(4) and 1002-61.8; *see also* WQCD, Permit Compliance Schedules, Clean Water Policy No. 3 (March 4, 2014).

C. The revised SAR approach does not account for laboratory imprecision.

The revised SAR approach is also inappropriate due to unavoidable variability in laboratory test results. Pioneer originally proposed an 85th percentile approach incorporating a 20 percent margin of error necessary to account for inherent imprecision in laboratory testing for SAR. Pioneer did not pull this approach out of thin air, but in fact derived it from established EPA testing methodology. Such methodology accounts for the fact that, under laboratory conditions, the same sample can be analyzed and re-analyzed and the results can vary by as much as 20 percent. *See* Memorandum from K. Quast, Norwest Corp., to L. Mulsoff re: SAR effected by sodium reporting accuracy and precision (June 17, 2014). From a practical standpoint, variations within this range have had no measurable effect on downstream water used for irrigation, as monitored in the Purgatoire River. *Id*. The Division's rejection of any margin of error amounts to an unfounded presumption that laboratory data are perfectly accurate and precise. Because laboratory data demonstrate unavoidable variability, however, the Division's selection of the lower confidence limit ("LCL") approach, which does not take such variability into account, is arbitrary and capricious.

D. The Draft Permits create a disincentive to retest for SAR.

Unlike the existing permits, the Draft Permits have a disincentive for retesting EC and SAR. Assuming that one sample per month ($n = 6$) were collected, then the semiannual compliance reporting would use a LCL value of 0.417 at $\hat{p} = 0.85$. This means that the 41.7^{th} percentile SAR value of the six samples would be tested against the effluent limit. However, if an additional sample were collected ($n = 7$), then the semiannual test uses a higher LCL value of 0.464 (i.e., the 46.4^{th} percentile SAR value of the seven samples would be tested against the effluent limit). If two retests were performed during the six month period ($n = 8$), then the LCL value of 0.499 essentially tests the median of the 8 samples against the effluent limit. In other words, the more samples Pioneer collects, the smaller their compliance "window" becomes.

E. It is illegal to have permit limits where compliance cannot be predicted because Pioneer cannot determine necessary controls to attain proposed limits.

The Division's own analysis demonstrates that Pioneer will have difficulty consistently meeting the SAR limits. In the Fact Sheets, the Division provides the results of its analysis and states that "discharge data from January 1, 2014 through September 20, 2014 would exhibit exceedances of the revised effluent limits, using the LCL concentration method, ..." 47767 Fact Sheet at 10. Specifically, the Division's analysis indicates that 10 of 28 (36%) active Pioneer outfalls with SAR limits in Draft Permit No. CO-0047767 (East Spanish Peaks) would have exceeded the proposed SAR limits during this period. 47767 Fact Sheet at 10.

Similar unpredictability in SAR compliance is found in all of Pioneer's permits. For example, the performance of the Division's proposed SAR approach to setting limits was evaluated using existing data and by generating random data within the range of observed values

for all data and for the "current condition" (from 2010 to 3rd quarter 2013). Potential exceedances using the Division's proposed SAR approach were evaluated by generating two random, but very probable, semi-annual datasets with the RANDBETWEEN Excel function using the minimum and maximum values from the "current condition" dataset at each site. The results of this analysis confirm the Division's own acknowledgment in the Fact Sheets that exceedances of SAR limits using the LCL concentration are likely. In addition, the analysis indicated that compliance with the SAR limits will be unpredictable. Specifically, from one semi-annual period to the next, those outfalls exceeding their limits could change. Consequently, it will be difficult to identify which outfall needs to be mitigated. This demonstrates that the Division's proposed SAR approach is flawed, due to Type 1 error, in that the "current condition" data itself can easily generate outfall-specific exceedances that vary statistically from one semi-annual reporting period to the next and for sites that, to date, have not shown an exceedance.

In summary, the Division's proposed statistical approach will result in a high probability of exceeding an effluent limit that will vary from site to site for each semi-annual reporting period.

F. SAR limits should be set at the maximum historic values, which have proven protective.

Although Pioneer did not request it, the Division developed a revised SAR approach based on the LCL method developed for the 2016 Listing Methodology, in which the LCL concentration of the reported value would be compared to the effluent limitations (which are based on the 85th percentile of the "current condition" data) on a semi-annual basis. 47767 Fact Sheet at 7-10; 47776 Fact Sheet at 6-9; 48003 Fact Sheet at 6-8; *see also* Draft Permits, Appendix B – Statistical Method Used for Compliance Determinations for SAR (Jan. 8, 2015) ("Appendix B"). By contrast, the limits in the February 28, 2014 modification were based on the maximum value observed in the "current condition" dataset. 47767 Permit at 6-7; 47776 Permit at 4; 48003 Permit at 4.

The 85th percentile and the 95% LCL of the 85th percentile approach is based on a policy for determining water quality impairment under 303(d). *See generally* Appendix B. These statistical protocols were not established, or approved, for developing limits in discharge permits. In the Fact Sheets, the Division attempts to explain its reasons for selecting this approach:

> The Division maintains that the data used in setting the current permit limitations for EC and SAR was based on a representative data set that was adequate for evaluating "current condition".

47767 Fact Sheet at 7; 47776 Fact Sheet at 6; 48003 Fact Sheet at 6. However, the above statement was written with respect to the SAR limits in the existing permits, prior to the introduction of the new revised methodology using the 85th percentile. The existing SAR limits are based on the maximum of 15 quarterly SAR values from the "current condition" time frame of 2010 to 3rd quarter of 2013. The Division goes on to explain:

> Nevertheless, noting the "field variability" described above, the Division explored options for the establishment of effluent limitations and evaluation of compliance for limits for SAR which, would expressly allow for variability and for slight single value exceedances of the current permit limits to be considered compliant.

47767 Fact Sheet at 8; 47776 Fact Sheet at 6; 48003 Fact Sheet at 6. However, the 85th percentile method selected for setting the new SAR limits does the opposite of allowing for variability by design. A percentile indicates the relative standing of a data value when the data are sorted in numerical order and the percent of data values are less than or equal to the *n*-th percentile. For example, 85% of data values are less than or equal to the 85th percentile and 15% of the data values (including the maximum) exceed the 85th percentile. Percentiles are mostly used with very large data sets because removing data values, such as the top 15% when using the 85th percentile, is not significant. However, with smaller datasets, such as here, this censorship can have significant implications. When using the 85th percentile, 15% of the highest data points are removed from the analysis. In the case of 15 data points the two highest values are removed reducing the dataset to only 13 values. Additionally, removing these two values also reduces the variability of the dataset, especially when the spread in data values is large. Thus, the use of percentiles reduces the variability in the available dataset by removing the largest numbers and restricting the remaining numbers to the lower values. This censorship achieves the opposite effect of what was sought by Division when making the revised SAR limit approach.

G. The Division erroneously thought the data set was large, so using the 85th percentile would be inappropriate.

The Division states that the SAR "current condition" effluent limitations are based on "15 data points from each outfall from January 2010 through September 2013. This resulted in an evaluation based on well over 500 data points for this facility." 47767 Fact Sheet at 7; 47776 Fact Sheet at 6; 48003 Fact Sheet at 6. This is a misleading statement. The Division's dataset actually only involves 13 data points per outfall, because two values were eliminated. As such, the Division's analyses are based on 13 quarterly data points for each outfall, *not* a combined analysis of 500 data points as the Fact Sheet suggests. The potential variability between these datasets of size n=13 and n=500 are quite different. For example, Appendix B, Table 2 of the Draft Permits indicate an LCL of 0.622 ($\hat{p}$ = 0.85) for n = 15 [sic, n = 13, LCL is 0.599]. However, for n = 100 (highest value provided in Table 2) the LCL is much higher (0.780). For a sample size of n = 500, the LCL would be well above that at n = 13.

Furthermore, the Division's assessment of "current condition" is inconsistent with the Division's past practices in applying this term. The purpose of the "current condition" approach is to maintain current environmental standards in the receiving body, allowing the permittee some flexibility in the details of its operations so long as the ultimate outcome is satisfactory. Imposing per-outfall limits, however, with no regard for the actual condition of the receiving body, contradicts the very purpose of the "current condition" approach. The Division has not

established that the "current condition" warrants more stringent EC/SAR limits. In fact, data from April 2010 to December 2014 indicates that EC/SAR levels in the Purgatoire River downstream of the outfalls remain protective of crops grown and irrigated in the basin. *See* Figure I-1 and XII-2 above.

H. The Division is not authorized to dictate the Companies' operations in order to accommodate its proposed SAR monitoring schedule.

In its discussion of SAR sample collection, the Division states that:

> [T]he permittee is encouraged to plan any decommissioning of outfalls for the end of the reporting period, or to collect additional samples in advance of any planned decommissioning to ensure that the minimum of five samples needed to report the LCL concentration will be available.

47767 Fact Sheet at 8; 47776 Fact Sheet at 19; 48003 Fact Sheet at 8. This statement fails to acknowledge or account for unplanned shutdowns of outfalls, such as those due to prolonged cold weather, large snow/rainfall events, and wildfires or due to unscheduled operational issues such as pump failures. In suggesting that the Companies' should plan outfall operations to accommodate the Division's monitoring schedule is beyond the Division's authority and ignores operational realities. Force majeure events could cause unexpected and unplanned shutdowns of outfalls that would impact the Division's proposed monitoring schedule. To accommodate these operational realities, the monitoring schedule should be monthly and the minimum number of samples collected during that monitoring period will represent what activity actually took place at the outfall. The Companies cannot anticipate or plan for unexpected outfall shutdowns and the monitoring schedule must take this reality into account.

I. The Division's application of "current condition" in developing limitations in the Draft Permits is inconsistent with prior agency practice and without justification.

In implementing more stringent EC/SAR limits, the Division repeatedly stated that it established these limitations based on effort to maintain the "current conditions" within the watershed. The Division explained:

> The current condition approach used for both the 2014 modification and for this renewal permit is to establish effluent limits that characterize the water quality of the discharge for the period of record January 1, 2010 through September 30, 2012. Effluent limits are intended to <u>hold the current condition in place</u> from a water quality standpoint, <u>which allow the permittee operational flexibility to change the quantity and quality of water from each outfall, to the extent that these changes do not result in a significant departure</u>

> from the characterized condition. The Division agrees that these changes in quality can be attributed to a number of operational factors, including reductions and increases in flow from existing sources within the piping network to each outfall, changes in chemistry in groundwater formations from which produced water is currently withdrawn, changes in formations from which groundwater is withdrawn within existing wells, and changes in sources (wells) to the outfall piping network. All of these changes can have a diluting, or concentrating effect on the SAR level and remain both a flexibility and a responsibility for the permittee to manage.

47767 Fact Sheet at 11 (emphasis added). *See also* 47776 Fact Sheet at 6 ("One objective of the establishment of effluent limits set to represent the current condition characterized from January 2010 through September 2013, was to allow these operational and discharge changes to occur only to the extent that they do not result in a decrease in water quality"); 48003 Fact Sheet at 6 (same language). Allowing for operational and discharge changes that do not result in a decrease in water quality is consistent with the Division's past practices in developing limitations to maintain "current conditions." "Current condition" is typically used in the context of temporary modifications. *See*, *e.g.*, 5 C.C.R. § 1002-38.82 ("the Division will assess the current effluent quality, recognizing that it changes over time due to variability in treatment plant removal efficiency and influent loading from industrial, commercial, and residential sources. One necessary element of an approach to maintain the current condition would be a requirement that the total loading from commercial and industrial contributors be maintained at that level as of the date of adoption of the temporary modification and that neither the concentration nor the frequency of high concentration shall increase over historic levels and frequency.").

Despite espousing that the new limits would allow the Companies' operational flexibility, the Draft Permits imposed flow limits to specific outfalls, which negates the flexibility the Division highlighted in imposing new limits based on "current conditions." Draft 47767 Permit at 4-5; Draft 47776 Permit at 5-10; Draft 48003 Permit at 5-7. The Division explained that because the new EC/SAR "permit limitations were revised to ensure that the 'current condition' was retained, flow limits were added to each outfall." 47767 Fact Sheet at 5; 47776 Fact Sheet at 4; 48003 Fact Sheet at 4 (emphasis added). The Division's explanation for imposing new, more stringent SAR limits while also imposing flow limits flies in the face of the Division's past practice in applying limits that maintain "current conditions."

The purpose of the "current condition" approach is to maintain current environmental standards in the receiving body, allowing the permittee some flexibility in the details of its operations so long as the ultimate outcome is satisfactory. Imposing per-outfall limits, however, with no regard for the actual condition of the receiving body or operational realities, contradicts the very purpose of the "current condition" approach. Years of real-life experience with the Pioneer's operations in the Raton Basin and water quality data collected from wellheads, outfalls,

and at numerous surface water monitoring stations demonstrate that the current condition of the Purgatoire River is clean and healthy and that Pioneer's continued CBM operations will not adversely impact the River. Such a backward application of the Division's stated methodology is arbitrary and capricious. The Division has the discretion to set the EC and SAR limits at the maximum levels, as proposed by Pioneer.

J. Applying different EC/SAR requirements and compliance schedules in the Companies' permits and in the New Elk permit is arbitrary and inconsistent.

On the same day the Division issued the Draft Permits for Pioneer and XTO, it issued a Draft Permit for New Elk Coal Company ("New Elk"). Draft Authorization to Discharge, Permit No. CO-0000906 (Feb. 6, 2015). New Elk outfall 001 discharges to the Middle Fork of the Purgatoire River, upstream of outfalls covered by Permit Nos. CO-0047767 and CO-0047776. Fact Sheet to Permit No. CO-0000906 at 2 (Feb. 6, 2015) ("906 Fact Sheet"). Because of their close proximity and discharge locations, a comparison of effluent limitations and compliance schedules presented in the Draft Permits shows that New Elk was provided a longer period of time with which to meet the new SAR limitation on its one applicable outfall (001). In terms of SAR, the Division recognized that Pioneer would not be able to meet the new, lower limits that were effective immediately on 34 outfalls dispersed throughout the basin. In the WQA, the Division noted that New Elk may not be able to consistently meet the limits. WQA at 23. Given these similar compliance scenarios, it would be logical to expect that both permittees would be issued compliance schedules (consistent with the Division's past practice, regulations, and policies). However, only New Elk was granted a compliance schedule for this requirement. The Division's approach to imposing new, more stringent requirements on one permittee and allowing another additional time to comply demonstrates the arbitrary and unsupported manner in which the Division developed the Draft Permits. Permittees to the same body of water and in the same watershed should be given comparable permit limitations and compliance schedules.

K. EC/SAR limitations should not apply to outfalls that discharge into low- or no-flow tributaries.

The Agricultural Policy does not apply to discharge water that does not reach irrigation diversions (no downstream diversions). Discharges from outfalls in the Draft Permits are located in the canyons tributary to the Purgatoire River, in large part to dry arroyos as depicted below.

Figure XII-4-A. Upstream photo of Lorencito outfall 027A (Aug. 2014). Outfall discharges to a normally dry arroyo with no continuous natural surface flow below the outfall.

Figure XII-4-B. Downstream photo of Lorencito outfall 027A (Aug. 2014).

Figure XII-5-A. Upstream photo of Melbourne outfall 217A (Sept. 2014). Outfall discharges to a normally dry arroyo with no continuous natural surface flow below the outfall.

Figure XII-5-B. Downstream photo of Melbourne outfall 217A (Sept. 2014).

In accordance with current permit conditions, monitoring is taking place in appropriate locations to protect the agricultural use, namely in the Purgatoire River (where diversions occur) and on parcels that have a long history of irrigation in the Purgatoire valley. The data collected in the Purgatoire River (*see* Figure XIII-1) and field soils demonstrate that there are no EC or SAR issues in the Purgatoire that would cause harm to irrigated acreages located many miles downstream of outfalls which discharge to upstream dry arroyos. *See* EC/SAR Compliance Report (submitted Dec. 2014). Contrary to the Division's concerns, there has been no increasing level of contamination that would threaten to push the system over the target soil and water levels suitable for local crops.

L. The Division inappropriately applies Appendix B to the Draft Permit SAR limits.

It was inappropriate for the Division to incorporate the LCL approach contained in Appendix B. That policy is intended for the 303(d) impaired waters analysis; neither the intent or scope of that policy applies to determining discharge limits. Moreover, Appendix B was still a draft policy, even for 303(d) impaired waters.

XIII. IRON

A. Iron at Historic High Levels

Water quality data collected by USGS (1978 -1981) and Tetra Tech (April 2010 to December 2014) demonstrate that the Purgatoire Watershed produces and transports very high volumes of sediment (as measured by TSS) and associated iron.

The monitoring network design implemented by Tetra Tech April 2010 through December 2014 included 27 stations that were monitored monthly and nine monitoring sites which continuously recorded data near real-time (Figure XIII-1). Three Purgatoire River monitoring sites [North Fork Purgatoire-5.2 (NFPR-5.2), Middle Fork Purgatoire-37.1 (PR-37.1), and South Fork Purgatoire 12.7 (SFPR-12.7)] are upstream of CBM outfalls and represent ambient water quality entering the basin. A variety of water quality parameters were measured at these three upstream locations, including total recoverable iron (Fe_{TR}) and TSS. This data has been made available to the Division and the public. Summary statistics for the iron and TSS data collected from these three stations since April 2010 are provided in Table XIII-1. While the upper basins of the Purgatoire River watershed can produce water containing high concentrations of TSS and iron, this is particularly true of the upper South Fork basin. Following on discussions with the Division's Permit Section which started as early as 2012/2013, Pioneer proposed a system to reduce iron from streambank erosion, a significant contributor of iron in the Purgatoire River.

Figure XIII-1. Purgatoire River Watershed Monitoring Network (Tetra Tech, April 2012 – Dec. 2014).

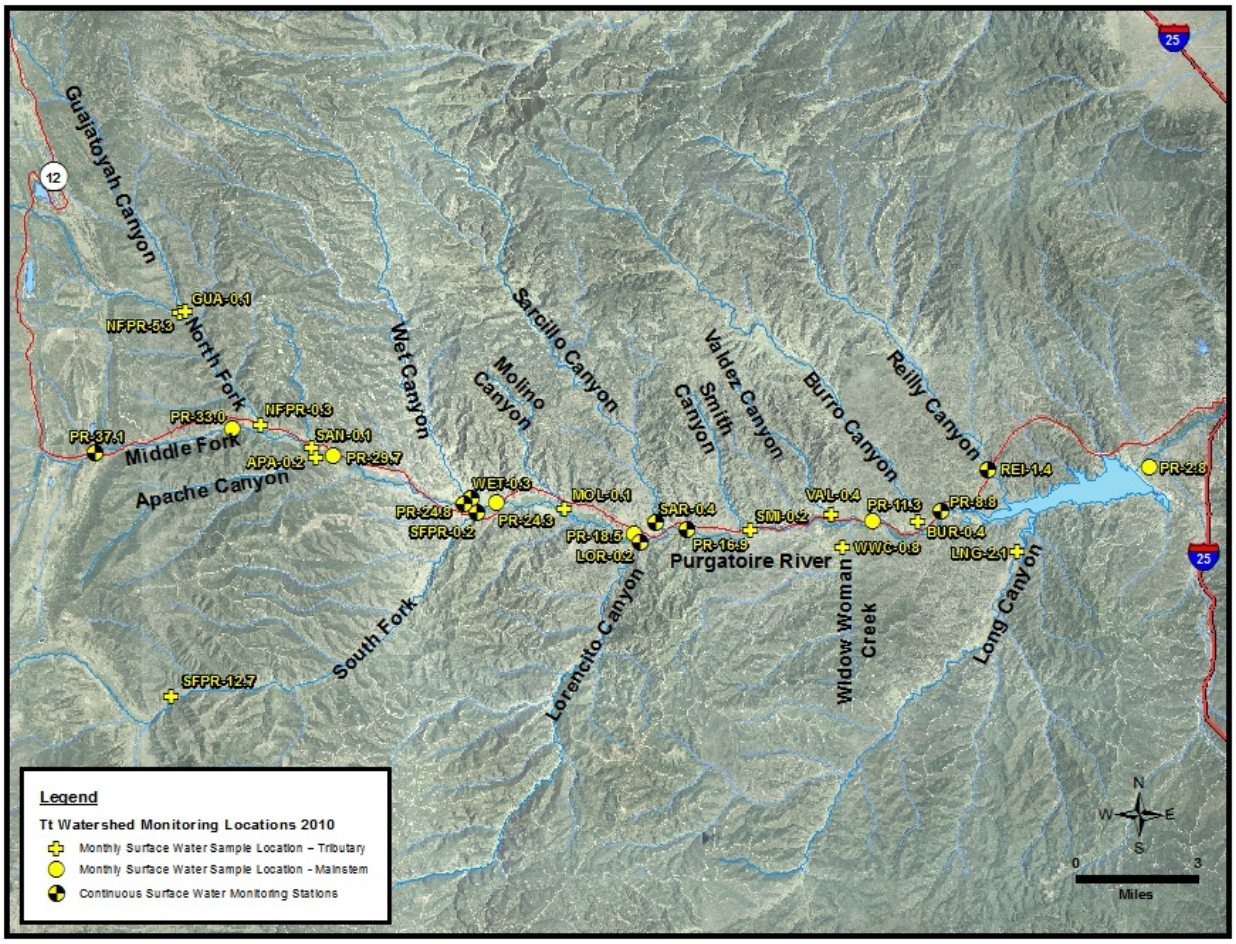


Table XIII-1. Ambient Total Recoverable Iron (Fe_{TR}) and TSS Data for Purgatoire River Upstream of CBM Influence (Tetra Tech, 2010 – 2013).

Sample Location	Parameter	Number of Samples	Minimum (µg/L)	50th Percentile Median (µg/L)	Mean (µg/L)	Maximum (µg/L)
North Fork (NFPR-5.3)	Fe_{TR}	28	30	190	304	1,230
	TSS	28	5,000	5,000	7,179	18,000
Middle Fork (PR-37.1)	Fe_{TR}	28	20	165	261	1,500
	TSS	28	5,000	5,000	7,143	20,000
South Fork (SFPR-12.7)	Fe_{TR}	30	60	185	833	12,600
	TSS	30	5,000	5,000	17,433	227,000

Note: The MLD for TSS is 5,000 µg/L.

The Purgatoire watershed monitoring program also includes sampling tributaries within the footprint of the CBM operational area that have no active CBM produced water outfalls. This includes a monitoring station near the mouth of Long Canyon Creek. Summary statistics for the iron and TSS data collected from this non-CBM influenced tributary is provided in Table XIII-2.

Table XIII-2. Total Recoverable Iron (Fe_{TR}) and TSS Data from Non-CBM Influenced Tributary Long Canyon Creek (Tetra Tech, 2010 – 2013).

Sample Location	Parameter	Number of Samples	Minimum (µg/L)	50th Percentile Median (µg/L)	Mean (µg/L)	Maximum (µg/L)
Long Canyon (LNG-2.1)	Fe_{TR}	28	60	255	464	1,810
	TSS	28	5,000	6,500	12,714	72,000

Note: The MDL for TSS is 5,000 µg/L.

Additional total recoverable iron and TSS data are available from the USGS Gaging Station No. 07124200 (Purgatoire River at Madrid, Colorado) which is located just upstream of Trinidad Lake and downstream of the majority of the CBM outfalls. This gage has been active for approximately 40 years and water chemistry data collected 1978 to 1981 reflects ambient, non-CBM conditions for the entire watershed. The iron and TSS data collected by the USGS at this station during this historical period of record are summarized in Table XIII-3.

Table XIII-3. Ambient Total Recoverable Iron (Fe_{TR}) and TSS Data Collected by USGS at Madrid Gaging Station (Period of Record 1978 to 1981 – prior to CBM-development).

Parameter	Number of Samples	Minimum (µg/L)	50th Percentile Median (µg/L)	Mean (µg/L)	Maximum (µg/L)
Fe_{TR}	15	20	26,000	134,505	650,000
TSS	33	3,000	146,000	5,045,303	37,000,000

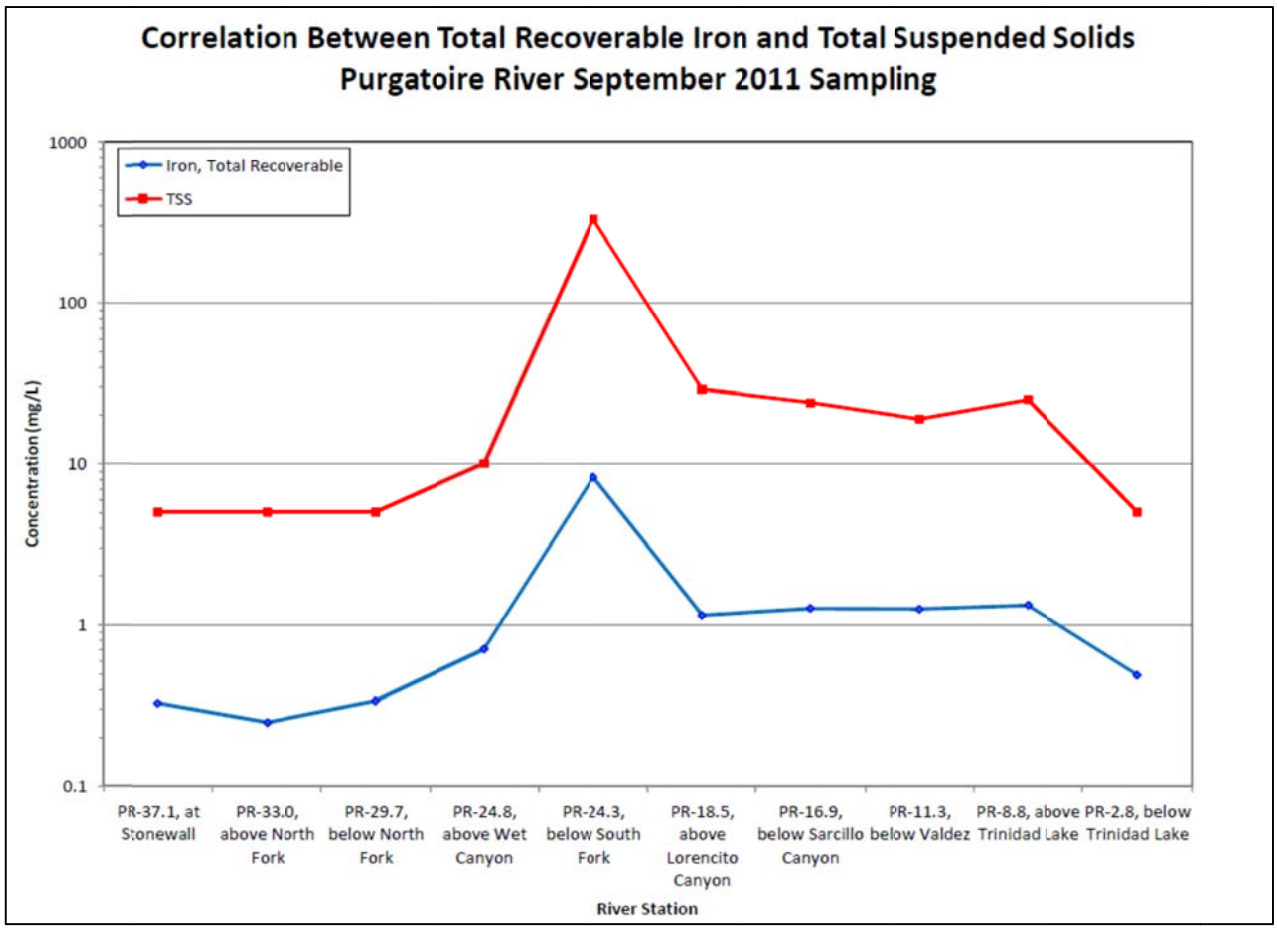
Historic iron and TSS data are also available for several Purgatoire tributaries from 1978 through 1981 when the USGS performed a focused monitoring program in the watershed. While a few of these tributaries now have CBM produced water outfalls within their boundaries, during the USGS study they did not. Therefore, these data reflect ambient, non-CBM conditions for these sub-basins in the Purgatoire watershed. The iron and TSS data collected by the USGS at these stations are summarized in Table XIII-4.

Table XIII-4. Total Recoverable Iron (Fe_{TR}) and TSS Data for Tributaries Monitored by the USGS (Period of Record 1978 to 1981).

Sample Location	Parameter	Number of Samples	Minimum (µg/L)	50th Percentile (µg/L)	Mean (µg/L)	Maximum (µg/L)
Reilly Canyon 07124220	Fe_{TR}	30	10	280,000	261,134	590,000
	TSS	13	68,000	22,300,000	39,235,923	142,000,000
Sarcillo Canyon 07124120	Fe_{TR}	20	190	430,000	395,324	720,000
	TSS	14	340,000	7,100,000	15,800,929	60,900,000
Molino Canyon 07124100	Fe_{TR}	26	76,000	240,000	318,539	670,000
	TSS	8	27,400,000	41,400,000	41,650,000	59,000,000
Middle Fork Purgatoire @Stonewall 07124050	Fe_{TR}	11	20	180	4,344	43,000
	TSS	25	2,000	12,000	322,480	3,670,000

Elevated sources of iron and sediment loads are derived from soils throughout the watershed and more predominately from the South Fork Purgatoire watershed where wildfire and grazing practices have increased runoff, stream bank erosion and resulting sediment and iron loads. Figure XIII-2 exemplifies the elevated TSS and iron concentrations recently measured in the Purgatoire watershed below the South Fork Purgatoire (PR-24.3).

Figure XIII-2. Relationship between TSS and Total Recoverable Iron (Fe_{TR}) in Purgatoire River Watershed including South Fork.



Although wildfires in the upper South Fork basin have contributed to the high sediment and associated iron loads, the historic data collected at the Madrid gaging station by the USGS (Table XIII-3) indicate that this is not a recent issue. The historic tributary data (Table XIII-4) and recent non-CBM tributary data (Table XIII-2) also demonstrate that erosion and sediment transport is a regional issue, a conclusion that is supported by the presence of numerous historic sediment control structures that are present in the tributaries throughout the basin.

Water quality data collected as part of the Purgatoire watershed monitoring program (April 2010 to December 2014) and U.S. Geological Survey (Madrid Station, upstream of Trinidad Lake, 1978 to1981) demonstrate the significant correlation between sediment and iron concentrations in the watershed, with 42 data observations (n = 42, 10 USGS data and 32 Tetra Tech data) and a statistically significant coefficient of determination (r2) of 0.9829 (Figure XIII-3).

Figure XIII-3. Regression Analysis TSS vs. Fe_{TR}.

Water quality data collected as part of the Purgatoire watershed monitoring program (April 2010 to present) and US Geological Survey (Madrid Station, upstream of Trinidad Lake, 1978 to1981) demonstrate the significant correlation between sediment and iron concentrations in the watershed, with a coefficient of determination (r^2) of 0.9829 (Figure 4).

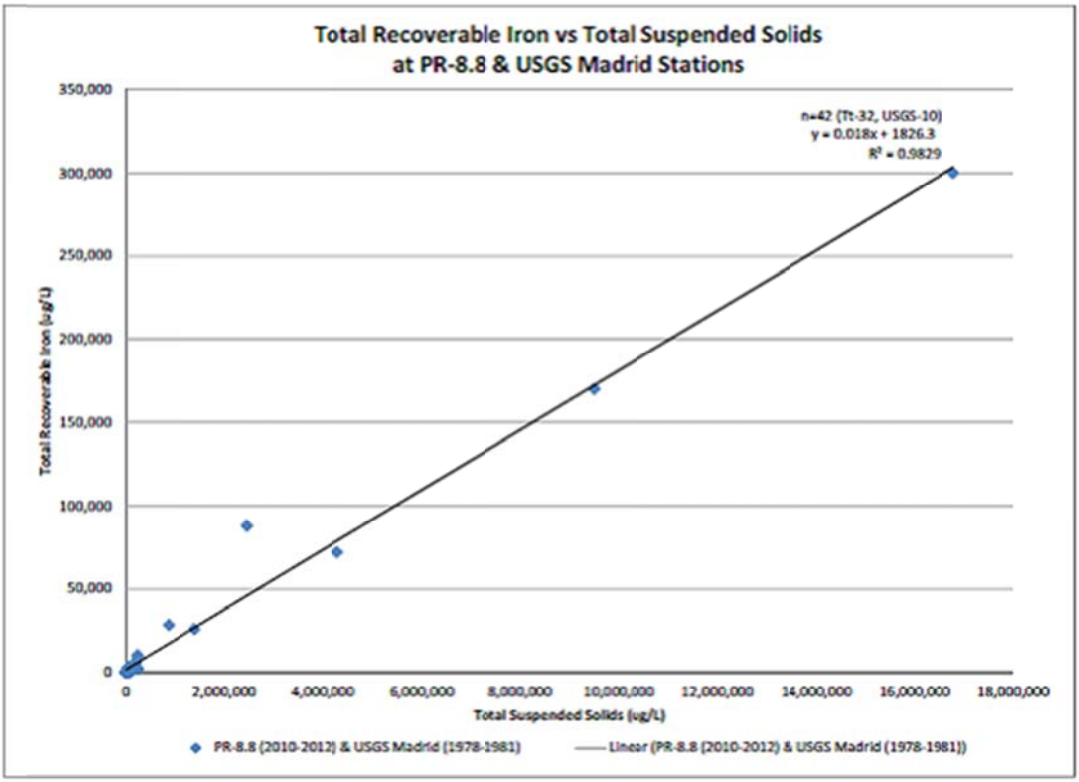


Figure 4: Regression Analysis TSS vs. Fe_{TR}

B. Iron limits will be erroneously required for outfalls which discharge to tributaries without iron standards.

Discharges to Segments 5b and 6a have iron limits in the Draft Permit even though there are no iron standards for these segments. WQA at Table A-3b. As such, the applicable permits impose an iron limit based on this standard for discharges to segment 6a because they assert that the discharges reach the Purgatoire River (Segment 5b). The iron limits were calculated using receiving water low-flow values for the each specific reach of the Purgatoire (all segment 5b), as follows:

- South Fork of the Purgatoire – Iron limit of 1,308 ug/l based on chronic (30E3) low-flow of 0.5 cfs.

- Middle Fork of the Purgatoire – Iron limit of 1,471 ug/l based on chronic (30E3) low-flow of 1.0 cfs.

- Mainstem of the Purgatoire – Iron limit of 1,649 ug/l based on chronic (30E3) low-flow of 11 cfs.

However, in imposing these limits, footnotes to WQA Tables A-15a thru -15j explain that "Downstream segment (COARLA05b) has this parameter, not the immediate receiving stream."

Many of the segment 6a discharges have iron limits based on the discharged effluent eventually reaching a stream segment with iron standards. In some cases, the original discharge may be 5 to 10 miles (estimate) from the stream segment where the standards are being applied. This logic could be used to apply segment standards even farther downstream and lead to questions of how far is too far, and as such are arbitrary.

C. The Division erroneously eliminated elevated total recoverable iron concentrations from the dataset.

In the WQA, the Division erroneously eliminated nine elevated total recoverable iron concentrations from the dataset based on a "statistical outlier analysis." *See* WQA at 33-36. Given that the Purgatoire watershed is subject to frequent monsoonal flood events, as illustrated in Figure XIII-4 below, as well as high flows associated with the annual spring freshet, eliminating these data were inappropriate.

Figure XIII-4. Purgatoire watershed flooding in Burro Canyon on August 16, 2012 near its confluence with the Purgatoire River.

During these high flows, a large amount of sediment is mobilized and transported to the Purgatoire River. Elevated TSS and total recoverable iron (Fe_{TR}) concentrations were observed throughout the watershed based on this localized flood event. Fe_{TR} and TSS data collected at this time are not outliers. In fact, these data are applicable and representative of iron concentrations during spring runoff and during post-summer monsoonal storm events, when elevated TSS and iron concentrations are observed (Table XIII-5). Therefore, the elevated iron concentrations and corresponding high TSS are validated by other hydrologic data and field observations.

The data demonstrate that high sediment concentrations after storm events correspond to high iron concentrations, regardless of pre-CBM (USGS, 1978-1981) or current conditions (2010-2012).

Table XIII-5. Validated Streamflow, Fe_{TR} and TSS Data for Purgatoire River (2010-2012).

Sample Location	Date	Parameter	Maximum
North Fork[13] (NFPR-5.3)	6/16/10	Fe_{TR}	1,230 ug/L
	6/16/10	TSS	18,000 ug/L
	6/16/10	Flow	68.29 cfs
North Fork (NFPR-0.3)	7/21/10	Fe_{TR}	2,840 ug/L
	7/21/10	TSS	53,000 ug/L
	7/21/10	Flow	21.75 cfs
North Fork (NFPR-0.3)	4/14/10	Fe_{TR}	2870 ug/L
	4/14/10	TSS	55,000 ug/L
	4/14/10	Flow	34.66 cfs
Middle Fork[13] (PR-37.1)	8/18/10	Fe_{TR}	1,500 ug/L
	8/18/10	TSS	20,000 ug/L
	8/18/10	Flow	25.53 cfs
South Fork[13] (SFPR-12.7)	4/14/10	Fe_{TR}	12,600 ug/L
	4/14/10	TSS	227,000 ug/L
	4/14/10	Flow	33.54 cfs
Guajatoyah (GUA-0.1)	7/21/10	Fe_{TR}	13,000 ug/L
	7/21/10	TSS	270,000 ug/L
	7/21/10	Flow	3.01 cfs
Guajatoyah (GUA-0.1)	09/14/11	Fe_{TR}	3,730 ug/L
	09/14/11	TSS	63,000 ug/L
	09/14/11	Flow	0.64 cfs
Guajatoyah (GUA-0.1)	7/13/11	Fe_{TR}	3,340 ug/L
	7/13/11	TSS	54,000 ug/L
	7/13/11	Flow	0.64 cfs

[13] Locations upstream of all CBM operations.

D. Iron Trading – Reducing Iron and TSS and Improving Stream Channel and Aquatic Habitat.

1. Description of Proposed Iron Trade and Division's Rejection

Pioneer submitted its request for a modification of iron limits in all three of the Permits on

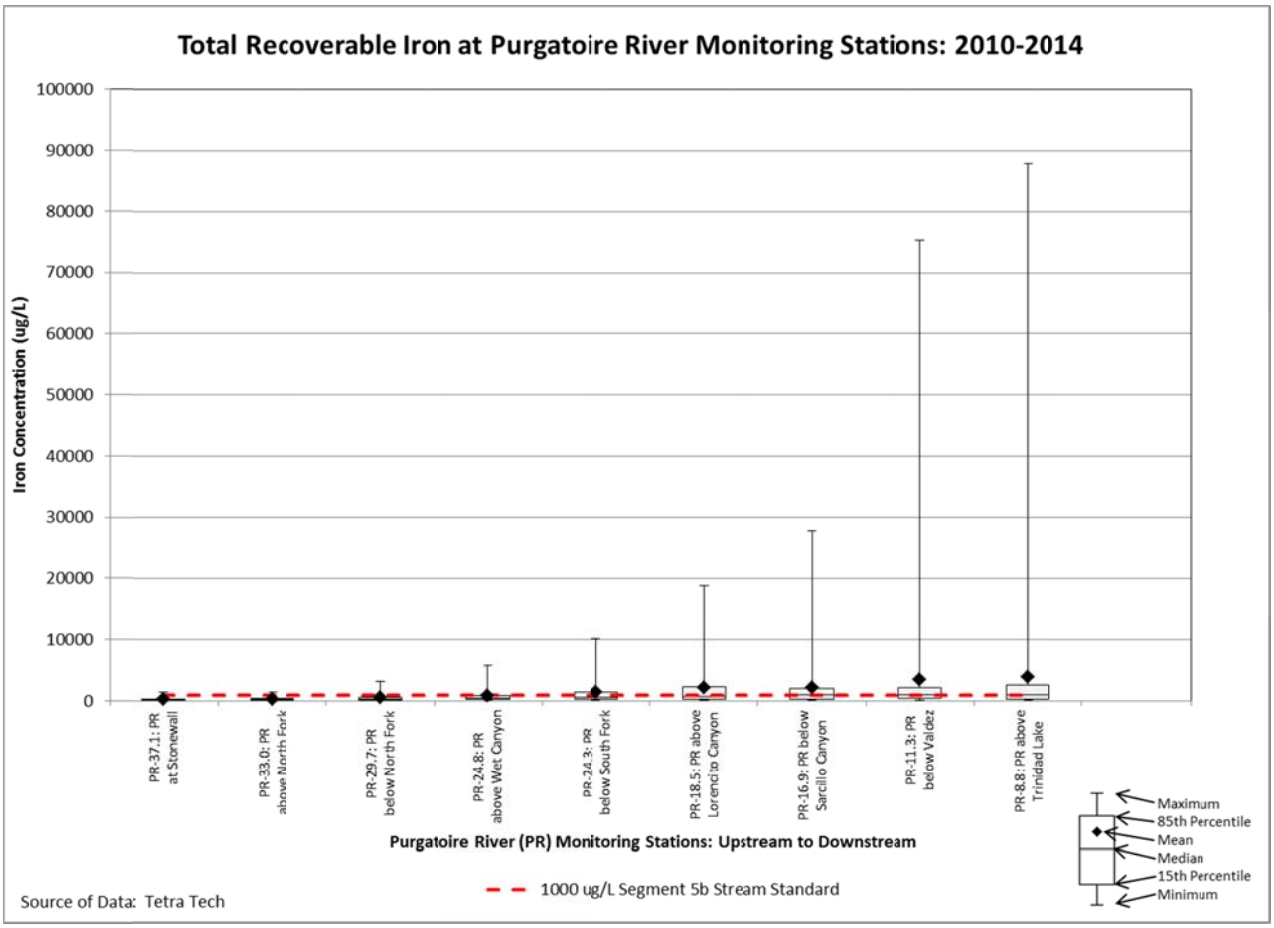
December 18, 2013. *See* 47767 Iron Permit Modification Form (Dec. 18, 2013); 47776 Iron Permit Modification Form (Dec. 18, 2013); 48003 Iron Permit Modification Form (Dec. 18, 2013). Pioneer proposed that the Division authorize an iron trading program that would reduce the background sources of iron in the Purgatoire River and provide 2:1 credits to offset Pioneer's (i.e., reduction to be two times the actual iron discharged). *See* Sandquist Letter at 1 (Dec. 18, 2013); 47767 Iron Permit Modification Form at 2 (Dec. 18, 2013); 47776 Iron Permit Modification Form at 2 (Dec. 18, 2013); 48003 Iron Permit Modification Form at 2 (Dec. 18, 2013). As detailed in a comprehensive report by Tetra Tech submitted in support of the proposal, Pioneer noted that because streambank erosion is a substantial source of iron in the Purgatoire, implementing streambank stabilization projects "along the Purgatoire River" would reduce iron loading. *See* Tetra Tech, "Iron Trading Program in the Purgatoire Watershed, Las Animas County, Colorado," at 7 (Dec. 2013) ("Iron Trading Study"); *see also* Sandquist Letter at 1 (Dec. 18, 2013). Using the South Fork of the Purgatoire River as a case study (not the final, proposed location), the report addressed iron loading and the benefits of streambank stabilization in the Purgatoire Watershed as a whole. *See generally* Iron Trading Study. Pioneer proposed that "iron trades be authorized in its Permits as means to comply with the iron effluent limits." Sandquist Letter at 1 (Dec. 18, 2013).

The Division rejected this proposal in the Draft Permits and instead proposed iron limits that, in 2017, will be more than three times as strict as those currently in effect. *See* 47767 Fact Sheet at 12; 47776 Fact Sheet at 10; 48003 Fact Sheet at 10. In proposing these limits, the Division suggested an alternatives analysis to request relief based on the socioeconomic impacts, and the technological or economic infeasibility of meeting these effluent limits. *See* WQA at 88; 47767 Fact Sheet at 18; Draft 47776 Permit at 24; Draft 48003 Permit at 19.

Ratcheting down the end-of-pipe discharges limits for total recoverable iron will result in loss of the water resource and economic impacts in a community already challenged by a downturned economy. Moreover, there is no positive environmental impact, as iron sources are overwhelmed by the primary sources of iron discharged into the Purgatoire, TSS, erosion, and stormwater runoff from wildlife areas.

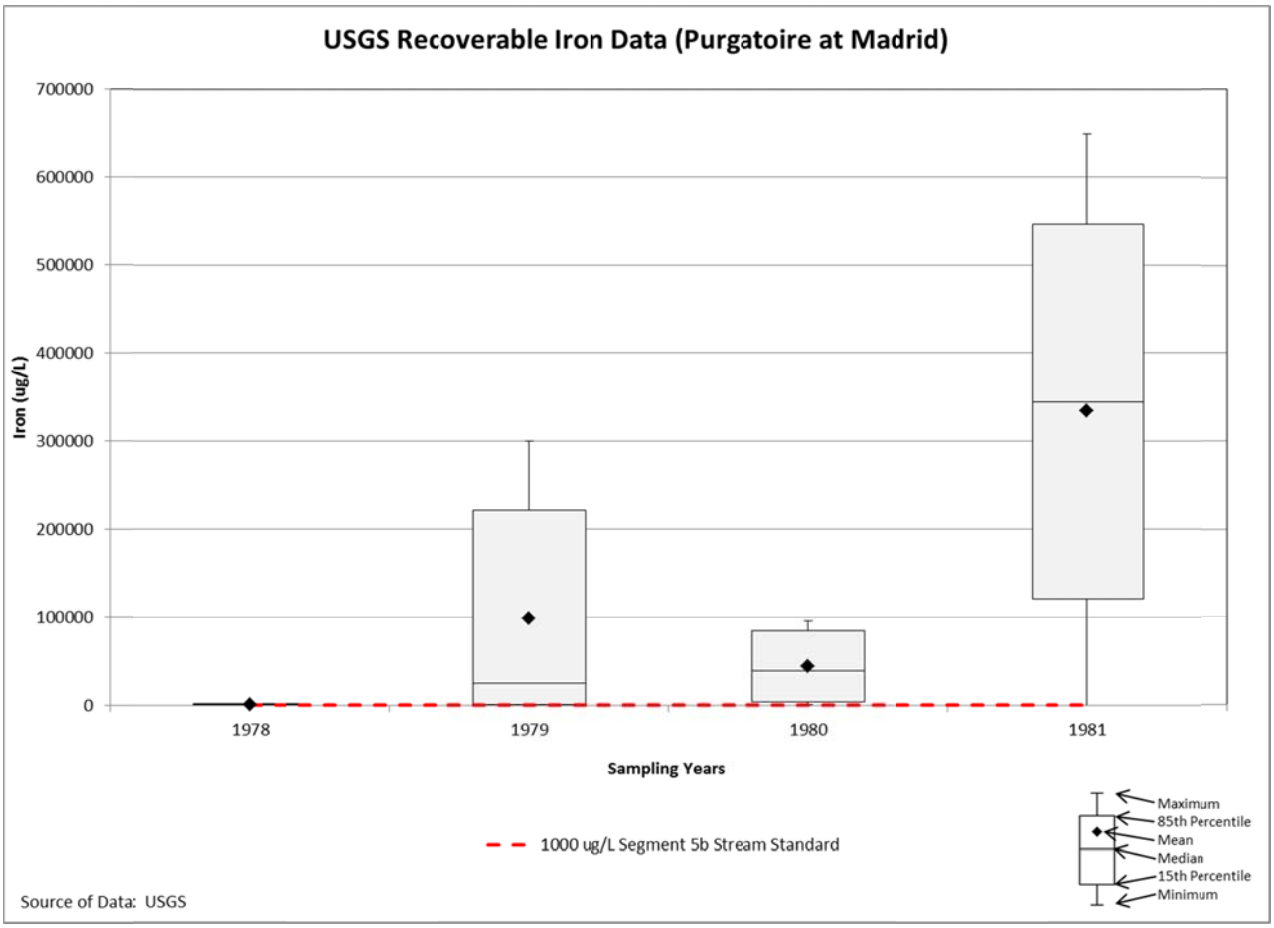
By way of illustration, the following graph depicts total recoverable iron levels in the Purgatoire Watershed using data collected between April 2010 and December 2014.

Figure XIII-5. Total Recoverable Iron: April 2010 – December 2014.



During this time, total recoverable iron has exceeded the 1.0 mg/L limit as a result of iron in sediment and large sediment loads post-runoff events. Notably, historical USGS data depict this phenomena pre-CBM development. *See* chart of historical USGS iron data (1978-1981), below.

Figure XIII-6. USGS Recoverable Iron Data (Pre-CBM Development).



2. It is inconsistent with the Division's DMR guidance to require compliance with a new permit limit using "report only" data from a prior permit term.

The Draft Permits state that compliance with two-year rolling average limits (for any parameters) must be calculated using the prior 23 months of data.[14] *See*, *e.g.*, Draft 47767 Permit at 8-20, 34; Draft 47776 Permit at 5-11; Draft 48003 Permit at 5-7 ("[t]he 2 yr average should be reported using the previous 23 months, regardless of the permit term[.]"). In some of the Draft Permits, the Definitions of Terms section provides a different calculation of two-year rolling average calculations. *See*, *e.g.*, Draft 47776 Permit at 20 (two-year rolling average "limits become effective upon the effective date of the permit, but are not reportable on a DMR until two years (typically 24 months) of data have been collected."); Draft 48003 Permit at 17. It is not within the Division's DMR guidance and is arbitrary to falsely penalize a company for report-only data

[14] The Division applies this approach to all parameters with two-year rolling average limits, not just iron.

collected during the compliance period. The Division's Discharge Monitoring Report Guidance state that:

> Collection of the data required to calculate a two-year rolling average shall start immediately upon the effective date of the permit, but the data is not reported on a DMR until two years after the effective date of the permit.

WQCD, "Discharge Monitoring Report Guidance" at 17 (Nov. 2014).

3. It continues to be technically and economically infeasible to treat produced water to attain the iron limits.

Despite the Division's assumptions to the contrary, it continues to be technically and economically infeasible to treat produced water to reduce iron concentrations. Based on Tetra Tech's evaluation of the produced water chemistry and required finished water quality, a reduction in iron concentrations to the 2-year average concentration as low as 363 µg/l would require a robust treatment process that includes microfiltration ("MF") and pipe network to collect and convey produced water to nine separate treatment facilities to consistently meet the target iron concentration needed to comply with the lower 2-year average limitations. The capital costs of MF treatment and backwash disposal of the waste stream for both Pioneer and XTO is estimated at $83.3M – $91.9M, or alternatively, disposing produced water via injection ($93M – $184.8M) is not economically viable. Moreover, once the produced water is injected, no produced water will be available for other uses in the Purgatoire watershed including agricultural, wildlife, recreation, and tourism purposes.

The Companies have set forth the economic realities of treating produced water to reduce these concentrations in the alternatives analysis included hereto as Attachment B.

Furthermore, the Division is already in possession of a significant body of data—collected at the Companies' expense—that shows that the new limitations cannot be met and why they cannot be met. *See* Pioneer Iron Compliance Reports; Pioneer DMRs from 2011-present (previously submitted to Division). However, in four years, the Division did not provide any feedback on annual compliance reports. The Division has chosen to implement requirements that can only be met at the end of the pipe with the installation of at least 50 water treatment facilities – one for each outfall where iron cannot be achieved or alternatively, sewer infrastructure from each tributary canyon to nine satellite MF treatment facilities located at the bottom of each tributary canyon produced water is discharged into. The Division is already aware of the infeasibility of treating water at different locations in the field, as this was addressed in the alternatives analysis previously submitted to the Division for chloride and Commission hearings. Letter from R. Sandquist to A. Neuhart re: Alternatives Analysis for Chloride (Nov. 28, 2012), and Pioneer submissions for the June 2013 Hearings on Arkansas River certifications and standards.

To the extent the Draft Permits impose new, significantly more stringent iron limits, an appropriate compliance schedule (i.e., a minimum of five (5) years) is required. 5 C.C.R. § 1002-31.14(4) and 1002-61.8; see also WQCD, Permit Compliance Schedules, Clean Water Policy No. 3 (March 4, 2014).

4. Alternatives Analysis for Iron

The Companies informed the Division throughout the permit renewals and compliance reports that attainment of the iron limits was neither technologically or economically feasible. The Companies have prepared an Alternatives Analysis for Iron Limits and requests that the Renewed Permits contain iron limits as determined, and specifically proscribed, in the Alternatives Analysis for each outfall.

See Alternatives Analysis for Iron included here as Attachment B.

XIV. Metals

A. The Division has imposed highly complex analytical requirements outfall by outfall without adequate justification.

In imposing metals testing requirements, the Division has adopted a highly complex system where analytical requirements vary from outfall to outfall, even where some outfalls are less than one mile from each other. For example, in the case of the Draft West Spanish Peaks Permit (Permit No. CO-0048003), there are three different monitoring and reporting protocols imposed, even though the permit only has three outfalls. Similarly, different sampling and compliance schedules apply, even where two outfalls are on the same drainage and are within two miles of each other. For example, one outfall (005A) in Parras Canyon has a report-only requirement for chloride, while another (245A) has a two-year average permit limit. Draft 48003 Permit at 5, 7. The Division's imposition of inconsistent monitoring and reporting requirements is unwarranted and unnecessarily burdensome on Pioneer.

B. The Division's Reasonable Potential analysis is inherently flawed.

The Division has included monitoring and reporting requirements for numerous parameters in each of the Companies' five Draft Permits. For many of these parameters, the Companies have amassed large datasets from monitoring required under the prior permits (some the Division has even characterized as "too voluminous"). Data are also available from other state agencies (e.g., the Colorado Oil and Gas Conservation Commission or "COGCC"). There are more efficient, timely, and more economic methods to develop the data required to assess Renewable Potential ("RP") than requiring routine monitoring over the next five years. Additionally, a large dataset was provided and is available from the Purgatoire River Watershed Monitoring Network established by the Companies in April 2010 (and lasting until December 2014) to provide water quality and flow data throughout the 600 square mile basin. The Companies provided the Division with water quality and flow data from April 2010 through December 2012 from the Purgatoire River Watershed Monitoring Network stations in the Permit Renewal Application submitted on December 23, 2013. *See* Permit Renewal Application.

The Division should have utilized the Purgatoire River Watershed Monitoring Network data when evaluating the "Pollutants of Concern" in the WQA. The Division should have incorporated these data into the reasonable potential evaluation, especially for those outfalls located in segments COARLA4b and COARLA6a, as samples collected from monitoring stations near the mouths of the ephemeral tributaries in these segments represent the cumulative discharge of all outfalls in the drainage. These surface water data, combined with outfall data and CBM wellhead data available at COGCC, should be used to develop more scientifically-based and reasonable monitoring and reporting requirements. Moreover, it is not acceptable to ignore these robust datasets, because by doing so, it results in erroneous permit limits and monitoring frequencies. Additionally, if requested, the Companies can provide the Division with additional

water quality and flow data for these stations that has been assembled since the Permit Renewal Application was submitted over a year ago.

The Division should also revise the low flow analysis for Guajatoyah Creek using flow data collected from Purgatoire River Watershed Monitoring Network stations. *See above* Section IX (Flow). Use of actual flow data, instead of reliance on estimated low flows, will result in higher critical low-flow values. These higher low flows should translate to higher WQBELs, etc. for effluent monitoring parameters in the affected streams, which may impact the reasonable potential analysis for outfalls in Guajatoyah Creek.

The Division has included monitoring and reporting requirements for numerous parameters in each of the Companies' five Draft Permits, even though the Division made a quantitative determination of no RP. The Division is requiring semi-annual monitoring when no RP is concluded, and quarterly monitoring when either RP is concluded or when no RP is concluded but the maximum estimated pollutant concentration ("MEPC") is greater than 50% of the maximum allowable pollutant concentration ("MAPC"). The imposition of semi-annual monitoring for parameters that have been found to have no quantitative RP appears arbitrary and excessive. Furthermore, requiring quarterly monitoring and reporting for both parameters with RP and those with no RP but where the MEPC is greater than 50% of the MAPC seems inequitable and does not recognize the lower potential for impact posed by those parameters. For example:

- Permit No. CO-0047776 – Iron (total recoverable) at outfall 059A – No RP is concluded since the MEPC was less than the MAPC for both the WQBEL and ADBAC. However, ADBAC quarterly monitoring is required in the Draft Permit because the MEPC was greater than 50% of the MAPC for the WQBEL. This monitoring frequency is inappropriate and excessive.

Based on the determinations of no RP in the Fact Sheets, the Division erred in requiring additional monitoring and reporting for so many parameters on the outfalls in the Draft Permits. Over the course of the five-year permit life, this excessive monitoring would result in the generation of over 20,000 additional data points at an estimated cost of $1.8M to the Companies (Table XIV-1). Further, no environmental benefit would result from the expensive and labor intensive collection, analysis, and evaluation (by both Companies and the Division) of these additional data. For some of these parameters, the Division has already stated that the "available data was too voluminous."

Table XIV-1. Estimated Additional Costs of Data Collection and Lab Analyses at Companies' Outfalls Where No RP Exists.

Parameter	Number of Outfalls	Number of Samples Collected	Analytical Cost per Sample	Total Analytical Cost	Labor Cost	Vehicle Cost	Shipping Cost	Total Cost
Arsenic (TR)	127	1270	9	11,748	70,000	14,400	12,800	108,948
Beryllium (TR)	10	200	9	1,850	14,500	2,400	2,080	20,830
Cadmium (TR)	40	400	9	3,700	29,000	4,800	4,000	41,500
Chloride	127	2540	8	20,955	140,000	14,400	25,600	200,955
Trivalent Chromium (TR)	127	1270	24	30,480	70,000	14,400	12,800	127,680
Copper (PD)	111	1110	15	16,928	70,000	14,400	11,200	112,528
Copper (TR)	74	740	9	6,845	53,960	11,100	7,520	79,425
Iron (TR)	127	2540	9	23,495	92,600	18,720	25,600	160,415
Lead (TR)	40	400	9	3,700	29,000	4,800	4,000	41,500
Lead (PD)	71	710	15	10,828	53,960	11,100	7,200	83,088
Manganese (TR)	24	240	9	2,160	17,500	3,600	2,400	25,660
Manganese (PD)	10	100	15	1,500	7,300	1,500	1,120	11,420
Mercury (T)	127	1270	17	20,955	70,000	14,400	12,800	118,155
Molybdenum (TR)	127	1270	9	11,748	70,000	14,400	12,800	108,948
Nickel (TR)	110	1100	9	10,175	40,500	8,325	11,200	70,200
Nickel (PD)	111	1110	15	16,928	40,500	8,325	11,200	76,953
Selenium (TR)	34	340	9	3,145	12,400	2,550	3,520	21,615
Selenium (PD)	52	520	15	7,930	19,000	3,900	5,280	36,110
Zinc (PD)	111	1110	15	16,930	40,500	8,325	11,200	76,955
Boron (T)	104	1040	24	24,960	37,900	7,800	10,400	81,060
Radium 226	127	635	69	43,815	23,150	4,765	6,400	78,130
Radium 228	127	635	69	43,815	23,150	4,765	6,400	78,130

Parameter	Number of Outfalls	Number of Samples Collected	Analytical Cost per Sample	Total Analytical Cost	Labor Cost	Vehicle Cost	Shipping Cost	Total Cost
Strontium 90	39	390	69	26,910	14,200	2,925	4,000	48,035
Total	**1957**	**20940**	**$463**	**$361,498**	**$1,039,120**	**$196,100**	**$211,520**	**$1,808,238**

Note: T = total; PD = potentially dissolved; TR = total recoverable

There are more efficient and economic means to develop the dataset to perform an RP evaluation than to require the semiannual monitoring for the duration of the Draft Permits. Specifically, analytical laboratories can extract data on additional metals from prior analyses stored in their Laboratory Information Management System ("LIMS"). For example, the five current permits have required quarterly monitoring of total recoverable iron since 2010. Had the Division communicated to the Companies that they were considering the addition of the total recoverable form of several metals (*see* Table XIV-1 above) to the Draft Permits, the Companies could have supplied the Division with up to 20 data points (four quarters per year, for five years) for these metals for each outfall. This simple "ask" by the Division could have potentially resolved the RP issue for some of these metals prior to the issuance of the Draft Permits.

Because of the number of parameters involved, the discussion below only focuses on examples where erroneous assessments of RP have been made. The entire RP analysis should be revisited using all available CBM wellhead water quality data (COGCC) , outfall water quality data, surface water quality data, and surface water flow data

Arsenic (total recoverable)

In three of the five Fact Sheets, the Division states that:

> Approximately 90 total data points were submitted. Because data for total recoverable arsenic indicates that the arsenic in the effluent will be non-detect, or significantly below the current limitation of 100 µg/l, limitations are not warranted and monitoring for total recoverable arsenic will be required during this permit term.

47767 Fact Sheet at 22; 48054 Fact Sheet at 40; 48062 Fact Sheet at 26.

Notwithstanding the very low arsenic data, the Draft Permits would require semi-annual monitoring and reporting of total recoverable arsenic from a combined 127 outfalls. Over the course of the five-year permit life this would result in the generation of 1,270 data points.

No environmental benefit will result from the expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of these 1,270 data points at a total cost of approximately $108,948. In fact, the monitoring requirements will require additional

energy use, increased collection and shipping impacts, and laboratory chemicals. The Division should eliminate reasonable potential for arsenic, and delete the associated monitoring requirements.

Cadmium (total recoverable)

The Division has included monitoring and reporting requirements for total recoverable cadmium in Pioneer Permit No. CO-0047767 and both XTO permits. In the Fact Sheets associated with each of these permits, the Division indicates that, based on a review of available data:

> [A]ll values were non-detect at a reporting limit of 5 µg/l. The current [practical quantification limit ("PQL")] for this parameter is 1 ug/l. Consequently, the "total" cadmium data from the previous permitting action are not considered adequate for use in determining that there is no RP. Thus, periodic monitoring at a PQL of 1 ug/l will be specified for this parameter in order to gather data that will enable a more accurate RP analysis to be completed.

48062 Fact Sheet at 27. *See also* 48054 Fact Sheet at 40. Similarly,

> Results for total recoverable cadmium were all non-detect at a reporting limit of 1 µg/l. As the potential limitation is 10 µg/l (chronic WQBEL), a determination of no reasonable potential has been made and no limitations are required. However, the PQL for this parameter is 1 ug/l, and periodic monitoring for this parameter at a PQL of 1 ug/l will be included.

47767 Fact Sheet at 22. The Draft Permits would require semi-annual monitoring and reporting of total recoverable cadmium from numerous outfalls. Over the course of the five-year permit life, this would result in the generation of hundreds of data points from both Pioneer and XTO.

No environmental benefit would result from the expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of the hundreds of data points generated by this requirement, with total estimated costs of $41,500. Simply because a new, lower PQL is available does not justify this data collection effort when the Division acknowledges no reasonable potential for cadmium. The Division should eliminate the reasonable potential for cadmium and delete the associated monitoring requirements.

Chloride

A quantitative determination of no RP was concluded in Permit No. CO-0047767 for chloride at outfalls 183A and 202A because the MEPC was less than the MAPC, and therefore no limitations were required. 47767 Fact Sheet at 36. However, the MEPC was greater than 50% of

the MAPC and quarterly monitoring is included in the Draft Permit. Quarterly monitoring is also imposed at outfalls where RP was concluded and a limit is imposed. These quarterly monitoring requirements are excessive. No environmental benefit would result from the expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of the hundreds of data points generated by this requirement, with total estimated costs over $200,000.

In addition, despite accepting an Alternatives Analysis for Chloride that addressed the infeasibility and negative consequences of adopting a strict chloride limit (*see* Authorizations to Discharge for CO-0047767, CO-0047776, and CO-0048003 (eff. April 1, 2014)), stricter chloride limits have been retained for some outfalls, particularly in Draft Permit Nos. CO-0047776 (outfalls 005A, 117A, and 22A), and CO-0047767 (outfalls 60A, 287A, and 239A). In these cases, it is likely the Division applied these limits due to a misunderstanding of reported isolated cases of higher-than-typical chloride levels. Two-year average chloride limit are not appropriate and must be deleted.

Trivalent Chromium (total recoverable)

Chromium occurs in the environment primarily in two valence states: trivalent chromium (Cr^{+3}) and hexavalent chromium (Cr^{+6}). Combined, the sum of the Cr^{+3} and the Cr^{+6} concentrations should equal the total (unspeciated) chromium concentration. In the Fact Sheets for all five of the Companies' Draft Permits, the Division draws the following conclusion regarding the potential for hexavalent chromium to be present in the Companies' effluent:

> According to the Agency for Toxic Substances and Disease Registry, hexavalent chromium is produced by industrial processes. Activities authorized under this permit (subsurface gas extraction with no frac water) would not generate hexavalent chromium.

47767 Fact Sheet at 23; 47776 Fact Sheet at 28; 48003 Fact Sheet at 24. Following the Division's logic, if hexavalent chromium is not present, then the total (unspeciated) chromium concentration will equal the trivalent chromium (Cr^{+3}) concentration.

Commercial analytical laboratories do not offer a method for trivalent chromium analysis. The industry practice is to analyze separate aliquots for hexavalent chromium and total (unspeciated) chromium, and then to calculate the trivalent chromium concentration by the difference. Thus, to meet a trivalent chromium reporting requirement, two separate analyses must be performed at each location.

Hexavalent chromium is not stable and generally has a short (24-hour) holding time. Collecting samples for hexavalent chromium analysis has proven problematic for the Companies as samples must be transported from distant outfall locations in the watershed to the overnight courier's offices in Trinidad. Additionally, access restrictions during the fall and spring hunting seasons prohibit the Companies from starting sampling activities until 10:00 am and, with the 24-

hour hold time and taking special delivery into consideration, the Companies are limited to sampling only a few hours a day during several months of the year.

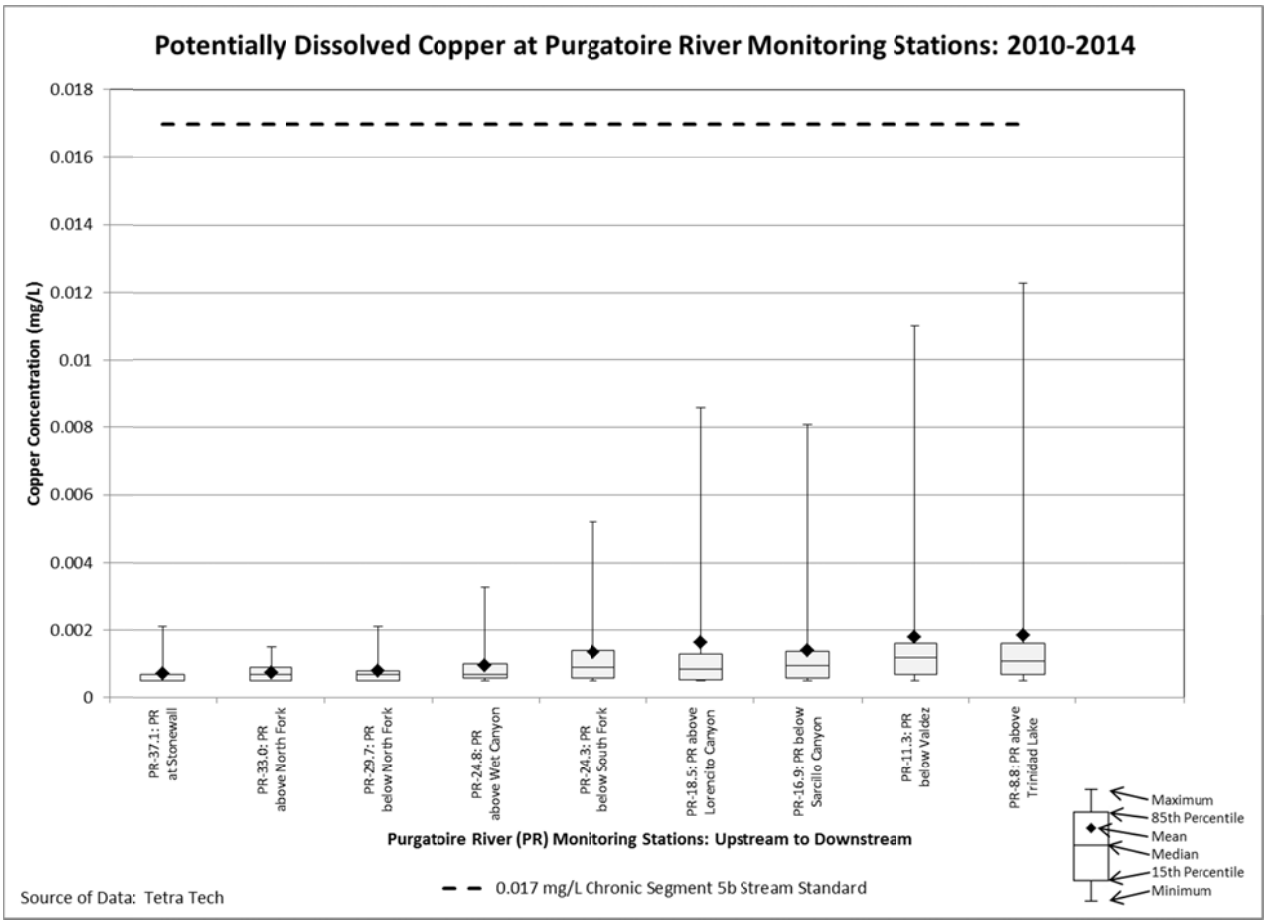
The Draft Permits would require semi-annual monitoring and reporting of total recoverable trivalent chromium (Cr^{3+}) from a combined 127 outfalls. Over the course of the five-year permit life, this would result in the generation of 1,270 data points. No environmental benefit would result from the expensive and time-consuming collection, analysis, and evaluation (by both Companies and the Division) of these 1,270 data points, at an estimated cost of $127,680. The Division should readdress the question of reasonable potential for this parameter. If monitoring is warranted, then it should be for total (unspeciated) chromium.

Copper (potentially dissolved)

The amount of data used by the Division to perform its RP analysis for potentially dissolved ("PD") copper is unclear as the discussion varies from Fact Sheet to Fact Sheet. The number of data points considered by the Division ranges from either no samples (Pioneer Permit Nos. CO-0047767, CO-0047776 and CO-0048003) to "too voluminous (600+ data points, plus additional data points supplied by the permittee) to run a statistical data analysis for most outfalls" (XTO Permit Nos. CO-00480054 and CO-0048062). The Division has also placed monitoring and reporting requirements for potentially dissolved copper on most outfalls located in Segment COARLA6a, even though this segment does not possess a dissolved copper standard.

In addition to the outfall data, there are abundant receiving water quality data available for dissolved copper from the Purgatoire River Watershed Monitoring Network (Figure XIV-1). These stations were sampled on a monthly to quarterly basis for dissolved and potentially dissolved copper. The data demonstrate copper concentrations are well below chronic stream standards in Segment 5b of the Purgatoire River.

Figure XIV-1. Potentially Dissolved Copper at Purgatoire River Monitoring Stations: 2010-2014.



The maximum concentrations of dissolved cooper data collected from April 2010 through 2014 from stations located in segments COARLA4b and COARLA5b are compared to their hardness-based standards in Table XIV-2.

Table XIV-2. Comparison of Maximum In-Stream Concentrations from Purgatoire River Watershed Monitoring Network Stations (2010 – 2014) to WQA Calculated Dissolved Copper Standards.

Segment	Description	Surface Water Monitoring Station	Maximum Observed Concentration (µg/L)	Chronic Standard (µg/L)	Standard Source (WQA Table)
COARLA4b	Lorencito Canyon	LOR-0.2	3.1 (n = 32)	9.6	A -4k
COARLA5a	Guajatoyah Creek	GUA-0.1	0.9 (n = 33)	13	A -4a
COARLA5b	Parras Canyon/ NF Purgatoire	NFPR-0.3	1.3 (n = 33)	13	A -4b
COARLA5b	Middle Fork Purgatoire	PR-29.7	2.5 (n = 33)	12	A -4e
COARLA5b	South Fork Purgatoire	SFPR-0.2	2.6 (n = 33)	10	A -4d
COARLA5b	Mainstem Purgatoire	PR-8.8	2.2 (n = 33)	17	A -4c

Based on the data summarized in Table XIV-2, it is apparent that copper concentrations remain well below the most stringent water quality standard after over 15 years of large-scale CBM development in the basin (current conditions). It is important to note that most of these surface water data were collected during a period of prolonged drought when natural surface water flows in the basin were low and the relative percentage of CBM-produced water was high.

In summary, the Division has determined that no reasonable potential exists for potentially dissolved copper for Pioneer's outfalls and watershed monitoring confirms that current conditions meet aquatic life standards in segments COARLA4b and COARLA5b. However, the Division has still imposed semi-annual monitoring and reporting requirements on 111 outfalls (from both Pioneer and XTO) in the Draft Permits at an estimated cost of $112,500. The existing outfall data, combined with the downstream water quality, supports a finding of no reasonable potential for dissolved copper for all of Pioneer's outfalls. Consequently, the monitoring requirements proposed in the Draft Permits should be eliminated.

Copper (total recoverable)

The Division has required monitoring and reporting for total recoverable copper in Draft Permit No. CO-0047767. In the Fact Sheet for the Draft Permit, the Division comes to the following conclusion regarding the available total recoverable copper data:

> Results were typically non-detect at reporting limits of 1 µg/l. As the potential limitation is 200 µg/l (chronic WQBEL), a determination of no reasonable potential has been made and no limitations are required.

47767 Fact Sheet at 23. Because there is no RP determination in the Fact Sheet, no semi-annual monitoring and reporting for total recoverable copper at the 40 outfalls in the Draft Permit should be required. Over the course of the five-year permit life, this would result in the generation of 400 data points. No environmental benefit would result from the expensive and time-consuming collection, analysis, and evaluation (by both Companies and the Division) of these 400 data points at an estimated cost of $43,000 to Pioneer. No monitoring or reporting for copper (total recoverable) should be required.

Iron (total recoverable)

The Division should reduce the sampling frequency for this parameter. During the last permit term the Division also requested a quarterly sampling frequency and received thousands of data points summarizing total recoverable iron concentrations. The data collected is relatively consistent - iron increases and decreases with flows and TSS levels. The Division's request for quarterly monitoring and reporting requirements again during the Draft Permit term is excessive and unreasonable, resulting in an estimated cost of $160,415 to the Companies.

Lead (total recoverable)

The Division required monitoring and reporting for total recoverable lead in Permit No. CO-0047767. In the Fact Sheet, the Division comes to the following conclusion regarding the available total recoverable lead data:

> The chronic WQBEL for total recoverable lead is 100 µg/l….For the previous permitting action, results were reported at less than 1 µg/l for total recoverable lead. A determination of no reasonable potential has been made and no limitations are required.

47767 Fact Sheet at 30-31. Yet, in contrast to the above determination, the Division concludes: "However, for the purposes of future reasonable potential determinations, semiannual monitoring for total recoverable lead will be included in the permit." *Id*.

Based on the no RP determination, no semi-annual monitoring and reporting for total recoverable lead on the 40 outfalls in the Draft Permit should be required. Over the course of the five-year permit life, this would result in the generation of 400 data points. No environmental benefit would result from the expensive and time consuming collection, analysis, and evaluation (by Pioneer and the Division) of these 400 data points at an estimated cost of $41,500 to Pioneer.

Total recoverable lead data are available from many of the ephemeral tributaries covered under Permit No. CO-0047767 and are summarized in Table XIV-3.

Table XIV-3. Comparison of Maximum In-Stream Total Recoverable Lead Concentrations from Purgatoire River Watershed Monitoring Network Segment COARLA6a (Tributary) Stations (2010 – 2014) to Standards.

Description	Surface Water Monitoring Station	Maximum Observed Concentration (µg/L)	Chronic Standard (µg/L)	Standard Source (WQA Table)
Apache Canyon	APA-0.2	< 40 (n = 42)	100	A-3a
Burro Canyon	BUR-0.4	< 40 (n = 45)		
Reilly Canyon	REI-1.4	80 (n = 47)		
Santisteven Canyon	SAN-0.1	< 40 (n = 42)		
Sarcillo Canyon	SAR-0.4	60 (n = 47)		

These sample locations are near the mouths of the tributaries and represent the cumulative discharge of all outfalls in the tributary. These data indicate that total recoverable lead concentrations in the tributaries remain below the water quality standard after over 15 years of large-scale CBM development in the basin. No limits or monitoring for lead should be required.

Lead (potentially dissolved)

With the exception of those outfalls in Permit No. CO-0047767 determined not to reach the Purgatoire, the Division has placed a semi-annual monitoring and reporting requirement on 34 of Pioneer's outfalls in their three permits. This includes outfalls located in Segment COARLA6a, even though this segment does not possess a dissolved lead standard. In Fact Sheets for two of Pioneer's permits, the Division indicates that sampling results for the total recoverable form of lead were all below a detection limit of 1 µg/L. 47767 Fact Sheet at 30; 47776 Fact Sheet at 34; 48003 Fact Sheet at 27. As a total recoverable analysis reports the sum of the particulate and the dissolved forms of a metal, it is reasonable to determine that dissolved lead concentrations in these samples are also less than 1 µg/L and, therefore, below the PQL provided in Part I D.3 of the permits. Consequently, there is no reason to assume that CBM-produced water contains dissolved lead concentrations at a level to warrant the monitoring and reporting requirements in the Draft Permits.

The data from the Purgatoire River Watershed Monitoring Network support this conclusion. The maximum concentrations of dissolved lead data collected from April 2010

through 2014 from stations located in segments COARLA4b and COARLA5b are compared to their hardness-based standards in Table XIV-4.

Table XIV-4. Comparison of Maximum In-Stream Concentrations from Purgatoire River Watershed Monitoring Network Stations (2010 – 2014) to WQA Calculated Dissolved Lead Standards.

Segment	Description	Surface Water Monitoring Station	Maximum Observed Concentration (µg/L)	Chronic Standard (µg/L)	Standard Source (WQA Table)
COARLA4b	Lorencito Canyon	LOR-0.2	0.4 (n = 32)	2.8	A -4k
COARLA5a	Guajatoyah Creek	GUA-0.1	0.4 (n = 33)	3.9	A -4a
COARLA5b	Parras Canyon/ NF Purgatoire	NFPR-0.3	0.3 (n = 33)	3.9	A -4b
COARLA5b	Middle Fork Purgatoire	PR-29.7	0.8 (n = 33)	3.5	A -4e
COARLA5b	South Fork Purgatoire	SFPR-0.2	1.5 (n = 33)	3	A -4d
COARLA5b	Mainstem Purgatoire	PR-8.8	0.5 (n = 33)	5.8	A -4c

Lead concentrations throughout segments COARLA4b and COARLA5b remain well below the most stringent water quality standard after over 15 years of large-scale CBM development in the basin (current conditions).

Over the course of the five-year permit life, monitoring and reporting of potentially dissolved lead would result in the generation of 340 data points presumably below the PQL. No environmental benefit would result from the expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of these 340 data points at an estimated cost of $40,000 to Pioneer.

Manganese (total recoverable).

The Division has included semi-annual monitoring and reporting of total recoverable manganese in the Draft Permit No. CO-0047767 for the 24 outfalls that reach the Purgatoire River. The Division presents no rationale for monitoring this parameter in the WQA or the Fact Sheet, nor is total recoverable manganese included on the list of potential limitations for this permit (*see* WQA at Tables A-15a and A-15b). Additionally, there is no water quality standard for total recoverable manganese in Segment COARLA6a or the downstream segment, COARLA5. 5 C.C.R. § 1002-32.

It is not clear why the Division placed semi-annual monitoring and reporting for total recoverable manganese on 24 outfalls in this permit. Over the course of the five-year permit life, this would result in the generation of 240 data points. It is unclear what environmental benefit would result from the expensive and time consuming collection, analysis, and evaluation (by the Company and the Division) of these data totaling $25,660 to Pioneer.

Manganese (potentially dissolved)

The Division has required monitoring and reporting for potentially dissolved manganese in Draft Permit Nos. CO-0047776 and CO-0048003 based on a "perceived" lack of data. 47776 Fact Sheet at 34; 48003 Fact Sheet at 27. However, "600+ data points plus additional data provided by the permittee" are available from XTO Permit No. CO-0048054, with a maximum concentration being well below levels that would require monitoring. 48054 Fact Sheet at 57. The Division relied on these data in XTO's Draft Permit CO-00480062 to determine that monitoring and reporting for potentially dissolved manganese was not required because: "given the volume of data provided from the DMRs from similar facilities in the area, the Division has determined that potentially dissolved manganese is no longer a parameter of concern for this facility." 48062 Fact Sheet at 32. The Division should apply the same facts and rationale to the nearby Pioneer facilities.

Over the course of the five-year permit life, monitoring and reporting for potentially dissolved manganese in Pioneer Permit Nos. CO-0047776 and CO-0048003 would result in the generation of 100 data points. Given the large dataset that the Division already has for this parameter, no environmental benefit would result from the expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of these additional data points at a cost of $11,420. At a minimum, a less intensive monitoring and reporting schedule appears appropriate for potentially dissolved manganese in Pioneer Permit Nos. CO-0047776 and CO-0048003.

Molybdenum (total recoverable)

The Division has included semi-annual monitoring and reporting requirements for total recoverable molybdenum in all of the Draft Permits. Semi-annual monitoring and reporting for the five-year permit life is excessive for both Companies (approximately $109,000) when there is no evidence to suggest that CBM-produced water is a significant source of molybdenum. A less intensive monitoring and reporting program is appropriate for molybdenum.

Mercury (Total)

The Draft Permits contain a mixture on "Hg, Tot" and "Hg, Tot (Low-Level)" monitoring and reporting requirements. Under the existing permits, the Division required the Companies to perform a one-time sampling event in 10 percent of the outfalls covered by each permit for total mercury, using low-level sampling and analytical methods. This resulted in 38 data points for total mercury. With the exception of the mercury results from Pioneer outfall 096-A in Permit No. CO-0047767, all low-level mercury concentrations were below potential limitations. Yet, in the Draft

Permits the Division has required semi-annual to annual monitoring and reporting requirements on all outfalls. Over the course of the five-year permit life, this would result in the generation of hundreds of data points. No environmental benefit would result from the very expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of these data totaling $118,155. Based on existing basin-wide information, the Division should eliminate the monitoring and reporting requirements for mercury.

Nickel (total recoverable)

The Division has required monitoring and reporting for total recoverable nickel in Pioneer Draft Permit No. CO-0047776 and XTO Draft Permit Nos. CO-0048054 and CO-0048062. Previous sampling has demonstrated that total/total recoverable nickel concentrations are less than 2 µg/L, with the exception of one detection at 5 µg/L. The Division acknowledges that "potential limitations [WQBEL of 200 µg/L] are significantly higher than the detection value." *See* 47767 Fact Sheet at 32. However, the Division requires semi-annual monitoring and reporting for total recoverable nickel on 40 Pioneer outfalls and 70 XTO outfalls.

Over the course of the five-year permit life, monitoring and reporting for total recoverable nickel at 110 outfalls would result in the generation of 1,100 data points for Pioneer and XTO combined. No environmental benefit would result from this expensive and time-consuming collection, analysis, and evaluation (by both Companies and the Division) of these data points totaling $70,200. Monitoring or reporting requirements for total recoverable nickel are not necessary.

Nickel (potentially dissolved)

Because of a purported lack of data, the Division placed a semi-annual monitoring and reporting requirement for potentially dissolved nickel on all outfalls, except for those in Pioneer Draft Permit No. CO-0047767 determined not to reach the Purgatoire. As discussed under total recoverable nickel above, total/total recoverable nickel data are available to the Division. Because dissolved concentrations should be equivalent to or less than a total/total recoverable analysis, the Division could perform the reasonable potential evaluation using the total/total recoverable data. Given a likely determination of no reasonable potential, the Division should eliminate the monitoring and reporting requirement for potentially dissolved nickel, which would reduce monitoring costs by $77,000 for the Companies.

Selenium (total recoverable)

Purgatoire watershed data submitted to CDPHE during 2011 provided the basis for removing Purgatoire from the 303(d) list for selenium. *See* presentation, "Consideration of 2012 303(d) Listing for Purgatoire River Segments COARLA04, COARLA05a, and COARLA05b," Pioneer and XTO (Dec. 12, 2011). Despite this history, the Division has proposed requirements for selenium in the Draft Permits.

Additionally, the Fact Sheet to Pioneer Draft Permit No. CO-0047767 contains the following contradictory statements:

> There is no current data available regarding the presence/absence or quantification of this parameter in the discharge from the previous (current) permit term. For the previous permitting action, results were reported at less than 1 µg/l for total recoverable selenium.

47767 Fact Sheet at 32. Data below 1 µg/L should result in a determination of no RP for outfalls in Segment 6a, which covers all the outfalls in Draft Permit No. CO-0047767. Supporting this conclusion are the total recoverable selenium data that are available from many of the tributaries covered under Pioneer Permit No. CO-0047767 and are summarized below in Table XIV-5.

Table XIV-5. Comparison of Maximum In-Stream Total Recoverable Selenium Concentrations from Purgatoire River Watershed Monitoring Network Segment COARLA6a (Tributary) Stations (2010 – 2014) to Standards.

Description	Surface Water Monitoring Station	Maximum Observed Concentration (µg/L)	Chronic Standard (µg/L)	Standard Source (WQA Table)
Apache Canyon	APA-0.2	1.4 (n = 28)	20	A-3a
Burro Canyon	BUR-0.4	2.3 (n = 33)		
Reilly Canyon	REI-1.4	2.1 (n = 33)		
Santisteven Canyon	SAN-0.1	0.5 (n = 28)		
Sarcillo Canyon	SAR-0.4	1.3 (n = 33)		

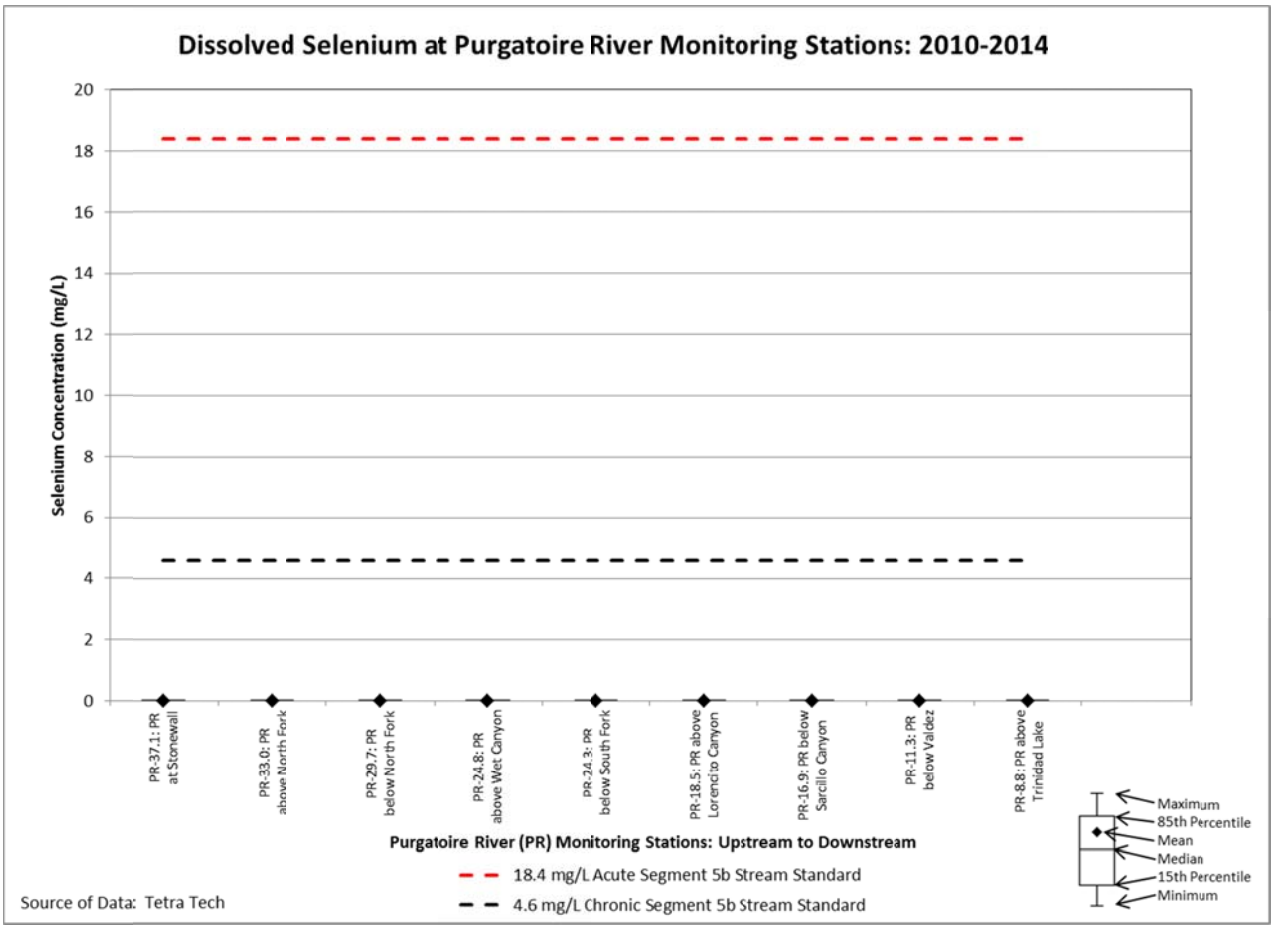
These sample locations are near the mouths of the tributaries and represent the cumulative discharge of all outfalls in the tributary. These data indicate that total recoverable selenium concentrations in the tributaries remain below the water quality standard after over 15 years of large-scale CBM development in the basin. As such, monitoring requirements for this parameter should be removed.

Selenium (potentially dissolved)

The Division has placed semi-annual monitoring and reporting requirements on 34 of the outfalls in the three draft Pioneer permits. This includes the 24 outfalls that do reach the Purgatoire in Permit No. CO-0047767. These 24 outfalls are located in Segment COARLA6a, which does not possess a dissolved selenium standard. 5 C.C.R. § 1002-32.

As illustrated in Table XIV-5 above, long-term monitoring of several of the tributaries covered under Permit No. CO-0047767 exhibit total recoverable selenium concentrations all below the chronic dissolved steam standard (4.6 µg/L) in the downstream receiving water, Segment COARLA5b. Because dissolved concentrations are equivalent or less than total recoverable concentrations, these data demonstrate low dissolved selenium concentrations are present in the tributaries after over 15 years of large-scale CBM development in the basin. In addition, long-term monitoring of dissolved selenium in the mainstem Purgatoire River demonstrates very low concentrations of this parameter (Figure XIV-2).

Figure XIV-2. Dissolved Selenium at Purgatoire River Monitoring Stations: 2010-2014.



Given the data available to the Division and the 2011 hearing removing the Purgatoire river from the 303(d) list for selenium, there is no reason to suspect that CBM-produced water is a significant source of dissolved selenium to the Purgatoire watershed. No environmental benefit would result from the expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of these additional data points totaling $24,300.

Zinc (potentially dissolved)

Potentially dissolved zinc data from the previous permits are available for outfalls in XTO Permit No. CO-0048062 (monitoring for zinc was not required under the other permits). However, the amount of data available to the Division for this parameter is large. Notably, the Division noted in the Fact Sheet that: "The available data was too voluminous (600+ data points plus additional data supplied by the permittee) to run a statistical program." 48062 Fact Sheet at 37.

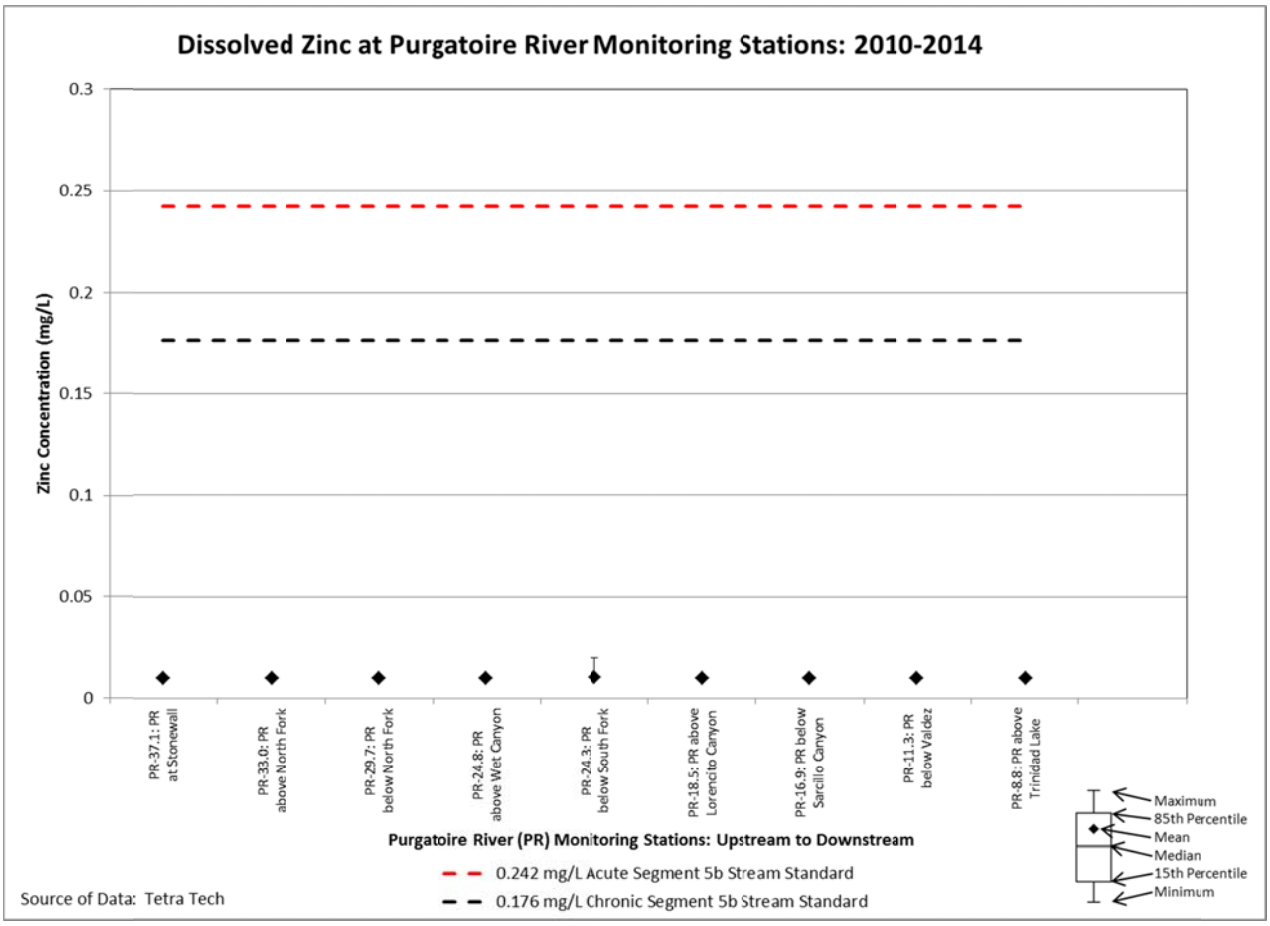
The Division states:

> Considering all available data are significantly below proposed limitations, a qualitative determination of no RP. However, for the purposes of future reasonable potential determinations, semi-annual monitoring for this parameter for these outfalls will be included in the permit.

Id. However, with the exception of those outfalls in Pioneer Draft Permit No. CO-0047767 determined not to reach the Purgatoire, the Division has placed a semi-annual monitoring and reporting requirement on all of XTO and Pioneer's outfalls.

In addition to the extensive Pioneer dataset from which the Division acknowledges no RP, long-term monitoring of dissolved zinc in the mainstem Purgatoire River demonstrates very low concentrations of this parameter (Figure XIV-3).

Figure XIV-3. Dissolved Zinc at Purgatoire River Monitoring Stations: 2010-2014.



Dissolved zinc concentrations were all below a detection limit of 10 µg/L, well below the most stringent water quality standard after over 15 years of large-scale CBM development in the basin (current conditions).

Over the course of the five-year permit life, monitoring and reporting for potentially dissolved zinc in all permits would result in the generation of 1,110 data points. Given the 600+ data points that the Division already has for this parameter, no environmental benefit would result from the expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of these additional data points totaling $76,955.

The Division has sufficient data (600+ data points) to make a determination of no reasonable potential for this parameter in all five permits. No RP exists. No limits or monitoring should be required in the Draft Permits for this parameter.

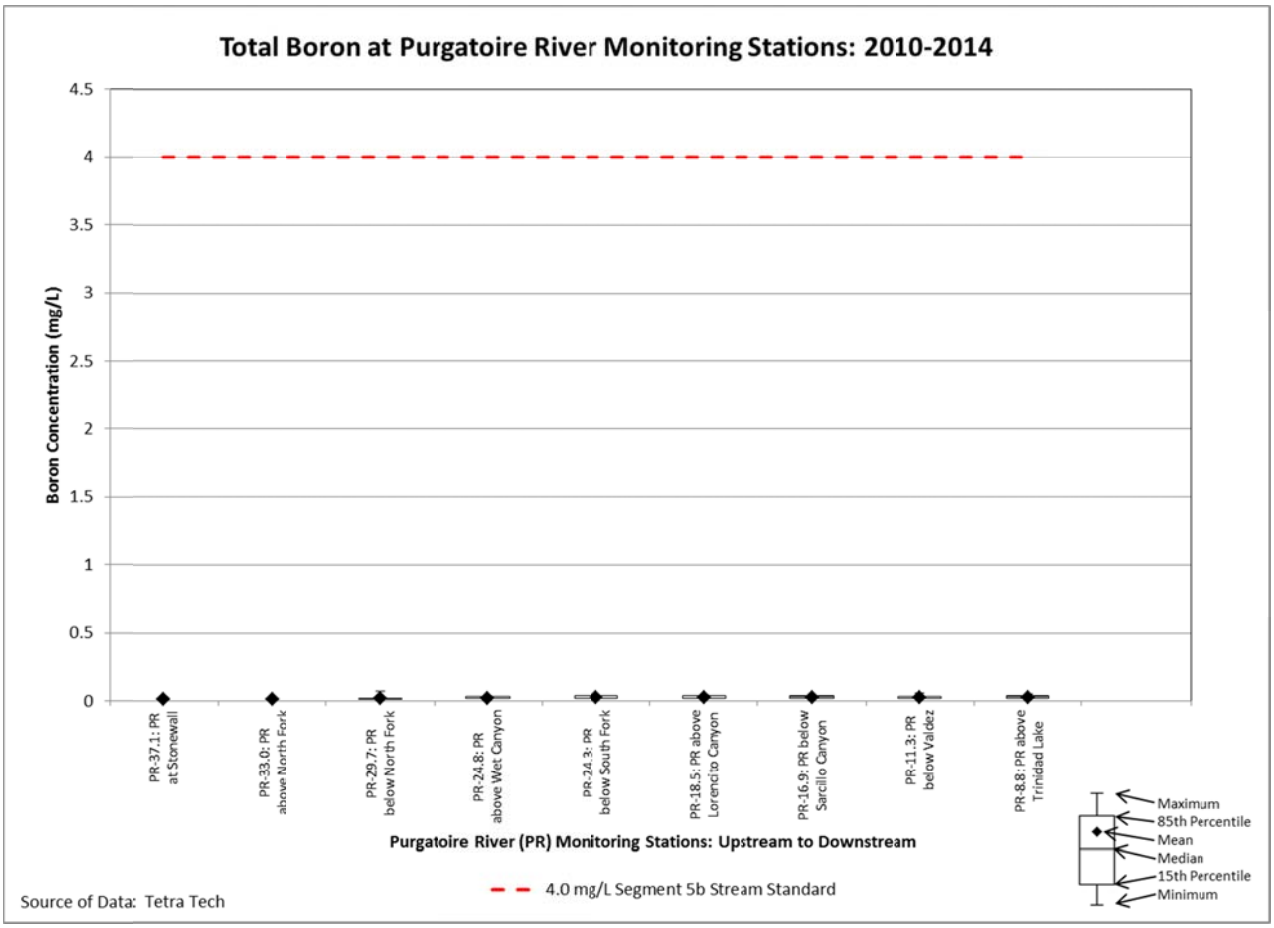
Boron (Total)

The Draft Permits require semi-annual monitoring and reporting requirements for total boron on all outfalls in the five permits and 2-year limits on select outfalls. The requirements even apply to outfalls in Permit No. CO-0047767 determined not to reach the Purgatoire and, therefore, not subject to diversion because agricultural water rights do not exist.

The Division has sufficient information to complete a reasonable potential evaluation for boron. There is no reasonable potential. The Division, by this analysis, is attempting to circumvent the decisions on boron standards for the Purgatoire River made by the Commission in 2013. *See* WQCC proceedings re: Classifications and Numeric Standards for Arkansas River Basin, Regulation #32 (2013), incorporated herein by reference. In the June 2013 Regulation #32 Standards Hearing, the WQCC reviewed the Companies' data, along with crop usage information, and determined to increase the boron standards in stream segments in the upper Purgatoire River watershed to reflect that current conditions were protective of the actual commercial crops grown in the area.

Specifically, the long-term monitoring in the mainstem Purgatoire River demonstrates very low concentrations of total boron (Figure XIV-4).

Figure XIV-4. Total Boron at Purgatoire River Monitoring Stations: 2010-2014.



Boron concentrations remain well below the water quality standard in Segment COARLA5b, where water is actually diverted for agricultural uses, after over 15 years of large-scale CBM development in the basin (current conditions).

Total boron data are also available from many of the ephemeral tributaries covered under Permit No. CO-0047767 and are summarized in Table XIV-6.

Table XIV-6. Comparison of Maximum In-Stream Total Boron Concentrations from Purgatoire River Watershed Monitoring Network Segment COARLA6a (Tributary) Stations (2010 – 2014) to Standards.

Description	Surface Water Monitoring Station	Maximum Observed Concentration (mg/L)	Chronic Standard (mg/L)	Standard Source (WQA Table)
Apache Canyon	APA-0.2	0.55 (n = 52)	4	A-3a
Burro Canyon	BUR-0.4	0.11 (n = 55)		
Reilly Canyon	REI-1.4	0.12 (n = 57)		
Santisteven Canyon	SAN-0.1	0.4 (n = 52)		
Sarcillo Canyon	SAR-0.4	0.09 (n = 57)		

These sample locations are near the mouths of the tributaries and represent the cumulative discharge of all outfalls in the tributary. These data indicate that total boron concentrations in the tributaries remain below the water quality standard after over 15 years of large-scale CBM development in the basin (current conditions).

Over the course of the five-year permit life, monitoring and reporting for total boron in all permits would result in the generation of over a thousand data points. Given the large amount of data that the Division already has for boron, the Commission's decisions, and the fact that monitoring in the Purgatoire watershed demonstrates that the boron levels have been and will continue to be protective of agricultural use, there is no environmental benefit from the expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of additional boron data exceeding $81,000.

Sulfide

The Division has included quarterly to annual monitoring for sulfide in the Companies' five Draft Permits. Tables A-3a, A-3b and A-3c of the WQA indicate that the applicable stream standard for sulfide is 0.002 mg/L. However, Part I D. of the permits indicates that the PQL for sulfide is 0.2 mg/L. Consequently, obtaining sulfide data from the outfalls over the life of the permit that is at or below the stream standard of 0.002 mg/L is not practical.

The Division should revise the WQA and Fact Sheets to acknowledge this technical issue. In the event that all data collected over the next five years are reported as below detection limit *but* the detection limit exceeds the stream standard, the Division should also describe how these data

will be evaluated and what decision(s) the Division will make based on these data during the next permitting cycle.

Radium 228 and Radium 226

Under the prior permits, the Division required the Companies to perform a one-time sampling event in 10 percent of the outfalls covered by each permit for radium-226 & -228. This resulted in 51 data points from 41 outfalls. With the exception of XTO outfall 049-A in Permit No. CO-0048054, the radium-226 & -228 activity was below potential limitations in all outfalls.

In spite of this data set, the Draft Permits require semi-annual to annual monitoring and reporting requirements on all outfalls. Such extensive data gathering is not warranted; the existing data demonstrates that radium is not present at levels of concern. Over the course of the five-year permit life, the required monitoring would result in the generation of hundreds of data points. No environmental benefits would result from the expensive and time consuming collection, analysis, and evaluation (by both Companies and the Division) of these data totaling $156,260.

Strontium 90

Under the prior permits, the Division required the Companies to perform a one-time sampling event in 10 percent of the outfalls covered by each permit for strontium-90. This resulted 41 data points. With the exception of Pioneer outfall 096-A in Permit No. CO-0047767, the strontium-90 activity was below potential limitations in all outfalls.

In spite of this data set , in the Draft Permits the Division has placed semi-annual monitoring and reporting requirements on the 39 other outfalls in Pioneer Draft Permit No. CO-0047767. Over the course of the five-year permit life, this would result in the generation of 390 data points. No environmental benefit would result from the expensive and time consuming collection, analysis, and evaluation (by Pioneer and the Division) of these data exceeding $48,035. Based on existing basin-wide information, the Division should readdress the question of reasonable potential for this parameter. At a minimum, a less intensive monitoring and reporting schedule appears appropriate for this parameter.

XV. Permit-Specific Comments

Pioneer also provides permit-specific comments and corrections to the Draft Permits, Fact Sheets, and Water Quality Assessment. These additional comments and corrections are set forth in Attachment A, hereto.

XVI. Conclusion

Pioneer has provided extensive comments on the Draft Permits, describing—in great detail—their errors, inaccuracies, and problems. Pioneer's comments are supported by a robust water quality monitoring data set, evaluation of aquatic life, tests of the procedures and protocols

available to reduce discharge levels, the costs, and environmental and energy impacts of such processes. We provide this summary list of how the Draft Permits should be revised.

Summary of Draft Permit Terms With Data to Support Changes:

A. Flows
    1. Permit flows must be re-calculated using the flow data collected with actual, scientific, instrument-based flow measurements.
    2. Limits on quantity of flow from each outfall must be deleted.
    3. Delete mixing zone study requirements.

B. Temperature Limits
    1. Temperature limits should be removed for segments where there is no aquatic life or to receiving waters with zero low flows.
    2. Ambient temperature monitoring in the dry streambeds, flowing tributaries or Purgatoire River should be deleted.

C. WET Testing
    1. Chronic WET testing should only be required at the confluences of the tributaries and Purgatoire River where aquatic life exist.
    2. Acute WET testing with *Daphnia magna* may be required annually at the outfalls.

D. EC and SAR Limits
    1. No EC or SAR limits for outfalls to waters that are not diverted for irrigation (i.e., Segment 6A) or that discharge to low or no-flow tributaries.
    2. Set quarterly EC and SAR limits at the maximum value reported by tributary for the maximum value reported in 2010 – 2014.

E. Iron
    1. Set iron limits at each outfall to the limits specified in the Alternatives Analysis.

F. Metals
    1. Delete monitoring and/or reporting requirements for arsenic (TR), boron, iron (TR), beryllium, cadmium (TR & PD), chromium, copper (TR & PD), lead (TR & PD), manganese (TR & PD), molybdenum (TR), mercury, nickel (TR & PD), radium-226 and 228, selenium (TR & PD), strontium-90, and zinc (PD).

We ask that the Division sincerely consider these requests. The continued discharge of CBM-produced water is important for the State because of its obligations in the Arkansas River Compact and the objectives of the State Water Plan. It is important to Pioneer so they can continue their operations and produce the gas reserves that exist in this area. The water and economic benefits to the community derived from gas operations in the Raton Basin enhance public health, safety and welfare. Moreover, these benefits are critical for the local communities

who depend on the water sources, and the economic drivers that support their ranches, businesses, wildlife , tourism and recreation – all of which make this a great place for them to live.

Respectfully submitted,

Ronda L. Sandquist

Attachments & Exhibits

cc: Erin Scott (e-mail only)
Lori Mulsoff (e-mail only)
Pioneer Natural Resources USA, Inc.
Tetra Tech, Inc.
Engineering Analytics

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Pioneer Natural Resources USA, Inc. Comments on
Draft Public Notice for Permit Nos. CO-0047767, CO-0047776, and CO-0048003.

ATTACHMENTS

Attachment	Description
A.	Permit-Specific Comments and Corrections on Draft Permit Nos. CO-0047767, CO-0047776, and CO-0048003
B.	Alternatives Analysis for Iron
C.	Harvey Economics, "Economic Benefits of CBM Industry Activity and Produced Water in Las Animas County, Colorado, 2015"

EXHIBITS

Exhibit	Description
1.	Excerpts from letters to Water Quality Control Commission from Las Animas landowners (submitted June 2013)
2.	Written Comments of Hill Ranch Ltd., et al. to WQCC re: Revised Water Quality Classifications, Standards, and Designations for Multiple Segments in the Arkansas Basin, Regulation #32 (received June 26, 2002)
3.	Temporary Modification Temperature Request in the Purgatoire Watershed Las Animas County, Colorado, Lower Arkansas River Segments 3A, 3B, 4B, 5A, 5B, 6A, 6B, 16, and 17 (April 19, 2013) (submitted as Exhibit 6 to Responsive Prehearing Statement of Pioneer and XTO in WQCC Hearing re: Classifications and Numeric Standards for Arkansas River Basin, Regulation #32, and Rio Grande River Basin, Regulation #36 (April 23, 2013)
4.	Joint Letter from Pioneer and XTO to EPA, the Division, and USGS re: WET/Alternative Testing Procedure Meeting (Feb. 22, 2012)

Attachment A

Permit-Specific Comments and Corrections on
Draft Permit Nos. CO-0047767, CO-0047776, and CO-0048003

Pioneer Natural Resources USA, Inc.

I. Comments and Corrections Related to Draft Permit No. CO-0047767

A. Draft Permit

Part I A.1., page 3. The table of permitted features in the Draft Permit contains numerous inaccuracies. The table below presents more accurate coordinates and sampling point descriptions for the outfalls. All coordinates are "end of pipe." Coordinates or parameters that have been changed are highlighted in yellow.

Outfalls	Sampling Point	Main Drainage	Latitude	Longitude
004-A	End of discharge pipe	Santisteven Canyon	37.18611	-104.93533
007-A	End of discharge pipe	Unnamed Tributary to Purgatoire River	37.17799	-104.94195
016-A	Wellhead	Sarcillo Canyon	37.18649	-104.76083
022-A	End of discharge pipe	Burro Canyon	37.19574	-104.74877
028-A	Wellhead	Burro Canyon	37.18403	-104.74698
057-A	End of discharge pipe	Reilly Canyon	37.23183	-104.71364
060-A	End of discharge pipe	Reilly Canyon	37.20537	-104.68251
061-A	Sampling valve	Reilly Canyon	37.21319	-104.70066
063-A	Wellhead	Sarcillo Canyon	37.18171	-104.75927
065-A	Sampling valve	Reilly Canyon	37.22754	-104.69736
071-A	End of discharge pipe	Cow Canyon	37.09648	-104.85325
073-A	Sampling valve	Unnamed Tributary to Purgatoire River	37.11139	-104.85461
075-A	Sampling valve	Sarcillo Canyon	37.19365	-104.76610
079-A	Sampling valve	Burro Canyon	37.21597	-104.71967
090-A	Sampling valve	Reilly Canyon	37.24787	-104.68689
094-A	Sampling valve	Reilly Canyon	37.25140	-104.66709
096-A	Sampling valve	Sarcillo Canyon	37.17707	-104.77507
105-A	End of discharge pipe	Sarcillo Canyon	37.16460	-104.77660
108-A	Sampling valve	Reilly Canyon	37.24176	-104.73830
112-A	End of discharge pipe	Burro Canyon	37.19445	-104.68835
147-A	End of discharge pipe	Sarcillo Canyon	37.17749	-104.79132
152-A	Sampling valve	Reilly Canyon	37.25923	-104.73921
156-A	Sampling valve	Sarcillo Canyon	37.21578	-104.83392
160-A	End of discharge pipe	Burro Canyon	37.21903	-104.73867
183-A	Sampling valve	Burro Canyon	37.20851	-104.74383
191-A	End of discharge pipe	Burro Canyon	37.22371	-104.78366
198-A	Wellhead	Sarcillo Canyon	37.21526	-104.85877
202-A	Wellhead	Reilly Canyon	37.23238	-104.66210
210-A	End of discharge pipe	Sarcillo Canyon	37.20063	-104.84083
212-A	End of discharge pipe	Burro Canyon	37.21382	-104.78011
213-A	End of discharge pipe	Sarcillo Canyon	37.22643	-104.85117
215-A	Sampling valve	Smith Canyon	37.17765	-104.75256
217-A	End of discharge pipe	Unnamed Tributary to Purgatoire River	37.13299	-104.80183
220-A	Sampling valve	Burro Canyon	37.21778	-104.74736
221-A	End of discharge pipe	Burro Canyon	37.21914	-104.73579
222-A	Sampling valve	Burro Canyon	37.20763	-104.76467
228-A	End of discharge pipe	Sarcillo Canyon	37.18097	-104.79704
230-A	End of discharge pipe	Reilly Canyon	37.22096	-104.65016
238-A	Sampling valve	Sarcillo Canyon	37.25272	-104.85246
239-A	Sampling valve	Sarcillo Canyon	37.19395	-104.83724

Part I.A.2, page 4. Without waiving our contention that limits on flow are beyond the scope of the Division's regulatory authority (*see* Comment Letter Section VII), Pioneer does offer that it may not be objectionable if flow limits are included in the final permit based on total flows for each tributary. The following sentence would be added to this section to allow for operational flexibility, "Flows for outfalls have been combined where the outfalls are on the same segment and the combined outfall is at a point identified in this permit." If the Division elects this option, please confer with Pioneer on the outfalls to be combined, language describing the combined flow limits, and the new points of compliance. There are physical obstacles and legal impediments to points of compliance at some locations and on properties not controlled by Pioneer.

Part I A.2, pages 9-10, 12-13. The Draft Permit states that Outfalls 075-A, 228-A, 202-A, 230A, 057-A, 065-A, 094-A, 147-A, 156-A, and 238-A require acute WET testing until December 31, 2016. Pioneer believes this an error and that the listing for Acute WET testing should actually be report-only chronic WET testing until December 31, 2016. The Draft Permit does not identify a TCF/IWC for acute tests for this outfall, confirming the belief that it should be a report-only requirement for chronic WET testing. If acute testing is required, a compliance plan and appropriate TCF/IWC are needed.

Part I A.2, pages 9-10, 12-13, 15, 18-20. The Draft Permit and/or Fact Sheet do not identify TCF/IWC for acute tests for Outfalls 075-A, 228-A, 202-A, 230A, 057-A, 065-A, 094-A, 147-A, 156-A, 238-A, 096-A, 060-A, 105-A, and 239-A. If acute testing is ultimately required, the permit should specify the applicable TCF/IWC.

Part I A.2, pages 8-21. The Draft Permit proposes *C. dubia* as the test species for acute WET testing for Outfalls, rather than *D. magna*, which is the test species under the current permit. The Division must correct this error to be consistent with prior permits, which allowed acute WET testing with *D. magna*. Also, please consider this as Pioneer's formal request to substitute and use *D. magna* as the species for all acute WET tests under this Draft Permit.

Part I A.2, page 10-20. Mercury measurements collected during the current permit term were for low-level mercury. In the Draft Permits, the Division inconsistently requires total mercury measurements, while referencing low-level mercury testing in the Fact Sheets. The Division has not demonstrated that mercury measurements should continue (low-level or total) at all outfalls. Therefore, this requirement should be deleted.

Part I A.2, page 14. The Draft Permit and/or Fact Sheet do not explain the change in WET testing requirements for Outfall 073-A, although it does explain that WET testing requirements have been made less restrictive under the Draft Permit, with lower IWC for Outfalls 079-A, 160-A, 220-A, and 221-A (which are listed with Outfall 073-A on the permitted features table). *See* 47767 Fact Sheet at 38; 47767 Draft Permit at 14. The Division must explain this discrepancy.

Part I A.2, page 21. The outfalls listed on this page do not reach the Purgatoire River. As such, there is no opportunity (or legal water right) for water to be diverted and used for irrigation. Therefore, boron, a parameter pertinent to crop growth, should not be included on the effluent parameter list. There is no reasonable potential.

Part I A.2, page 21. The outfalls listed on this page do not reach the Purgatoire River. As such, there is no reasonable potential to promote aquatic life. Therefore, WET testing should not be required for outfalls that do not reach the Purgatoire River.

Part I A.3, page 22. The "Due Date" in the second event code 50008 should be revised to reflect that the 2014 study and results have been submitted.

Part I B.2.a, page 23. Strontium 90 has a semi-annual monitoring requirement. If the permit becomes effective July 1, 2015, there is insufficient time to sample, analyze, and evaluate the data and to develop strategies to prepare a progress report by December 31, 2015. A due date of one year after the permit effectiveness for this first progress report, with subsequent due dates each moved out a corresponding period of time, would be more reasonable.

Part I B.3.b, page 26. This section includes two sentences that state: "The IWC for this permit has been determined to be 100% effluent." However, the IWCs listed prior to this section in the Draft Permit at Part I B.3, page 26, as well as the Fact Sheet, page 38, contradict this statement. These sentences should be eliminated or revised to reference the IWCs presented in the other sections of the Draft Permit and Fact Sheet

Part I C.12, page 31. The Draft Permit requires a minimum sampling frequency to obtain six values. As discussed in the permit comments, conditions beyond the control of Pioneer (e.g., wildfire, cold weather, floods, heavy snows, etc.) may inhibit the permittee's ability to collect six samples per semi-annual reporting period. The permit should acknowledge this and provide guidance for cases where $n \leq 5$. In addition, the Division has failed to consider that as water production in the Basin declines, outfalls may be operated intermittently. As such, it is possible that the minimum number of values may not be obtained where an outfall is not used for months at a time. The final permit should account for these potential operational changes and only require sampling on a monthly basis.

Part I D.1, page 34. This section of the Draft Permit requires that data gathered in compliance with Part I.A or Part I.B shall be reported on a monthly basis, but then goes on to provide an example that indicates that DMRs are due on a quarterly basis. This section should be revised to clarify that DMR reporting should remain on a quarterly basis. Monthly reporting would be a change from the prior permit and there is no reason for this change. The data are generally consistent with little variability, as demonstrated by several years of data. Monthly reporting would be unduly burdensome on the permittee.

Part I D.2, page 35. The final sentence of this section should be revised to read (new text underlined): "Monitoring points shall not be changed without notification to and approval by the Division, except in cases where such move is needed for reasons of safety, public health, or environmental protection, in which case an explanation shall be provided."

B. Fact Sheet

Part III, page 3. In rejecting Pioneer's iron trading proposal, the Fact Sheet explains that "[d]ischarges within the scope of this permit do not fall into the 'South Fork' watershed, only the 'mainstem of the Purgatoire River watershed.'" However, the outfalls covered by Permit No. CO-0047767 fall into segment COARLA06a, which do not possess an iron standard at all. The

Division has provided no basis for imposing iron standards anywhere other than Lorencito Canyon. There is no evidence to suggest that Pioneer's activities have any adverse impact on downstream iron levels. Segment 6a only has standards for the total recoverable form of the following metals: As, Be, Cd, CrIII/CrVI, Cu, Pb, Mo, Ni, Se, and Zn. The Division has provided no basis for imposing standards for metals not included on this list or for other forms (e.g., potentially dissolved) of these metals. There is no evidence to suggest that Pioneer's activities have any adverse impact on downstream levels of these metals.

Part III, Compliance Schedule Determination, page 10. In this section, the Division states that a compliance schedule necessity determination was made based "upon information that is available for SAR values for 2014 for each outfall." It is unclear, however, why the Division did not use data from these samples in setting SAR permit limits. As discussed on page 9 of the Fact Sheet (SAR Revised Approach), the SAR permit limits were based on data from January 2010 through September 2013.

Part VI B., page 16. The Fact Sheet lists at least six examples of purported DMR effluent limitation violations that are not actual DMR violations. Specifically, the Fact Sheet identifies flow violations in DMRs dated 04/30/2014, 05/31/2014, and 06/30/2014 for outfalls 152-A and 214-A. These discrepancies were addressed in Pioneer's responses to previous compliance advisories, which have already been submitted to the Division. These purported violations are not violations of DMR limits and therefore should be deleted from this list.

Part VII.A.3.a, pages 17-18. The Fact Sheet states that "each outfall has been assigned a limitation for SAR and EC, set to the previous permit cycle's maximum value for each parameter." This statement is not accurate. The proposed effluent limits for SAR are set at the 85th percentile of the historic data, not the maximum recorded value.

Part VII.B, page 37. In the discussion of adjusted SAR, the Fact Sheet states that "[a]s outlined in the WQA, the approach to assigning limitations for the outfalls of this facility was different than the typical process of calculating SAR limitations. Instead, the SAR limitations are set at the maximum recorded value for each individual outfall (note that outliers were removed from consideration)." This statement is not accurate. The proposed effluent limits for SAR are set at the 85th percentile of the historic data, not the maximum recorded value. Consistent with the WQA, Pioneer requests that the SAR levels be set at the maximum recorded value.

II. Comments and Corrections Related to Draft Permit No. CO-0047776

A. Draft Permit

Part I A.1., page 3. The table of permitted features in the Draft Permit contains numerous inaccuracies. The table below presents more accurate coordinates and sampling point descriptions for the outfalls. All coordinates are "end of pipe." Coordinates or parameters that have been changed are highlighted in yellow.

Outfall No.	Sampling Point	Main Drainage	North	West
005 A	End of discharge pipe	Puertecito Canyon	37.10065	-104.81341
010 A	End of discharge pipe	Puertecito Canyon	37.09949	-104.79886
022 A	End of discharge pipe	Lorencito Canyon	37.08232	-104.79249
027 A	End of discharge pipe	Little Pine Canyon	37.08620	-104.81690
059 A	End of discharge pipe	Alamosa Canyon	37.06256	-104.81483
075 A	Sampling valve	Alamosa Canyon	37.06069	-104.82310
076 A	Wellhead	Chimney Canyon	37.07536	-104.83199

Part I A.1., page 3. Outfall 022A is the only outfall to Lorencito Canyon; the "Main Drainage" for all of the other outfalls should be revised to read "Tributaries to Lorencito Canyon" to clearly identify them as falling into Segment 6a.

Part I A.2, pages 5-11. "Oil and Grease (Visual)" should be added to the list of effluent parameters to be monitored for all outfalls, with monitoring "contingent (based on visual results)." This approach is consistent with 5 C.C.R. § 1002-62.5(1), n. 6, which states that "A numeric effluent limit will be assigned in permits for discharges to surface waters, however, monitoring for a 'visual sheen' will generally be required. Where a visual sheen is detected, the discharger will be required to collect a grab sample and have it analyzed for oil and grease." Any other oil and grease requirements should be deleted.

Part I A.2, page 11. In the existing permit, the Division ruled that Outfall 076A "does not reach the mainstem of the Purgatoire River." 47776 Permit at 7. Consequently, Outfall 076A should not include the following parameters: EC, As, Cd, Cr, Cr+3, Cu, Pb, Mn, Mo, Hg, Ni, Se, Zn, Chloride, Sulfide as H2S, Calcium, Magnesium, Sodium, Bicarbonate as HCO_3, and Radium 226+228. If these are new parameters, the Division should provide a basis for these new reporting requirements.

Part I A.3.1, page 12. The final sentence of the paragraph 1, which reads "First report will be submitted by December 31, 2014 to cover the after-irrigation season for 2014 due to the effective date of this permit modification." should be deleted.

Part I A.3.1, page 12. The Special Study (Code 21599), "Conduct preliminary field sampling to establish initial soil pH, EC, and SAR/SARadj" should be deleted from this table because it has already been completed.

Part I A.3.1, page 12. The "Due Date" in the second event code 50008 should be revised from "December 31, 2014" to "December 31, 2015" and the language updated to reflect that the 2014 study and results have been submitted.

Part I B.2.b, page 14. The first three items of the "Activities to Meet Chronic Whole Effluent Toxicity (WET)" (codes 43699 (due date 9/30/15) and 25099 (due dates 10/31/15 and 12/31/15)) have already been completed and should be deleted.

Part I C.12, page 17. The Draft Permit requires a minimum sampling frequency to obtain six values. As discussed in the permit comments, conditions beyond the control of Pioneer (e.g., wildfire, cold weather, floods, heavy snows, etc.) may inhibit the permittee's ability to collect six samples per semi-annual reporting period. The permit should acknowledge this and provide guidance for cases where $n \leq 5$. In addition, the Division has failed to consider that as water production in the Basin declines, outfalls may be operated intermittently. As such, it is possible that the minimum number of values may not be obtained where an outfall is not used for months at a time. The final permit should account for these potential operational changes and only require sampling on a monthly basis.

Part I D.1, page 21. This section of the Draft Permit requires that data gathered in compliance with Part I.A or Part I.B shall be reported on a monthly basis, but then goes on to provide an example that indicates that DMRs are due on a quarterly basis. This section should be revised to clarify that DMR reporting should remain on a quarterly basis. Monthly reporting would be a change from the prior permit and there is no reason for this change. The data are generally consistent with little variability, as demonstrated by several years of data. Monthly reporting would be unduly burdensome on the permittee.

Part I D.2, page 21. The final sentence of this section should be revised to read (new text underlined): "Monitoring points shall not be changed without notification to and approval by the Division, except in cases where such move is needed for reasons of safety, public health, or environmental protection, in which case an explanation shall be provided."

Part I D.3 and D.6, pages 22 and 24. The Draft Permit requires "Flow Measuring Devices" and "Influent and Effluent Sampling Points." Pioneer continuously monitors flow at the wellhead. Continuously measuring for flow at the wellhead and then requiring such monitoring again at the outfall is duplicative and unnecessary. The Division has not established that additional continous flow monitoring at the outfall would serve any purpose, other than to impose extraneous costs on the company. As such, these requirements should be deleted from the permit.

B. Fact Sheet

Part III, Compliance Schedule Determination, page 9. In this section, the Division states that a compliance schedule necessity determination was made based "upon information that is available for SAR values for 2014 for each outfall." It is unclear, however, why the Division did not use data from these samples in setting SAR permit limits. As discussed on page 7 of the Fact Sheet (SAR Revised Approach), the SAR permit limits were based on data from January 2010 through September 2013.

III. Comments and Corrections Related to Draft Permit No. CO-0048003

A. Draft Permit

Part I A.1, page 3. The table of permitted features in the Draft Permit contains numerous inaccuracies. The table below presents more accurate coordinates and sampling point descriptions for the outfalls. All coordinates are "end of pipe." Coordinates or parameters that have been changed are highlighted in yellow.

Outfall No.	Sampling Point	Main Drainage	North	West
005 A	End of discharge pipe	Parras Canyon, North Fork of Purgatoire	37.20319	-104.94585
241 A	Sampling valve	An unnamed tributary of Guajatoyah Creek	37.20918	-104.98773
245 A	Sampling valve	Parras Canyon, North Fork of Purgatoire	37.19574	-104.94720

Part I A.2, page 4. Table referring to Permitted Feature UST1A. The text should clearly state that reporting at this location is limited to "Report" for the duration of the permit as described in the associated Fact Sheet.

Part I A.2, pages 5-7. "Oil and Grease (Visual)" should be added to the list of effluent parameters to be monitored for all outfalls, with monitoring "contingent (based on visual results)." This approach is consistent with 5 C.C.R. § 1002-62.5(1), n. 6, which states that "A numeric effluent limit will be assigned in permits for discharges to surface waters, however, monitoring for a 'visual sheen' will generally be required. Where a visual sheen is detected, the discharger will be required to collect a grab sample and have it analyzed for oil and grease." Any other oil and grease requirements should be deleted.

Part I A.2, page 6. The subheading for "WET, acute" in the table for Outfall 241 should be deleted; there are no WET acute requirements for this outfall.

Part I A.2, pages 5-7. Data from this geographic area should support a finding of no reasonable potential for the following metals listed in this permit: As, Cd, Cr, Cr+3, Cu, Pb, Mn, Mo, Hg, Se, Ni, and Zn.

Part I A.3.a.1, page 8. The final sentence of the paragraph 1, which reads "First report will be submitted by December 31, 2014 to cover the after-irrigation season for 2014 due to the effective date of this permit modification." should be deleted.

Part I A.3.a.1, page 8. The Special Study (Code 21599), "Conduct preliminary field sampling to establish initial soil pH, EC, and SAR/SARadj" should be deleted from this table because it has already been completed.

Part I A.3.a.1, page 8. The "Due Date" in the second event code 50008 should be revised from "December 31, 2014" to "December 31, 2015" and the language updated to reflect that the 2014 study and results have been submitted.

Part I A.2.b, pages 9-10. Outfall No. 241 discharges to a small ephemeral tributary at a location approximately 0.34 miles above the confluence with Guajatoyah Creek. The temperature of this discharge is expected to normalize by it reaches Guajotoyah Creek. Consequently, Pioneer believes that a Mixing Zone Analysis is not required as the effluent temperature should be equivalent to that of the receiving water by the time they join. The Division has provided no rationale to justify these requirements.

Part I A.3.c, page 10. The Division has chosen to adopt a recommendation it received from a member of the USGS interested in testing a new, prototypical technology for temperature monitoring in ephemeral and intermittent streams. It is inappropriate to use a permit as a way of requiring the testing of a new technology. The Division has offered no explanation or justification for this requirement.

Part I B.2, page 10. The permit should include a compliance schedule for iron. Pioneer has offered to fund significant stream restoration efforts as a way of reducing the amount of iron found in the Purgatoire River watershed, including that of tributaries of the Purgatoire upstream of Trinidad Reservoir. Since it was submitted in 2012, the Division has provided no comments or opportunities to discuss or review Pioneer's preliminary iron-reduction proposal. Pioneer's proposal was general in nature and could have been tailored to address sediment-related iron issues in any number of drainages. The Division is already in possession of a significant body of data showing that iron reductions are not possible, necessitating a compliance schedule.

Part I B.2, page 10. The first three steps in the temperature monitoring compliance schedule (codes 43699 (due 9/30/15) and 25099 (due 10/31/15 and 12/31/15)) should be deleted because they have already been completed.

Part I B.3.b, page 12. The first paragraph of this section states that "IWC for this permit has been determined to be 100% effluent. 53% effluent for Outfall 241"; the second paragraph states that the IWC for this permit has been determined to be 100% or 53%. On page 30 of the Fact Sheet states that outfall 245 has an IWC of 53%. It is unclear why one chronic discharge for this permit has a reduced IWC and the two others have IWCs equal to 100%. The outfalls associated with reduced IWC should be clarified. Furthermore, the IWC appropriate for these outfalls may change based on the use of actual flow data form station GUA-0.1.

Part I C.13, page 14. The Draft Permit requires a minimum sampling frequency to obtain six values. As discussed in the permit comments, conditions beyond the control of Pioneer (e.g., wildfire, cold weather, floods, heavy snows, etc.) may inhibit the permittee's ability to collect six samples per semi-annual reporting period. The permit should acknowledge this and provide guidance for cases where $n \leq 5$. In addition, the Division has failed to consider that as water production in the Basin declines, outfalls may be operated intermittently. As such, it is possible that the minimum number of values may not be obtained where an outfall is not used for months at a time. The final permit should account for these potential operational changes.

Part I D.1, page 18. This section of the Draft Permit requires that data gathered in compliance with Part I.A or Part I.B shall be reported on a monthly basis, but then goes on to provide an example that indicates that DMRs are due on a quarterly basis. This section should be revised to clarify that DMR reporting should remain on a quarterly basis. Monthly reporting would be a

change from the prior permit and there is no reason for this change. The data are generally consistent with little variability, as demonstrated by several years of data. Monthly reporting would be unduly burdensome on the permittee.

Part I D.2, page 19. The final sentence of this section should be revised to read (new text underlined): "Monitoring points shall not be changed without notification to and approval by the Division, except in cases where such a move is needed for reasons of safety, public health, or environmental protection, in which case an explanation shall be provided."

Part I D.4 and D.6, pages 19 and 22. The Draft Permit requires "Flow Measuring Devices" and "Influent and Effluent Sampling Points." Pioneer continuously monitors flow at the wellhead. Continuous measuring for flow at the wellhead and then requiring such monitoring again at the outfall is duplicative and unnecessary. The Division has not established that additional continuous flow monitoring at the outfall would serve any purpose, other than to impose extraneous costs on the company. As such, these requirements should be deleted from the permit.

B. Fact Sheet

Part III, Compliance Schedule Determination, page 8. In this section, the Division states that a compliance schedule necessity determination was made based "upon information that is available for SAR values for 2014 for each outfall." It is unclear, however, why the Division did not use data from these samples in setting SAR permit limits. As discussed on page 7 of the Fact Sheet (SAR Revised Approach), the SAR permit limits were based on data from January 2010 through September 2013.

Part VIII D. Compliance Schedules, page 32. The Fact Sheet mistakenly refers to a lower IWC for outfall 241 under the heading "Whole Effluent Toxicity (Chronic) Outfalls 005 and 245." The following sentence should be revised to refer to outfall 245: "Note that for outfall 241, chronic limits can be attained as the IWC becamse [sic] less stringent from the previous permit term." *See* discussion on page 30 regarding the 53% IWC for outfall 245.

Part VIII D. Compliance Schedules, page 32. The Fact Sheet mistakenly refers to outfall 245 as having 100% IWC under the heading "Whole Effluent Toxicity (Chronic) Outfalls 005 and 245," when it should refer to outfall 241. *See* discussion on page 30 regarding a 100% IWC for outfall 241.

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April 6, 2015

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Water Quality Control Division, Permits Section, P-B-2
4300 South Cherry Creek Drive South
Denver, CO 80246

Re: **Alternatives Analysis for Iron**
XTO Energy, Inc. and Pioneer Natural Resources USA, Inc.
XTO Permit Nos. C0-0048062 and C0-0048054
Pioneer Permit Nos. C0-0047776, C0-0047767, and C0-0048003

Dear Janet:

Coalbed Methane ("CBM") operations in the Raton Basin produce valuable, clean-burning natural gas, which has been responsible for significant reductions in our country's greenhouse gas emissions. The CBM operations by XTO Energy, Inc. ("XTO"), and Pioneer Natural Resources USA, Inc. ("Pioneer"), (collectively "Raton Basin" or "Companies") are important economically, socially and environmentally to the local community and our state. The Companies' CBM operations make significant direct contributions to the economies of the City of Trinidad, Las Animas County and the State of Colorado through its facilities, employees and contractors in Trinidad and Denver, and through payment of permit fees, local and state sales and property taxes, and state severance taxes.

Environmentally, water produced in connection with CBM extraction is beneficial for aquatic habitat and fish, and is used in state wildlife areas, wildlife watering ponds, downstream irrigation and livestock watering. These operations have continued for many years with no adverse water quality or environmental impacts; it is important that CBM production continues. The State has applied a chronic total recoverable iron standard of 1000 µg/l to the permits in an attempt to ensure these uses are protected. These iron standards have been consistently exceeded in the Purgatoire River, as shown by data available to the public and the state, and such exceedances predate the development of CBM in the watershed. *See* http://www.Purgatoirewatershed.org.[1] The iron exceedances can directly be correlated with sediment loads, as measured by total suspended

[1] The Purgatoire Watershed in this document means that portion of the watershed that is west of I-25, upgradient of Trinidad Reservoir (dam).

solids ("TSS"), to the River; sediment and iron loads which are contributed by extensive streambank erosion. In preparing the draft discharge permit limits published on February 6, 2015, the Water Quality Control Division ("Division") determined that discharges of iron at various levels from the CBM operations would result in attainment of the standard. These draft limits (30-day and 2-year averages) are presented in Table 7 below. *See also* Water Quality Assessment at 90 (rev. Jan. 12, 2015) ("WQA"). A two-year average iron limit calculated by the antidegradation analysis resulted in a limit as low as 363 µg/l (Permit No. CO-0048003), 366 µg/l (Permit No. CO-0048062) and 495 µg/l (Permit Nos. CO-0047767, CO-0047776, and CO-0048054). These limits dictate the Companies' response and request for relief through this alternatives analysis for new proposed iron limitations. The WQA and Fact Sheets to the draft permits stated that the Companies may complete an alternatives analysis for antidegradation-based effluent limitations. WQA at 88-89; Fact Sheets to Permit Nos. CO-0048054 at 36, CO-0048062 at 21, CO-0047767 at 18, CO-0047776 at 18, and CO-0048003 at 19.

The Division provided compliance schedules in the existing permits for the Companies to evaluate and develop plans to attain the iron limits and data collected during the compliance schedule indicate that the two-year average iron limit cannot be regularly attained at nearly every outfall, nor can the 30-day limit in some instances. In developing the iron limits, the Division did not consider the socioeconomic impacts nor the technological or economic feasibility of meeting these effluent limits. Therefore, the Companies are requesting that their final discharge permits be modified for iron and the iron limits be determined as set forth in this Alternative Analysis. The criteria and process for alternatives analysis for unclassified waters are set forth in the regulations:

> An intermediate level of water quality protection applies to waters that have not been designated outstanding waters or use-protected waters. These waters shall be maintained and protected at their existing quality unless it is determined that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. For these waters, no degradation is allowed unless deemed appropriate following an antidegration review in accordance with section 31.8(3).

5 C.C.R. § 1002-31.8(1)(b).

We provide evidence and address each criteria for an alternative analysis in this proposal.

ALTERNATIVES ANALYSIS

A. Basis of Alternatives Analysis

According to the Basic Surface Water Quality Standards (5 C.C.R. § 1002-31), if a discharge is related to important economic or social development, a determination is then made regarding whether the degradation that would result from such discharges is necessary to

accommodate that development. The degradation may be deemed necessary where there are no water quality control alternatives that are determined to be economically, environmentally and technologically reasonable. Considering these broad directions and individual regulatory factors, the Companies set forth in this submittal their alternatives analysis as it pertains to iron.

B. Regulation 31.8(3)(d) Factors

If a determination is made that a proposed regulated activity is likely to result in significant degradation of reviewable waters, a determination is then made pursuant to Section 31.8(3)(d) regarding whether the degradation is "necessary to accommodate important economic or social development in the area in which the waters are located."

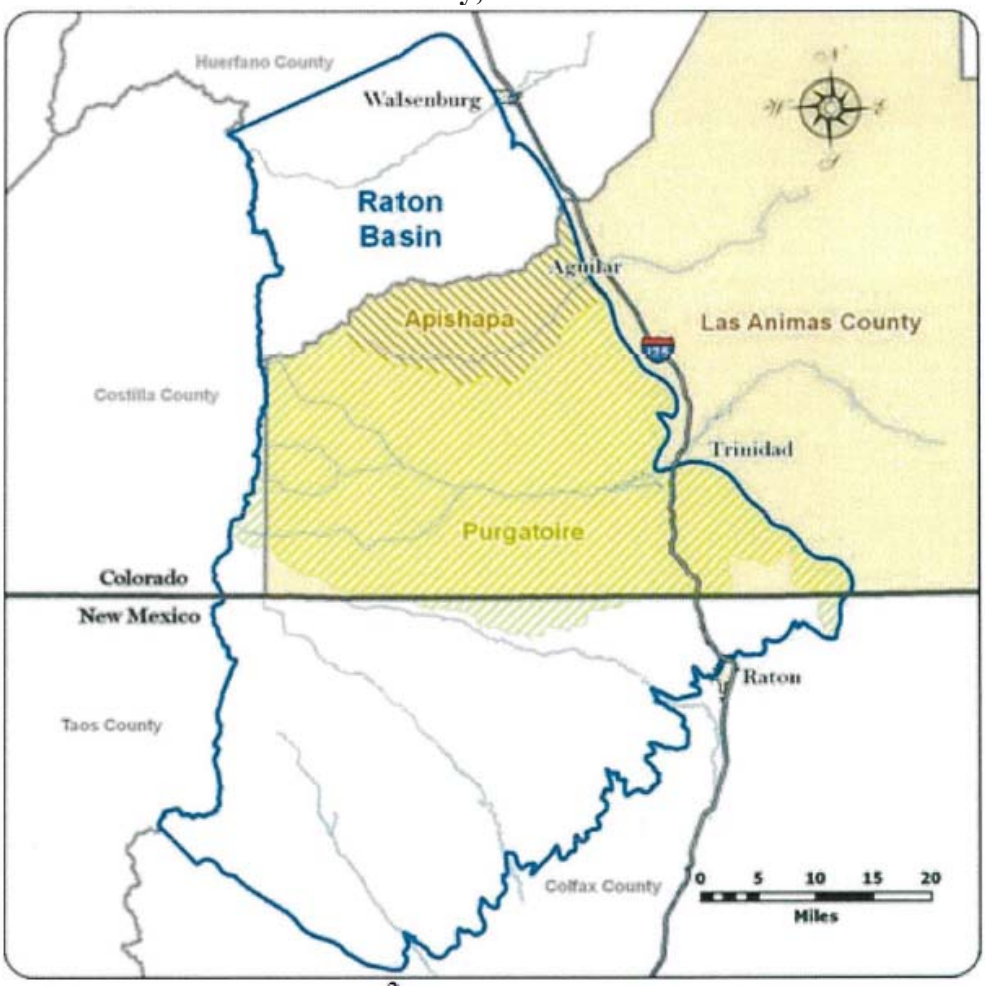
No significant degradation of reviewable waters occurs as a result of the companies' activities. Any variation in iron levels contributed by the Companies' activities is completely overwhelmed by large, natural sources of iron in the watershed. Although produced waters are discharged with iron levels higher than the limits proposed, there are no increases to the background iron concentrations in the Purgatoire River, as shown by USGS and more recent data. Continuous monitoring data collected in the Purgatoire River since April 2010, during which time CBM discharges continued at full operational levels, demonstrates the in-river iron concentrations have remained at historic levels, which is above the standard.

The following factors are considered in connection with such a determination and we have set forth an analysis of their applicability below.

1. 31.8(3)(d)(i) – Areas Impacted.

CBM gas only exists in certain limited geographic areas throughout the country. The Raton Basin is a prime geological formation for CBM production in Las Animas County, Colorado (Figure 1, USGS, 2005).

Figure 1. Raton Basin in Las Animas County, Colorado.



CBM producers cannot re-locate facilities to other geologic formations (that have less restrictive water quality limits) because there are no coal seams or CBM gas there. Currently, CBM operators in the Raton Basin operate approximately 3,000 wells that extract natural gas from coal seams in the Vermejo and Raton Formations within the Raton Basin. This production has occurred for approximately twenty years.

A by-product of CBM extraction is produced water. However, this broad geographic area continues to benefit from increased water flows and supplies. While some of the CBM-produced water is re-injected into deep geologic formations in accordance with Underground Injection Control ("UIC") permits issued by the Colorado Oil and Gas Conservation Commission ("COGCC"), the majority of the produced water is discharged to tributaries of the Purgatoire River in accordance with Colorado Discharge Permit System ("CDPS") permits. Collectively, the Draft Permits allow the discharge of up to 8.57 million gallons per day ("MGD"), or approximately 9,600 acre-feet annually of CBM-produced water into the upper Purgatoire watershed, including the North

and South Forks of the Purgatoire River, and more significantly in tributary canyons that flow into the mainstem of the Purgatoire River. Between 4,150 and 8,000 acre-feet of water has been discharged to Purgatoire River tributaries each year as a result of the Companies' CBM operations; however, natural declines in CBM produced water, recent decreased production rates, and changes in permit conditions have resulted in reduced water discharge. In 2014, an estimated 1,700 acre-feet of CBM water reached the mainstem of the river, comprising about 4% of total Purgatoire River flow at the USGS gaging station upstream of Trinidad Reservoir at Madrid, CO. CBM-produced waters are constant, year-round flows, therefore enhancing stream and river flows during the most critical times: seasonal low flows and drought conditions.

2. 31.8(3)(d)(ii) – Important Economic or Social Development.

CBM operations help provide energy for national and regional areas – improving the energy independence of the United States. The Companies produced 78,662,139 Mcf (a unit of measure used in the oil and gas industry equal to 1000 cubic feet) of CBM gas in 2014 from the Raton Basin, with average annual production of over 99,800,000 Mcf per year since 2008. Colorado produces more than a quarter of all CBM produced in the United States, with the Raton Basin producing about 6% of total U.S. CBM supplies annually (Colorado Geological Survey; EPA). Put another way, this field annually produces the equivalent amount of natural gas consumed by over one million average American households each year. Natural gas contribution allows Colorado power plants to reduce coal burning under the Colorado Clean Air – Clean Jobs Act.

The economic bases of Las Animas County are primarily mining activity (which includes the oil and gas industry), agriculture and tourism/recreation, which bring money into the region to be circulated, creating other businesses and employment opportunities. The CBM companies contribute to all three components of the Las Animas County economic base, in terms of employment, income, and level of local economic activity (for example, amount of agricultural production and recreational activity and local spending). School districts and local medical facilities are large employers; however, other than the extractive-related activity undertaken by the CBM Companies, there are no major industries in the region. In Las Animas County, the Companies directly employed 345 people in 2014, about 4.4% of local employment, and indirectly account for more than 11% of employment. However, the Companies employment and the total employment supported by industry activities was even greater in past years when prices and production rates were higher. For example, in 2011, direct industry employment was almost 600 people and about 18% of local employment was due to industry operations. The flows from CBM-produced waters benefit agricultural crop irrigation and livestock watering and the tourism and recreation sectors, including hunting, fishing and other outdoor recreational activity.

CBM production by the Companies provide considerable economic, fiscal, and social benefits to the local region, including:

- Employment and associated income;
- Local spending and economic stimulus;

- Property tax and sales tax revenues;
- Generation of severance tax and Federal Mineral Lease revenues;
- Royalty payments to local, individual mineral owners;
- Corporate cash and in-kind contributions to local non-profit agencies and community projects;
- Agricultural production and recreational/tourism activity supported by increased flows in the Purgatoire River and tributaries, particularly in drought years; and
- Support of quality of life for local residents, including the natural aesthetics and recreational opportunities related to flows in Purgatoire River tributaries.

Figure 2. Trinidad, Colorado.

Source: http://www.southercolorado.info.

Employment and Associated Income. The Companies employ a considerable number of people in the area and average CBM industry employee salaries are more than twice the local average for all other industries. The number of employees holding high salary positions is particularly important in this area, which experienced unemployment rates of over 9% between 2009 and the early part of 2014. Table 1 summarizes the impact of CBM activity on local employment, income and retail sales. In 2014, the Companies directly employed 345 people in the Trinidad area (about 4.4% of total employment), at an average annual salary of about $79,400 (compared with the County average of $37,500 per year). CBM employees' total annual income amounted to $38.7M (about 13% of total income in Las Animas County) in 2014. Additionally, local spending by the Companies and their employees generates indirect and induced employment and income. Accounting for direct and induced effects, about 870 jobs and $54.5M of income in Las Animas County are supported by the local CBM industry. In total, CBM activity supports 11% of Las Animas County employment and over 18% of the County's total income. *See* Harvey Economics,

Economic Benefits of CBM Industry Activity and Produced Water in Las Animas County, Colorado, 2015.

The CBM Companies spend an estimated $59.5M with Las Animas County local businesses each year. Similar to personal income, this money circulates through the economy, generating additional indirect business sales, or an estimated total of $85.6M sales in 2014.

Table 1. Impact of CBM Activity on Local Employment, Income and Retail Sales (Harvey Economics, 2015).

	CBM Industry-Related	County Totals
Direct Employment	345	NA
Total Employment	871	7,860
Annual Average Wage	$79,400	$37,500
Direct Income	$38.7 M	NA
Total Income	$54.5 M	$297M
Direct Sales of Goods and Services	$59.5M	NA
Total Sales of Goods and Services	$85.6M	$332M

a. Property and Sales Tax Revenues, Severance Tax Payments and Royalty Payments.

Property and Sales Tax Revenue – The taxable value of real property associated with the Companies comprises over 40% of the total taxable assessed property in Las Animas County. In 2014, the Companies paid estimated property taxes of about $4.3M; that revenue is distributed to school districts ($2.4M), used for countywide projects and expenses ($1.5M) and is revenue for local improvement and service districts ($350,000). The $59.5M spent by the Companies in Las Animas County in 2014 generated sales tax revenues of over $340,000. *Id.*

Severance Tax and Federal Mineral Lease Payments and Distributions – The value of the Companies' Raton Basin gas production directly affects the amount of severance tax and Federal Mineral Lease (FML) revenues distributed to Las Animas County local governments. Statewide severance tax revenues are distributed to counties based on the number of industry employee residents, number of mining and well permits and total mineral production in the County. FML revenues are distributed to counties based on the revenue's county of origin and industry employee residents. Sub-county distributions are based on population, industry employees and road miles. In Las Animas County, more than $683,000 in severance taxes and about $293,000 in FML revenues were distributed to the following jurisdictions in 2014:

- Las Animas County government: $536,700
- Town of Aguilar: $16,920

• Town of Branson:	$1,810
• Town of Cokedale:	$3,890
• Town of Kim:	$1,950
• Town of Starkville:	$1,380
• City of Trinidad:	$390,600
• Local School Districts:	$22,900
Total	**$976,150**

Id. Between 2009 and 2014, annual severance tax revenue and FML revenues together have ranged from about $835,000 (2013) to over $2.2M (2009) for these Las Animas County jurisdictions.

Royalty Payments – The Companies pay royalties for CBM production on private and state lands. In 2014, royalties paid by the Companies included about $4.0M to private mineral owners in Las Animas County. Royalties paid to individual landowners add to their personal income levels; a portion of those royalties is likely spent in local communities.

Community Contributions and Support – CBM Companies contribute money to local non-profit agencies and fund specific community projects. Together, the companies have donated more than $3M to over 100 educational, environmental, agricultural, artistic, social welfare and healthcare related projects in Las Animas County. Additionally, the Gas Assistance Program, founded by the Companies, helps Las Animas County senior citizens with their energy bills. The companies have contributed funds to help area senior citizens pay their energy bills. Qualifying senior citizens get a direct payment made to their utility bill; the subsidized payment is determined by the citizen's income level and heating costs.

b. Agriculture, Recreation, and Tourism Benefit from Increased Flows.

The Purgatoire watershed is located in an arid region and local water supplies are currently over-appropriated, making each acre-foot of existing flow of the utmost importance. *See generally*, "Colorado's Water Plan," (draft issued Dec. 10, 2014). CBM-produced water increases flows in the Purgatoire River and its tributaries, providing benefits to ranchers, farmers, recreation users and other water users, both in the local area as well as downstream to the Arkansas River. As detailed below, CBM-produced water supports agriculture, recreation and tourism, including fishing, hunting, wildlife watching, boating, irrigation, and livestock operations.

Figure 3. Agricultural activity in the Purgatoire watershed.

Discharge points which have been intentionally dispersed throughout the watershed allow for water ponds, creating watering holes and dispersing habitat for wildlife species throughout the area. Landowners rely on CBM-produced water for wildlife ponds which supports increased utilization of wildlife habitat and benefits hunting and wildlife watching activities. The multiple dispersed sources of produced water increase the amount and quality of habitat available for large and small game, as well as animal density and patterns of movement throughout the region. In Las Animas County, hunting and wildlife watching contribute over $9.9M and $10M to the local economy, respectively. *See* Harvey Economics, 2015.

Figure 4. Deer feeding near XTO outfall 070A.

Source: XTO.

High quality hunting occurs on both public and private property in the region. The Purgatoire watershed is home to the second largest elk herd in Colorado (18,000 elk), as well as numerous other large and small game species, including deer, bear, mountain lion and pronghorn. About 54% of total hunting activity in Las Animas County occurs within the Purgatoire watershed, which encompasses only about one-quarter of the County's total land area. Elk are the most popular species hunted in the County and about 75% of all elk hunting occurs within the Purgatoire watershed. CBM produced water flowing through the Purgatoire watershed provides habitat for game species and contributes to $4.4M in hunting activity in the County. Hunting on specific privately-owned properties can cost up to $15,000 per license, which is paid to the landowner.

The Colorado Parks and Wildlife manages Bosque del Oso State Wildlife Area ("Bosque"), which also benefits from the CBM-produced water. The Bosque is managed for a high-quality hunting experience and obtaining an elk hunting license for that area is highly competitive. Approximately 700 acre-feet of produced water is provided to the Bosque each year, which is available for wildlife watering and habitat growth. In addition, the Companies perform road maintenance duties; provide and maintain cattle guards and gates; and contribute funding for forest thinning projects on the Bosque. The Companies also re-vegetate specific areas using a Division of Wildlife seed mix.

CBM water that reaches the Purgatoire River and Trinidad Reservoir enhance and sustain aquatic habitat for fish and other species. Fishing contributes about $16M annually to the Las Animas economy. Anglers enjoy the trout fishery and each angler day contributes approximately $78 to the economy. Aquatic habitat throughout the basin, including Trinidad Lake, also supports many cold and warm water fish species popular to anglers, including trout, bass, perch, chub, catfish, and sunfish.

Figure 5. Trinidad Lake, Colorado.

Source: Colorado State Parks, Trinidad Lake Facebook Page

Recreational activity also focuses on fishing and boating on Trinidad Lake, where there is a direct correlation between water levels and visitation. State Park visitors currently spend about $6.0M in local communities each year, representing an important source of revenue for local businesses. CBM water in Trinidad Lake is associated with about $240,000 in direct local visitor spending and $390,000 in total spending in local communities. This level of spending supports 6 local jobs.

Local ranchers use water from CBM wells for livestock watering. Agriculture in Las Animas County focuses on livestock production, mainly cattle and calves. Many ranchers rely on CBM water as a year round water source for livestock, especially in winter months and during drier

periods. Between 80% and 85% of total water use in Las Animas County goes towards agriculture. Downstream irrigators use Purgatoire River water, that includes some portion of CBM water, for crops, specifically forage crops such as alfalfa and pasture grass. These uses were the basis for landowner requests that the discharges be dispersed, making it more available to downstream users. The availability of CBM water has added about $1.1M to Las Animas County agricultural sales in recent years, resulting in over $2.0M in total annual local economic activity. In 2013, CBM produced water helped support about 21 agricultural jobs and over 40 total jobs in Las Animas County, with associated total personal income of about $365,000.

c. Quality of Life, Natural Aesthetics and Lifestyle

The year-round discharge of CBM water into tributaries of the Purgatoire River helps to support regeneration of native plant life and other vegetation, enhances wildlife habitat for animals and provides aquatic habitat for fish and other species. These environmental enhancements contribute to the natural beauty of the region and quality of life for local residents.

The economic and social benefits provided by CBM company activities, as well as the produced water by-product, are of considerable value to the residents, visitors and local jurisdictions of Las Animas County. CBM activities generate employment, income and a variety of local tax revenues and support the agriculture and recreation industries in the area. The water produced from CBM extraction provides a critical resource that supports recreation, tourism, and agriculture in the basin. The combination of these economic, fiscal, and socioeconomic benefits provides the necessary ingredients for developing an attractive location for residents and visitors, growing the local economy and providing a good quality of life.

3. 31.8(3)(d)(iii) Is Degradation Necessary to Accommodate the Development.

Continued levels of iron discharge to the watershed are necessary to accommodate CBM development in Las Animas County. It is not technologically feasible to produce CBM gas without producing water; nor is it economically feasible to treat produced water or socioeconomically feasible or desirable to dispose of all produced water via subsurface injection. The 30-day iron limits necessary to accommodate this development at the existing points of discharge on tributaries to the Purgatoire River are outlined in Table 7, below. Degradation at the outfalls is necessary, but it does not cause degradation of the Purgatoire River which, in many cases, is located miles downstream of the actual outfalls. The elevated iron levels in the river are directly attributable to background iron concentrations primarily generated by nonpoint sources such as stream bank erosion and erosion from wildfire-impacted lands.

a. It is not technologically feasible to produce gas without the associated produced water.

The iron concentration in the produced water brought to the surface with the CBM natural gas is part of gas production in the Raton Basin. The Companies have no control over this naturally occurring concentration. The water is separated from the gas, and the waters are discharged. The

production of CBM discharge water is inextricably related to CBM production, as the gas is under hydraulic pressure, and in order for the coalbed gas to flow, the hydraulic pressure must be released by production of the water.

b. It is not economically feasible to treat produced water to reduce iron concentrations.

CBM development in the Raton Basin dictates a dispersed well system, and the accompanying surface discharge system. In many cases, local landowners specifically demanded access to the produced water, which mitigated against high-volume surface discharge facilities. Similarly, the current holdings and water handling systems of Pioneer and XTO are actually the agglomeration and legacy of CBM development projects initiated by many companies that predate the current owners. The produced water is currently discharged from approximately 130 outfalls over a 600 square mile area of rugged terrain. Because of the broad distribution of discharge locations and variable topography, if produced water were to be treated, pipeline and satellite treatment facilities (approximately 0.75 MGD - 1.00 MGD each) that combine flow from multiple outfalls would need to be located throughout the watershed at an estimated cost ranging between $83.3M - $91.9M deemed economically infeasible (Table 2).

Based on Tetra Tech's evaluation of the produced water chemistry and required finished water quality, a reduction in iron concentrations to the 2-year average concentration as low as 363 µg/l would require a robust treatment process that includes microfiltration (MF) and pipe network to collect and convey produced water to nine separate treatment facilities to consistently meet the target iron concentration needed to comply with the lower 2-year average limitations. Other processes were evaluated (i.e., aeration/sand filtration, aeration/settling, and aeration/addition of organic polymers (flocculants/settling) and subsequently dismissed due to not being able to consistently meet the proposed iron limits. Further, such processes would likely result in unintended consequences – causing potential exceedances with other permit limitations, namely SAR and EC. Aeration increases evaporation, which can increase SAR and EC levels. There is evidence that extensive aeration can also increase pH and calcium carbonate precipitation, therefore, increasing SAR values potentially beyond SAR permit limits.

Table 2. Summary of Capital Costs Associated with Microfiltration Treatment and Disposal of Backwash Waste Stream.

Item	Description	Estimated Cost
MF Treatment Facilities	Nine (9) MF facilities – approximately 0.75 - 1.00 MGD each Includes the following: Microfilters Buffer Tank Trailer mounted MF facility Backwash Tank Waste Collection, tank/pumps Aeration tank to oxidize and precipitate iron Aeration blowers Concrete foundation and structural support for MF trailer systems Engineering Installation Delivery Startup/Commissioning Chemical Cleaning Acid storage/delivery Caustic storage/delivery NaOCl Storage/delivery Anti-sealant storage/delivery Containment Miscellaneous Mobilization/Demobilization PipingNalves Electrical/controls Contingency (20%)	$25.7M - $34.3M
Deep Injection Disposal Wells	Nine (9) deep injection wells permitted and drilled to inject backwash waste stream (10% of total treated volume) to depths of approximately 4000-6000 feet. Includes the following: Drill and complete costs in Raton Basin ($3.0 M/well) Surface facilities (SCADA, pumps, tanks, etc. $0.5M/well)	$31.5M
Pipeline	Installation of approximately 70 miles of 6-inch HDPE pipe to convey produced water from outfalls to each treatment facility; acquisition of pipeline easement.	$24.7M

Item	Description	Estimated Cost
Electrical infrastructure	3-phase power drops for treatment sites. Includes the following: 600 KVA transformers, 1200 amp, 480/277V service, underground services, and metering.	$765,000
Land	Approximately 315-acres of land needed for treatment facilities in the watershed.	$630,000
Total Estimated Capital Investment Costs		**$83.3M - $91.9M**

Included in the capital investments are the following:

- Construction of nine satellite MF treatment facilities each with a capacity ranging between 0.75 MGD - 1.00 MGD. In essence, a MF treatment facility would be needed at the downstream end of each tributary that Companies discharge to, or nine locations due to the dispersed location of discharges in the watershed and the over 2000 feet of vertical relief within the study area. Even after MF treatment, approximately 10% of the total water volume remains as an iron waste stream.

- Drilling and installation of nine injection wells and surface facilities (i.e. SCADA, pumps, etc.) for disposal of the iron backwash waste stream at each MF treatment facility. One companion disposal well and surface facilities, located in proximity of each treatment facility, would cost approximately $3.5 M/well, with an estimated cost $31.5M.

- Over 70 miles of high-density polyethylene (HDPE) pipe to convey produced water from each tributary outfall to the satellite treatment facility located at the terminus of each tributary canyon. An extensive pipeline project such as this would have environmental effects and require a significant permitting effort. Approximately 200 acres of land would need to be acquired as pipeline easement and disturbed as part of the pipeline construction, some of which would impact environmentally sensitive areas, including wetlands. The estimated cost of pipeline infrastructure including acquisition of construction and permanent easements on private lands, permitting, and engineering and construction costs, is $24.7M.

- Because of the energy requirements for the MF treatment process to power the systems and pressurize pumps, electrical infrastructure, including adequate voltage and 3-phase power, are paramount. In order to operate the MF treatment systems with suitable electricity to treat the range of discharges anticipated from both Companies (4.0 – 8.6 MGD), the satellite treatment systems would need to be placed at a downstream location, near the mouth of each tributary canyon, where 3-phase power drops could be provided. Estimated capital cost for energy infrastructure is $85,000 for each facility, totaling $765,000.

- Each MF treatment and well injection/backwash disposal facility will require acquisition of land. This analysis assumes acquisition of 35-acre parcel for each treatment location, or a total of 315 acres, with an estimated cost of $630,000.

Based on an overall view of the cost to treat produced water, a significant expense over the life of a plant is the operation and maintenance (O&M) costs, particularly power, membrane replacement, and labor costs. O&M costs assume an additional 20-year life of the Raton Basin CBM gas field. O&M costs include labor, equipment and materials (Table 3).

Table 3. Annual O&M Costs Associated with Microfiltration Treatment.

Item	Description	Estimated Annual Cost
Nine 1-MGD MF Facilities	Power, membrane replacement, cartridge filter replacement, chemicals, labor, equipment repair	$2.1
Nine Disposal Wells	Power, labor, vehicles	$1.8M
Total Estimated O&M Costs		**$3.9M**

It is recognized that MF treatment in and of itself has environmental consequences. The transport, delivery and use of chemicals needed as part of the treatment process (sodium hypochlorite, sodium hydroxide, citric acid) has potential for environmental impacts also. Moreover, environmentally sensitive areas, including wetlands, would be impacted due to new pipeline systems to convey produced water to treatment facilities. Additionally, the MF treatment systems are also relatively energy-intensive compared to non-membrane treatment processes, requiring approximately 1.2 megawatt hours of electrical energy per year per 1 MGD treatment unit.

While still cost-prohibitive, another treatment option evaluated to meet the 2-year average iron limit as low as 363 µg/l was disposal of all CBM-produced water via underground injection wells (Table 4). The capital costs of injecting approximately 4.0 – 8.6 MGD of produced water via an anticipated 20 – 54 gravity flow injection well facilities is approximately $93M - $184.8M. Injection wells are drilled and completed at depths of 4,000- to 6,000-feet deep, in the Dakota Entrada geologic formation. Wells are drilled in accordance with federal law and COGCC rules and policies, permitted as Class 11 Underground Injection Control (UIC) wells. Each gravity flow disposal well can accommodate approximately 4500 barrels of water per day (or 210 acre-feet/year). Drill and complete costs, estimated at $3.5M per well, vary based on depth of well, location and geologic conditions. Over 66-miles of pipeline is estimated to convey produced water to injection sites, estimated at $23.3M. Single phase electricity ($3M) and land acquisition (35-acres/site, exceeding $1M) are included in capital costs. Annual O&M of injection wells is approximately $1.8M/year.

A concern with subsurface injection is seismicity. The term “induced seismicity” has been used to describe cases where seismicity was suspected to have been triggered by injection of fluids into the subsurface. COGCC has had recent discussions with operators, EPA and the USGS

regarding induced seismicity (COGCC, January 2012), including permitting safeguards such as injection volume; pressure below the fracture gradient; and, input from state agencies to reduce the potential for induced seismicity related to UIC Class II wells.

Table 4. Summary of Capital and O&M Costs of Treatment and Disposal of CBM Produced Water in the Purgatoire Watershed.

Treatment Technology	Description	Estimated Capital Cost ($M)	Estimated Annual O&MCOST ($M/yr)
Microfiltration and Backwash Disposal	9 MF treatment facilities, infrastructure, and 9 injection wells for backwash disposal of waste stream, pipe network to convey produced water to treatment facility.	$83.3 M - $91.9M	$3.9M
Subsurface Injection/Disposal of Produced Water	20 - 54 gravity flow injection well facilities each sited on 35-acre parcels; pipeline, single phase electricity, and SCADA systems.	$93M - $184.8M	$1.8M

c. It is not socioeconomically feasible to dispose of the produced water.

The capital costs of disposing produced water via injection ($93 – 184.8M) is more costly than MF treatment ($83.8 – 91.9M). Moreover, once the produced water is injected, no produced water will be available for other uses in the Purgatoire watershed including agricultural, wildlife, recreation, and tourism purposes.

It is not socioeconomically feasible or desirable to permanently dispose of the produced water that is relied upon by the citizens of Las Animas County. The impacts of injecting produced water as a way of addressing iron limits has ripple down socioeconomic impacts on the agricultural, tourism and recreational sectors of Las Animas County, as described in more detail in (2) above.

4. 31.8(3)(d)(iii)(A) – Whether the Costs of the Alternatives Significantly Exceed the Costs of the Proposal (In this Case the Existing Facility).

The costs of the two alternatives described above, (1) MF treatment and backwash disposal ($83.8 – 91.9M) or (2) disposal of all produced water via subsurface injection ($93M - $184.8M) significantly exceed the costs of the proposal herein, namely, to maintain surface water discharge of produced water at iron levels not to exceed the current conditions defined as the maximum Fe_{TR}

concentration discharged at each outfall based on DMR data and statistical analyses that removed outliers. *See* XTO or Pioneer Fe_{TR} limits proposed, Table 7 below.

Current conditions take into account the ambient iron concentrations documented in the Purgatoire River that have historically exceeded iron river standards during pre-CBM development periods. Historic iron and TSS data are available along the Purgatoire River and for several Purgatoire tributaries from 1978 through 1981 when the USGS performed a focused monitoring program in the watershed. Iron and TSS data are available from the USGS Gaging Station No. 07124200 (Purgatoire River at Madrid, Colorado) which is located just upstream of Trinidad Lake and downstream of the majority of the CBM outfalls. This gage has been active for approximately 40 years and water chemistry data collected 1978 to 1981 reflects ambient, non-CBM conditions for the entire watershed. The iron and TSS data collected by the USGS at this station during this historical period of record are summarized in Table 5 and depicted on Figure 6. The USGS collected iron and TSS data in a few of the Purgatoire tributaries that now have CBM produced water outfalls within their boundaries, but during the historic USGS study they did not. Therefore, these data reflect ambient, non-CBM conditions for these sub-basins in the Purgatoire watershed. The iron and TSS data collected by the USGS at these stations are summarized in Table 6. *See* USGS data, 1978-1981, Table 6.

Figure 6. Historical USGS Iron Concentrations in Purgatoire River (1971-1981).

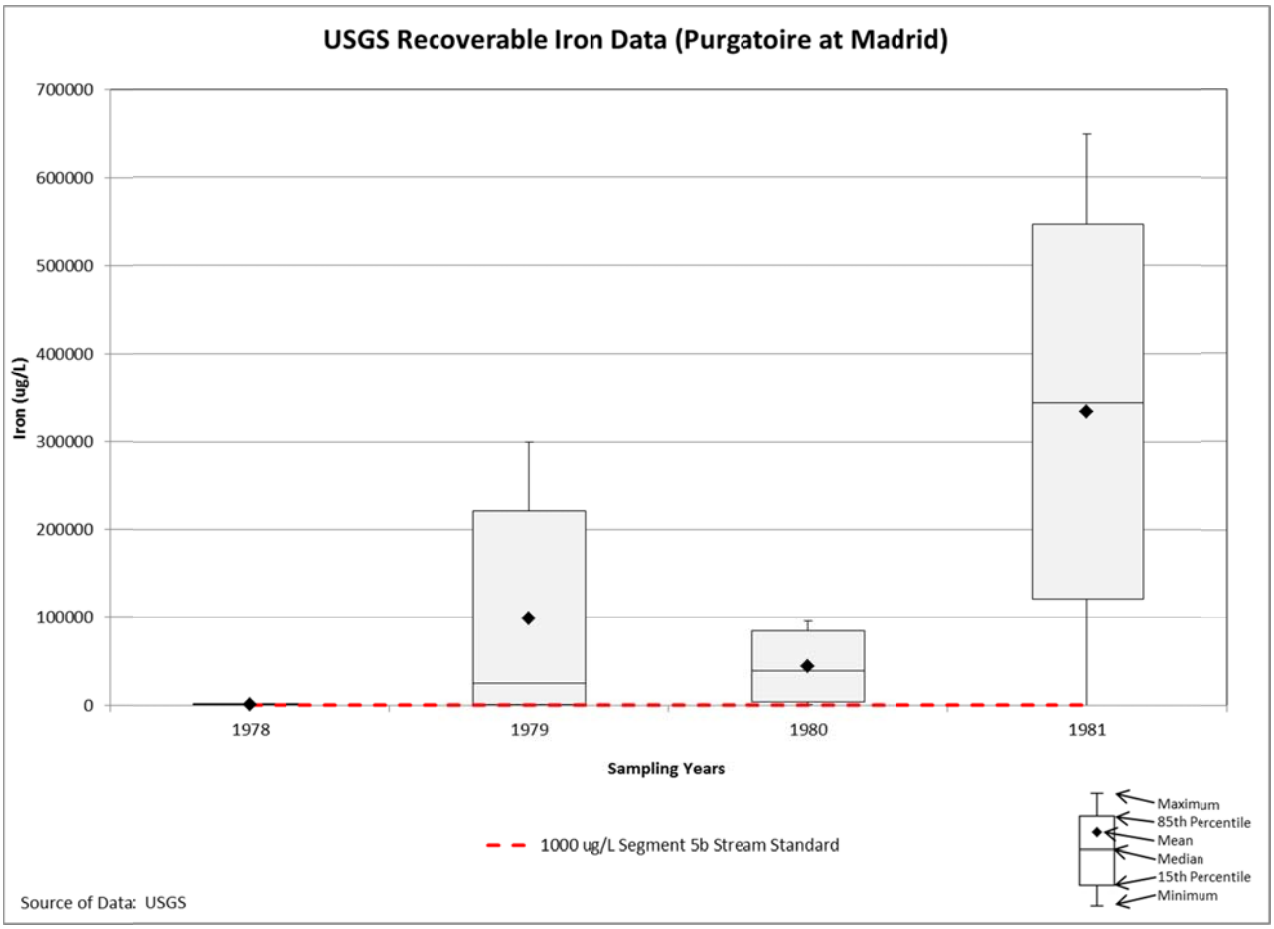


Table 5. Ambient Fe_{TR} and TSS Data Collected by USGS at Madrid Gaging Station (Period of Record 1978 to 1981).

Parameter	Number of Samples	Minimum (µg/L)	50th Percentile Median (µg/L)	Mean (µg/L)	Maximum (µg/L)
Fe_{TR}	15	20	26,000	134,505	650,000
TSS	33	3,000	146,000	5,045,303	37,000,000

Table 6. Fe_{TR} and TSS Data for Tributaries Monitored by the USGS (Period of Record 1978 to 1981).

Sample Location	Parameter	Number of Samples	Minimum (µg/L)	50th Percentile (µg/L)	Mean (µg/L)	Maximum (µg/L)
Reilly Canyon 07124220	Fe_{TR}	30	10	280,000	261,134	590,000
	TSS	13	68,000	22,300,000	39,235,923	142,000,000
Sarcillo Canyon 07124120	Fe_{TR}	20	190	430,000	395,324	720,000
	TSS	14	340,000	7,100,000	15,800,929	60,900,000
Molino Canyon 07124100	Fe_{TR}	26	76,000	240,000	318,539	670,000
	TSS	8	27,400,000	41,400,000	41,650,000	59,000,000
Middle Fork Purgatoire @Stonewall 07124050	Fe_{TR}	11	20	180	4,344	43,000
	TSS	25	2,000	12,000	322,480	3,670,000

Tetra Tech water quality data depict the more recent iron concentrations along the Purgatoire River, Segment 5b (Figure 7). Similar to the historic water quality condition, iron standards are exceeded after storm events when iron-laden sediments increase iron concentrations after runoff events (Figure 8). Water quality data collected as part of the Purgatoire watershed monitoring program (April 2010 to present) and U.S. Geological Survey (Madrid Station upstream of Trinidad Lake, 1978 to 1981) also demonstrate the significant correlation between sediment and iron concentrations in the watershed, with a coefficient of determination (r^2) of 0.9829 (Figure 9).

Figure 7. Iron Concentrations in Purgatoire River (2010-2014).

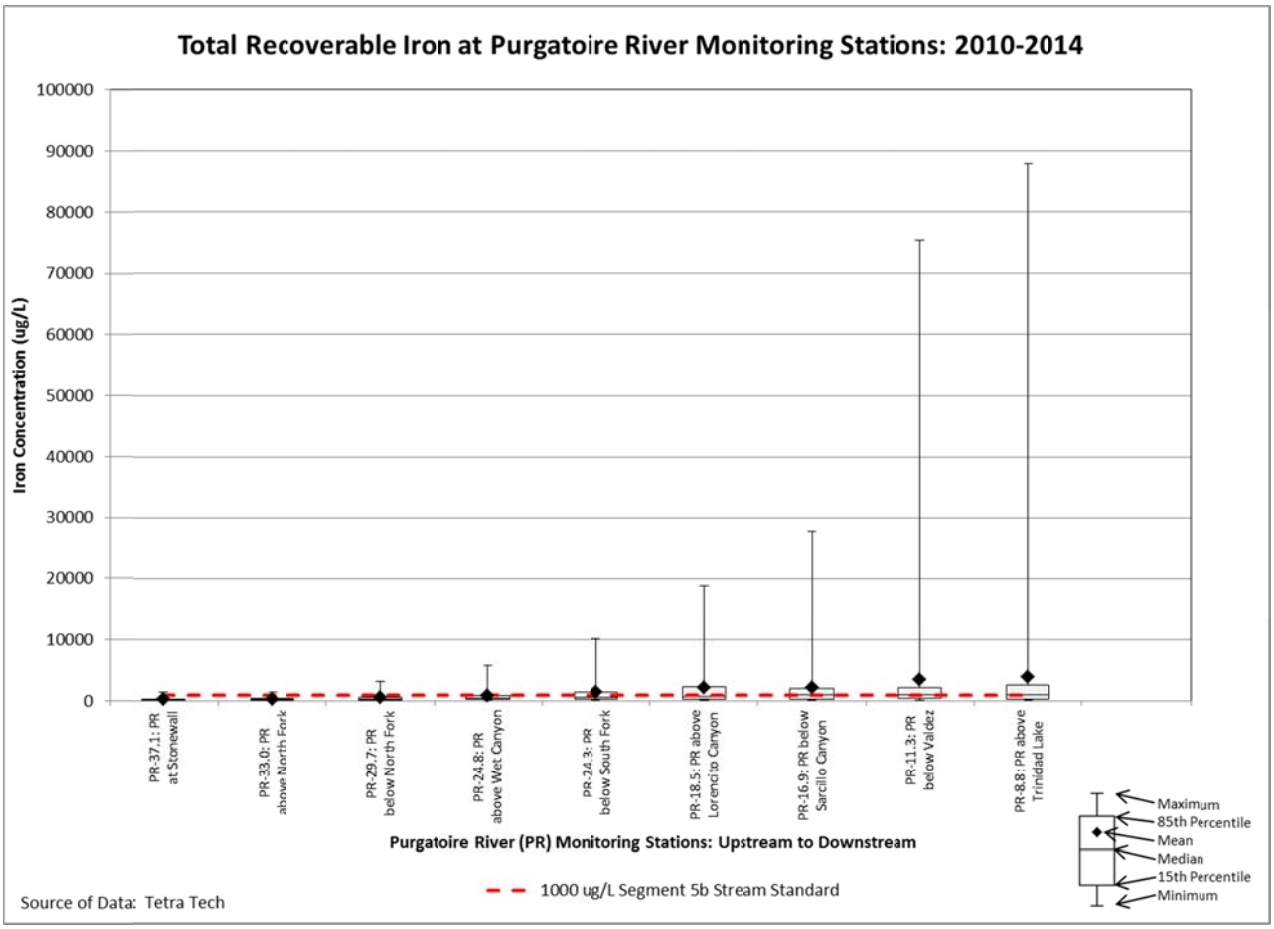
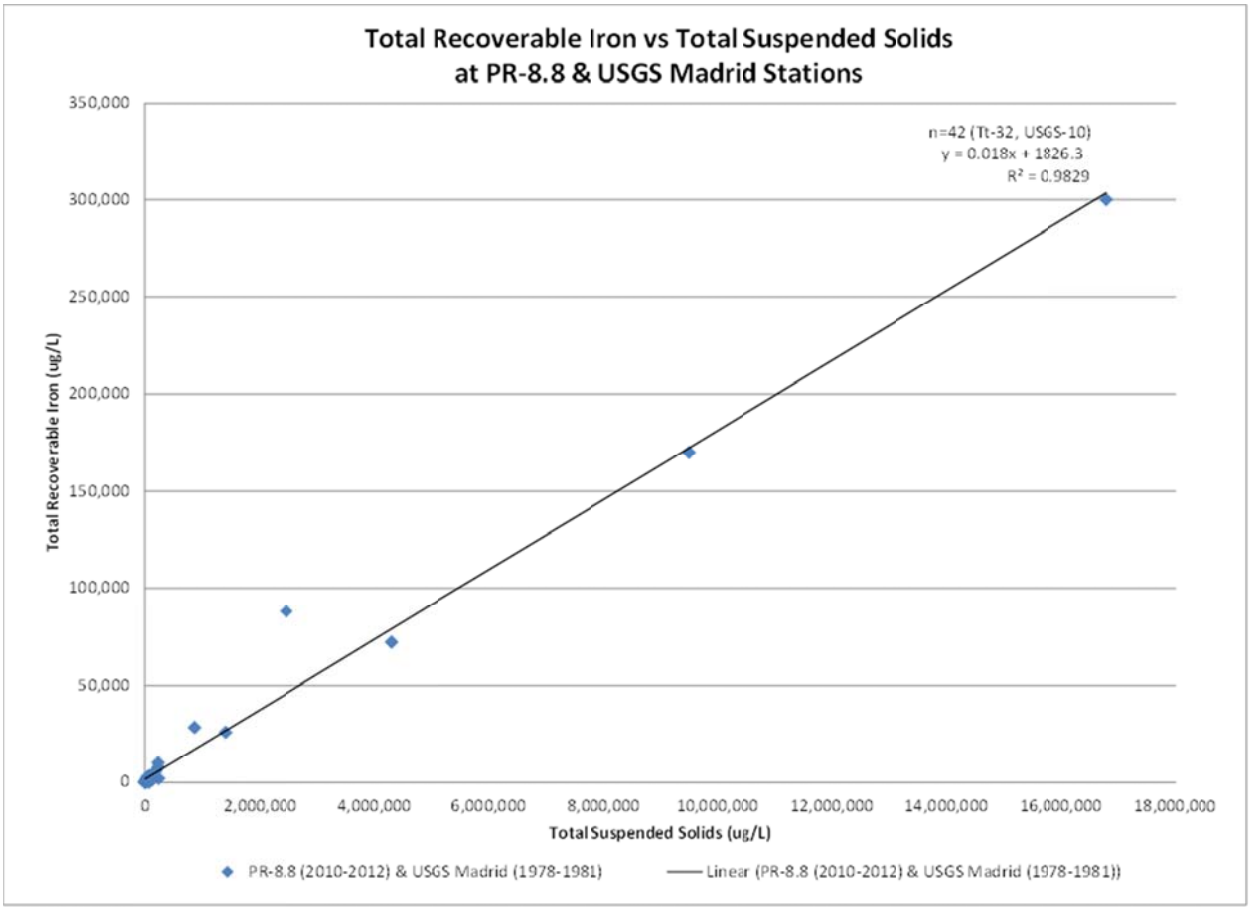


Figure 8. Sediment and Iron laden runoff in Lorencito Canyon near its confluence with the Purgatoire River after August 16, 2012 storm event.

Figure 9. Strong relationship between Fe (TR) and TSS (sediment) in the Purgatoire River at Madrid, CO, $r^2 = 0.9829$. Data in this analysis included historical USGS data (1978-1981) and recent Tetra Tech data collected at the same monitoring station location (2010-2012).



5. 31.8(3)(d)(iii)(B) – For a POTW, whether user charges resulting from the alternative would significantly exceed user charges for similarly situated POTWs.

N/A.

6. 31.8(3)(d)(iii)(C) – For private industry, whether the alternative would have a significant adverse effect upon the project's profitability or competitive position.

The costs of the alternatives also suggest a significant adverse effect upon the project's profitability or competitive position within the Companies in the Raton Basin, making the operations in the Raton Basin economically infeasible. The price of natural gas is at historic low levels so if costs increase for CBM production in the Raton Basin, other alternatives will be considered. It is possible that the Companies would close certain wells in the Raton Basin rather than invest in treatment. Treatment of CBM water for iron reduction would have an insignificant

effect on iron loading in the Purgatoire River given: a) the percentage of the water that reaches the River; and b) the percent of iron loading for which CBM is responsible compared to natural sources. There is no environmental benefit or benefit to protected uses as a result of such treatment. Unlike oil and gas wells, if CBM wells are shut off or closed, the wells cannot be easily or readily re-activated. So, reduced production or closure of Raton CBM wells could result in permanent closure.

Both alternatives to surface discharge (sub-surface injection and MF treatment and backwash disposal) would have a significant adverse effect on the profitability and competitive position of the Raton Basin project due to the high capital costs required for implementation, particularly with the value of gas at $2-3/Mcf. With estimated annual net sales of $36-43M the capital cost of either injection ($93M - $184.8M) or MF treatment ($83.8M – 91.9M) would have the effect of driving the cash flow from Raton CBM production negative for 2-5 years. In addition, the annual operating and maintenance costs of the alternative would raise the cost of Raton Basin gas production, but, since gas prices are set by North American market forces, such increased costs cannot be passed on as price increases for the gas. Hence, the alternative will have the effect of reducing profits for individual wells and the Raton Basin producing region as a whole. If profitability for an individual well is reduced to less than a break-even point, the well would be prematurely abandoned resulting in the loss of future reserves.

Alternatively, when we conduct an analysis of profit margins on the project by looking at the total costs of both alternatives to surface discharge on a point- forward, full cycle basis (capital plus O&M) over an estimated remaining field life of 20 years, we project that the added costs will have a significant adverse effect on profitability. We estimate that the full cycle costs of MF treatment are approximately $0.23/Mcf of gas and that the costs for injection are approximately $0.15/Mcf. With profit margins on net gas sales of less than $1.00/Mcf, these increased costs will reduce the margins on the project by at least 23% and 15% respectively. Again, given the relatively thin margins of the project, we assert that such costs will have an adverse effect on profitability and lead to premature abandonment of the project and loss of future reserves.

One option considered would be shut-in wells that are uneconomic due to the operating and maintenance cost of the alternative while waiting for higher gas prices. However, restoring production in a mature CBM well to pre-shut-in levels can be quite difficult, and could require months of water pumping for very little gas production with the hope that gas production will resume. Oftentimes, the pre-shut-in level of production will never be achieved again because of the re-saturation of the near wellbore region by encroaching water as the reservoir pressure equalizes during the shut-in period. This situation leads to an under-saturated reservoir condition at a lower than initial reservoir pressure with less reservoir pressure to again de-water the coals. Also, there may be a build-up of coal fines and sediment in the well bore that can interfere with pumping at a later date.

In summary, large capital and operating cost increases similar to those implied with this alternative, would threaten continued CBM gas and water production in Las Animas County, and could result in closure of the field.

7. 31.8(3)(d)(iii)(D) – For any dischargers, whether the treatment costs resulting from the alternative would significantly exceed treatment costs for any similar existing dischargers on the segment in question.

Natural gas from the Raton Basin is produced for a national market. The Companies compete with gas producers from other geographic areas which do not have to meet these limits and install expensive infrastructure which does nothing to improve the efficiency of operations, but rather detrimentally increases lease operating costs per unit of gas, making gas from the Raton Basin less competitive in the market.

Treatment costs (MF or disposal of produced water via injection) are similarly economically infeasible for other CBM Operators in the basin. Red River Ranch recently closed their CBM operations in the Raton Basin due in large part to high water production and the cost of treatment. If treatment costs are high, CBM production will be reduced or terminated, with significant impact to the Companies and Las Animas County citizens. All of this comes with very little, if any, environmental benefit.

In light of all of the above, the permits should be revised to include the 30-day average iron limits as set forth below in Table 7. These limits would provide iron levels below the historical background iron concentrate for this watershed.

Table 7-A. XTO Proposed Total Recoverable Iron (Fe_{TR}) 30-day Average Permit Limits – Permit Nos. CO-0048054 and CO-0048062.

Permit No. CO-0048054				Permit No. CO-0048062			
Outfall	XTO Proposed Fe_{TR} Limits (µg/L)	WQCD Draft 30-day Avg. Fe_{TR} Limits (µg/L)[1]	WQCD Draft 2-year Avg. Fe_{TR} Limits (µg/L)[1]	Outfall	XTO Proposed Fe_{TR} Limits (µg/L)	WQCD Draft 30-day Avg. Fe_{TR} Limits (µg/L)[1]	WQCD Draft 2-year Avg. Fe_{TR} Limits (µg/L)[1]
010A	1350	1000	495	001A	2800	1308	366
012A	2080	1000	495	016A	1640	1308[2]	366[2]
016A	1770	1000	495	017A	1380	1308[2]	366[2]
018A	2630	1000	495	018A	1570	1308[2]	366[2]
019A	871	1000	495	019A	2810	1308	366
021A	857	1000	495	022A	1300	1308	366
025A	779	1000	495	023A	971	1308	366
027A	2120	1000	495	032A	644	1308	366
028A	928	1000	495	033A	1050	1308	366

Permit No. CO-0048054				Permit No. CO-0048062			
Outfall	**XTO Proposed Fe_{TR} Limits (µg/L)**	**WQCD Draft 30-day Avg. Fe_{TR} Limits (µg/L)[1]**	**WQCD Draft 2-year Avg. Fe_{TR} Limits (µg/L)[1]**	**Outfall**	**XTO Proposed Fe_{TR} Limits (µg/L)**	**WQCD Draft 30-day Avg. Fe_{TR} Limits (µg/L)[1]**	**WQCD Draft 2-year Avg. Fe_{TR} Limits (µg/L)[1]**
031A	1470	1000	495	034A	765	1308	366
032A	2770	1000	495	040A	2590	1308	366
034A	1890	1000	495	049A	4280	1308	366
035A	1850	1000	495	060A	1640	1649	495
036A	3580			040G	1910	1308	366
037A	1476	1000	495	043G	4390	1308	366
039A	699	1000[2]	495[2]	079H	2150		
040A	3030	1000	495	080H	1970	1308	366
042A	2860	1000	495	014A	850	1308	366
045A	830	1000	495	001G	665	1649[2]	495[2]
047A	3370	1000	495	002G	2520	1649	495
049A	1480	1000	495	004G	1820	1649	495
050A	1580	1000	495	006G	1040	1649[2]	495[2]
051A	1070	1000	495	007G	647	1649[2]	495[2]
057A	3370	1000	495	015G	1080	1649	495
066A	4230	1000	495	016G	871	1649	495
067A	3010	1000	495	021G	706	1308[2]	366[2]
068A	2960	1000	495	022G	1160	1649	495
069A	3770	1000	495	023G	4990	1649	495
070A	6110	1000	495	024G	1640	1649	495
072A	2380	1000	495	027G	717	1649[2]	495[2]
073A	2210	1000	495	028G	332	1649[2]	495[2]
074A	4570	1000	495	031G	1470	1649[2]	495[2]
078A	2640	1000	495	033G	1020	1649	495
082A	2650			036G	866	1649[2]	495[2]
083A	1680	1000	495	037G	2160	1649	495
084A	2260	1000	495	038G	828	1649	495
088A	1460	1000	495	039G	1430	1649	495
091A	4850			042G	1380	1649	495
093A	4230	1000	495				

[1]Fe, TR (µg/L), starting Jan. 1, 2017.
[2] No compliance schedule; effective immediately upon permit issuance.

Table 7-B. Pioneer Proposed Total Recoverable Iron (Fe_{TR}) 30-day Average Permit Limits – Permit Nos. CO-0047767, CO-0047776 and CO-0048003.

Permit No. CO-0047767				Permit No. CO-0047776			
Outfall	Pioneer Proposed Fe_{TR} Limits (µg/L)	WQCD Draft 30-day Avg. Fe_{TR} Limits (µg/L)[1]	WQCD Draft 2-year Avg. Fe_{TR} Limits (µg/L)[1]	Outfall	Pioneer Proposed Fe_{TR} Limits (µg/L)	WQCD Draft 30-day Avg. Fe_{TR} Limits (µg/L)[1]	WQCD Draft 2-year Avg. Fe_{TR} Limits (µg/L)[1]
230	560	1649[2]	495[2]	059	770	1000	495
075	1400	1649[2]	495[2]	075	880	Report	Report
007	760	1649[2]	495[2]	010	1100	Report	Report
217	960	1649[2]	495[2]	076	510	1000[2]	495[2]
004	600	1649[2]	495[2]	027	1300	1000	495
228	610	1649[2]	495[2]	005	1400	1000	495
202	1000	1649	495	022	1400	1000	495
147	1100	1649	495	Permit No. CO-0048003			
094	1300	1649	495				
160	2600	1649	495	Outfall	Pioneer Proposed Fe_{TR} Limits (µg/L)	WQCD Draft 30-day Avg. Fe_{TR} Limits (µg/L)[1]	WQCD Draft 2-year Avg. Fe_{TR} Limits (µg/L)[1]
073	950	1649	495				
065	2800	1649	495				
079	990	1649	495				
221	2700	1649	495				
057	1000	1649	495				
156	2700	1649	495	241	970	Report	Report
096	1100	1649	495	005	920	1000	363
183	1800	1649	495	245	1300	1000	363
060	2600	1649	495				
215	2700	1649	495				
238	3000	1649	495				
220	1700	1649	495				
239	2500	1649	495				
105	2100	1649	495				

[1]Fe, TR (µg/L), starting Jan. 1, 2017.
[2] No compliance schedule; effective immediately upon permit issuance.

8. 31.8(3)(d)(iii)(E) – The relative, long-term, energy costs and commitments and availability of energy conservation analysis.

The energy needs and costs associated with construction of treatment infrastructure, including pipelines, is significant. In particular, approximately 5,000 gallons of fuel per day would be required to support construction activities for up to a year ($5.5M).

The long-term energy costs for electricity would be substantially greater if water were treated or injected rather than discharged. The energy costs are very high to treat water via MF and subsequently inject the waste stream. Many remote areas lack adequate electrical infrastructure, adequate voltage, and three-phase power. Estimated energy costs are $2.1M annually.

The CBM operations and its produced water are important economically, socially and environmentally to the local community and Colorado. Implementation of the proposed iron limits would lead to the produced water being disposed of and as a result that produced water and all its benefits would be permanently lost. Thank you for your consideration of this Alternatives Analysis. If you have any questions, please contact me.

CONCLUSION

This alternative analysis for iron meets the requirements under the Antidegradation Regulations and Policy for an alternatives analysis. The Division approved a similar alternatives analysis for chloride. We request that the Division adopts this alternatives analysis for iron.

Sincerely,

Ronda L. Sandquist

cc: Erin Scott
Lori Mulsoff
Pioneer Natural Resources USA, Inc.
XTO Energy Incorporated
Tetra Tech, Inc.
Engineering Analytics

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Final Report

April 2, 2015

Economic Benefits of CBM Industry Activity and Produced Water in Las Animas County, Colorado

Prepared by

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Executive Summary

The economic benefits of the coalbed methane (CBM) industry in Las Animas County stem from the global demand for natural gas, the industry activity that takes place locally and the availability of produced water for local and regional uses. This report quantifies the economic benefits to agriculture, tourism and recreation and the local economy from water produced from CBM activity and from CBM industry activity itself. Non-quantifiable benefits, and their importance, are also described in the report, including the role of CBM water in the larger Arkansas River Basin.

In recent years, between 5,000 and 8,000 acre-feet of CBM produced water has been discharged into tributaries of the Purgatoire River annually, with an estimated 2,000 to 3,500 acre-feet reaching the main stem of the river. That water provides economic and other benefits to local landowners, agricultural operators, visitors and recreators, local municipalities and county government. In addition, CBM industry activity creates jobs and income for employees and produces tax revenues for local jurisdictions. The economic benefits of CBM industry activity and CBM water production in Las Animas County are summarized for 2014:

- Over $2.0 million in total economic activity, 41 jobs and about $365,000 in total local income as a result of the direct and indirect benefits to agriculture;
- Dispersion of wildlife and aquatic habitat and year-round water sources for wildlife and aquatic species;
- High quality hunting experience and support of up to $4.4 million in big game hunting activity, including hunting that occurs on Ranching for Wildlife properties;
- About $240,000 in visitor spending by Trinidad Lake State Park visitors, resulting in over $390,000 in total county economic activity, 6 jobs and about $141,000 in local income;
- Almost 350 people directly employed by CBM companies and their contractors and a total of about 870 Las Animas County jobs directly or indirectly attributable to industry activity;
- About $54.5 million in total annual income supported by industry activity;
- Over $5.6 million in annual property, sales and severance taxes and Federal Mineral Lease revenues distributed among school districts, county government, municipalities and other agencies;
- Almost $4.0 million in royalties to private landowners;
- Produced water adds to water supplies in the critically water-short Arkansas River Basin.

Future CBM activity and water production will be influenced by natural gas prices, production costs and costs of produced water management. This report demonstrates that CBM water and industry activity provide substantial benefits to Las Animas County and the larger region.

Section 1
Introduction and Background

1.1 Background

In early 2012, Harvey Economics (HE) performed a study of the economic benefits of the coalbed methane (CBM) industry in the Purgatoire River watershed, situated in Las Animas County, Colorado, with a focus on the economic value of CBM produced water. The goal of the study was to examine the benefits and economic value of CBM produced water in the face of potential changes in regulations related to the quality and treatment of water that is produced along with the natural gas. HE identified the benefits of the industry and the water, gathered data about those benefits and then conducted an analysis that produced estimates of economic benefits.

This report is an update of that initial 2012 study; it incorporates updated and additional recent data on gas and water production, as well as data from the most recent agricultural census. It also includes current data about CBM industry activities, including employment numbers, operations and various payments made to Las Animas County.

1.2 History of the CBM Industry in Las Animas County

CBM exploration in the Raton Basin (Basin) of Las Animas County began in about the mid-1980s at which point a small number of wells were developed and a small amount of production occurred. By the mid-1990s, well development and gas production ramped-up to a much larger scale and generally increased until about 2009. Annual Las Animas County gas production peaked in 2008 at about 131.8 BCF. In recent years production has slowed and experienced a steady decline, mostly due to low natural gas prices. As of 2014, there were about 3,000 wells in the Basin. However, in recent years there has been almost no new gas well drilling, again mainly due to low gas prices. CBM production currently makes up about 92 percent of total natural gas production in Las Animas County. Exhibit 1.2-1 presents historical total natural gas production and CBM production in Las Animas County. Pioneer Natural Resources USA Inc. (Pioneer) and XTO Energy (XTO) gas production are highlighted; together they produce about 95 percent of total natural gas in Las Animas County.

Exhibit 1.2-1.
Historical Natural Gas and CBM Gas Production in Las Animas County, MCF

Year	Pioneer (MCF)	XTO (MCF)	Other Producers (MCF)	Las Animas County Gas Production (MCF)	Las Animas County CBM Production (MCF)	CBM % of Total County Gas Production
2004	17,738,665	10,846,514	53,118,044	81,703,223	70,271,895	86.0%
2005	70,238,146	14,406,009	4,994,794	89,638,949	74,195,641	82.8%
2006	77,375,926	19,004,479	7,631,204	104,011,609	88,028,037	84.6%
2007	83,240,283	23,857,058	10,185,375	117,282,716	100,950,855	86.1%
2008	96,657,417	30,140,978	5,018,687	131,817,082	114,992,635	87.2%
2009	91,896,092	31,029,855	4,755,206	127,681,153	112,640,575	88.2%
2010	84,343,681	31,061,102	4,762,102	120,166,885	107,630,264	89.6%
2011	79,500,349	28,007,128	5,134,330	112,641,807	101,886,097	90.5%
2012	74,397,051	25,691,340	4,388,847	104,477,238	95,899,363	91.8%
2013	67,070,583	23,140,960	4,209,227	94,420,770	87,003,529	92.1%
2014	62,072,866	19,414,387	4,104,668	85,591,921	78,662,139	91.9%

Source: Colorado Oil and Gas Conservation Commission.

Historically, there have been a number of operators in the Basin, each with their own set of wells and infrastructure, as well as their own method of operations. Over time, there has been considerable consolidation of the industry as smaller companies have been acquired by larger ones. Pioneer and XTO are currently the largest operators in the Basin.

CBM extraction also results in the production of water. On a countywide basis, water production generally follows a similar pattern to gas production; as gas extraction declines, so does water production. Since 2004, annual water production from CBM activity in Las Animas County has averaged about 11,300 acre-feet per year. Peak water production occurred in 2007, with over 121.7 million barrels of water, or about 15,700 acre-feet. In recent years, water production has declined and in 2014 total water production amounted to about 54.3 million barrels, or about 7,000 acre-feet. However, although the decline in very recent water production is due in large part to the decrease in gas production, it is also the result of the closing of a number of outfalls throughout the watershed. Those outfalls were closed due to recent changes in water quality designations in certain locations or the implementation of specific standards; the water from those outfalls is now disposed of via deep injection wells, as opposed to surface discharge, and is not available for other uses.

Exhibit 1.2-2 provides data on historical water production associated with CBM extraction. Together, Pioneer and XTO produce about 92 percent of the county's produced water supplies.

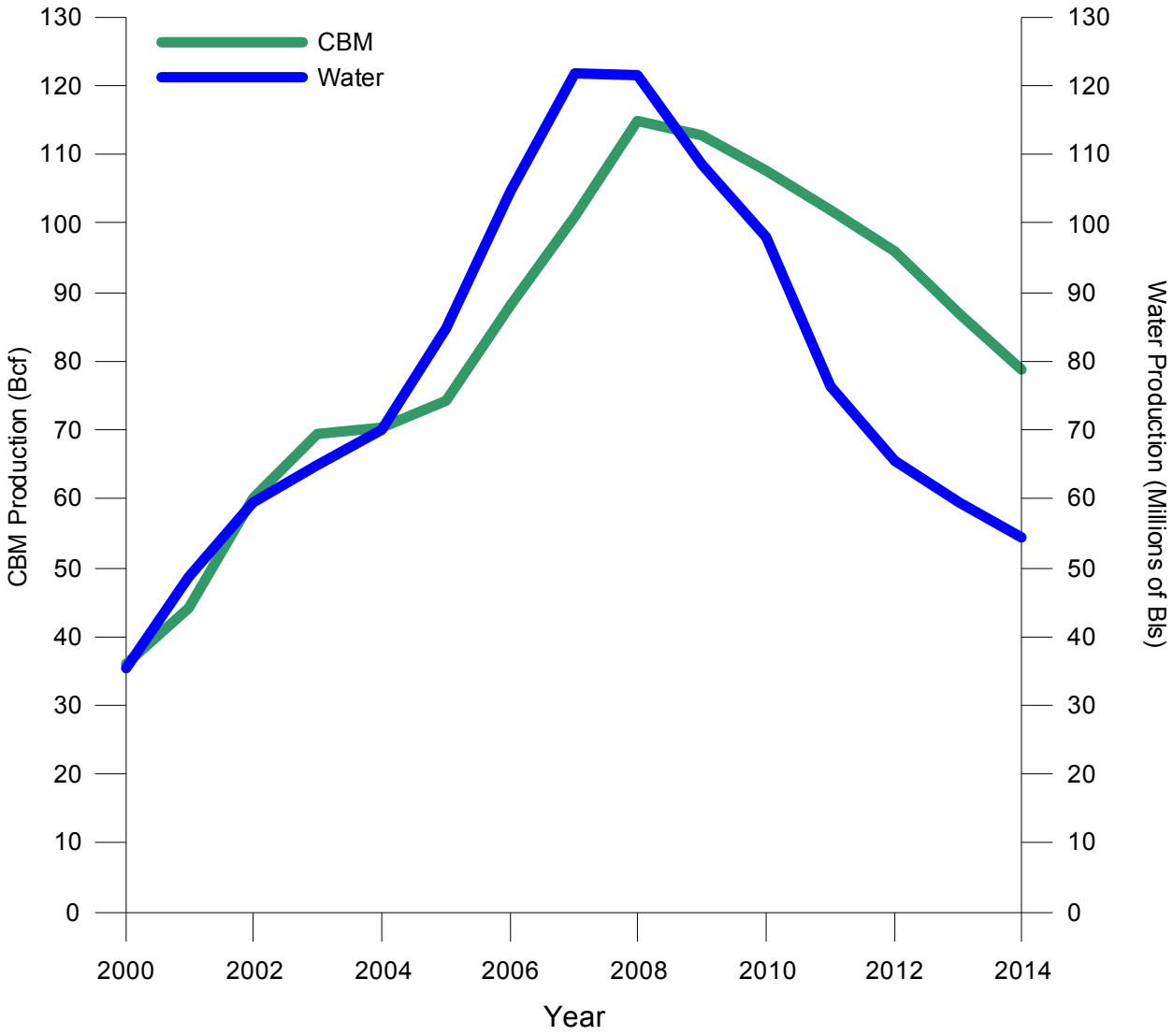
Exhibit 1.2-2.
Historical CBM Water Production in Las Animas County, Barrels and Acre-feet

Year	Pioneer (Bls)	XTO (Bls)	Other Producers (Bls)	Las Animas County (Bls)	Pioneer and XTO % of County Total	Las Animas County (AF)
2004	15,313,849	6,066,091	48,724,905	70,104,845	30.5%	9,036
2005	61,293,703	10,984,274	12,459,627	84,737,604	85.3%	10,922
2006	70,810,166	12,181,093	21,640,244	104,631,503	79.3%	13,486
2007	78,999,971	15,684,864	27,037,371	121,722,206	77.8%	15,689
2008	88,147,058	22,656,962	10,786,143	121,590,163	91.1%	15,672
2009	74,949,417	23,770,455	9,865,098	108,584,970	90.9%	13,996
2010	68,882,235	21,060,204	8,165,573	98,108,012	91.7%	12,645
2011	51,877,698	17,177,297	7,431,114	76,486,109	90.3%	9,859
2012	45,824,374	15,837,555	3,939,800	65,601,729	94.0%	8,456
2013	40,983,042	15,027,682	3,351,941	59,362,665	94.4%	7,651
2014	37,354,223	12,669,619	4,279,185	54,303,027	92.1%	6,999
					Average (2004 - 2014)	**11,310**
					Range (2004 - 2014)	**7,000 - 16,000**

Source: Colorado Oil and Gas Conservation Commission.

Exhibit 1.2-3 depicts historical CBM production and water production in Las Animas County between the year 2000 and 2014. As illustrated in the graphic and as discussed above, both gas production and water production increased annually, and at about the same pace, between 2000 and about 2007 (water) or 2008 (CBM). In more recent years, production of both resources has decreased steadily. However, there are a number of factors which will influence future gas and water production levels in Las Animas County. Section 5 of this report includes a detailed discussion of the future of CBM production.

Exhibit 1.2-3.
Historical CBM Gas Production (BCF) and Water Production (Millions of Bbls) in Las Animas County



Source: Colorado Oil and Gas Conservation Commission

1.3 CBM Water Uses in the Purgatoire River Sub-Basin

Agriculture and tourism/ recreation are the two basic industries in Las Animas County that make current use of CBM produced water. CBM water is used to support livestock production and also as part of irrigation supplies to water crops; in terms of tourism and recreation, produced water helps to provide habitat for certain species which supports hunting, fishing and wildlife watching activities. Therefore, HE focused its analytical efforts on the economic benefits related to those industries, in addition to the economic benefits provided by CBM operations and the companies themselves.

1.4 Role of CBM Water in the Arkansas River Basin

The demand for water in the Arkansas River Basin substantially exceeds supply, and the pressure on available supplies makes every water resource important. The 2014 Draft of Colorado's Water Plan addresses the challenges faced in the Arkansas Basin with regard to current and future water management. These include the lack of available water for new uses; difficulty in securing augmentation water for new uses; concern about agricultural transfers and the impacts to rural economies; the availability of water flows for recreation and other issues surrounding water rights for recreational purposes; and the increase in demand for municipal water supplies, among others. The Basin currently experiences annual water shortages, mainly for irrigation, and projections of future water demands indicate that agricultural and municipal needs will continue or increase in the future. Municipal shortages in the Basin are estimated at as much as 94,000 AF by 2050, while agricultural shortages are anticipated to include up to 50,000 AF of necessary augmentation water. Water availability to support environmental purposes and recreational activities is also a serious concern within the Basin.

A key component of Colorado's Water Plan is a focus on closing the "gaps" between supplies and demands in each Basin. Although the Plan does not endorse specific projects, it does state that "implementing a combination of projects and methods will be necessary to meet Colorado's current and future municipal, industrial, agricultural, environmental, and recreational water needs." As part of this study, HE conducted research about the role and importance of CBM produced water in meeting the current and future demands of the Arkansas Basin.

1.5 Report Content

This report provides the assumptions and estimation methods (Section 2), data sources (Section 3) and results (Section 4) of HE's work to identify and quantify the economic benefits of CBM activity in Las Animas County. Section 4 presents the detailed results of HE's analysis, including the benefits of CBM water to the agricultural and recreational industries in Las Animas County as well as the benefits of CBM industry activity to the local economy. A description of the future water needs in the Arkansas Basin and a discussion of the existence of CBM water as a portion of available supplies are also included in Section 4. The future of the CBM industry in the County, including the future production and availability of CBM water, is addressed in Section 5. That section provides an overview of the factors which may impact CBM gas and water production in the long-term and also summarizes the general economic impacts of the potential loss of CBM water.

1.6 Caveats

This report focuses on the economic and other environmental benefits of CBM activity and produced water. This is not an environmental or socioeconomic impact study, since it does not consider any negative impacts, such as an increase in traffic or noise in certain areas. This study was also not intended to be a cost-benefit study which would take into account other indirect positive or negative effects within Las Animas County.

This study also does not provide an estimation of the potential economic value of CBM produced water itself. Rather, HE has focused solely on the economic contributions CBM water makes to

portions of the agricultural and recreational economies in this particular area. Even so, the economic benefits alone are quite substantial.

Section 2
Methodology

This section of the report describes the methodologies and assumptions used to determine the benefits of CBM produced water to agriculture; tourism and recreation; and local economic and fiscal conditions in Las Animas County.

2.1 Volume of Available CBM Produced Water

To develop estimates of the benefits of produced water, we first needed to determine the amount of produced water that would be available for use by various industries. According to Colorado Oil and Gas Conservation Commission data (COGCC) data, an average of about 11,300 acre-feet (AF) of CBM water is produced in Las Animas County each year; of course that amount can vary substantially in any individual year, as previously shown and discussed for Exhibit 1.2-2. Over the long-term, between 7,000 and 8,000 AF per year are discharged to tributaries of the Purgatoire River, with the remainder being re-injected into the ground.[1] However, in very recent years, the amount of surface discharge has dropped to as little as 5,000 AF. Under permits issued by the State of Colorado to operators, about one hundred and twenty five potential discharge points are currently located throughout the watershed, at various distances from the main stem of the Purgatoire River.[2] Based on information provided by hydrologists at Norwest Corporation and by CBM operators, an estimated 2,000 to 3,500 AF of produced water, or about 40 percent of total surface water discharge, may reach the main stem each year.[3] That amounts to between 4 and 7 percent of total Purgatoire River flows, as measured at the USGS gage at Madrid, as illustrated in Exhibit 2.1-1.[4]

[1] Tetra Tech, 2012, based on CBM company data.
[2] All discharge points are located on tributaries of the Purgatoire River; none of the existing CBM outfalls are located directly on the main stem of the river.
[3] Norwest Corporation discharge and gage information; COGCC water production data and operator information.
[4] The percentage of the Purgatoire River that is CBM water will vary from year to year depending on factors including weather conditions. For example, in dry years CBM water will comprise a larger portion of river flows than in wetter years, assuming a similar level of water production.

Exhibit 2.1-1.
Assumptions about the Amount of CBM Produced Water that Reaches the Purgatoire River

CBM Produced Water (AF) (2004 - 2014 Avg)	11,310
Range of Annual CBM Water Production (AF) (2004 - 2014)	7,000 - 16,000
Amount of CBM Water Discharged to Tributaries Annually (AF)	5,000 - 8,000
Amount of CBM Water Reaching the Mainstem (AF)	2,000 - 3,500
Average Annual Purgatoire River Flows (AF)	49,605
Percent of Purgatoire River Flows that are CBM Water	4% - 7%

Note: Average annual Purgatoire River flows are reported at the USGS gage at Madrid, west of Trinidad Lake.
Sources: Colorado Oil and Gas Conservation Commission, Tetra Tech, Norwest, US Geological Survey and Harvey Economics

2.2 Water Quality

As documented in Tetra Tech's 2012 Purgatoire River Watershed Monitoring Report and as classified by the Colorado Water Quality Control Commission, water in the Purgatoire River mainstem, north and south forks, and tributaries is suitable for the following uses: (1) Aquatic life; (2) Recreation; and (3) Agriculture.[5] Essentially, this means that the water is suitable for animal consumption (livestock and wildlife) and support of plant life, native vegetation and wildlife habitat, as well as recreation (boating, fishing, other water based activities) and aquatic life (habitat and aquatic species).

In addition to the uses described above for the tributaries, water in the main stem of the Purgatoire River is also suitable as a water supply for human consumption (drinking water supply).[6] Although there are currently no public drinking water intakes on the main stem of the Purgatoire River, this classification addresses the possibility that this use could occur in the future and aims to protect that potential use.[7]

Purgatoire River tributaries in closer proximity to the discharge points are not utilized for direct beneficial purposes, except for limited cattle stock ponds and wildlife drinking water. HE understands that these waters at these locations are suitable for those purposes.

HE did not make any independent calculations or perform any additional analyses related to water quality as part of this study. Detailed information about Purgatoire River water quality can be found on the Purgatoire Watershed website, http://purgatoirewatershed.org/.

[5] Tetra Tech, Purgatoire River Watershed Monitoring, 2012 Monitoring Report, July 2013, http://purgatoirewatershed.org/water.html and Colorado Water Quality Control Commission, Regulation No. 32 Classification and Numeric Standards for Arkansas River Basin, as amended on March 11,2014, https://www.colorado.gov/pacific/sites/default/files/Regulation-32.pdf.
[6] Ibid.
[7] The City of Trinidad's drinking water supply comes from North Lake Reservoir and Monument Lake Reservoir, both located upstream of CBM outfalls.

2.3 Estimating Agricultural Benefits of CBM Water

The USDA Census of Agriculture provides information about the dollar value of livestock and crop sales.[8] Livestock sales in Las Animas County are mainly cattle and calves. Crop sales come from both irrigated and dryland acreage. We separated the irrigated crop sales from the dryland crop sales, since dryland crops would not receive any CBM produced water to support crop growth. As a result, dryland crop sales would not realize any direct benefits from CBM produced water. Using Census of Agriculture data, we estimated that half the county's crop sale value would come from irrigated acreage and half from dryland acreage. However, both irrigated and dryland crops in this region are devoted primarily to cattle feed; the benefits to cattle production from the availability of CBM produced water are accounted for in the County's livestock sales. Any changes in either crop output or drinking water available to cattle as a result of changes in the volume of CBM produced water available to agriculture would impact cattle production and livestock sales, the effects of which would be felt throughout the County's agricultural economy. With knowledge that the majority of agricultural water use occurs downstream of Trinidad Reservoir, we relied on the assumption described previously that in recent years about 4 percent of the Purgatoire River has been comprised of CBM water and applied that percentage to applicable livestock and crop sales in the county in order to estimate the portion of agricultural sales attributable to the produced water. Although the 4 percent assumption is on the lower end of the range of river flows that are CBM water, that lower number is more representative of recent years. Agricultural employment and earnings attributable to the existence of produced water were estimated in a similar manner based on total county-wide agricultural data.

Agriculture is one of Las Animas County's most important basic industries. A basic industry is one which brings new money into the area from outside the region; that money then circulates through the local economy to the benefit of local businesses and residents. For example, people or businesses in other parts of Colorado or the U.S. will spend money on agriculture products grown or raised in Las Animas County. The money brought into the county by those products is then spent by the agricultural community on local goods and services, as well as wages for employees; in that way, the money filters through other sectors of the economy and to local residents and jurisdictions in the form of income and taxes. Because of this multiplier effect, the direct benefits of CBM water to the agricultural industry are not the only economic impacts to the county; the total economic effects include the money brought in by agriculture, as well as the effects of the circulation of that money throughout other sectors of the economy.

The total economic benefits of CBM water, as a result of its use by the agricultural industry, were calculated using standard multipliers for the crop and animal production industry in the Southern Colorado Region.[9] Sales, employment and income multipliers were applied to the direct benefits numbers.

[8] United States Department of Agriculture, 2012 Census of Agriculture, http://agcensus.usda.gov/Publications/2012/.
[9] U.S. Bureau of Economic Analysis, Regional Input-Output Modeling System (RIMS II) multipliers, http://www.bea.gov/regional/rims/index.cfm.

2.4 Estimating Tourism and Recreational Benefits of CBM Water

The first steps in the tourism and recreation evaluation required an identification of what activities are available in the county, where these activities occur and how many people participate in tourism and recreation activities.

The basis of our analysis and conclusions came from interviews conducted with personnel from Colorado Parks and Wildlife (CPW), CPW databases and interviews with local landowners. The following sections describe our approach to evaluating the benefits of CBM water in specific locations or to specific activities.

2.4.1 Trinidad Lake State Park Visitation and Spending

The Purgatoire River flows through Trinidad Lake, on the west side of the City of Trinidad. CBM water is a part of those river flows and therefore, also makes up a portion of the water in Trinidad Lake. According to CPW, and as adjusted for inflation by HE, visitors to Trinidad Lake State Park (local and non-local together) spend an estimated $6.0 million in local communities each year. CPW personnel have also determined that the volume of visitation to the park, and therefore the amount of local expenditures, is directly correlated with water levels in the reservoir. Therefore, HE applied the assumption that in recent years 4 percent of the Purgatoire River has been comprised of CBM water to the estimate of visitor spending in order to determine the portion of that spending that is attributable to the existence of CBM water in the lake. Direct employment and earnings multipliers for the recreation industry in the southern Colorado region were applied to the CBM related visitor spending to calculate the associated employment and local income created by that level of spending.

Tourism and recreation is another of Las Animas County's basic industries. The economic theory behind the importance of basic industries and their effect on local economies is discussed in Section 2.3, which describes the methodology behind the agricultural analysis. Basically, money brought into Las Animas County by the tourism and recreation industry circulates through the local economy to the benefit of local businesses and residents. As a result, the total economic benefits of CBM water resulting from spending by visitors to Trinidad Lake State Park were calculated using multipliers for the recreation industry in the Southern Colorado Region. Total sales, employment and income multipliers were applied to the direct benefits numbers to estimate the total economic effects of CBM water in the lake.

2.4.2 Hunting Activity and Expenditures

Game Management Units (GMUs) 85 and 851 are located on the western side of Las Animas County in the Purgatoire River watershed. These are the areas where wildlife benefit from CBM produced water flows in terms of increased water availability and distribution of habitat. In addition, the Bosque del Oso State Wildlife Area and private Ranching for Wildlife properties are the site of numerous CBM discharge points that are used by the resident big game herds. Competition for big game hunting permits on the Bosque, as well as on nearby Ranching for Wildlife properties, is intense. Under CPW drawing rules, a trophy hunt on those properties is effectively a once in a lifetime opportunity that attracts hunters from around the state to the area.

CPW reports provide data about the number of hunters and hunter days by GMU for big game species. HE applied the per person per day expenditures for big game hunting, adjusted for inflation, to the data on big game hunter days for the portions of GMUs 85 and 851 located in Las Animas County (a part of GMU 85 is located in Huerfano County). That number is the amount of hunter spending that occurs in Las Animas County as a result of hunting activity in areas affected by CBM water. Direct employment and earnings multipliers for the recreation industry in the Southern Colorado Region were applied to hunter spending in GMUs 85 and 851 to calculate the associated employment and local income.

Hunter days for small game species are only reported at the county level. HE could not determine the number of small game hunter days that occur in GMUs 85 or 851, where CBM produced water is discharged. Therefore, the estimates of hunter spending supported by CBM water do not include any spending related to small game activity.

HE acknowledges that it is likely that some hunting would occur in these GMUs even without CBM water; the number of hunter days directly due to the existence of CBM water is uncertain. Therefore, HE states that CBM water supports the hunting activity and hunter spending that occurs in these GMUs, not that the CBM water is the basis for that activity or spending. For that reason, total estimates of the economic benefits of CBM produced water, as shown in Section 4, do not include estimates of employment, income or sales as related to hunting activity. HE believes those estimates are conservative for that reason.

2.4.3 Fishing Activity and Wildlife Watching

After a careful review of the relevant data and interview notes, HE determined that there was no evidence of a direct link between the flow of CBM water and the volume of local angler activity or spending, or between CBM water and wildlife watching or related expenditures for the following reasons:

- Although CBM water comprises all or a good portion of the flow in many of the tributaries, and creates riparian and aquatic habitat in those areas, little to no fishing occurs on the tributaries;

- Fishing does occur at specific locations along the main stem of the Purgatoire River; however, many of those locations are upstream of the tributaries with CBM water flows;

- A limited amount of fishing occurs along the South Fork of the Purgatoire River, where there are also a number of CBM outfalls that discharge produced water, both to South Fork tributaries and the South Fork itself. However, the relationship between fishing days along the South Fork and river flows at those locations is undetermined. Overall, the number of fishing days along the South Fork is anticipated to be small;

- It is likely that Purgatoire River flows, even without the CBM water, are adequate to support existing fish populations and habitat in most years in locations where fishing activity occurs;

- The CBM industry produces water year round, which supports wildlife habitat throughout the watershed; however, the link between expanded habitat and wildlife numbers, species or behaviors in the watershed is largely anecdotal. Additionally, wildlife watching is an activity that is not closely monitored, as opposed to hunting, where a person receives a license to hunt a specific species in a specific location. No data is collected as to where people go to watch wildlife within the county or what are the species of interest. Therefore, the link between CBM water production and wildlife watching behavior is not made in this report.

The qualitative benefits to wildlife from CBM water flowing in the tributaries are discussed in Section 4, which provides a summary of study results.

2.5 Estimating Fiscal and Economic Benefits of CBM Water

HE gathered information about Las Animas County employment, income, annual wages, retail sales and tax revenues from various sources, as described in Section 3.2. Company specific data on Pioneer and XTO employment, wages, property taxes, sales taxes, royalties and local expenditures were obtained from the companies themselves. Pioneer and XTO together make up about 90 percent of CBM industry activity in Las Animas County. HE estimated total employment, income, property taxes and local expenditures associated with the CBM industry based on the assumption that other companies in the county make up about 10 percent of total activity. The royalty and sales tax data presented in Section 4 of this report reflect those of Pioneer and XTO only and do not include estimates of those items for the remaining companies operating in the county. This approach was taken because royalties and sales taxes paid by Pioneer and XTO varied greatly between the two companies and did not appear to be directly associated with their volume of gas production; that made estimating the royalties and sales taxes of other companies unreliable for this study.

Mining is a basic industry in Las Animas County. According to the North American Industry Classification System (NAICS), the mining industry encompasses a number of sectors, including Oil and Gas Extraction and Support Activities for Mining, both of which apply to CBM activity in Las Animas County.[10] As described previously for the agriculture and tourism/ recreation industries, money brought into Las Animas County by the mining industry circulates through the local economy to the benefit of local businesses and residents. Total economic benefits of CBM industry activity in Las Animas County were estimated by applying the averages of the Oil and Gas Extraction multipliers and the Support Activities for Mining multipliers to the direct CBM industry employment, income and local expenditure data.[11] The Oil and Gas Extraction multipliers reflect the effects of production activities only; the Support Activities for Mining multipliers include the economic effects of all related activities, including exploration, drilling, transmission, processing and other tasks. Therefore, an average of the two sets of multipliers was required to estimate the total economic benefits of the CBM industry in Las Animas County.

[10] U.S. Census Bureau, North American Industry Classification System, http://www.census.gov/eos/www/naics/index.html.
[11] U.S. Bureau of Economic Analysis, Regional Input-Output Modeling System (RIMS II) multipliers, http://www.bea.gov/regional/rims/index.cfm.

2.6 Role of CBM Water to Regional Water Supplies and Demands

HE did not develop any original calculations or methodologies related to the analysis of CBM produced water as a source of regional water supply. Information was gathered about current water uses and supplies and about future water demands in the Arkansas River Basin from the 2014 Draft Colorado's Water Plan, the Draft Arkansas Basin Implementation Plan (2014) and the 2010 Statewide Water Supply Initiative (SWSI) report.[12] HE focused on current and projected agricultural, municipal and industrial (M&I) and environmental and recreational demands and potential shortages. Interviews with knowledgeable local officials confirmed the water demand-supply conditions and shortages. We then summarized recent annual CBM water production, volume discharged to Purgatoire River tributaries and overall water quality in addition to providing a discussion of the contribution of CBM water to the Basin.

[12] 2014 Draft Colorado's Water Plan, https://www.colorado.gov/cowaterplan, Draft Arkansas Basin Implementation Plan (2014), https://www.colorado.gov/pacific/cowaterplan/arkansas-river-basin, and Statewide Water Supply Initiative 2010, http://cwcb.state.co.us/water-management/water-supply-planning/Pages/SWSI2010.aspx.

Section 3
Data Sources

The data used to perform the calculations and analyses for this study were obtained through two different avenues of research: primary and secondary data collection. Primary research was comprised of personal interviews with individuals who had relevant and applicable information related to the existence and use of CBM water in Las Animas County or knowledge on a specific topic addressed in the study. The secondary research effort consisted of document and internet searches related to specific areas of interest and data needs. The following text describes the data sources used in this study, including website addresses.

3.1 Primary Data Sources

HE staff conducted detailed personal or telephone interviews with a number of individuals regarding specific components of this work. HE gathered certain information from the CBM companies and their consultants, initially in mid-2012 and again in March 2015. We obtained water quality and water flow information from Tetra Tech and Norwest Corporation. CBM companies provided information about their operations. HE also interviewed people knowledgeable about Las Animas County economic activity, water use and the role of CBM water. The majority of these interviews were conducted between August and October, 2012. A list of the people interviewed, as well as their organization or position and the topics covered in the interview can be found in Appendix A.

3.2 Secondary Data Sources

In addition to information obtained from interviews, HE also gathered published data, reports and other available studies from a number of different sources. The following sections describe the data sources and specific information we gathered for each topic area.

3.2.1 Coalbed Methane Industry and Operations in Las Animas County

The Colorado Oil and Gas Conservation Commission website, http://cogcc.state.co.us/, provided information about current and historical CBM gas and water production and the number of active wells. Data is available at the county level, as well as by operator, and is available both annually and monthly. Staff at the Colorado Geological Survey provided information on the production value of the gas, based on COGCC production data and estimates of local gas prices discounted from the NYMEX Henry Hub.

Tetra Tech's annual watershed monitoring reports also provided information about local CBM operations, as well as data on water quality and water flow at various locations throughout the watershed. The 2012 report can be found at http://purgatoirewatershed.org/water.html.

3.2.2 Agriculture in Las Animas County and Colorado

The bulk of agricultural data and information came from the USDA's 2012 Census of Agriculture, http://agcensus.usda.gov/Publications/2012/. The Census provided detailed information about farms, livestock and crops for both Las Animas County and the State of Colorado. The Census of Agriculture is conducted every 5 years and at the time of this work, the 2012 Census was the most recently available data.

The 2010 Statewide Water Supply Initiative (SWSI) report provided data about agricultural water demands in the Purgatoire watershed, including livestock water consumption, number of irrigated acres and crop consumption. The full suite of SWSI 2010 documents can be found on the Colorado Water conservation Board (CWCB) website, http://cwcb.state.co.us/water-management/water-supply-planning/Pages/SWSI2010.aspx.

Data on farm employment and employee earnings was collected from the Bureau of Economic Analysis' (BEA) Regional Economic Accounts Program, http://www.bea.gov/regional/index.htm. Region specific economic multipliers for the agricultural industry are also developed by the BEA; these were obtained by HE via the Colorado Department of Local Affairs (DOLA).

Additional background on the agricultural industry and agricultural water use in the Purgatoire watershed was obtained from a 2011 draft Tetra Tech Report entitled "*Agricultural Diversions of Surface Water in the Purgatoire River Upstream of Trinidad Lake*". The University of Florida report, *The Impact of Water Quality on Beef Cattle Health and Performance*, provided qualitative information about the importance of sufficient water availability to cattle, https://edis.ifas.ufl.edu/an187.

3.2.3 Tourism and Recreation in Las Animas County

Data about tourism and recreation opportunities and activity came from a number of different sources. The Colorado Parks and Wildlife (CPW) website, http://cpw.state.co.us/, provided general information about Trinidad Lake State Park and local State Wildlife Areas.[13] CPW's *Hunting Harvest Reports* and *Hunting Recap Summaries* were the sources of detailed data on the number of recreational days by Game Management unit (GMU) and by animal species. Total harvest numbers and number of hunters are also available in these reports

A report prepared by BBC Research and Consulting for the Colorado Division of Wildlife provided economic data on the per person per day spending levels of anglers, hunters and wildlife watchers. The expenditure data in that report were adjusted for inflation, as noted in the Methodology section of this report. The report, *The Economic Impacts of Hunting, Fishing and Wildlife Watching in Colorado*, can be found at http://www.socioeconimpacts.org/documents/sei_12.pdf or by contacting the Research Librarian at CPW.

[13] Colorado State Parks and the Colorado Division of Wildlife joined together in 2011 to form Colorado Parks and Wildlife.

The Economic Contributions of Outdoor Recreation in Colorado: A regional and county-level analysis, prepared by Southwick Associates, was also recently completed for Colorado Parks and Wildlife and can be found at http://cpw.state.co.us/Documents/Commission/2014/May/ITEM21-2013COEconImpactReport.pdf#search=economics. That report provided additional data on recreational activity, recreational expenditures and economic impacts by activity type and by location throughout Colorado.

Data about employment and income in local tourism and recreational industries was obtained from the Bureau of Economic Analysis' (BEA) Regional Economic Accounts Program, http://www.bea.gov/regional/index.htm. County level retail sales data for these industries was collected from the Colorado Department of Revenue website, http://www.colorado.gov/cs/Satellite?c=Page&cid=1213954128545&pagename=Revenue-Main%2FXRMLayout, as well as from personal communication with Department staff.

3.2.4 Economic and Fiscal Characteristics of Las Animas County

Employment and income data for Las Animas County was gathered from the Bureau of Economic Analysis (BEA) and the Bureau of Labor Statistics (BLS); county level retail sales and sales tax data was collected from the Colorado Department of Revenue.

Property tax data, as well as information about the distribution of those taxes was provided by the Colorado Department of Local Affairs' (DOLA) Division of Property Taxation, http://www.colorado.gov/cs/Satellite/DOLA-Main/CBON/1251590375296. DOLA was also the source for data about Las Animas County's severance tax and FML revenue distributions and information about the distribution of those dollars to the county; cities and towns; and school districts, http://www.colorado.gov/cs/Satellite/DOLA-Main/CBON/1251593244354.

3.2.5 Water Supplies and Demands in the Arkansas River Basin

The majority of the information gathered about current water supplies and demands in the Arkansas Basin came from the 2014 Draft Colorado's Water Plan, https://www.colorado.gov/cowaterplan, the Draft Arkansas Basin Implementation Plan (2014), accessed through the Colorado Water Plan website at https://www.colorado.gov/pacific/cowaterplan/arkansas-river-basin and various elements of the 2010 Statewide Water Supply Initiative (SWSI) report, http://cwcb.state.co.us/water-management/water-supply-planning/Pages/SWSI2010.aspx. These documents provided extensive background information about the Arkansas Basin, as well as details about current and projected agricultural water use; municipal and industrial (M&I) use and non-consumptive environmental and recreational uses.Calculations of future irrigation and M&I water shortages were also included. All three documents discussed specific water related challenges faced in that area of the state and provided an overview of projects to be developed to meet future needs. Both the Arkansas Basin Implementation Plan and the SWSI Report provided information on water supplies and uses in the Purgatoire River sub-basin.

Division of Water Resources data provided a picture of average Arkansas River flow levels at various locations throughout the Basin, http://water.state.co.us/DataMaps/Pages/default.aspx#bulkdata.

Section 4
Summary of Results

The presence of CBM produced water, both in local tributaries of the Purgatoire River and as part of main stem Purgatoire River flows, provides a number of benefits to several sectors in Las Animas County. This report section provides a brief summary of the benefits to agriculture; tourism and recreation; and the local economy. Comments on the role of CBM water in the larger Arkansas River Basin are also included.

4.1 Agriculture and CBM Produced Water

Exhibit 4.1-1 provides a picture of current agricultural operations in Las Animas County and in Colorado.

Exhibit 4.1-1.
Profile of Agricultural Activity in Las Animas County and Colorado, 2012

	Las Animas County	Colorado	Las Animas County % of State
Farms	602	36,180	1.66%
Land in Farms (acres)	2,140,776	31,886,676	6.71%
Average Farm Size (acres)	3,556	881	
Average market value per farm	$47,228	$215,060	21.96%
Total cropland acres	71,061	10,649,747	0.67%
Harvested cropland acres	16,143	5,182,628	0.31%
Irrigated acres	11,313	2,516,785	0.45%
Crop Sales	$3,170,000	$2,434,583,000	0.13%
Livestock Sales	$25,261,000	$5,346,292,000	0.47%
Cattle and Calf Sales	$24,706,000	$4,321,308,000	0.57%
Total Value of Products Sold	$28,431,000	$7,780,875,000	0.37%
Farms with cattle and calf operations	321	13,970	2.30%
Cattle and calves (inventory)	41,904	2,630,082	1.59%
Average number of cattle per cattle operating farm	131	188	

Note: The 2012 Census of Agriculture is the most recent published Census data.
Source: USDA Census of Agriculture, 2012

Farming is an important economic sector to Las Animas County, but it is relatively small in statewide terms. Irrigated acres are more than half of total harvested acres, but most of the acreage is grassland. Cattle and calves are the predominant agricultural cash producers for the County.

Exhibit 4.1-2 presents data on the agricultural economy in Las Animas County.

Exhibit 4.1-2.
Agricultural Employment and Income in Las Animas County, 2013

Total County Employment	7,860
Farm Employment	568
Non Proprietor Farm Employment	85
Farm Employment % of Total County Employment	7.23%
Average Countywide Annual Income	$37,500
Average Farm Annual Income	$35,800
Total Countywide Annual Income	$297,824,000
Total Farm Annual Income	$3,507,000
Total Farm Income % of County Total	1.2%

Note: Total Farm Annual Income includes wages, salaries and benefits for non-proprietor employees.
Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Harvey Economics

Agricultural employment makes up over 7 percent of total countywide employment.

Exhibit 4.1-3 indicates the economic benefit of CBM produced water both directly to the agricultural industry in Las Animas County and to the county as a whole. These benefits will vary from year to year along with the amount of CBM water production. The benefits in the exhibit below reflect the relatively low water production seen in recent years.

Exhibit 4.1-3.
Direct and Total Economic Benefit of CBM Produced Water to the Agricultural Industry in Las Animas County

	Direct Impacts of CBM Water to Agriculture	Total Economic Impact Related to Agriculture and CBM
Sales	$1,074,000	$2,015,000
Employment	21	41
Income	$132,000	$365,000

Sources: DOLA and Harvey Economics

As described in Section 2.3, we applied the assumption that 4 percent of the Purgatoire River is comprised of CBM water to applicable livestock and crop sales in the county in order to estimate the portion of agricultural sales attributable to the produced water. Livestock sales in Las Animas County amount to about $25,261,000 per year as illustrated in Exhibit 4.1-1. HE also assumed

that half the county's crop sale value would come from irrigated acreage ($1,585,000). Therefore, about $1.1 million of crop and livestock sales each year can be attributed to the existence of CBM produced water in Las Animas County. This amounts to about 3.8 percent of total agricultural sales in Las Animas County. The agricultural employment and income attributable to CBM water were then estimated as 3.8 percent of total county-wide agricultural employment and income; an estimated 21 agricultural jobs and about $132,000 of employee income are attributable to CBM water. This money circulates through the local economy, resulting in a total benefit of about $2.0 million in sales, 41 jobs and about $365,000 in income.

In previous years, with relatively higher CBM gas and water production, CBM water has made up about 7 percent of Purgatoire River flows, resulting in about $1.7 million in agricultural sales and about 38 direct agricultural jobs in Las Animas County.

4.2 Tourism and Recreation and CBM Produced Water

Exhibit 4.2-1 offers an overview of fishing, hunting, wildlife watching and other water related recreational activities in Las Animas County. Clearly, hunting and fishing are important elements of countywide tourism and recreation, which is an important sector of the local economy; over $36 million in total local expenditures are supported by tourism and recreation activities in Las Animas County annually.

Exhibit 4.2-1.
Profile of Recreational Activity in Las Animas County

Fishing	• The majority of activity occurs at Trinidad Lake, as well as North Lake and Monument Lake • Some fishing occurs on the North Fork of the Purgatoire River, generally above CBM discharge locations • A small amount of fishing occurs on the South Fork of the Purgatoire River, in the vicinity of CBM discharge locations • Over 100,000 fishing days per year occur in the County, most of which are resident days
Hunting	• Activity occurs on public and private land throughout the County • High quality elk hunting • Other popular game include bear, deer, mountain lion and turkey • Over 26,000 big game hunting days per year occur in the County
Wildlife Viewing	• Large and small game species, as well as waterfowl and birds attract a number of visitors to the area • Over 58,000 days of wildlife watching activity occurs in the County each year
Other	• Boating and water-skiing occur on Trinidad Lake
Total Expenditures	• $16.4 million from fishing; $9.9 million from hunting; $10.0 million from watchable wildlife

Sources: Colorado Parks and Wildlife, Trout Unlimited, GEI Consulting, BBC, Bureau of Labor Statistics and Harvey Economics

CBM produced water benefits wildlife and recreation in Las Animas County in a number of ways:

- The discharge of produced water results in a year-round, reliable water source for wildlife. Produced water is discharged at a relatively stable rate throughout the year, making it an available drinking water source for animals during dry summer or winter months; this may also positively affect the quality of available wildlife habitat;

- Dispersed discharge locations support the distribution of wildlife habitat throughout the area, which affects the type, density and location of various species. Elk and other large game are redistributed throughout the watershed, reducing concentrations in riparian areas;

- XTO has contributed between 700 and 1,200 AF of water to the Bosque Del Oso State Wildlife Area (SWA) annually in recent years. The water is used by a variety of wildlife; however, elk hunting is of especially high quality in the SWA and there are many more applications than permits granted for hunting at that location;

- According to some outfitters, the availability of CBM water results in better quality hunting experiences, in terms of the availability and distribution of game species, as well

as the health and quality of the animals. CBM water supports up to $4.4 million of hunting activity in Las Animas County annually, as explained in Exhibit 4.2-2;

- CBM water discharged into Purgatoire River tributaries provides habitat for fish and other aquatic species;

- At Trinidad Lake State Park, about $240,000 in visitor spending can be attributed to CBM water. This amounts to over $390,000 in total economic activity in the county, 6 jobs and about $141,000 in local income. A discussed in Section 2.4.1, visitation to the Park is correlated with water levels in the reservoir; therefore, the economic benefits related to Park visitation will vary from year to year along with CBM water production.

Exhibit 4.2.2 focuses on the benefits of CBM water to hunting activity. Almost 54 percent of big game hunting days in Las Animas County occur within Game Management Units (GMUs) 85 and 851, which are located within the Purgatoire watershed and which benefit from the discharge of CBM water. Big game hunting in this area mainly consists of elk and deer hunting, along with a small amount of bear and mountain lion hunting. Of the approximately $9.9 million impact of hunter spending in the county, about $4.4 million is associated with big game hunting in areas with CBM produced water flowing in Purgatoire River tributaries. Total economic impacts related to hunter activity in this area include 68 jobs and about $1.6 million in income.

Exhibit 4.2-2.
CBM Related Impacts to Hunter Activity and Spending

Big Game Hunter Activity Days in Las Animas County	26,100
Big Game Hunting Days in Game Management Units 85 and 851	14,000
Percent of Big Game Hunting Days in GMUs 85 and 851	53.7%
Total Impact of Hunter Spending in Las Animas County	$9,893,000
Total Impact of Big Game Hunter Spending in GMUs 85 and 851	$4,421,000
Total Local Employment Attributable to Hunting in GMUs 85 and 851	68
Total Local Income Attributable to Hunting in GMUs 85 and 851	$1,595,000

Notes: (1) Big game hunting days in GMUs 85 and 851 have been adjusted to reflect only the hunting days occurring in Las Animas County.

(2) The $9.9 million of total impact from hunter spending in Las Animas County includes the effects of both big and small game hunting.

Sources: Colorado Parks and Wildlife, BBC, Bureau of Labor Statistics, Harvey Economics

As stated in Section 2.4.2, the number of hunter days directly due to CBM water is uncertain. There is evidence that CBM water supports the hunting activity and hunter spending that occurs in these GMUs, but it is unclear to what extent CBM water has an impact on that activity or spending.

4.3 Fiscal and Economic Benefits of CBM Activity

Exhibit 4.3-1 illustrates the direct and total effects of the CBM industry on employment and income in Las Animas County. As of 2014, almost 350 people working in Las Animas County were directly employed by the CBM industry and contractors. For each of those employees, about an additional 1.5 positions were created by industry and direct employee spending, for a total of about 870 jobs supported by CBM operations.[14] Direct employee income amounted to about $38.7 million in 2014; accounting for the multiplier effect, total countywide income supported by the CBM industry came to about $54.5 million, or over 18 percent of total Las Animas County income.

[14] The methodologies used to estimate the employment and income benefits related to CBM industry activity, including the application of certain multipliers, are discussed in Section 2.5.

Exhibit 4.3-1.
Impact of CBM Industry on Employment and Income in Las Animas County

CBM Industry Direct Employment	345
Mining Industry Employment Multiplier	2.5
Total Employment Supported by CBM Activity	871
CBM Supported Employment % of County Employment	11.1%
CBM Industry Direct Income	$38,700,000
Mining Industry Earnings Multiplier	1.6
Total Income Supported by CBM Activity	$54,500,000
CBM Supported Income % of County Income	18.3%

Notes: The employment and earnings multipliers for the mining industry are the averages of the Oil and Gas Extraction multipliers and the Support Activities for Mining multipliers for the Southern Colorado Region.

Sources: Bureau of Economic Analysis, CBM Operators, Harvey Economics

The level of employment and income supported by the CBM industry in Las Animas County is dependent on a number of factors, including CBM production levels, and therefore varies from year to year. Recent low gas prices have driven industry employment down over the last couple of years; in comparison to 2014, CBM industry direct employment was almost 600 people in 2011, with over $57 million in direct income.

Exhibit 4.3-2 presents the total effects of CBM industry activity and produced water to employment, income and sales in Las Animas County. About 12 percent of the County's employment and over 18 percent of the County's income can be attributed to CBM activity. About 26 percent of the county's total retail sales of goods and services also result from industry operations. As discussed above, these numbers can vary substantially from year to year, depending on CBM production levels and other factors.

Exhibit 4.3-2.
Aggregate Contribution of CBM Activity to Employment, Income and Sales in Las Animas County and Local Jurisdictions

	CBM Industry	Agriculture	Recreation and Tourism	Total	Percent of County Total
Economic Measures					
Employment	871	41	6	918	11.7%
Income	$54,500,000	$365,000	$141,000	$55,006,000	18.5%
Sales	$85,597,000	$2,015,000	$391,000	$88,003,000	26.0%

Source: Harvey Economics

Exhibit 4.3-3 describes the sales tax and property tax revenues paid by the CBM industry in Las Animas County. About $340,000 in sales taxes and about $4.3 million in property taxes were paid by CBM companies in 2014. The bulk of property taxes are distributed among the county's

school districts and the county itself; local improvement and service districts also receive a portion of property taxes.

Exhibit 4.3-3.
CBM Industry Generated Sales and Property Tax Revenues in Las Animas County, 2014

Local Sales Tax Paid by CBM Operators	$340,000
Total Las Animas County Sales Tax Revenue	$4,200,000
CBM Supported Sales Tax Revenue % of County Sales Tax Revenue	8%
Estimated CBM Property Taxes Paid	$4,290,814
Total Las Animas County Property Tax Revenue	$14,035,634
CBM % of County Total	31%
CBM Property Tax Recipients	
School Districts	$2,412,608
Las Animas County	$1,528,161
Local Improvement and Service Districts	$350,045

Sources: Colorado Department of Local Affairs, Division of Property Taxation; CBM Operators; Harvey Economics

Exhibit 4.3-4 displays the distribution of sales and property taxes paid by CBM companies among various jurisdictions, along with the distribution of severance taxes and FML revenues. Overall, Las Animas County and local jurisdictions were the recipients of about $5.7 million in revenues from various sources in 2014.

Exhibit 4.3-4.
Estimated Tax Revenues from CBM Activity in Las Animas County, 2014

Tax Revenue Source	City of Trinidad	Other Municipalities & Agencies	Las Animas County	Local School Districts	Total for Las Animas County Jurisdictions
Sales Tax	$ 340,000	$ -	$ -	$ -	$ 340,000
Property Tax	$ -	$ 350,000	$ 1,528,000	$ 2,413,000	$ 4,291,000
Severance	$ 281,000	$ 18,000	$ 384,000	$ -	$ 683,000
FML	$ 110,000	$ 7,000	$ 153,000	$ 23,000	$ 293,000
Other	$ -	$ 55,000	$ -	$ -	$ 55,000
Total	**$ 731,000**	**$ 430,000**	**$ 2,065,000**	**$ 2,436,000**	**$ 5,662,000**

Sources: Colorado Department of Local Affairs, Harvey Economics

In addition to the revenues collected by Las Animas County government and other local jurisdictions described above, CBM companies in the county paid almost $4.0 million in royalties to local private landowners in 2014.

The economic benefits of the CBM industry to Las Animas County portrayed in Exhibits 4.3-4 and 4.3-4 are those of 2014 only. The benefits of industry activities can be variable over time, especially as seen in property tax and severance tax revenues. Additionally, the accumulated benefits to Las Animas County jurisdictions are quite large when calculated over a number of years. Tax revenues to those jurisdictions ranged between about $14.1 million and $5.1 million per year between 2009 and 2014, for an estimated total benefit of about $47.1 million over that time frame. Exhibit 4.3-5 depicts the various tax benefits to Las Animas County in recent years.

Exhibit 4.3-5.
Estimated Tax Revenues from CBM Activity in Las Animas County, 2009 - 2014

Year	Sales Tax	Property Tax	Severance Tax	FML	Other	Total for Las Animas County Jurisdictions
2009	$ 299,000	$ 11,539,000	$ 1,641,000	$ 571,000	$ 55,000	$ 14,105,000
2010	$ 308,000	$ 5,658,000	$ 437,000	$ 487,000	$ 55,000	$ 6,945,000
2011	$ 320,000	$ 6,221,000	$ 770,000	$ 455,000	$ 55,000	$ 7,821,000
2012	$ 332,000	$ 5,687,000	$ 846,000	$ 489,000	$ 55,000	$ 7,409,000
2013	$ 336,000	$ 3,906,000	$ 522,000	$ 313,000	$ 55,000	$ 5,132,000
2014	$ 340,000	$ 4,291,000	$ 683,000	$ 293,000	$ 55,000	$ 5,662,000
Total	**$1,935,000**	**$ 37,302,000**	**$ 4,899,000**	**$ 2,608,000**	**$ 330,000**	**$ 47,074,000**

Sources: Colorado Department of Local Affairs, Harvey Economics

In addition to the revenues collected by Las Animas County government and other local jurisdictions described above, CBM companies in the county paid an estimated $45 million in royalties to local private landowners between 2009 and 2014.

4.4 CBM Produced Water in the Arkansas River Basin

The Arkansas River Basin is the largest basin by area in Colorado, covering over 28,000 square miles across the south-east region of the state. The Basin includes a population of over one million people living both in urban and rural areas and supports a wide mix of economic activity, including tourism, recreation, agriculture and mining. The Purgatoire River Basin specifically includes each of those economic sectors. Major water sources in the Arkansas Basin include snowpack and other precipitation, groundwater supplies and trans-mountain diversions; CBM activity provides a supplemental water source to a Basin which is frequently water short.

4.4.1 Water Uses and Shortages in the Arkansas River Basin

4.4.1.1 Agriculture

Agriculture is the largest water use in the Basin; agricultural use accounts for about 87 percent of total water withdrawals. The Basin contains 428,000 irrigated acres, with about one million acre-feet (AF) of crop water demand annually. Current irrigation shortages exceed 450,000 AF per year. Given the projected decrease in future irrigated acres, shortages are anticipated to be approximately 370,000 AF per year by 2050. Colorado's Water Plan and the Basin

Implementation Plan (BIP) identify an augmentation gap of up to 50,000 AF by 2050.

The BIP indicates that much of the land in the Basin is unsuitable for dryland farming due to climactic conditions; therefore, reducing or removing water from irrigated acres generally results in a decrease in total cropland. Goals related to agricultural water needs in the Basin include sustaining the agricultural economy and providing additional augmentation water.

4.4.1.2 Municipal and Industrial (M&I) Use

The population of the Arkansas Basin is expected to grow from just over 1 million people in 2013 to between 1.58 million and 1.84 million people by 2050; an increase of between 53 and 79 percent. M&I water use is currently a small portion of Basin demand (about 10 percent of total water withdrawals). However, due to future population growth, M&I demands are projected to reach between 298,000 AF and 352,000 AF by 2050, an increase of up to 170,000 AF. Shortages of at least 45,000 AF, and possibly as much as 94,000 AF, are anticipated by 2050.

According to the BIP, "continued dependence on non-renewable groundwater is exacerbating the gap in water supply and demand. This places significant pressure to secure future municipal water supplies." Goals for meeting municipal and industrial water needs in the Basin include developing collaborative solutions among different types of users, particularly in drought conditions.

4.4.1.3 Environmental and Recreational Use

Colorado's Water Plan and the BIP identify a number of goals related to nonconsumptive water uses in the Basin; these goals include maintaining and improving fish and wildlife populations and habitats, boating and other recreational opportunities, and wetland areas.

Environmental needs in the Basin include water for wetlands, birding areas, and threatened and endangered species. Numerous wetlands are present throughout the Basin. As stated in the BIP, "wetlands provide many ecological, economic, and social benefits, and provide habitat for fish, wildlife, and a variety of plants that have environmental, commercial, and recreational importance." Additionally, federally listed threatened and endangered plants and animals and other state species of concern in the Arkansas Basin rely on water availability for a number of purposes, including food sources and habitat; these species include the bald eagle, piping plover, least tern, lesser prairie chicken, Arkansas darter, boreal toad, and greenback cutthroat trout.

Recreational needs include water for boating, fishing and hunting. Recreational boating includes both whitewater and flatwater boating for commercial and private purposes. Fishing is a popular activity, which occurs at numerous reservoirs, lakes, rivers, streams and smaller tributaries throughout the Basin. The Arkansas Basin also includes prime waterfowl hunting areas and habitat for other commonly hunted large and small game species.

4.4.2 Importance of CBM Water to the Arkansas Basin

The many competing interests for existing and future water supplies in the Arkansas Basin indicate the need for collaboration among uses and industries, as well as creative solutions for

water management. Therefore, all available or potential water sources must to be considered for suitability in meeting the Basin's water gaps, including CBM water. CBM produced water is an existing source of water supply available to Basin water users to help meet a portion of current and future water needs; this source of water should be included in the discussion of future water management for the Arkansas Basin.

CBM water discharged into Purgatoire River tributaries and the between 2,000 and 3,500 AF of water that CBM activity adds to the Purgatoire mainstem annually provides water for agricultural and recreational activities and helps alleviate the pressure on other water supply sources. CBM water becomes more important in dry years when it represents a greater portion of total supply. CBM water is generally available throughout the year; its value increases in low flow periods of the growing season. The loss of CBM water would result in a reduced volume of water in the Purgatoire for all uses and associated benefits. In fact, any reduction in the amount of CBM water discharged to surface water would further exacerbate the estimated water demand gap for beneficial uses within the Basin, including M&I, agriculture and environmental and recreational uses.

Section 5
Future of Las Animas County CBM Production

In Las Animas County, CBM gas has been extracted from the Raton Basin for over 15 years. CBM industry activity and the associated produced water has the potential to continue to provide real benefit to the local economy in terms of employment, income and various revenues. However, a number of factors influence the pace and volume of gas production in the county, including:

- Natural gas prices – natural gas prices are volatile and are currently at historically low levels. Low gas prices tend to result in reduced gas production since operators work closer to the margin, in terms of profits;

- Production costs – the costs of drilling, materials and supplies and transportation all affect the level of annual gas production. As production costs increase, the potential exists for a reduction in gas extraction activity;

- Cost of field operations, also known as lease operating expenses (LOE); the cost of water management and surface discharge are among the major elements of LOE. Low natural gas prices require operators to consider ways of controlling costs in order to reduce LOE. As operating expenses increase, less money is spent on natural gas production and on extending the life of the field. In fact high LOE directly affects the level of CBM activity that occurs in Las Animas County;

- Changes in technology – exploration, drilling and extraction technologies will likely change and improve in the future, potentially increasing the amount of viable gas production and extending the life of the field;

- Costs of produced water treatment and injection – as a by-product of gas extraction, CBM companies are responsible for the disposal of produced water, whether it is discharged into tributaries as surface water flows or re-injected into the ground. The costs associated with the disposal of this water can impact gas production levels, future production and the overall economic viability of the field.

The Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE) regulates CBM produced water that is discharged to "waters of the state", which includes rivers, arroyos, gulches, ponds, lakes and other water bodies. Operators obtain permits from WQCD to discharge produced water into these water bodies; the permits are good for 5 years, at which time they can be considered for renewal. Discharge permits contain limits on a number of parameters, some of which are site- specific and vary by location. These limits are set based on the Water Quality Control Commission's classification of the receiving stream as beneficial for (1) aquatic life; (2) recreation; (3) agriculture; or (4) water supply.

Changes in permit limits or other regulations affecting the discharge of produced water have the potential for increasing associated discharge costs, if treatment is required, or for the re-injection

of additional water. Additional costs related to treatment of produced water may result in a reduction of CBM activity. Likewise, the high costs of re-injection wells may also have the potential for reducing gas extraction activities. An additional downside of re-injection is that produced water would become unavailable for any beneficial use in Las Animas County or in the Arkansas Basin, where all water supplies are sorely needed.

As this report shows, CBM industry activities, including the production of water, provide valuable benefits to the residents and jurisdictions of Las Animas County. Curtailment of CBM production in Las Animas County or re-injection of produced waters would have the following economic impacts:

- Reduction in water available for use by the agriculture and tourism/ recreation industries – reduced volume of agricultural activity or visitation to the area for hunting or other activities. Reduced activity in these industries will also lead to reduced employment and income in the county;

- Reduction in company employment and expenditures – local employment and spending by CBM companies would be reduced, along with sales tax revenue for the City of Trinidad or others;

- Reduction in royalty payments and various tax payments – royalty payments to private landowners would be reduced, as would the amount of severance taxes and FML revenues received by the county and local jurisdictions;

- Lower economic activity countywide – overall, reduced CBM mining activity and water production will result in a decline in employment and personal income, reduced local spending and fiscal impacts to both state and local governments.

Appendix A – Harvey Economics Interviews

Appendix A provides a list of the people interviewed by Harvey Economics for this study, as well as their organization or position and the general topics of the interview:

- *Levi Montoya, USDA Natural Resources Conservation Service* – agricultural activity in Las Animas County, the effects of CBM water on agriculture and ranching and the effects of CBM water on wildlife.

- *Jeff Montoya, Colorado Division of Water Resources, Water Commissioner* – water supply and demand conditions in the Purgatoire River sub-watershed, chronic shortages, the Arkansas River Compact agreement with Kansas and water conditions in the Arkansas River Basin.

- *Jeris Danielson, Purgatoire River Water Conservancy District* –District overview, local agricultural operations, regional water availability and CBM water.

- *Robert Valdez, Las Animas County Planning Commission Director, and Joe Richards, Las Animas County Building Inspector* – Las Animas County economy and demographics, major employers the impact of the CBM industry, tourism and recreation.

- *Jim Muzzulin, Trout Unlimited, President, Purgatoire River Anglers Chapter* – fishing locations along the Purgatoire River, the quality of local fishing, and the potential benefits of CBM water to fishing.

- *Heath Kehm, Colorado Parks and Wildlife, Park Manager, Trinidad Lake State Park* – recreational opportunities throughout Las Animas County, activities and visitation levels at Trinidad Lake State Park, and impact of water levels on visitation and the benefits of additional CBM water.

- *Mike Trujillo, Colorado Parks and Wildlife* – hunting activity in Las Animas County, quality of local big game hunting, elk management, and benefits of CBM water to wildlife.

- *Don Conklin, GEI Consultants* – ecological aspects of the Purgatoire River watershed, with a specific focus on aquatic life, aquatic habitat, fish populations, fishing activity and benefits of CBM water to the fishing experience.

- *Five local landowners with CBM wells on their property*. *Doug Taylor, Gary and Karen Salapich, Kevin Falduto, Warren McDonald, Jim Vigil*–CBM activity, availability of produced water, water quality, hunting activity, other recreational activity, wildlife presence and cattle operations.

Water Quality Control Commission

Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South, A-5
Denver, CO 80246-1530

Dear Members of the Commission:

We are writing this letter as concerned citizens and landowners in Las Animas County. We live, ranch, and farm along the Purgatoire River, and we rely greatly on the water. We have all been watching as our lands have suffered through this severe drought. This drought has been ongoing for the past 10 years with the past 3 being as bad or worse than the one in 2002. Las Animas County is currently sitting in a D4 drought, with no signs of future relief.

We wait as patiently as possible for the snow or rain to come but the amount it will take to moisturize these drought-stricken grounds will be huge. We have however, been lucky in one aspect, we have had the benefit of gas production in our area which has given us the use of "extra water" from the discharges. This discharge water has been used for the past 12 + years and we have only had positive effects, no negative effects from the water have been found. There has been water monitors placed along the river that gives the landowners and any interested persons real time data accessible online 24/7. There is even one at the out let side of the Trinidad Dam.

There are many landowners along the Purgatoire River who would not have had crops or been able to keep their animals had it not been for the water being discharged. With less water for crops this will mean less agriculture for Las Animas County agriculture is a huge part of our economy. We have already watched over ½ of our cattle population move out of the county. Because of such a small snow pack, had we not had the discharge water these past years, there would be even less cattle left in our county. Without the agriculture community having the availability of this good discharge water we would have lost the majority of our agriculture as well.

This water has been used by wildlife including deer, elk, bear, birds and fish to name a few. There are riparian areas where, before the water, it just dry, dusty, dead areas. Now the water covers miles of what would have been dry ground giving life to the livestock and wildlife along the way.

This water has also been vital to the suppression of wildfires that have started in the area. Without access to this water these fires would have caused immense damage to the land and homes in the area. We have been, and still are, in an extreme fire danger area. Making our living off of this land we would never want bad water, and we would never stand by if bad water were being put into the Purgatoire River. However, it is just as important that we fight to keep the good water. We have been using this water for over 12 years with absolutely no negative effects. Injecting this water that we know and can prove is good water, without any evidence that it is bad would be devastating to landowners and the county as a whole.

We thank you for your time and attention to this vitally important issue.

Fred Eichler
Michele Eichler
Charles Healey
Guy Salapich
Janice Salapich
Bill Brunelli
Sue Brunelli
Doug Taylor

210-317-7401

846-8520

Exhibit 1-A

Water Quality Control Commission

Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South, A-5
Denver, CO 80246-1530

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Land owner Matilda Mestas Phone No, 941-4389
Land Owner Florence a. martinez phone 719. 941-4401
Land owner Gary Mestas 719-941-4156
" Debbie Mestas 719-941-4156

Exhibit 1-B

Water Quality Control Commission

Colorado Department of Public Health and Environment

4300 Cherry Creek Drive South, A-5

Denver, CO 80246-1530

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We thank you for your time and attention to this vitally important issue.

Bob A. Tanberend

Cathy O Garcia

Tom A. Kozomik

Kimberly Kozomik

SP BC FD

Andrew Brown

Edward E Brown SR

albert Martinez

Alan Martinez

Debbie Barnes

Joe Barnes

Pat Tambarelli

Phil Tambarelli

WQCC -

Landowners on Purgatoire River

Eli Salapich	406 - 945 - 0453
Tom Monarco	719 - 548 - 8730
Jennifer Monarco	719 - 201 - 6384
Tony Hass	719 - 680 - 0619
Karen Salapich	719 - 680 - 0583

Ron Arant
14800 County Road 28.7
Trinidad, Colorado 81082

State of Colorado
Water Quality Control Commission
4300 Cherry Creek Drive South
Denver, Colorado 80246

Dear Mr. Frohardt;

I am writing this letter to you to encourage you to not allow the change proposed by certain companies to increase the boron levels in the Purgatoire River drainage system. I have read that Pioneer Natural Resources and XTO Energy are requesting a change that would allow higher boron levels than are now in effect.

I am a fourth generation farmer who operates a Centennial Farm northeast of Trinidad. My crops are dependent upon good, clean, quality water that originates in the Purgatoire watershed. My family also drinks that same water. To change the allowable limits of boron may put both uses in jeopardy.

In an article by Sam Montoya, published in the Chronicle News, March 28th edition Mr. Montoya contends that increasing the allowable amount of boron in our water would only hurt citrus crops. Obviously we do not grow citrus plants in Las Animas County, but we do have serious problems with salinity and heavy alkaline soils. Mr. Montoya makes the point that if these waters produced from their methane extraction methods are too high in boron they must be reinjected into the ground. He asserts that this would be water lost to area ranchers. I submit that the reason they are requesting a higher allowable boron limit, is not to the benefit of area ranchers, but rather the economical benefit to the companies: XTO and Pioneer Natural Resources.

I urge you to not allow this exception to be made. This would increase the amount of boron in our watershed by over 400%! Future serious problems can be avoided by simply allowing the present regulations to stay in place.

Thank you for your time and consideration on this matter.

Sincerely,

Ron Arant

Ron Arant

BEFORE THE WATER QUALITY CONTROL COMMISSION
STATE OF COLORADO

WRITTEN COMMENTS OF HILL RANCH LTD AND BOBBY HILL, INDIVIDUALLY, AND AS TRUSTEE FOR AMY HILL; AND INCORPORATING WRITTEN STATEMENTS OF SID E. BAYES AND MIKE POWELL

FOR CONSIDERATION OF THE ADOPTION OF REVISED WATER QUALITY CLASSIFICATIONS, STANDARDS AND DESIGNATIONS FOR MULTIPLE SEGMENTS IN THE ARKANSAS BASIN, REGULATION #32 (5 CCR 1002-32)

Comes now the Hill Ranch Ltd. and Bobby Hill, individually and as Trustee for Amy L. Hill, through its Counsel, Baker & Hostetler LLP, and submits these written comments regarding proposed classifications, standards and designations for portions of the Lower Arkansas River Basin and tributaries thereto; including the proceedings commencing on July 8, 2002 concerning the adoption of revised water quality classification standards and designations for multiple segments in the Arkansas Basin, Regulation # 32(5 CCR 1002-32).

1. Interests in Arkansas River Proceedings

Hill Ranch Ltd. and Bobby Hill, individually and as Trustee for Amy Hill (hereinafter referred to as "the Hills") are the owners of approximately 48,000 acres of the Maxwell Land Grant, situated in Las Animas County, Colorado. The Hills' properties are proximate to the Purgatoire River and therefore within the Lower Arkansas River Drainage which is the subject matter of these proceedings. In addition to ranching

activities on its properties, the Hills have leased portions of their properties for coalbed methane gas production to Evergreen Oil and Williams Production Company. The Hills own water rights, which they utilize for farming and agricultural activities. Further, the Hills have retained the rights to all waters produced from the coalbed methane gas production, including water from dewatering wells on their properties. The proposed revisions to the water quality standards and classifications for the Lower Arkansas River would classify waters, to which activities on the Hills' properties are tributary, for aquatic life, drinking water supplies and agriculture. Attendant with these classifications are numeric standards establishing the quality of waters in these streams and any discharges thereto.

The Hills received no actual notice of the proposed use classifications and standards; only learning of the potential proceedings from Evergreen Oil. The Hills contacted the Water Quality Control Division for information and on June 4, 2002, Mr. Bobby Hill received a responsive letter from the Division verifying him that Lorencito Canyon was subject to reclassification and new numeric water quality standards. As a property owner, water rights owner, rancher and gas producer within this area, it is important that the rights and concerns of the Hills be considered in these proceedings.

II. Lorencito Canyon Should Be Classified for: Aquatic Life Warm 2, Agricultural and Recreation 2.[1]

The Hills have three primary bases to support the existing water quality classifications.

(1) Historic Flows and Temporary Augmented Flows The historical water flows in Lorencito Canyon are not sufficient to sustain fisheries or fishery habitats. Lorencito Canyon is primarily a dry bed for significant periods each year. Mr. Sid Byes, who has worked cattle in the Longs/Lorencito Canyon for 50 years, testifies that water only runs in the Lorencito Canyon seasonally. (See, Statement of Sid E. Bayes, Exhibit 1). Further, Mr. Mike Powell who has managed the Hill Ranch for 16+ years testifies that there are long stretches of dry creekbed in Lorencito Canyon during the summer and fall. Interestingly, Mr. Powell and others have noted that windmills to pump alluvial waters were placed adjacent to the Lorencito creekbed, because waters were not available at the surface. (See, Statement of Mike Powell; Exhibit 2)

Waters, which now flow in Lorencito Canyon are from coalbed methane dewatering activities, so are temporary. When the dewatering activities subside or are eliminated, the waterflows will return to normal levels, including seasonal periods with a

[1] It is our understanding that Evergreen Oil and the Water Quality Control Division Act now concur with these uses classifications for Lorencito Canyon.

dry creekbed. Therefore, it is not reasonable to designate water quality uses and classifications based on temporary produced water in the canyon.

(2) No Drinking Water Supplies. The initial proposal to place Lorencito Canyon into Segment 5A of the Lower Arkansas River would result in Lorencito Canyon being classified for drinking water supplies. There is no evidence in the record that water supply uses exist for waters of Lorencito Canyon nor has any information been submitted to suggest that water supply uses are attained. No factual basis exists for classifying Lorencito Canyon as a drinking water supply.

(3) Extent of Lorencito Canyon The classification and designation of Lorencito Canyon includes the main stem of Lorencito Canyon, however, the notice is ambiguous regarding the extent of the "waters" that are included within Lorencito Canyon. Specifically, it is impossible from the proposal to determine the upgradient point where the Lorencito Canyon waters actually exist and the use classifications apply. Without careful designation of the waters actually classified, discharges in the upper reaches of the dry creekbed may be required to attain the water quality standards at the point of discharge (because of zero dilution) rather than downgradient where water flows and the uses actually exist. The Hills request that Lorencito Canyon water classifications and standards only apply to those sections of Lorencito Canyon with historic, water flows (not augmented by temporary coalbed methane produced waters) for significant periods of time each year.

III. Significant Ramifications

There can be significant ramifications if the Commission reclassifies and sets use designations for Lorencito Canyon not supported by long-term evidence or flows. Water flows have increased in Lorencito Canyon due to produced water within the watershed. As coalbed methane production continues, the volumes of water will decline. So, coalbed methane produced waters will not continue long term and, likewise, the uses that allegedly have developed recently based upon such produced water, and are dependent thereon, are not expected to be sustained. If such "classified uses" dependent upon produced water cease to exist or are diminished in quality or diversity, the Lorencito Canyon waters could be considered as "impaired". As an "impaired water", the Division will require either (1) a total maximum daily load (TMDL) to assure the waters attain the uses, or (2) a use attainability analysis (UAA) to explain why the uses dependent on produced water no longer exist. Because the impairment would be due to lack of water, it is unlikely that any TMDL could be satisfactorily developed. It is inappropriate to assign permanent water quality classifications and standards for waters based on temporary uses which only exist because short-term human-induced hydrologic conditions.

Since the Commission knows, now, that the water produced and the uses that are dependent upon that water are unlikely to be sustained, the waters of Lorencito

Canyon should be classified for historically documented uses, to wit: Agricultural, Recreation 2 and Aquatic Life Warm 2.

IV. Classification of Tributaries: Agricultural

Some proposals and revised proposals offered in these proceedings would erroneously result in dry tributaries to Lorencito Canyon being classified for the same, or even higher uses than Lorencito Canyon. No evidence suggests that waters, if and when it exists in these tributaries, should be classified for any uses except agricultural.

V. Conclusions

The Hills request that Lorencito Canyon be classified for designated uses of Aquatic Warm 2, Recreation 2 and Agricultural, for those reaches with sustained historic, water flows for ten months per year. The tributaries to Lorencito Canyon should only be classified for Agricultural uses.

Respectfully submitted this 26th day of June 2002.

ATTORNEYS FOR HILL RANCH, LTD. AND BOBBY HILL, INDIVIDUALLY AND AS TRUSTEE FOR AMY HILL

Ronda L. Sandquist, #9944
Baker & Hostetler, LLP
303 East 17th Avenue, Suite 1100
Denver, Colorado 80203
(303) 861-0600

June 22, 2002
Sid E. Bayes
2648 Aguilar Dr.
Trinidad, CO 81082

To Whom It May Concern:

I have worked cattle for the past 50 years, mostly in the Longa/Lorencito Canyon areas. During these many years I have observed and can attest that the water, at best, runs seasonally during summer months. In a dry year such as this one, it may not run at all. I believe that any water in Lorencito Canyon is due to the gas well activity in the canyon.

Thank you,

Sid E. Bayes

Sid E. Bayes
(719)846-4185

HILLS EXHIBIT 1

BOTH REGULATIONS
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Denver, CO 80203

Mary E. McCarty

TEMPERATURE TEMPORARY MODIFICATION REQUEST IN THE PURGATOIRE WATERSHED LAS ANIMAS COUNTY, COLORADO

LOWER ARKANSAS RIVER SEGMENTS 3A, 3B, 4B, 5A, 5B, 6A, 6B, 16 AND 17

Developed for:

Pioneer Natural Resources, USA, Inc.
XTO Energy, Inc.

Prepared by:

Julie Vlier, P.E.
Tetra Tech, Inc.
1900 S. Sunset Street, Suite 1-F
Longmont, CO 80501

Bruce Marshall, P.G.
Engineering Analytics, Inc.
1860 Blake Street, Suite 220
Denver, CO 80202

April 19, 2013

EXHIBIT 6
Exhibit 3

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INTRODUCTION

This report provides the technical basis and justification for the request for a temperature temporary modification in the Purgatoire and Apishapa Watersheds, Lower Arkansas River segments 3a, 3b, 4b, 5a, 5b, 6a, 6b, 16 and 17. The study area includes over 700 square miles of land located west of Interstate 25 near the Sangre de Cristo mountain range in the lower Arkansas River Basin (Figure 1).Temperature data collected by Pioneer Natural Resources USA, Inc. (Pioneer) and XTO Energy, Inc. (XTO) in the Purgatoire River and Apishapa River and their tributaries since April 2010 and 2005 respectively, coupled with the historical temperature data collected by the U.S. Geological Survey (USGS) at various locations in the watersheds have been assessed. The current data collection effort represents a large physical effort and financial commitment by Pioneer and XTO. The report presented herein demonstrates that

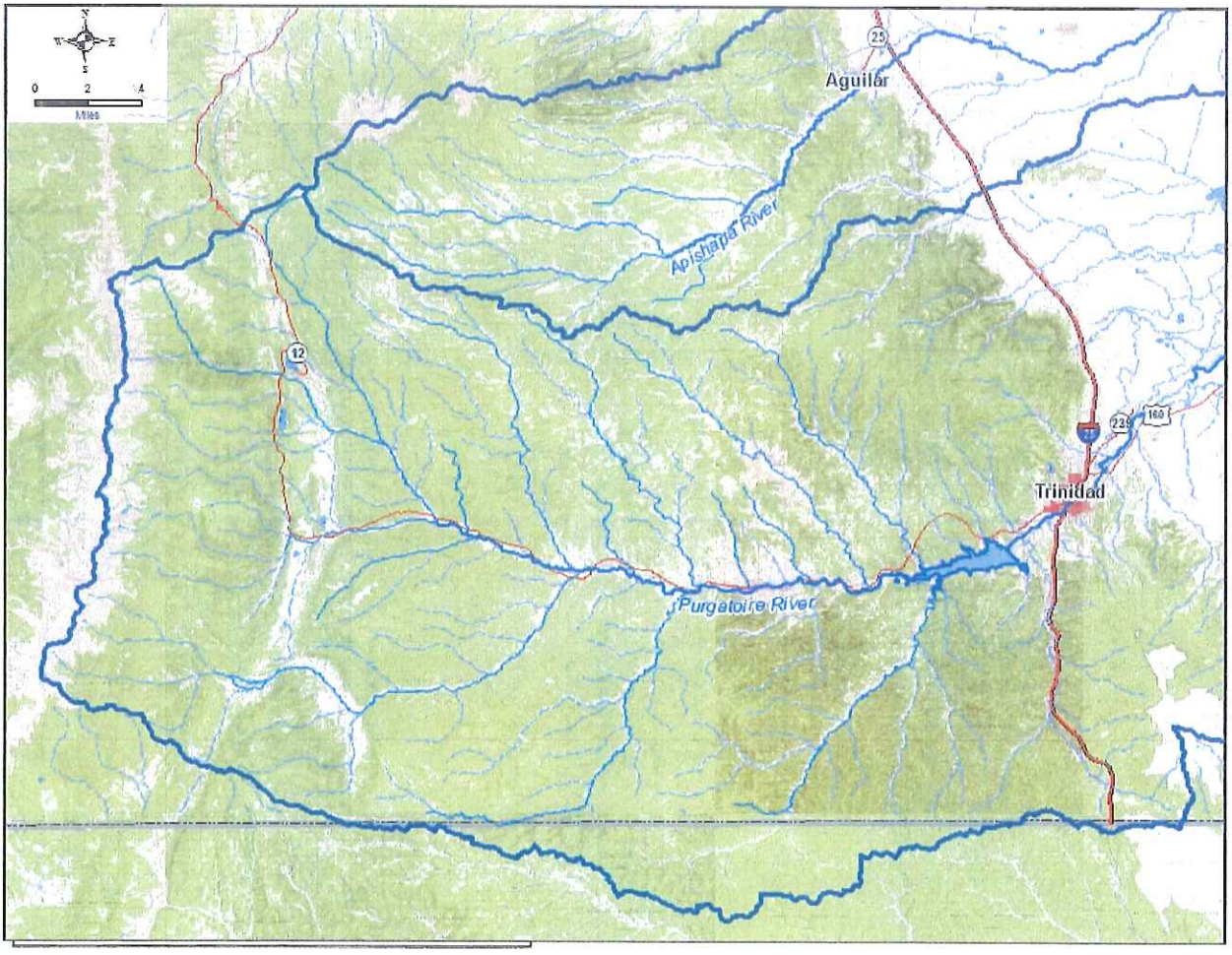

Figure 1 - General Location of Purgatoire Watershed in the Lower Arkansas River Basin, CO

implementation of the underlying temperature standards result in compliance issues for dischargers, XTO and Pioneer, and that significant uncertainty underlies the applicability of the temperature standards proposed by the Division for their new Lower Arkansas River Segments 3a, 3b, 4b, 5a, 5b, 6a, 6b, 16 and 17.

Given the scope of uncertainty regarding the temperature standard, a plan outline has been developed in coordination with the Division to support the request for the temperature temporary modification. The plan includes compiling and completing the temperature data record, quantifying the cumulative thermal impact of discharges, evaluating the transition point from cold to warm water, analyzing tributary canyons which are ephemeral and may be effluent dependent, and documenting the attainability of the designated uses. A "current condition" ambient temperature is proposed until December 2017, while the temperature temporary modification is in effect and data collection and analyses are being conducted.

I. EXISTING WATER TEMPERATURE MONITORING STATIONS

Tetra Tech has conducted a comprehensive monitoring program in the Purgatoire Watershed above Trinidad Lake for Pioneer and XTO since April 2010. Norwest Corporation has collected data in the Apishapa Watershed, upstream of the Town of Aguilar, for Pioneer since 2005. As part of these monitoring programs, water quality data, including temperature, is collected and transmitted, via satellite, to websites for near real time information.

Purgatoire Watershed

In the Purgatoire Watershed, temperature data is collected at 15-minute intervals at nine gaging stations. Five of the continuous gaging stations are located in the Division's proposed Segment COARALA05b, which includes the lower portions of the North, Middle, and South Forks of the Purgatoire River and the mainstem of the Purgatoire to Interstate 25. This includes the following five gaging stations, from upstream to downstream (Figure 2):

- PR-37.1 (Middle Fork)
- PR-24.9 (Mainstem)
- PR-16.9 (Mainstem)
- PR-8.8 (Mainstem)
- SFPR-0.1 (South Fork)

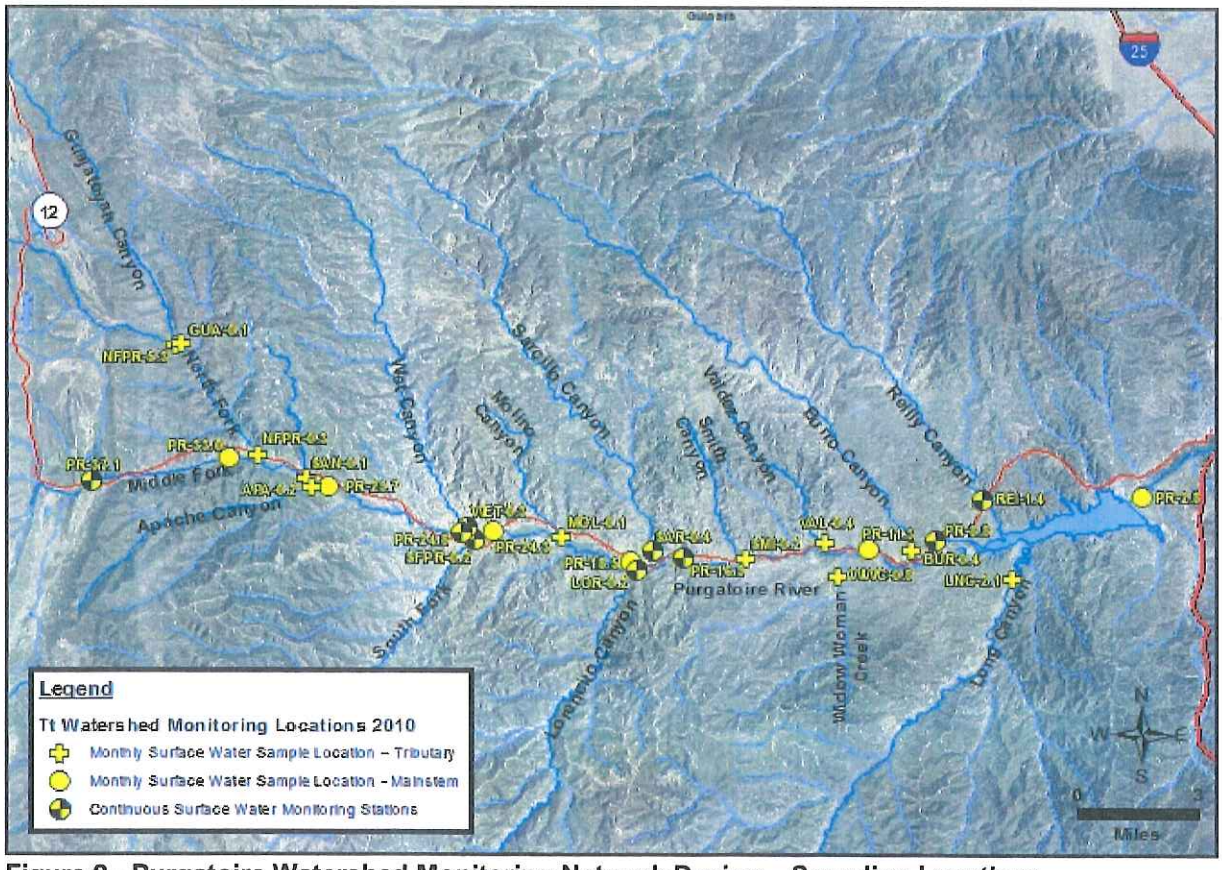

Figure 2 - Purgatoire Watershed Monitoring Network Design – Sampling Locations

An additional four gaging stations are operated for Pioneer and XTO on Purgatoire River tributaries. From upstream to downstream, these include (Figure 2):

- Wet Canyon (Station WET-0.3, proposed Segment COARALA06b)
- Lorencito Canyon (Station LOR-0.2, proposed Segment COARALA04b)
- Sarcillo Canyon (Station SAR-0.4, proposed Segment COARALA06a)
- Reilly Canyon (Station REI-1.4, proposed Segment COARALA06a)

In addition to the temperature data collected in the Purgatoire at 15-minute intervals from these gaging stations, Tetra Tech samples these nine and 18 additional locations (27 total) on monthly basis in the Purgatoire watershed (Figure 2). Instantaneous temperature data are available for these monthly samples. Between April 2010 and March 2013, approximately 36 instantaneous temperature data points are available for many of the locations shown on Figure 2; however, fewer instantaneous temperature data are available for many tributaries as these locations have proven dry during the past three years.

The USGS has also sampled in the Purgatoire watershed, collecting instantaneous temperature data from 1970s to present. Water temperature data available from the USGS stations tributary to Trinidad Lake is summarized in Table 1.

Table 1 – Historic USGS Purgatoire and Apishapa Watershed Temperature Data

USGS Station Number	Description	Start Date	End Date	Count	Proposed Division Segment
07124050	Middle Fork Purgatoire River at Stonewall	6/78	8/81	13	COARLA5b
07124200	Purgatoire River at Madrid	3/72	9/10	399	COARLA5b
07124100	Molino Canyon	5/80	8/81	23	COARLA6a
07124120	Sarcillo Canyon	10/78	9/81	8	COARLA6a
07124220	Reilly Canyon	6/78	9/81	41	COARLA6a
07124300	Long Canyon	2/72	8/89	170	COARLA5b
07118500	Apishapa River at Aguilar	6/79	10/81	27	COARLA3a

Data available from: http://nwis.waterdata.usgs.gov/co/nwis/ through April 16, 2013.

Apishapa Watershed

In the Apishapa Watershed, temperature data is collected near real time at 3 gaging stations on the Apishapa River, located at Division proposed segment COARLA03a (Figure 3):

- Apishapa River at Belarde
- Apishapa River at Eichler
- Apishapa River at Lisonbee

A fourth gaging station shown on Figure 3, Apishapa River at Nations, was discontinued in 2012 but provides additional recent temperature data.

The USGS also sampled in the Apishapa watershed, collecting instantaneous temperature data from 1978 through 1981 at the former Apishapa River at Aguilar gaging station (Table 1).

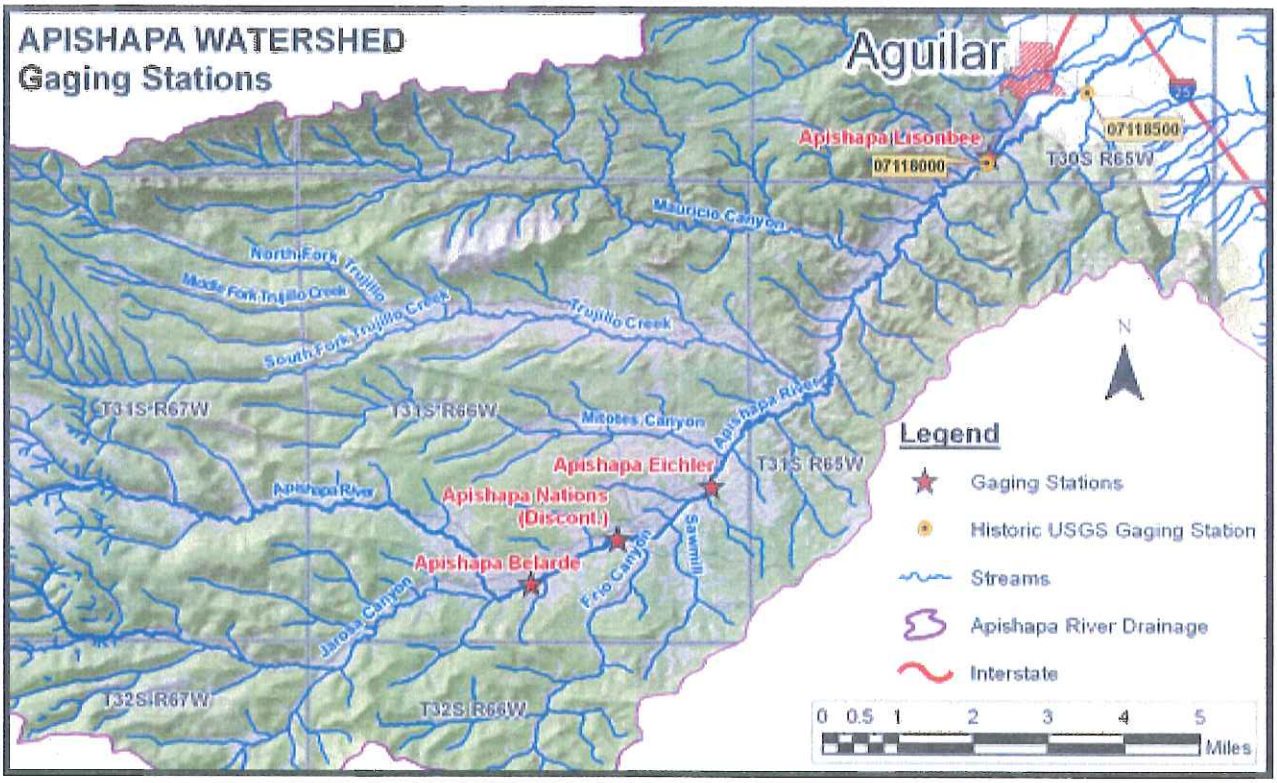

Figure 3 - Apishapa Monitoring Network and Gaging Stations

II. DIVISION TEMPERATURE PROPOSAL

The Division is proposing new temperature standards and river segmentation be adopted as part of the Arkansas River Basin triennial review hearing (Table 2).

Table 2 – Division Proposed Temperature Tiers and Segmentation

Segment	Proposed Temperature Tier	Summary Description	Applicable Months	Temperature Standard (°C)	
				MWAT	DM
3a	Cold Stream, Tier II	Apishapa River upstream of Aguilar	Apr - Oct	18.3	23.9
			Nov - Mar	9.0	13.0
3b	Cold Stream, Tier II	Frio, Mitotes, and other tributary canyons to the Apishapa River, Segment 3a	Apr - Oct	18.3	23.9
			Nov - Mar	9.0	13.0
4b	Warm Stream, Tier II	Mainstem of Lorencito Canyon	Mar - Nov	27.5	28.6
			Dec - Feb	13.8	14.3
5a	Cold Stream, Tier I	Mainstem of the North Fork of the Purgatoire River, including all tributaries and wetlands from the source to a point immediately below the confluence with Guajatoyah Creek; mainstem of the Middle Fork of the Purgatoire River, including all tributaries and wetlands from the source to the USGS gage at Stonewall Bar Ni Ranch Road at Stonewall Gap; mainstem of the South Fork of the Purgatoire River, including all tributaries and wetlands from the source to Tercio	Jun - Sep	17.0	21.7
			Oct-May	9.0	13.0
5b	Cold Stream, Tier II	North, Middle and South Forks of the Purgatoire from Segment 5a to their respective confluences, then the Mainstem of the Purgatoire to I25	Apr - Oct	18.3	23.9
			Nov - Mar	9.0	13.0
6a	Cold Stream, Tier II	All tributaries to the Purgatoire, excluding those listed in Segments 4b, 5a,5b and 6b	Apr - Oct	18.3	23.9
			Nov - Mar	9.0	13.0
6b	Cold Stream, Tier II	Wet Canyon	Apr - Oct	18.3	23.9
			Nov - Mar	9.0	13.0
16 and 17	Cold Lake	Tributary lakes (16) and Wet Canyon Lakes (17)	Apr – Dec	17.0	21.2
			Jan – Mar	9.0	13.0

III. COMPLIANCE ISSUES WITH UNDERLYING TEMPERATURE STANDARD

Since 1995, CBM operators XTO and Pioneer, and their predecessor companies, have extracted gas from this region. Water produced from CBM gas extraction is discharged into proposed Lower Arkansas River segments 3a, 3b, 4b, 5a, 5b, 6a, 6b, 16 and 17 from outfalls depicted on Figure 4 pursuant to their CDPS individual permits. There are no temperature limits in any of these CDPS permits summarized in Table 3.

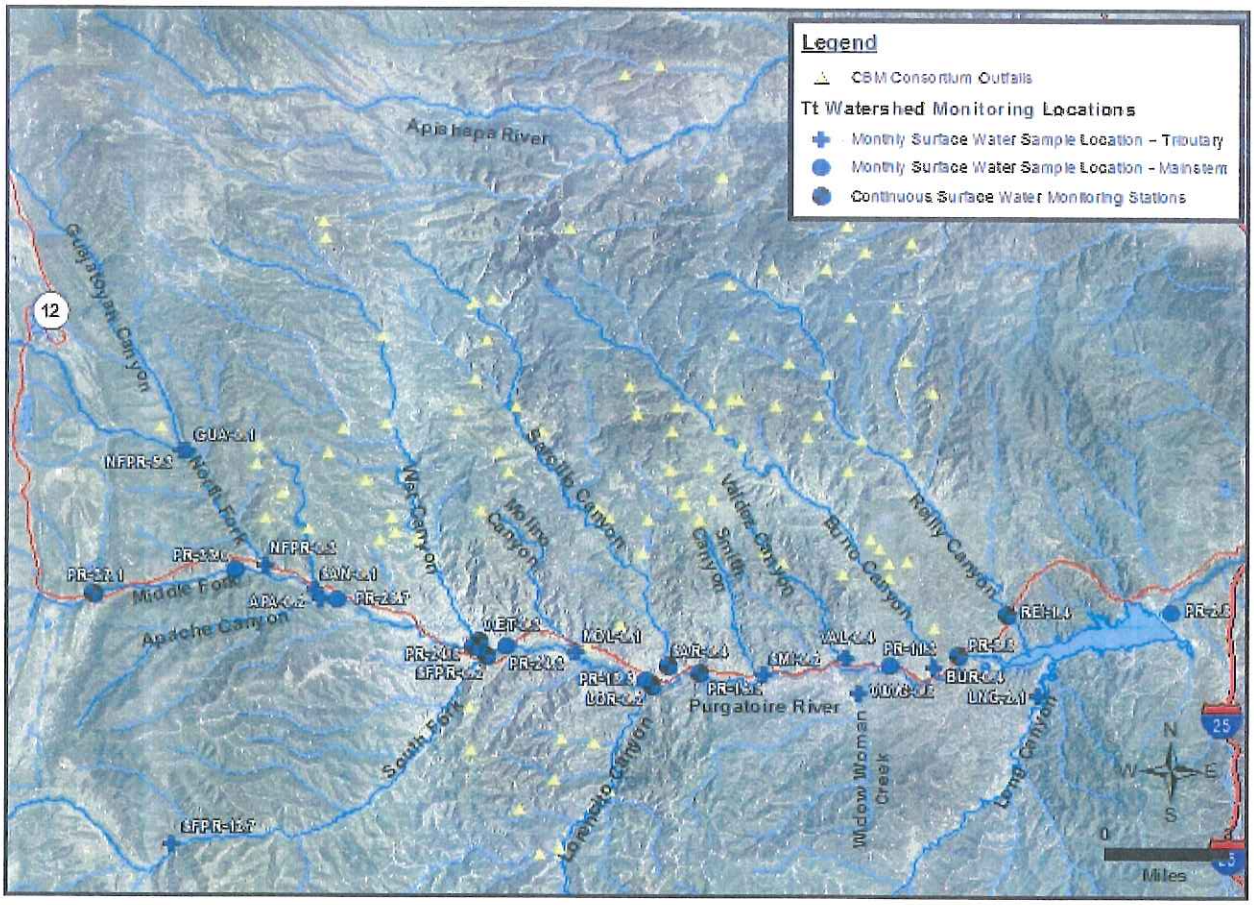

Figure 4 - Discharge Outfalls Located in the Purgatoire and Apishapa Watersheds

Table 3 – Summary of Pioneer and XTO Permits

Operator	Permit Number	Design Flow (max 30-day ave, MGD)	Design Flow (max 30-day ave, CFS)
Pioneer	CO0047767 (East Spanish Peaks) (prev: COG900001 and part of COG900018)	5.0	7.7
	CO0047776 (Lorencito Canyon) (prev: COG900004)	0.6	0.9
	CO0048003 (West Spanish Peaks) (prev: part of COG900018)	0.5	0.8
	COG900006 (near Gulnare, CO)	1.2	1.9
XTO	CO0048054 (Lorencito Canyon) (prev: part of COG900002)	1.3	2.0
	CO0048062 (Alamocito, Apache, Cherry, Circuela, and Gallegos Canyons) (prev: COG900007, COG900015, and part of COG900002,)	2.1	3.2

However, the Colorado Oil and Gas Conservation Commission (COGCC) has conducted produced water and well testing of select CBM wells in the study area and documented temperature of produced waters in Las Animas County (ESN Rocky Mountain, February 2002). These data are assumed representative of water temperature from CBM wells in the Raton Basin. Summary statistics from the 43 wells evaluated in the Purgatoire and Apishapa watersheds are summarized in Table 4, demonstrating exceedance of the proposed temperature standard(s) (Table 2) and potential temperature compliance issues for XTO and Pioneer.

Table 4 – Temperature Data from CBM Well Testing in the Purgatoire and Apishapa Watersheds (ESN, 2002)

Statistic	°C
Count	43
Minimum	15.8
15th Percentile	21.5
50th Percentile	23.8
85th Percentile	31.9
Maximum	41.7

IV. DATA UNCERTAINTY

As described in Section I, the water temperature data are available from monitoring locations throughout the Purgatoire and Apishapa River watersheds. However, the historic USGS data and much of the recent temperature data are in the form of instantaneous data (i.e., temperature measurements taken at the time of water quality sampling) collected monthly to quarterly over many years; these data generally fall short of the criteria provided in the Commission's *Temperature Criteria Methodology, Policy Statement 06-1* for developing temperature standards. It is only recently that continuous temperature data have been collected and, given the prolonged drought that the region has experienced over the past years', it is not clear how representative these data are of long-term water temperature. As discussed below, there is much uncertainty regarding the natural and/or irreversible man-induced impacts on water temperature in the Purgatoire watershed, the issue of effluent dependent/dominant in many of the tributaries, the potential thermal impact from CBM discharges on water temperature, and the relationship between ambient air temperature and water temperature.

Additional data collection is also required to ensure that the data relied upon is representative of long-term conditions, and not unduly influenced by short-term climatic affects such as the recent drought. What is clear in the existing data is that the temperature standards proposed by the Division may not be appropriate and, if applied to permits regulated under the Colorado Discharge Permit System (CDPS), may prove difficult for dischargers to meet. Given the size of the Purgatoire and Apishapa watersheds, additional data and time is required to alleviate the uncertainty associated with water temperature variability and to establish appropriate, long-term water temperature standards in the watersheds.

Variability Observed in Water Temperature Monitoring Results

The water temperature data collected by Tetra Tech along the Purgatoire River and the mouth of many tributary canyons and the historic data collected by the USGS, exceed the Cold stream tier II temperature standards proposed by the Division. Initial evaluation of the data indicates temperature (monthly and continuous data record) does not support the Division's proposed temperature standard. Figure 5 depicts continuous temperature and flow data collected in 2011 along the Purgatoire River at Madrid, CO (Station ID PR-8.8, Purgatoire River upstream of Trinidad Reservoir). This station coincides with USGS Station 07124200. As shown on Figure 5, the cold stream, tier II Maximum Weekly Average Temperature (MWAT) and Daily Maximum (DM) standards are currently not be met in the mainstem Purgatoire River.

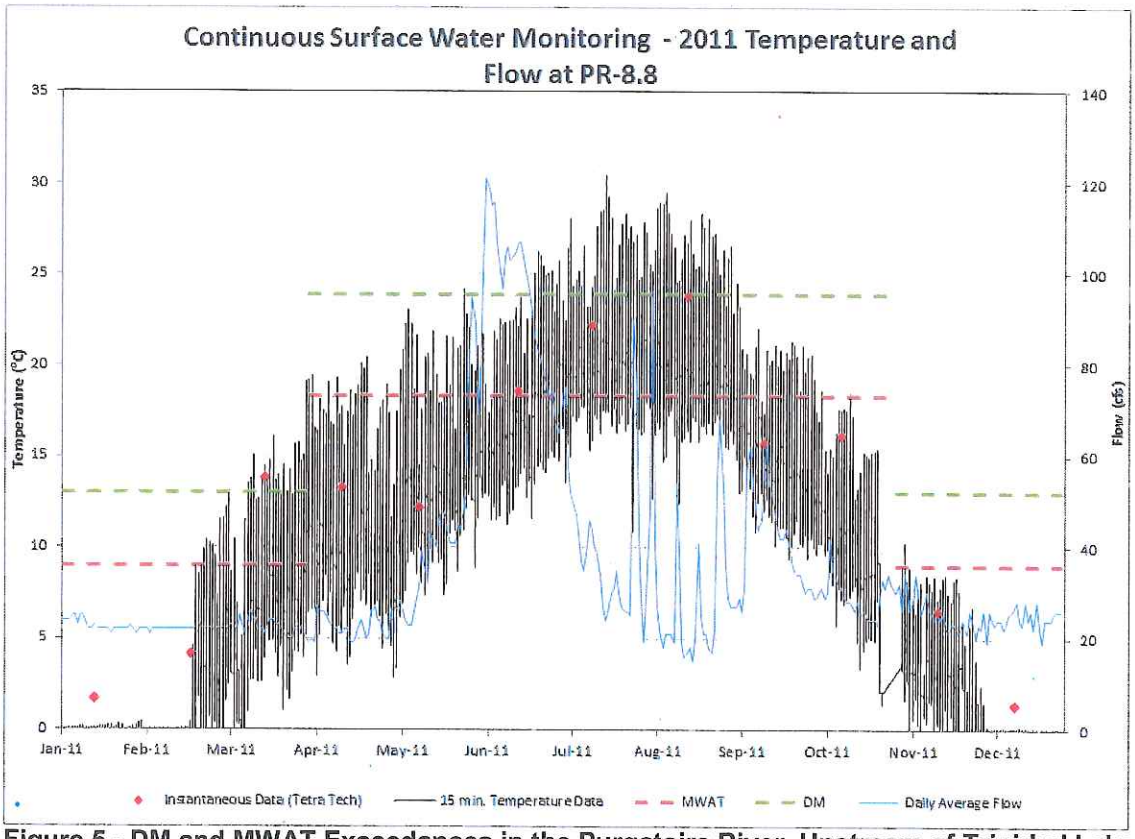

Figure 5 - DM and MWAT Exceedances in the Purgatoire River, Upstream of Trinidad Lake

The Division proposes that Lorencito Canyon (proposed Segment COARLA04b) have Warm Stream tier II temperature standards. During the period March through November, the Daily Maximum (DM) water temperature for such classified waters is 28.6°C (Table 2). As illustrated in Figure 6, during the warmest month of the year, July, the DM values at the mouth of Lorencito Canyon routinely exceeded the proposed temperature standard in 2011, 2012 and 2013.

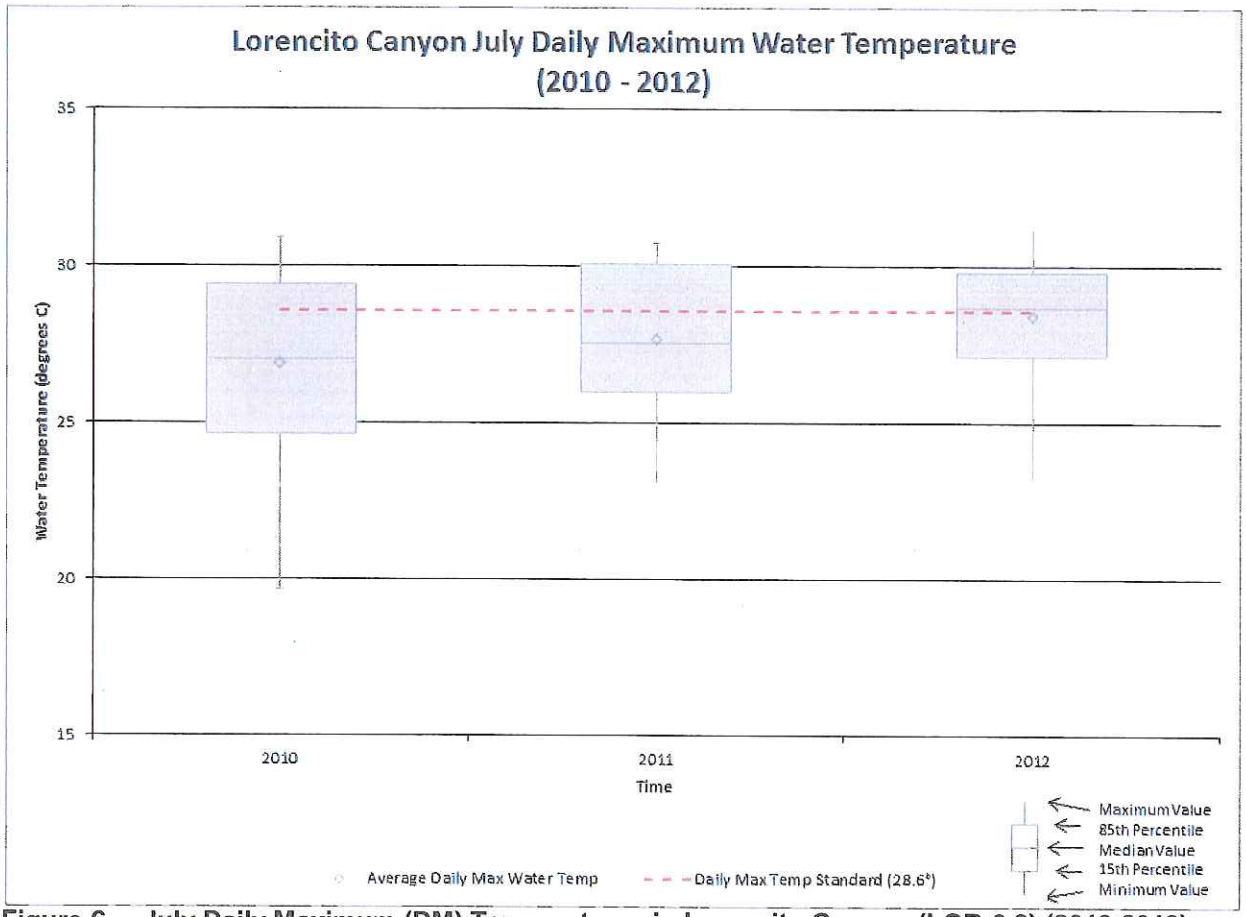

Figure 6 – July Daily Maximum (DM) Temperatures in Lorencito Canyon (LOR-0.2) (2010-2012)

The Division proposes that other Purgatoire River tributaries (proposed Segment COARLA06a) have Cold Stream tier II temperature standards. During the period April through October, the Daily Maximum (DM) water temperature for such classified waters is 23.9°C (Table 2). As illustrated in Figure 7, during the warmest month of the year, July, the DM at the mouth of Sarcillo Canyon routinely exceeded the proposed temperature standard in 2011, 2012 and 2013.

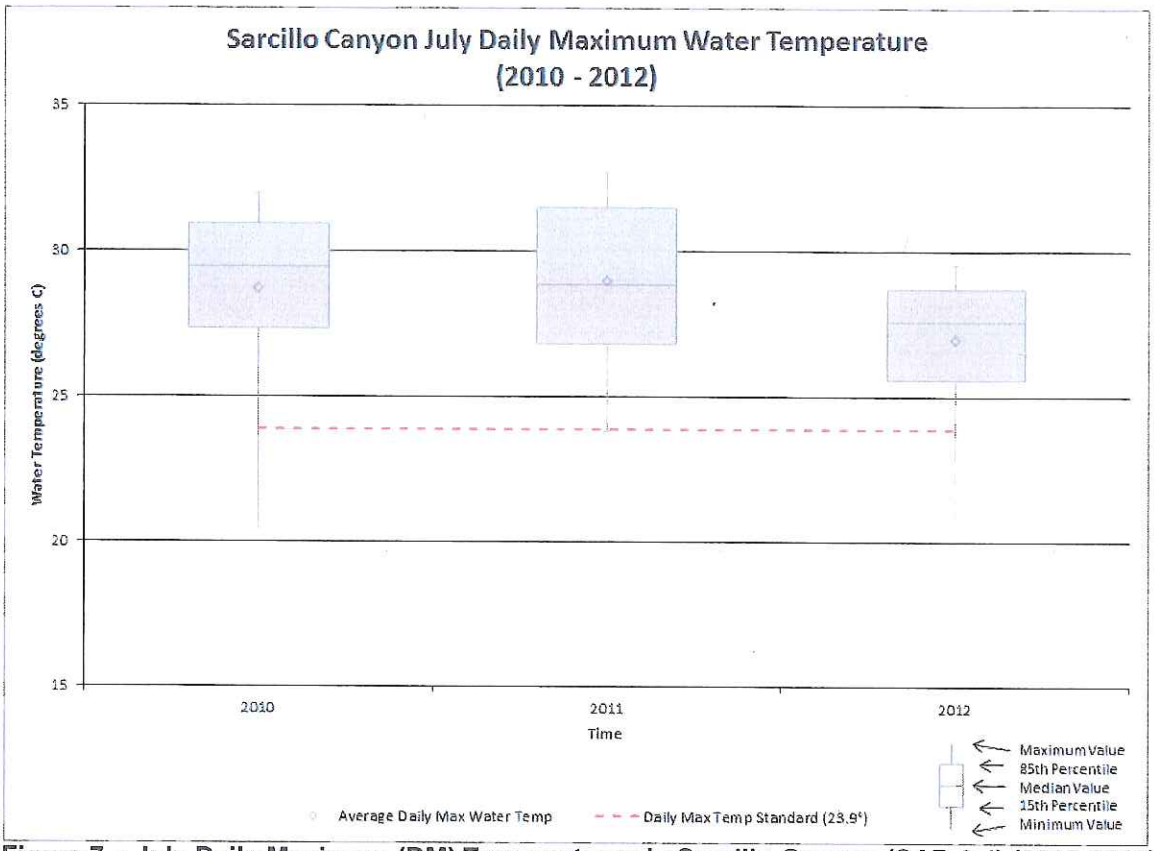

Figure 7 – July Daily Maximum (DM) Temperatures in Sarcillo Canyon (SAR-0.4) (2010-2012)

An assessment is required to determine the temperature variability in these waterbodies with regards to the MWAT and DM proposed by the Division. Additionally, the existing data need to be reviewed to determine if the seasons proposed by the Division are appropriate for the Purgatoire and Apishapa watersheds.

Effluent Dependent/Dominated Waters

In many, if not all of the discharge permits summarized in Table 3, the upstream critical low flow used to calculate the effluent discharge limits to Purgatoire River tributaries is assumed to be zero. This raises the issue of effluent dependent and effluent dominated waters. An assessment is required to determine the natural flow status of these tributaries and of the aquatic life communities, if present, in them.

Different Aquatic Life Community

Aquatic life data collected by GEI and summarized in a companion document also suggest additional uncertainty as to the extent to which the proposed temperature standards or the aquatic life use classifications are appropriate based on the physical habitat, fish species and macro-invertebrates present in the Purgatoire watershed.

Historic Purgatoire River Temperature Data, Pre-CBM, Exceeds Underlying Standard

Historic water temperature data demonstrate the proposed temperature standard was not met in the late 1970's and early 1980's, before (manmade) CBM gas production began in the watershed and produced water was discharged. Review of the historic USGS record, pre-CBM influence, also demonstrates the significant uncertainty of the proposed standard. The discharge of produced water in the basin started in 1995 and became a substantial component of the CBM production process in 2000; therefore, stream temperatures prior to this date were largely uninfluenced by discharge water.

Temperature data were obtained from the USGS gage 07124200 on the Purgatoire River at Madrid, Colorado between Burro and Reilly Canyons. The historical data contain instantaneous water temperature measurements generally recorded 10 to 12 times a year, from 1972 to 2010, and recorded maximum and minimum daily stream temperatures for most of the period from 1979 to 1981. The maximum daily temperature represents the maximum observed value and does not represent the rolling 2-hour averaged used to calculate the DM for determining attainment of the acute temperature standard.

Historical, instantaneous point data indicate that the Purgatoire River consistently exceeded the cold stream, tier II MWAT (chronic temperature standard of18.3°C) and the cold stream, tier II DM (acute temperature standard of 23.9°C) during the summer. Instantaneous grab temperature samples collected at the gage indicated that the Purgatoire River has consistently exceeded the cold stream, tier II temperature standards since 1972 (Figure 8) and despite the sample size difference, there is not an apparent difference in the pre-CBM versus CBM water temperatures in the mainstem Purgatoire River. Maximum daily temperature values also indicated that the Purgatoire and Apishapa Rivers, in the eastern portion of the basin, consistently exceeded the cold stream, tier II summer and winter temperature standards from 1979 to 1981 (Figure 9). Given the consistent historical exceedances of the cold stream, tier II temperature standards, it appears that the Purgatoire River in the eastern portion of the basin would have issues attaining the proposed cold stream, tier II temperature standards.

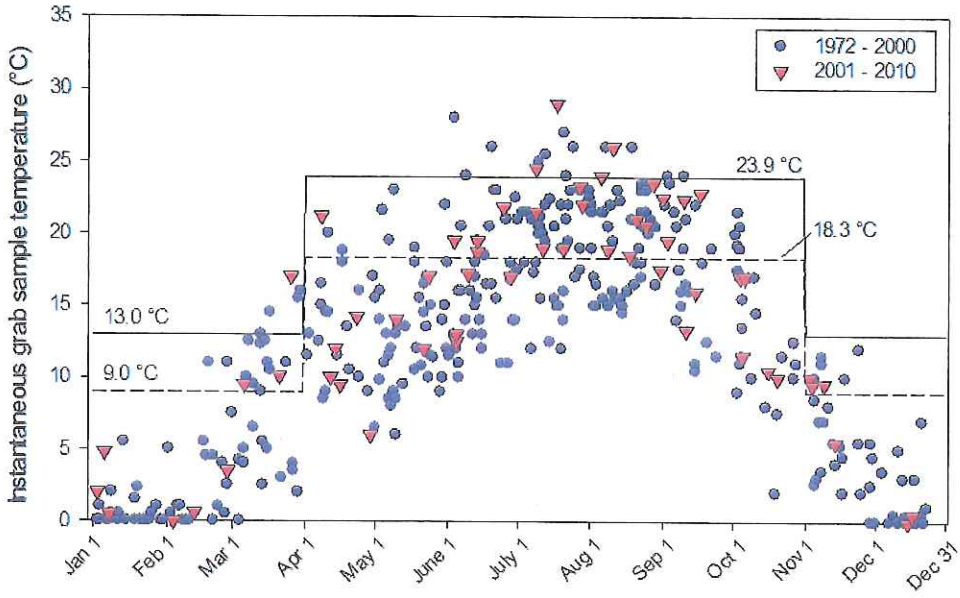

Figure 8 - Instantaneous grab sample temperatures from the USGS gage (07124200) at Madrid, Colorado, 1972 to 2010.

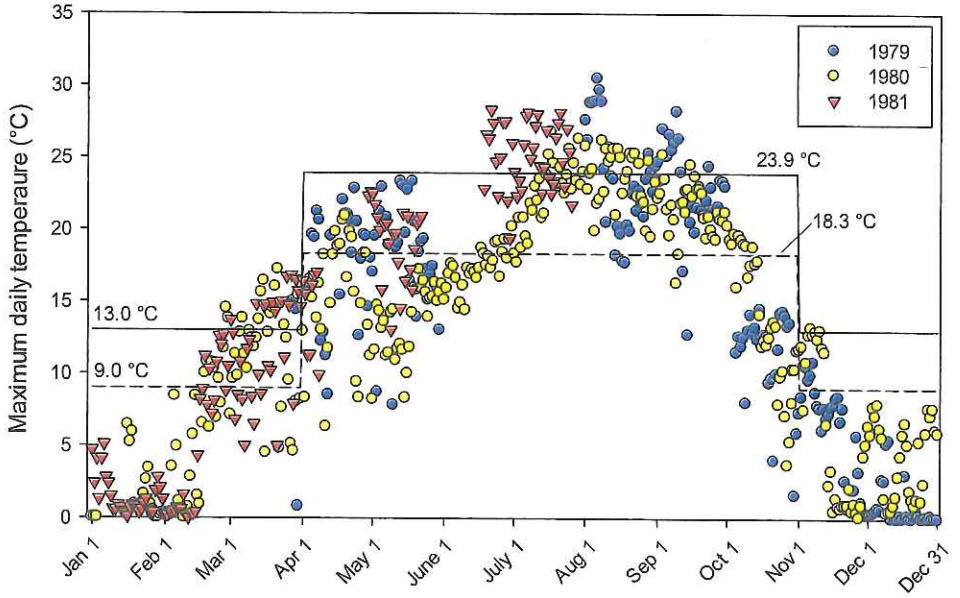

Figure 9 - Maximum recorded daily stream temperature at the USGS gage (07124200) at Madrid, Colorado, 1979 -1981.

Ambient Air Temperature

Climate data also suggest uncertainty as to the extent to which existing in-stream quality is the result of natural and irreversible human-induced conditions; whether the temperature is a result of natural sources (geothermal springs, regional drought, ephemeral streams, effluent dependent reaches with low flow or no flow) or irreversible human-induced (climate change). Average annual temperature data from Trinidad, CO (Figure 10) suggests air temperature increased in the mid-1990s relative to prior years. There are several climatological stations located throughout the Purgatoire and Apishapa watersheds. An assessment is required to determine (a) the variability of air temperature across the watersheds, and (b) the relationship between water temperature and air temperature.

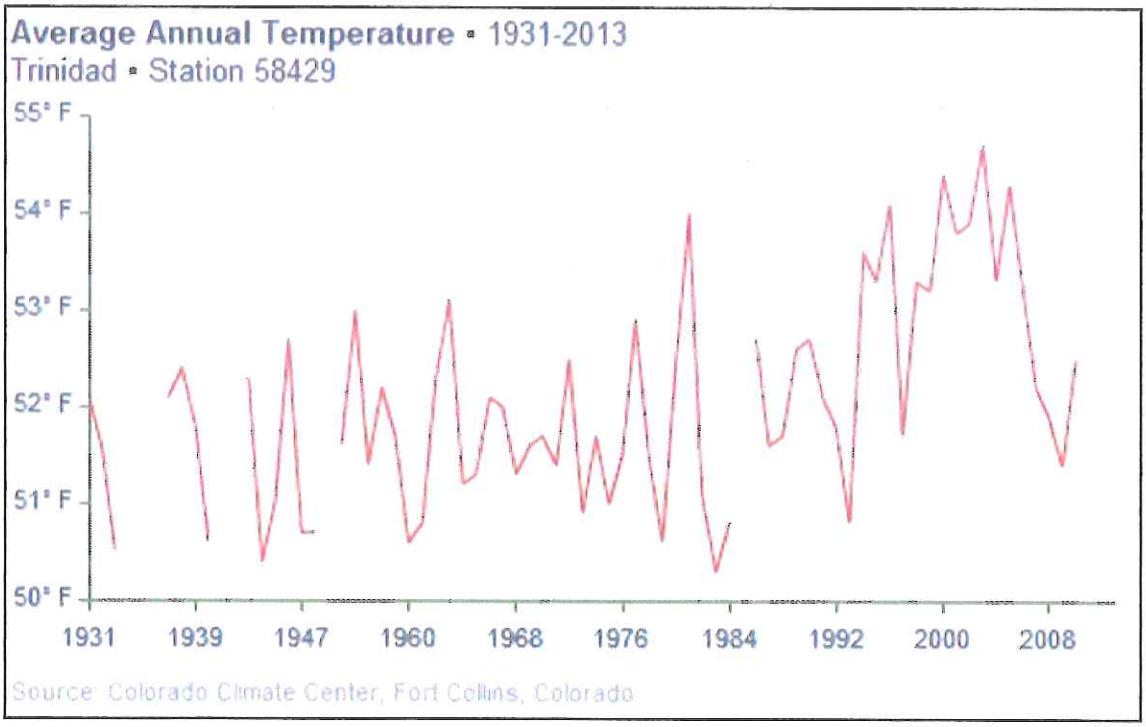

Figure 10 –Average Annual Air Temperature at Trinidad, 1931-2013.

V. TEMPORARY MODIFICATION FOR TEMPERATURE IS APPROPRIATE

Due to potential CDPS permit compliance issues and significant uncertainty, Pioneer and XTO propose that a Temporary Modification be granted for temperature in the proposed Lower Arkansas River segments 3a, 3b, 4b, 5a, 5b, 6a, 6b, 16 and 17. Review of existing data and information indicates:

- The permitted dischargers may have a compliance issue with the adopted temperature standard,
- Uncertainty as to the extent to which the temperature standards or the aquatic life use classifications are appropriate for the given segments given the flows (or lack thereof), habitat and biota present in these waterbodies, and
- Uncertainty as to extent to which existing in-stream quality is the result of natural and irreversible human-induced conditions.

The plan for addressing the uncertainty includes temperature data collection that will support compilation and collection of a complete temperature data record to support the temperature standard, evaluation of ephemeral reaches which appear to be effluent dependent and/or lacking water and aquatic habitat, evaluation of transition from cold to warm water and documentation of the use attainability analysis. Current conditions are proposed while the temporary modification is in effect and data is being collected and analyzed.

REFERENCES

ESN Rocky Mountain, *"Produced Gas and Water Testing of CBM Wells in the Raton Basin"*, prepared for the Colorado Oil and Gas Conservation Commission, February 2002. http://cogcc.state.co.us/Library/RatonBasin/ESN%20Final_Report.pdf

Tetra Tech, *"2010 Purgatoire Watershed Monitoring Program, Annual Report"*, April 2011.

Tetra Tech, *"2011 Purgatoire Watershed Monitoring Program, Annual Report"*, April 2012. http://purgatoirewatershed.org/downloads/2011%20Annual%20Report_Final.pdf

Norwest Corporation, *"2011 Apishapa Annual Report"* from http://apishapawatershed.org, April 2013.

U.S. Geological Survey, Temperature Data Record from Purgatoire Watershed, retrieved from: pubs.usgs.gov/wdr/2004/wdr-co-04-1/pdf/2004_AllDataSites.pdf, March 2013.

Water Quality Control Division, Exhibit A of Division Prehearing Statement, *"WQCD Temperature Standards"*, March 2013.

Water Quality Control Division, Exhibit 32-1 of Division Prehearing Statement, *"Arkansas River Basin Rationale"*, March 2013.

EXPERTISE

Mr. Marshall is a Principal Environmental Geochemist for Engineering Analytics, Inc. and manager of our Denver, Colorado office. He has over 28 years of consulting experience on a wide range of mining, energy, and water resources projects. Mr. Marshall has served as the Project Manager for large Abandoned Mine Land (AML) reclamation projects at high altitudes throughout the Rocky Mountains, mine permitting projects in the U.S. and Canada, Use Attainability Analyses (UAA) to modify stream water quality standards in areas of natural mineralization, and on numerous water resource projects. Mr. Marshall has also served as the Project Geochemist on projects involving the fate and transport of metals, inorganic parameters, organic compounds, and radionuclides in soil, surface water, groundwater, lacustrine, and estuarine settings.

REGISTRATIONS AND CERTIFICATIONS

Registered Professional Geologist – Wyoming (PG-161) and Virginia (PG-762)

MSHA Surface Miner Training: Coal, Metal & Non-Metal

OSHA 40-Hour HAZWOPER Training

OSHA 8-Hour HAZWOPER Supervisor Training

Confined Space Entry Training

EDUCATION

M.S., Environmental Sciences (Geochemistry), University of Virginia, Charlottesville, Virginia, 1985.

B.S., Geology, University of Maryland, College Park, Maryland, 1980.

PROJECT EXPERIENCE

ABANDONED MINE LAND CHARACTERIZATION AND REMEDIATION

- **RI/FS, Summitville Mine Superfund Site, San Juan Mountains, Colorado.** Project Manager for the Site-Wide (OU5) Remedial Investigation (RI) and Feasibility Study (FS) on this remote open pit, heap leach gold mine located at 11,500 feet in the San Juan Mountains of Southern Colorado. RI work included geochemical evaluation of mine pool chemistry; sediment leaching studies and electron microprobe analysis; groundwater and surface water monitoring including the operation of gaging stations providing real-time stream flow and chemistry data to the world wide web via satellite links; assessment of the metals content and nutritional quality of macroinvertebrates; acute and chronic fish

toxicity studies; and snow course surveys. FS work included: assessment of reclamation efforts; reactive transport modeling to evaluate the relative effectiveness of various remedial alternatives and to establish surface water action levels; and evaluation of traditional and passive water treatment technologies including successive-alkalinity-producing systems (SAPS), Aquifix systems, and zeolites. Oversaw the development of the Proposed Plan and the Record of Decision (ROD) for the site. Subsequent to the ROD issuance, participated in Remedial Design/Remedial Action (RD/RA) projects including evaluation of the treatment rate for a new lime-based water treatment plant, raising the spillway elevation to increase storage capacity of the contaminated water reservoir, enhanced surface water control, and design and installation of a micro-hydroelectric plant.

- **RI/FS Clear Creek, Central City Superfund Site, Gilpin and Clear Creek Counties, Colorado.** Project Manager for the OU4 RI/FS. The project quantified the point (tunnel discharge) and non-point contaminant loading sources related to historical mining in the North Clear Creek basin, and developed a series of remedial alternatives to reduce the loadings from these sources. Participated in RD/RA projects including surface water controls, assessment of waste pile capping options, and evaluation of the effectiveness of sedimentation dams.

- **Little James Creek Mine Site Remediation, Boulder County, Colorado.** Served as the Project Manager for a feasibility analysis evaluating abandoned mine waste pile capping/removal, open pit closure, surface water controls, and adit plugging/passive water treatment. Project was performed concurrent with a TMDL study and in cooperation with the USFS and Boulder County Parks and Open Space.

- **Ross-Adams Mine Engineering Evaluation/Cost Analysis (EE/CA), Prince of Wales Island, Alaska.** Project Manager for the Site Characterization Report for an EE/CA to develop closure options for this former open pit and underground uranium mine in the Tongass National Forest of southeast Alaska. This project included a large-scale gamma-survey; sampling of soil, surface water, stream sediment, and estuarine sediments for radionuclides; waste inventorying and characterization; an ecological risk assessment for avian, terrestrial, fresh water aquatic, and marine aquatic receptors, and a human health risk assessment including native subsistence hunter-gatherers.

- **Metals Contamination in Surface Water Evaluation, Blackbird Mine, Lemhi County, Idaho.** Performed surface water studies to assess nature and extent of metals contamination from this copper and cobalt mine in support of a Natural Resource Damage Assessment (NRDA) action. This included geochemical modeling of several watersheds and evaluation of metal distribution and mobility in stream sediments using sequential extraction techniques and the electron microprobe. Evaluated the long-term O&M costs of the final remedy in support of Consent Decree negotiations.

- **RI/FS, Bunker Hill Mine Superfund Site, Silver Valley, Idaho.** Managed the surface water and groundwater monitoring programs for the RI/FS at this large mining/smelting CERCLA site. The programs were key to the assessment of the relative contribution of point and non-point metal loading sources to the South Fork of the Coeur d'Alene River; this information was used to guide the design of remedial alternatives. Utilized lead isotopes to assess the relative contributions from the lead smelter and the mine tailings to allocate funding among principal responsible parties (PRPs) for residential yard remediation costs. Assisted in the preliminary design of proposed subsurface flow constructed wetlands for passive treatment of metals.

MINE FEASABILITY AND PERMITTING/MINERAL PROCESSING SUPPORT

- **Licensing, Eagle Gold Project, Yukon Territory, Canada.** Project Manager for the preparation of the Water Use License and the Mining License for this proposed open pit, heap leach gold mine in the northern Yukon. The project required coordination of a multidisciplinary team of engineers and scientists from several consulting firms throughout Canada and the United States. Key aspects of the project included water management, rinsing of the heap, and water treatment. Primary author of the Adaptive Management Plan.

- **Hairhan and Haraat Urainium Deposits, Mongolia.** Developed and implemented pre-feasibility metallurgical testing protocol using both sulfuric acid and bicarbonate lixiviants to optimize uranium recovery for both an open-pit, heap-leach mine and an in-situ mine.

- **Hydrogeologic Characterization, Martin Lake Lignite Mine, Longview, Texas.** Project Manager of the hydrogeologic characterization report for the permit renewal of a 26,000 acre open pit lignite mine. Field work included the drilling and logging of several thousand feet of core, geophysical logging of test holes, drilling and installation of 100 monitoring wells and piezometers, performance of aquifer tests, and collection of groundwater and surface water samples. Evaluation included analysis of aquifer test data and groundwater and surface water quality data, and determination of overburden suitability as top soil. Developed selective handling procedures for overburden materials for use in mine reclamation.

- **Site Characterization, Alcoa Point Comfort Operations, Point Comfort, Texas.** Authored hydrogeology section for the Site Characterization Report for aluminum smelter and chlor-alkali cell operations. Supervised combined groundwater, surface water, and impoundment sampling project. Characterized the nature and extent of organic and inorganic contamination, including the evaluation of mercury loading rates to the marine environment.

OIL AND GAS

- **Raton Basin CBM Produced Water Management, Purgatoire River Watershed, Colorado.** Lead scientist assisting the coalbed methane (CBM) operators to develop strategies for the long-term management of produced water. Evaluated the long-term impact of produced waters from approximately 3,000 wells on the agricultural, aquatic and water supply uses in this 600-square mile basin. Installation and operation of nine gaging stations providing real-time stream flow and chemistry data to the worldwide web via satellite links. Assisted the CBM operators on NPDES permitting. Performed column studies and used stable isotopes to assess the fate and transport of CBM produced water in the basin and to assess its impact on irrigated crop lands. The main CBM operator won the 2010 Oil and Gas Investor Best Corporate Citizen award for the deployment of the monitoring program.

- **Permitting, Wabash Gas Storage Facility, Edgar County, Illinois.** Lead geologist characterizing existing groundwater quality and gas composition as part of the redevelopment of this former underground natural gas storage facility. Using stable (deuterium and ^{18}O) and radiogenic (^{87}Sr) isotopes to characterize groundwater flow paths, and stable (deuterium and ^{13}C) and radiogenic (^{14}C) isotopes to fingerprint existing local methane sources. Lead author on Federal Energy Regulatory Commission (FERC) Environmental Resource Reports 2 (Water Resources) and 6 (Geological Resources).

- **Discharge Permitting, Carbon County, Wyoming.** Assisted the operators of a produced water treatment facility to negotiate modifications to their discharge permit with the Wyoming Department of Environmental Quality.

- **Permitting, Arizona Natural Gas Storage Project, Pinal County, Arizona.** Prepared the Class III UIC permit for mining wells that would be used to develop the salt caverns for natural gas storage. Provided technical input on the development of Environmental Resource Reports 2 (Water Resources) and 6 (Geological Resources) for submittal to FERC.

- **Seepage Investigation, Belridge Fields, San Joaquin Valley, California.** Evaluated the nature and extent of groundwater impacts resulting from produced water seepage from storage ponds. Utilized inorganic, organic, and stable isotopic data to distinguish impacted waters from non-impacted waters.

- **Leyden Natural Gas Storage Facility Closure, Leyden, Colorado.** Oversaw the drilling and construction of several deep Laramie-Fox Hills Formation wells. Sampled groundwater and soil gas for methane and a variety of isotopes to evaluate the integrity of the storage facility. Evaluated the value of water rights for wells.

WATERSHED/WATER RESOURCES/WATER RIGHTS STUDIES

- **Use Attainability Analyses, Alamosa River, Colorado.** Lead author on a Use Attainability Analyses (UAA) report submitted to the Colorado Water Quality Control Commission (WQCC). The Alamosa River UAA supported the proposed revision of aluminum standards to seasonally adjusted, ambient standards based on natural conditions, irreversible human-induced sources and technology-based limitations. The WQCC adopted the proposed increases to aluminum standards for Alamosa River segments 3a, 3b, 3c, 3d and 8.

- **Use Attainability Analyses, California Gulch Tributaries, Colorado.** Lead author on a UAA report submitted to the Colorado WQCC. The California Gulch UAA supported the proposed reclassification of mining-impacted tributaries (segment 5) from Class I Cold Water Aquatic Life classification to having no aquatic life classification based on physical and flow limitations. The WQCC adopted the proposal, incorporating the tributaries into segment 6 (mainstem California Gulch) which has no aquatic life standard.

- **Colorado Clean Watershed Needs Survey, Colorado Department of Public Health and Environment, Water Quality Control Division.** Served as the Project Manager to identify and document state-wide non-point source needs (specifically AML and urban runoff) for reporting to Congress through the 2004 Clean Watershed Needs Survey.

- **Riverbank Filtration and Aquifer Recharge for Prairie Waters Project, North Campus, City of Aurora, Colorado.** Part of a team designing and constructing dual riverbank filtration (RBF) and aquifer recharge and recovery (ARR) systems to naturally reduce nitrogen, phosphorus and trace organic compound concentrations in a new raw water source dominated by WWTP effluent. Responsibility included management of tracer studies to assess flow paths and travel times and evaluation of monitoring instrumentation to provide real-time system performance information.

- **Groundwater Recharge Plans, Prairie Ditch and San Luis Valley Canal Companies, San Luis Valley, Colorado.** Evaluated the use of historical direct surface water diversions to recharge the unconfined aquifer in the Closed Basin. Principal author of a report describing the historical location of the Groundwater Divide, which separates the Closed Basin from the Rio Grande River alluvial groundwater flow system. This project involved the hydrogeological characterization of the northern portion of the San Luis Valley. This included development of a water balance for the basin that considered pumping from multiple aquifers, artificial groundwater recharge, importation of water from the Rio Grande, and the impacts of these on the location of the hydraulic divide that defines the southern boundary of the Closed Basin. Testified in deposition regarding the hydrogeology of the Closed Basin (Case No. 96CW45).

- **Augmentation Plan for City of Pueblo Wells, City of Pueblo Wastewater Department, Colorado.** Managed and performed the analysis on a project that

quantified the volume and timing of stream depletions due to the operation of three wells. Developed an accounting system to determine the augmentation water obligations.

ENVIRONMENTAL ASSESSMENTS/IMPACTS

- **Annette Islands Reserve, Bald Ridge Aggregate Project Environmental Assessment (EA), Alaska.** Contributing author to the environmental assessment report for the development of rock quarry on the Metlakatla Indian Community's lands on the northeast side of Tamgas Harbor in southeast Alaska.

- **Wolf Creek Ski Area Facilities Expansion Environmental Assessment (EA), Colorado.** Contributing author to the environmental assessment report for the development of a resort on private lands adjacent to the Wolf Creek Ski Area and surrounded by U.S. Forest Service lands in the San Juan Mountains.

- **Red Dog Mine Environmental Impact Statement (EIS), Alaska.** Performed stream sediment and water sampling under winter conditions downstream of the Red Dog Mine in northwestern Alaska. Water sampling in concert with sequential sediment extraction techniques and geochemical modeling was employed to characterize the downstream partitioning of metals between the surface water and stream sediments. Work was performed in support of the NPDES permit renewal process under the EIS.

- **Cerro Grande Fire Assistance Act Damage Assessment, New Mexico.** Lead geochemist for the investigation of contaminant transport from the Los Alamos Laboratory onto lands of the San Ildefanso and Santa Clara Pueblos.

- **Natural Resource Damage Assessment, Tererro Mine, Pecos, New Mexico.** Task Leader for the evaluation of surface water and groundwater geochemistry for the Natural Resource Damage Assessment.

LANDFILLS

- **Landfill Closure, Rocky Flats Environmental Technology Site, Jefferson County, Colorado.** Project Manager for the Quality Assurance of the closure of two landfills. Landfill closure included the installation of caps, (including geosynthetic layers), seep collection and passive treatment systems, surface water run-on and runoff controls, and the installation of groundwater monitoring wells.

- **RCRA Hazardous Waste Treatment, Storage, and Disposal Facility, Deer Trail, Colorado.** Project Manager for the comprehensive background groundwater and surface water quality data evaluations, quarterly groundwater monitoring data evaluations, and annual groundwater monitoring data evaluations. This project included extensive data validation and statistical evaluation of analytical data, including the use of multivariate statistical analysis to minimize the number of analytes in the monitoring program.

- **RCRA Hazardous Waste Treatment, Storage, and Disposal Facility, Buttonwillow, California.** Field Supervisor for the design and installation of vadose zone and groundwater monitoring systems. Project Manager evaluating statistical exceedances in the groundwater monitoring program. Using geochemical modeling and revised statistical procedures, successfully demonstrated that the statistical exceedances were the result of spatial variability and/or inappropriate statistical evaluation methods.

- **RCRA Hazardous Waste Treatment, Storage, and Disposal Facilities, Martinez, California.** Hydrogeologic characterization of the shallow sediments underlying the Baker and Vine Hill facilities. Analyzed several hundred "slug" tests and performed and analyzed aquifer tests.

- **Groundwater and Methane Monitoring, Comanche Peak Nuclear Power Plant, Central Texas.** Conducted remedial investigation of seven industrial landfill cells. Included the design and installation of groundwater and methane monitoring systems, and the selective excavation and characterization of wastes. Oversaw the removal of one disposal cell.

- **Landfill Siting, Kigali Master Plan, Rwanda.** Part of a technical team developing a master plan for the Rwandan capital, Kigali. Provided preliminary siting of municipal landfills based on international guidelines.

VOLUNTARY CLEAN-UPS AND OTHER INVESTIGATIONS

- **South Platte Reservoir Development Project, Littleton, Colorado.** Authored and managed the Corrective Action Plan to excavate construction landfills and remove residual organic contamination at this former aggregate mine and cement plant. The site was converted into a raw water storage facility.

- **Prairie Waters Project, North Campus, Aurora, Colorado.** Authored the Voluntary Clean-up Plans (VCUPs) for two multi-hundred acre sites in Adams and Weld Counties. The Materials Management Plan in the VCUP addressed agricultural wastes, oil and gas exploration & production wastes, and miscellaneous petroleum and solvent impacted soils. Additionally, the VCUP contained provisions for handling asbestos-containing material, lead based paint, electrical transformers, Individual Sewage Disposal Systems, and above ground and underground storage tanks encountered during the demolition of the existing site structures.

- **Groundwater Contamination Investigation, Geneva Pharmaceuticals, Inc., Broomfield, Colorado.** Performed hydrogeological investigations to assess the nature and extent of groundwater contamination by chlorinated solvents from an adjacent facility. Co-authored a No Action Petition under Colorado's Voluntary Clean-up Program.

- **Hydrogeologic Investigation, TU Electric Company, Various Power Plants, Texas.** Performed hydrogeologic investigations at ash handling and disposal

areas. Assessed nature and extent of sulfate and selenium contamination using inorganic and stable isotopic data. Developed remedial options.

PROFESSIONAL EMPLOYMENT HISTORY

- Principal Environmental Geochemist, Engineering Analytics, Inc., Denver, Colorado (2012-present)
- Principal/Operations Manager/Senior Project Manager, Tetra Tech, Inc., various Colorado locations (2000-2012)
- Senior Project Manager, Rocky Mountain Consultants (now Tetra Tech), Longmont, Colorado (1994–2000)
- Environmental Geochemist, McCulley, Frick & Gilman (now Tetra Tech), Austin, Texas and Boulder, Colorado (1986-1994)
- Hydrogeologist, Hall Southwest Water Consultants: Austin, Texas (1984-1986)
- Graduate Research Assistant and Teaching Assistant, Department of Environmental Sciences, University of Virginia, Charlottesville, Virginia (1982-1984)
- Geodesist, U.S. Department of Defense, Defense Mapping Agency, Washington, DC and White Sands Missile Range, New Mexico (1980-1982)

PROFESSIONAL AFFILIATIONS

American Water Resources Association (AWRA) – Colorado Section

Colorado Oil and Gas Association (COGA) – Produced Water Committee

Colorado Water Quality Forum (CWQF)

Colorado Environmental Management Society (CEMS)

Association of Ground Water Scientists and Engineers (NGWA)

International Association of Geochemistry (IAGC)

PUBLICATIONS

Marshall, B.T. 2010. "CBM Water Management Tool: Raton Basin Water Monitoring Project." Colorado Hazardous Waste Management Society, Colorado, Coalbed Methane Water Quality Issues Workshop, October.

Marshall, B.T. 2010. "Understanding the Influence of CBM Produced Water." Colorado Oil and Gas Association Meeting, December.

Hesemann, T.J. and Marshall, B.T. 2003. "Measuring the Effectiveness of Mine Site Remediation." Association of Engineering Geologists 46th Annual Meeting, September.

Cox, T.J., Marshall, B.T and Drexel, R.T. 2002. "Monitoring and Management of Groundwater Stored in Underground Mine Workings." Hardrock Mining 2002, May.

Medine, A.J. and Marshall, B.T. 2002. "Modeling the Effectiveness of Remedial Alternatives at the Summitville Mine Superfund Site on Water Quality of the Alamosa River and Terrace Reservoir." Hardrock Mining 2002, May.

Marshall, B.T and Drexel, R.T. 2001. "Terrace Reservoir Recovery." Colorado Lake and Reservoir Management Association, October.

McCulley, B.L. and Marshall, B.T. 1990. "Distinction of Naturally-Occurring and Industry-Related Contaminants in Ground Water Monitoring Systems." Colorado Hazardous Waste Management Society, Fourth Annual Conference and Exhibition Proceedings, October.

Marshall, B.T. and Herman, J.S. 1986. "Trace Element Distribution in the Soils Above Deeply Weathered Pegmatites, Virginia, USA: Implications for Exploration." Applied Geochemistry, Vol. 1, pp. 681-690.

XTO ENERGY

PIONEER NATURAL RESOURCES

February 22, 2012

EPA Headquarters
Laura Phillips
Scott Wilson
Jackie Clark

Colorado Water Quality Control Division
Andrew Neuhart
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EPA Office of Research and Development
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U.S. Geological Survey
Travis Schmidt

EPA Region 8
Kristin Keteles
Sandy Spence
Elaine Lai

Re: WET/Alternative Testing Procedure Meeting

Dear Representatives of EPA, Water Quality Control Division, and U.S.G.S.:

Thank you very much for meeting with us on February 8th to discuss the WET testing data and WET species, particularly the draft work plan for considering an alternate test protocol for *Daphnia magna* chronic WET testing. We gained important insights about the WET program implementation. Although our initial goal was to evaluate *Daphnia magna* and an alternate test protocol, during our conversation EPA outlined several concepts and approaches that could be considered to address specific issues arising for WET testing in the Raton Basin. Given the zero flow, or very low flows in the tributaries of the Purgatoire River that are the site of outfalls, the effluent is the ambient quality, and because fish have migrated into this water, the water has shown itself suitable for the aquatic use. Results of acute WET testing with *Daphnia magna* and fathead minnow verify this. To address concerns about chronic toxicity, an approach was suggested that chronic WET testing occur for the waters at the confluence of the tributaries with the Purgatoire River, rather than at the end-of-the-pipe for outfalls in the tributaries. Other suggested approaches were that WET testing would be seasonal – during the times when waters naturally flowed in the tributaries, and the IWC be increased.

We will explore these approaches as part of work plan efforts. As we better determine our direction, we will communicate with you and provide updates on our progress.

In the meantime, if you have any questions or additional suggestions please contact us (or members of our consulting team). Thank you.

Exhibit 4

Sincerely,

Pioneer Natural Resources USA, Inc.

Gerald (Jerry) Jacob, Ph.D.
(Jerry.Jacob@pxd.com)

XTO Energy, a subsidiary of Exxon Mobil

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