Final Report

DEVELOPMENT OF 2012 OIL AND GAS EMISSIONS PROJECTIONS FOR THE PICEANCE BASIN

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INTRODUCTION

This document outlines the projection methodologies used in generating the 2012 emissions projections from oil and gas sources in the Piceance Basin. These methodologies will use as a starting point the 2006 baseline Piceance Basin oil and gas emissions inventory, described in the baseline emissions report entitled "Development of Baseline 2006 Emissions from Oil and Gas Activity in the Piceance Basin".

This methodology description is broken down into subsections which describe:

- Geographic grouping of data – regional differences in production or activity are factored into the projection methodology by geographic region
- Projected parameters – five basic parameters are projected forward to 2012 for purposes of developing scaling factors: well counts, spud counts, gas production, oil production and condensate production
- Scaling factors and developing uncontrolled emissions projections – the projected parameters are used to develop scaling factors (incorporating geographic groupings), and these scaling factors are applied to the 2006 baseline emissions
- Application of "on-the-books" regulations and control measures – existing regulations are summarized for their impacts on the future year emissions and applied to adjust the uncontrolled 2012 inventory.

Projections for years beyond 2012 (not addressed in this methodology) will likely include additional parameters and will be based on these 2012 projections as the start year. The methodology for developing far future year projections will be detailed in a separate analysis.

Following the discussion of the methodology, the results of the 2012 emissions projections for the Piceance Basin are presented in graphical and tabular formats.

GEOGRAPHIC GROUPING

The projections for 2012 have been conducted separately for 6 geographic groupings in the Piceance Basin:

1. Garfield County
2. Rio Blanco County
3. Mesa County
4. Moffat County
5. Routt County
6. All other counties in the Piceance Basin combined

It should be noted that while Chaffee, Eagle, and Lake Counties are included in the "all other counties" grouping, there is no production or active wells in these counties and they are not considered further in this analysis.

The reason for conducting this grouping is that the majority of 2006 gas production occurs in Garfield County, and the majority of oil production occurs in Rio Blanco County. Mesa, Moffat, and Routt Counties have small but non-negligible production as well. In 2006, Garfield County accounts for approximately 81% of gas production in the Piceance Basin, while Rio Blanco County accounts for approximately 79% of oil production in the Piceance Basin. Similarly, in 2006, Garfield County accounts for approximately 60% of active wells in the basin, while Rio Blanco accounts for approximately 27% of active wells in the basin. Garfield County alone accounts for approximately 74% of spuds occurring in the basin in 2006, indicating that it is the predominant area of activity for future development. For this reason the focus of the geographic grouping is Garfield and Rio Blanco Counties, with the additional groupings listed above used to provide detailed projections for the entire Piceance Basin.

PARAMETERS PROJECTED

The 2012 projections for oil and gas emissions in the Piceance Basin rely on scaling 5 parameters:

- Well counts
- Spud counts
- Gas production
- Oil production
- Condensate production

These five parameters are considered because each parameter applies to the emissions projections of one or more source categories. Note that the analysis uses data from the IHS database, which defines condensate production as liquid hydrocarbon production from wells which are classified as gas wells. Similarly, oil production is defined as liquid hydrocarbon production from wells which are classified as oil wells. The classification of gas vs. oil wells in the IHS database is based on the gas-oil ratio (GOR) of the well, using a cutoff GOR defined by the Colorado Oil and Gas Conservation Commission (COGCC). This is the only distinction made between condensate and oil production.

The mapping of source category to projection parameter is shown below in Table 1.

Table 1. Scaling parameter for each oil and gas source category considered in this inventory.

Source	SCC	Description	Projection Parameter
Unpermitted	2310000100	Heaters	well count
Unpermitted	2310000220	Drill rigs	spud count
Unpermitted	2310000230	Workover rigs	well count
Unpermitted	2310000300	Pneumatic devices	well count
Unpermitted	2310000700	Fugitives	well count
Unpermitted	2310000801	Truck loading of condensate liquid	condensate production
Unpermitted	2310000802	Truck loading of oil	oil production
Unpermitted	2310000820	Gas plant truck loading	condensate production
Unpermitted	2310001610	Venting - initial completions	spud count
Unpermitted	2310001620	Venting - recompletions	spud count
Unpermitted	2310001630	Venting - blowdowns	gas production
Unpermitted	2310002230	Condensate tanks	condensate production
Regulation 7	2310002240	Oil tanks	oil production
Unpermitted	2310003100	Exempt engines	well count
Unpermitted	2310003200	Pneumatic pumps	well count
Unpermitted	2310003500	Flaring	gas production
APENS	20200201	Compressor Engines	gas production
APENS	20200202	Compressor Engines	gas production
APENS	20200203	Compressor Engines	gas production
APENS	20200252	Compressor Engines	gas production
APENS	20200253	Compressor Engines	gas production
APENS	20200254	Compressor Engines	gas production
APENS	31000101	Permitted Fugitives	oil production
APENS	31000102	Oil Production, Miscellaneous Well: General	oil production
APENS	31000123	Oil Production, Well Casing Vents	oil production
APENS	31000130	Oil Production, Fugitives: Compressor Seals	oil production
APENS	31000132	Oil Production, Atmospheric Wash Tank: Flashing Loss	oil production

Source	SCC	Description	Projection Parameter
APENS	31000199	Oil Production, Processing Operations: Not Classified	oil production
APENS	31000201	Natural Gas Production, Gas Sweetening: Amine Process	gas production
APENS	31000202	Natural Gas Production, Gas Stripping Operations	gas production
APENS	31000203	Compressor Engines	gas production
APENS	31000205	Natural Gas Production, Flares	gas production
APENS	31000207	Permitted Fugitives	gas production
APENS	31000209	Natural Gas Production, Incinerators Burning Waste Gas or Augmented Waste Gas	gas production
APENS	31000215	Natural Gas Production, Flares Combusting Gases >1000 BTU/scf	gas production
APENS	31000216	Natural Gas Production, Flares Combusting Gases <1000 BTU/scf	gas production
APENS	31000220	Natural Gas Production, All Equipt Leak Fugitives	gas production
APENS	31000225	Natural Gas Production, Compressor Seals	gas production
APENS	31000227	Glycol Dehydrator	gas production
APENS	31000228	Glycol Dehydrator	gas production
APENS	31000230	Natural Gas Production, Hydrocarbon Skimmer	gas production
APENS	31000299	Natural Gas Production, Other Not Classified	gas production
APENS	31000301	Glycol Dehydrator	gas production
APENS	31000302	Glycol Dehydrator	gas production
APENS	31000303	Glycol Dehydrator	gas production
APENS	31000304	Glycol Dehydrator	gas production
APENS	31000305	Natural Gas Processing Facilities, Gas Sweeting: Amine Process	gas production
APENS	31000306	Natural Gas Processing Facilities, Process Valves	gas production
APENS	31000309	Natural Gas Processing Facilities, Compressor Seals	gas production
APENS	31000311	Natural Gas Processing Facilities, Flanges and Connections	gas production
APENS	31000404	Process Heaters	well count
APENS	31000405	Process Heaters	well count
APENS	31000406	Process Heaters	well count
APENS	31000502	Liquid Separator	well count
APENS	31088801	Permitted Fugitives	gas production
APENS	31088803	Permitted Fugitives	gas production
APENS	31088804	Permitted Fugitives	gas production
APENS	31088805	Permitted Fugitives	gas production
APENS	31088811	Permitted Fugitives	gas production
APENS	40400311	Tank Losses	oil production
APENS	40400322	Tank Losses	oil production

PROJECTION METHODOLOGIES FOR GEOGRAPHIC GROUPINGS

For each geographic grouping, the methodology for obtaining the 2012 value of each projection parameter (well count, spud count, condensate production, oil production and gas production) is described below. In general, well count projections in various geographic groupings were developed by obtaining the historical well count data for the geographic grouping using the IHS database, and projecting a trend line forward from 2006 to 2012. Spud count projections in various geographic groupings were developed by deriving an average ratio of annual spud counts to well counts for a number of historical years, and then applying this ratio to the projected well counts to estimate annual spud counts for future years. Gas production projections were developed by using typical Rulison-type well decline data for the Piceance Basin (Williams Production RMT Company, 2006) to predict the added annual gas production from the well count projections for each geographic grouping. Condensate production projections were developed by scaling the future year condensate production to the previous year condensate production using the same growth or decline rates as developed for gas production. Finally oil production projections were developed by obtaining the historical oil production data for the geographic grouping using the IHS database, and projecting a trend line forward from 2006 to 2012. Note that in general, oil production from conventional oil wells was not projected to grow or decline in this period.

The IHS database is a tool to query oil and gas statistical well and production data, and uses as its reference data the databases maintained by various state OGCC's (or equivalent). Previous work (Bar-Ilan et al., 2008) has confirmed that IHS data is consistent with the database maintained by COGCC.

Garfield County

Well Counts – Well counts in Garfield County have been plotted for the years 1970 – 2006 below in Figure 1, including projections to 2012.

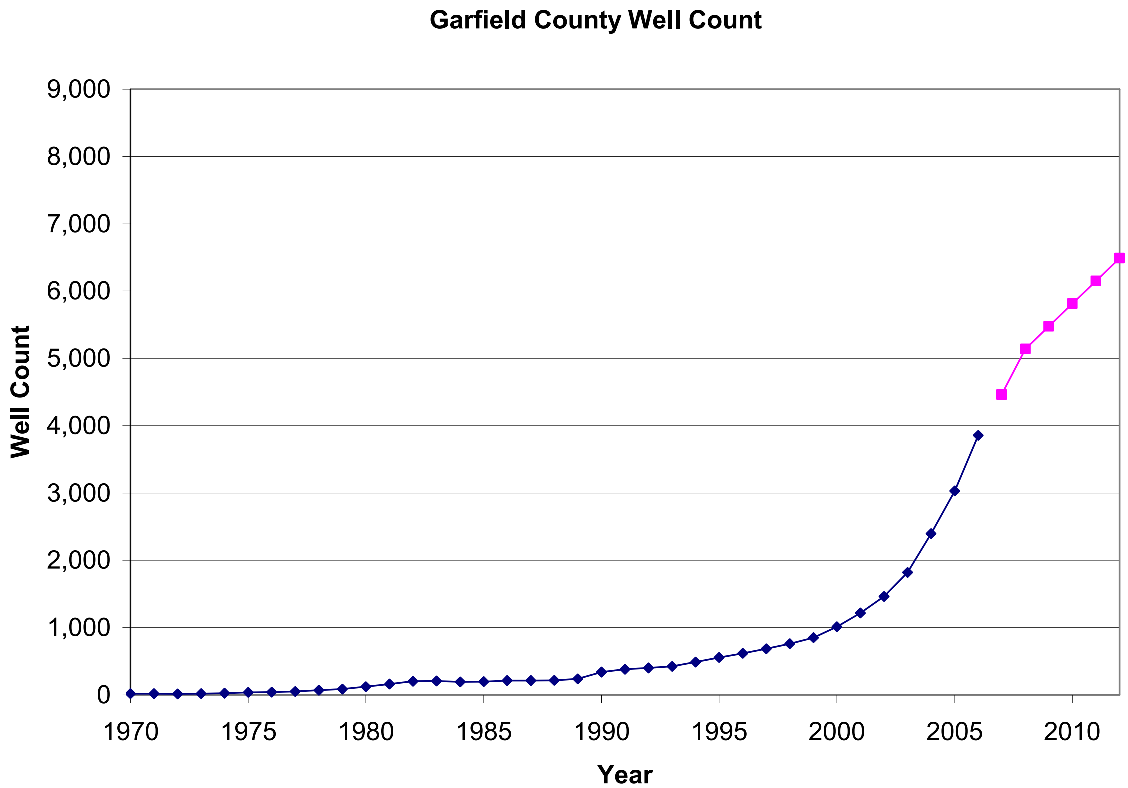

Figure 1. Well count historical data (from the IHS database) for Garfield County and projections to 2012.[1]

Well counts were linearly projected for the years 2007 – 2008 based on historical data from 2003 – 2006, since this period was considered representative of the recent significant increase in activity in the Piceance Basin. Starting in 2009, a second linear projection was used but the slope of the second linear projection from 2009 – 2012 was reduced by 50% compared to that of the period 2007 – 2008. The basis for this reduction in the growth rate of new wells includes:

1. Saturation of available areas for drilling in Garfield County and encroachment on population centers;
2. New Colorado Oil and Gas Conservation Commission (COGCC) regulations which will have the effect of slowing drilling and production;
3. More onerous permitting requirements, fees, and restrictions mandated by new COGCC regulations; and
4. A severe downturn in the economy, including a drop in commodity prices and lack of available capital to sustain the previous level of drilling and production activity.

[1] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Spud Counts – Spud counts in Garfield County have been plotted for the years 1970 – 2006 below in Figure 2, including projections to 2012.

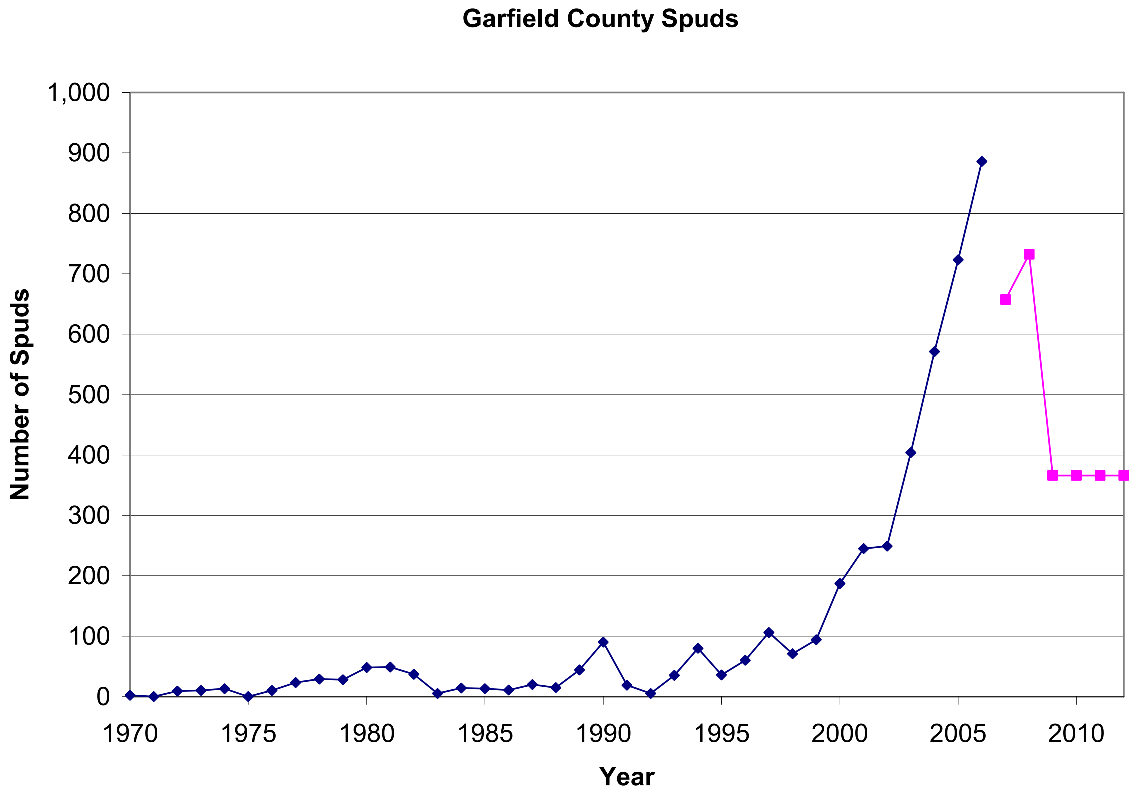

Figure 2. Spud count historical data (from the IHS database) for Garfield County and projections to 2012. [2]

Spud count projections were developed for the period 2007 – 2012 by first developing a ratio of the number of spuds in each year from 2003 – 2006 to the number of new wells added in each of those years. This represented the historic rate of drilling as compared to the rate of new well addition, accounting for factors such as unsuccessful drilling and wells which were plugged and abandoned. This data for the years 2003 – 2006 was averaged to develop a single historical drilling rate estimate of 1.085. This drilling rate estimate was then applied to the number of new wells added as predicted by the well count projection (see Figure 1) in order to determine the number of spuds in each year from 2007 – 2012.

It should be noted that the discontinuity between the projected spud counts for 2007 and the historic counts for 2006 is the result of applying the above methodology to the well counts, which are projected linearly from 2007 – 2009. However, the linear projection for well counts in the 2010 – 2012 period results in a steady drilling rate for that period, and therefore a constant annual spud count for that period.

[2] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Gas Production – Gas production in Garfield County has been plotted for the years 1970 – 2006 below in Figure 3, including projections to 2012.

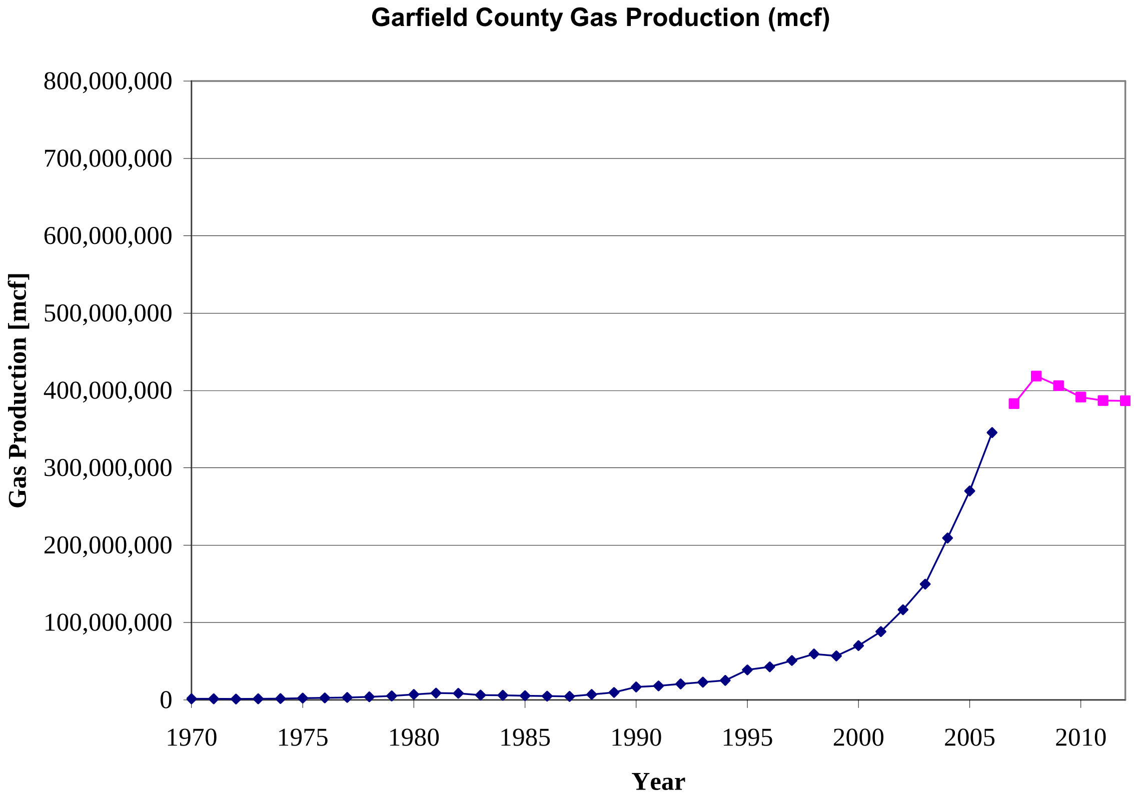

Figure 3. Gas production historical data (from the IHS database) for Garfield County and projections to 2012. [3]

The analysis to determine gas production projections in Garfield County relied on geologic reservoir data provided by the companies which was used to develop a production decline curve for typical gas wells in the Piceance Basin (Williams Production RMT Company, 2006). This is referred to as a Rulison-type curve and is shown below in Figure 4. As seen in Figure 4 the gas production of a new well brought on-line peaks in the first year of operation of the well and then declines following an approximately exponential decline curve. The methodology used to determine future year gas production in the county incorporated this Rulison curve data, as shown below in Equation (1):

Equation (1) $$P_i = \left[\left(N_{wells,i} - N_{wells,i-1}\right) \times 0.5 \times V_{Rulison,0} + \sum_{j=0}^{30} \left(N_{wells,j} - N_{wells,j-1}\right) \times V_{Rulison,j} \right] \times f$$

where:

P_i is the gas production in the geographic grouping in future year i [mscf]
$N_{wells,i}$ is the number of wells in the geographic grouping in future year i [# of wells]
$V_{Rulison,0}$ is the first-year predicted production per well following a Rulison curve [mscf/well]
$V_{Rulison,j}$ is the predicted production per well following a Rulison curve for year j [mscf/well]
j tracks the years of life of a well in the Piceance Basin, assumed to be a maximum of 20

[3] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

f is a correlation factor for wells that are plugged and abandoned and producing well fields that differ from the Rulison type curve (assumed to be 0.77 for Garfield County)

Equation (1) essentially uses the well count predictions of Figure 1 for a period of 20 previous years, assuming the same Rulison profile for all new wells added, and provides a prediction of the total production in the geographic grouping in a future year as the sum of these Rulison production values for each of the previous 20 years. The factor of 0.5 in Equation (1) is to account for the fact that in any current year new wells are added throughout the year. The correlation factor *f* was introduced to account for wells that are no longer active (e.g. plugged and abandoned) throughout the 20-year past calculation for each future year and also to account for production variances between well fields and the standard Rulison Type curve.

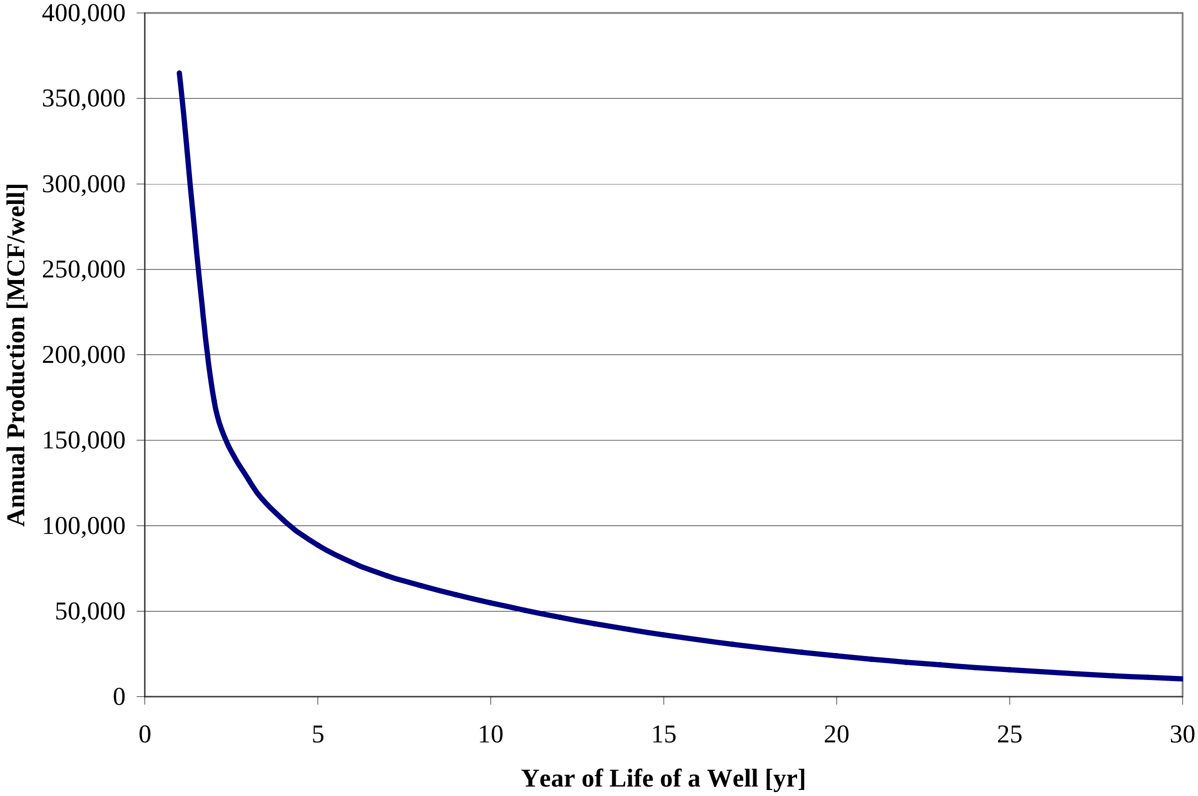

Figure 4. A Rulison-type curve showing well decline for an individual typical well in the Piceance Basin. [4]

An analysis was conducted to justify the use of the Rulison-type curve and to determine whether the particular curve shown in Figure 4 was sufficiently accurate to be representative of both the Piceance Basin generally, and the production characteristics of gas wells in Garfield County specifically (although it should be noted that Garfield County represents the majority of gas production in the Piceance Basin). The analysis was conducted by using Equation (1) to predict Garfield County gas production for years prior to 2007, for which IHS data was already available and could be used to compare the accuracy of this method. The results are shown below in Table 1 for calendar years 1999 – 2006 and show that this method, with the specific correlation factor selected, is reasonably accurate in predicting past county-level gas production volumes.

[4] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Table 2. Comparison of actual and predicted gas production volumes for Garfield County for the years 1999 – 2006 using the Rulison-type projection analysis.

Year	Actual Garfield County Gas Production [MCF]	Predicted Garfield County Gas Production [MCF]	Percentage Difference
1999	56,774,759	55,404,456	2.4%
2000	70,267,049	70,146,103	0.2%
2001	88,232,728	89,849,168	1.8%
2002	116,426,850	111,792,416	4.0%
2003	149,570,684	146,162,876	2.3%
2004	209,361,039	207,638,579	0.8%
2005	269,946,918	269,702,464	0.1%
2006	345,585,682	346,556,011	0.3%

As Table 2 shows there is reasonable agreement between the predicted gas production in Garfield County using the Rulison curve method of Equation (1) and the actual gas production in the County as obtained from the IHS database for the years 1999 – 2006. Since this is the period in which recent oil and gas development activity has begun in the Piceance Basin this period was used for the comparison purposes. The predicted gas production deviates no more than 4% from the actual gas production for any previous year in the period 1999 – 2006 and therefore it was concluded that this method is sufficiently accurate for prediction of future year production.

This Rulison-type analysis indicates that a large number of new wells are needed to sustain an overall growth rate for all production in the basin, since added production from new wells decreases immediately after the well's first year of production. It should be noted that the well count projections for the basin in the 2007 – 2012 period do not indicate that a sufficient number of new wells will be added each year to sustain a growth in production, and the curve shown in Figure 3 indicates an overall decline in production beginning in 2009.

Condensate Production – Condensate production in Garfield County has been plotted for the years 1970 – 2006 below in Figure 5, including projections to 2012.

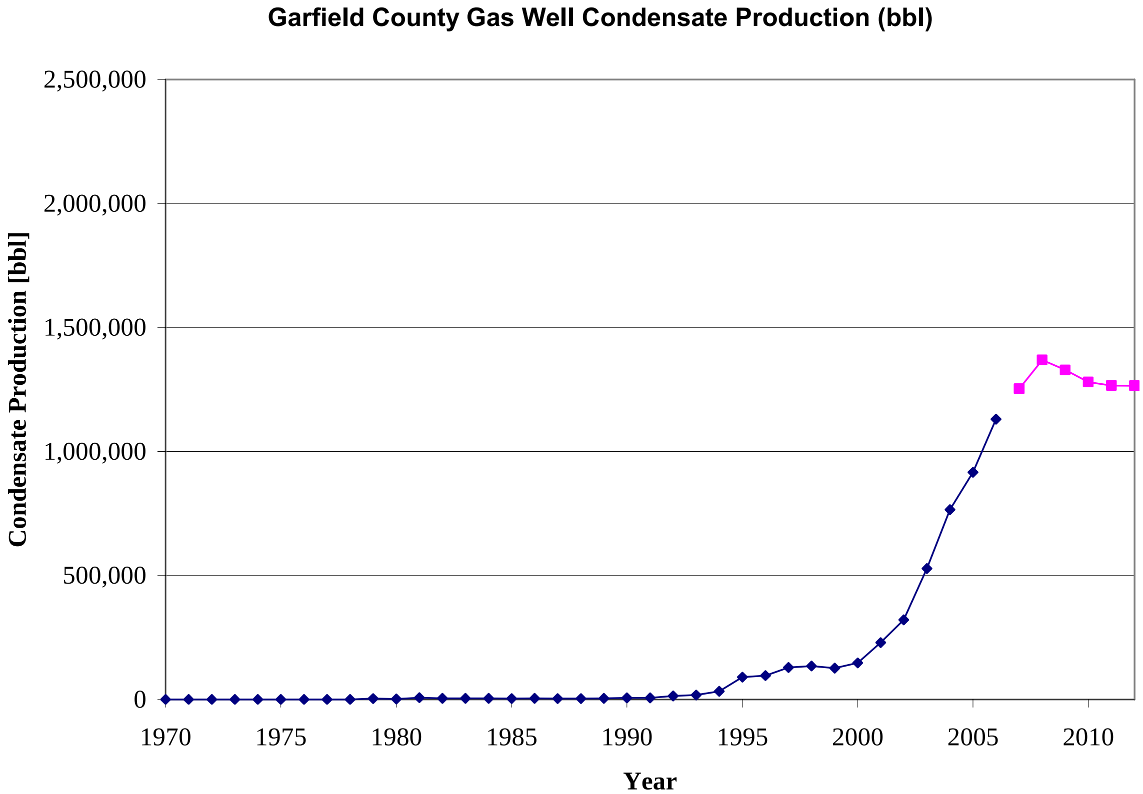

Figure 5. Condensate production historical data (from the IHS database) for Garfield County and projections to 2012. [5]

It was assumed that condensate production is a direct function of gas production, since "condensate" in this analysis refers to liquid hydrocarbon production that is an associated product of natural gas at gas wells. Therefore scaling factors were developed for each year from 2007 – 2012 that were the ratio of gas production in that year to gas production in the previous year. These scaling factors were then applied to the condensate production for each year from 2007 – 2012, and form the projections shown in Figure 5. It should be noted that this methodology is expected to result in a projection trend identical in form to that of the gas production projections, as shown in a comparison of Figures 3 and 5.

[5] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Oil Production – Oil production in Garfield County has been plotted for the years 1970 – 2006 below in Figure 6, including projections to 2012.

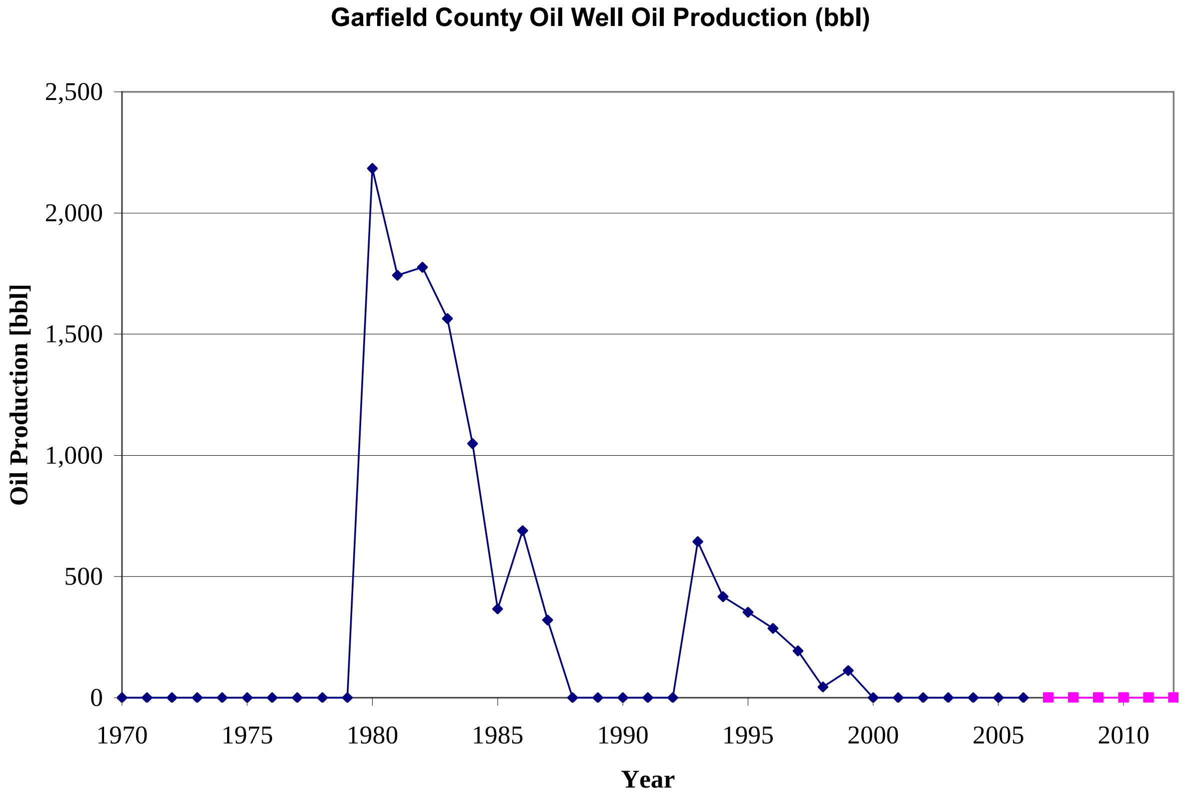

Figure 6. Oil production historical data (from the IHS database) for Garfield County and projections to 2012.

Garfield County does not have a significant amount of oil production. No data indicated that there would be any likely growth in oil production, and so oil production was projected to be negligible in the years 2007 – 2012. [6]

[6] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Rio Blanco County

Well Counts – Well counts in Rio Blanco County have been plotted for the years 1970 – 2006 below in Figure 7, including projections to 2012.

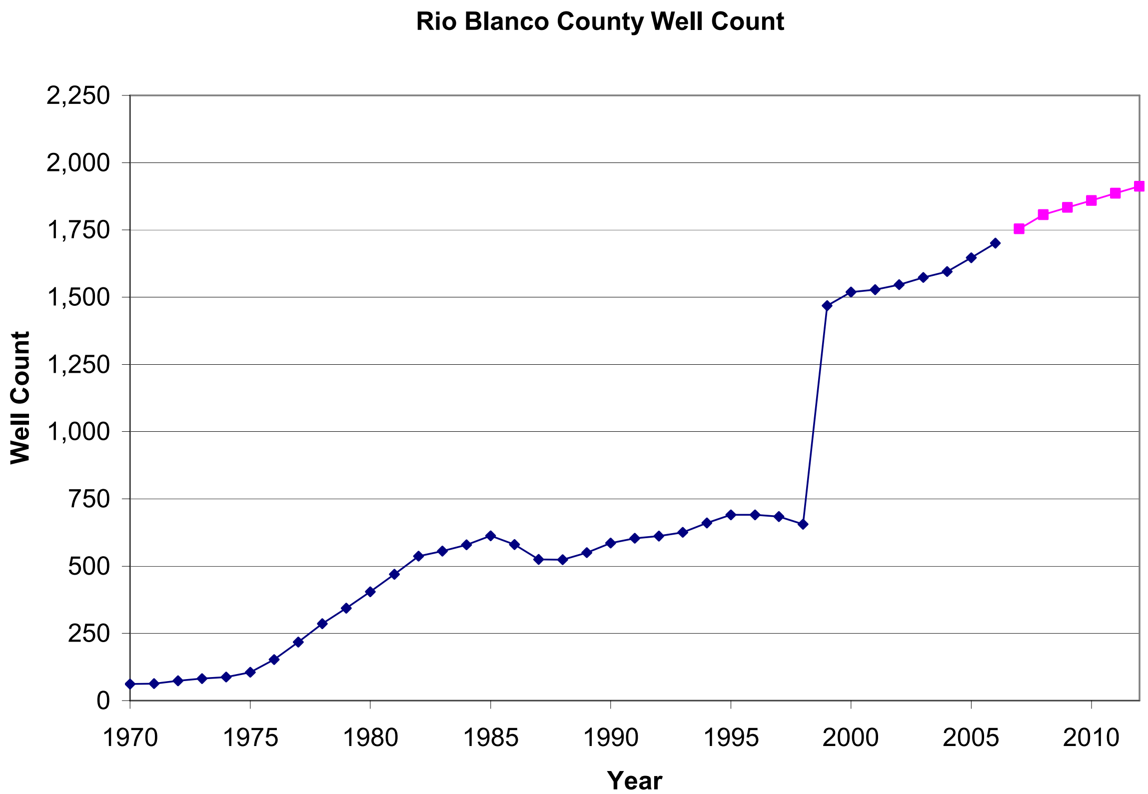

Figure 7. Well count historical data (from the IHS database) for Rio Blanco County and projections to 2012.[7]

Similar to the methodology for well count projections for Garfield County, well counts were linearly projected for Rio Blanco County based on data from 2004 – 2006. A best-fit linear projection was used for projecting well counts in 2007 – 2008, and then the slope of this linear projection was reduced by 50% and a second linear projection was used for 2009 – 2012. Similar to Garfield County, the well count projections were reduced in 2009 – 2012 to account for an anticipated decline in activity in this county based on data provided by participating companies.

[7] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Spud Counts – Spud counts in Rio Blanco County have been plotted for the years 1970 – 2006 below in Figure 8, including projections to 2012.

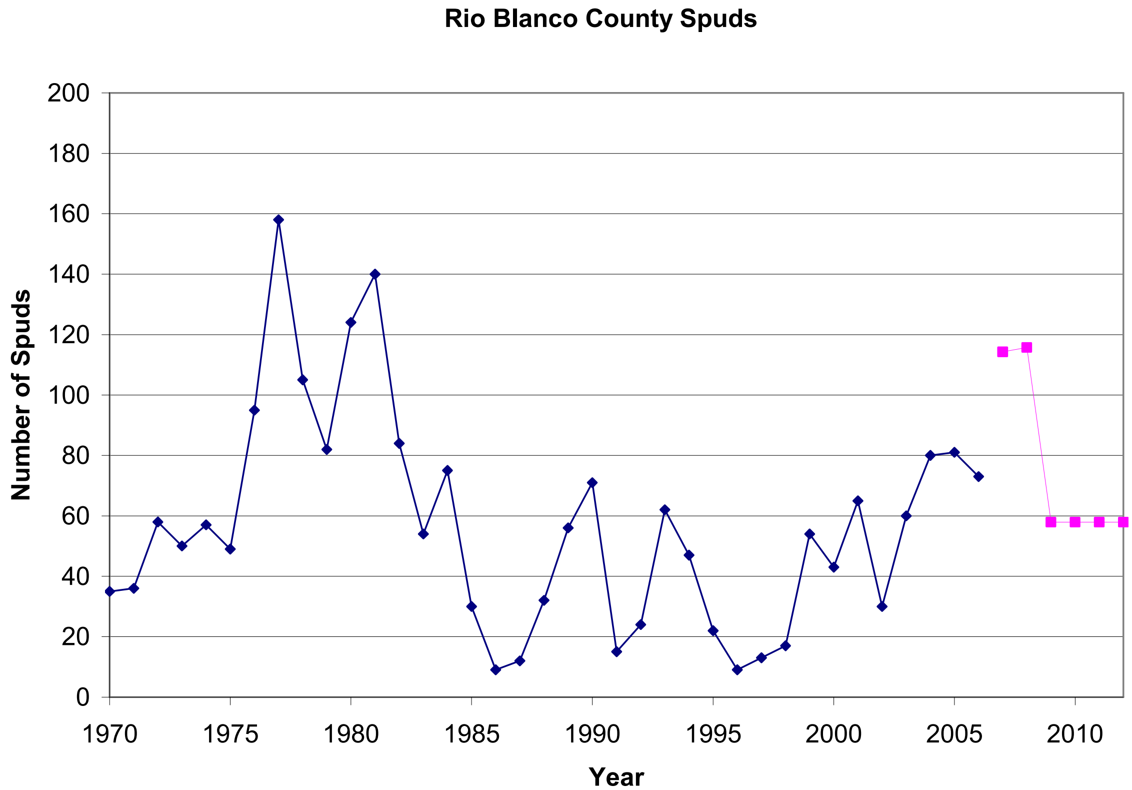

Figure 8. Spud count historical data (from the IHS database) for Rio Blanco County and projections to 2012. [8]

Similar to the methodology used to develop spud count projections for Garfield County, an average drilling rate in Rio Blanco County relative to the number of new wells added in the County was developed for the years 2004 – 2006. This factor was determined to be 2.184 for Rio Blanco County, indicating that significantly more drilling is needed to account for the projected well count in the County, and is likely an indication that more wells are being plugged and abandoned in this County than in Garfield County. Similar to Garfield County, the Rio Blanco spud count projections display a discontinuity due to the well count-based methodology used to project spud counts. Also similar to Garfield County, the Rio Blanco spud counts are constant for the period 2009 – 2012 since the well counts are linearly projected.

[8] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Gas Production – Gas production in Rio Blanco County has been plotted for the years 1970 – 2006 below in Figure 9, including projections to 2012.

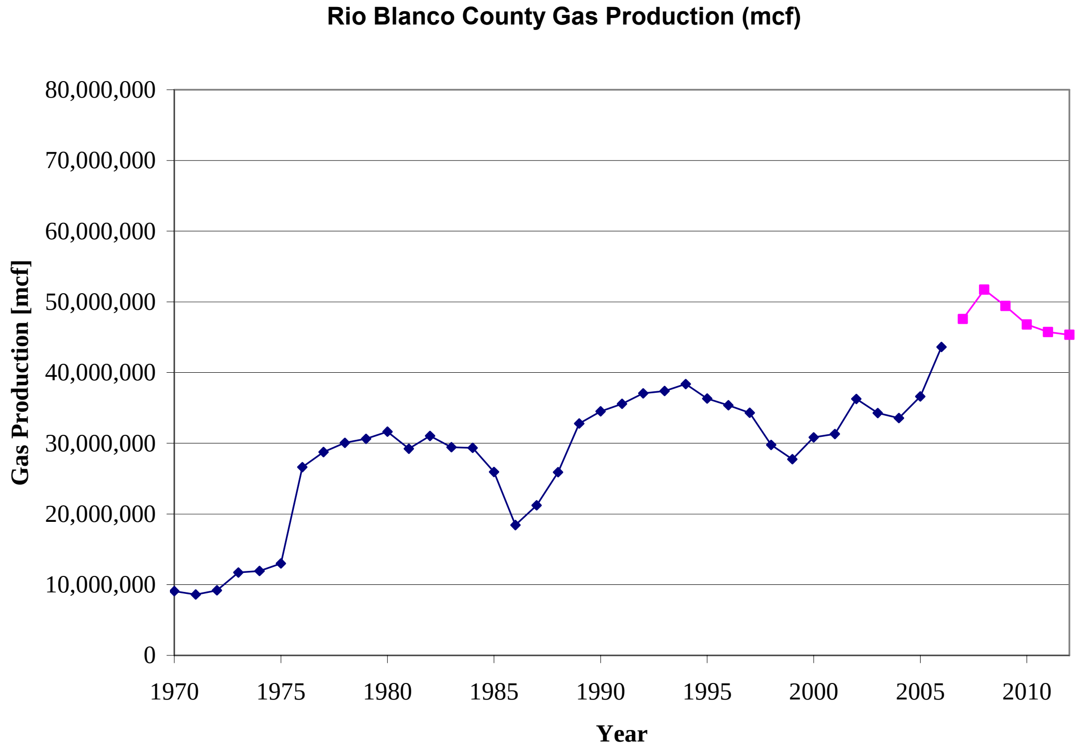

Figure 9. Gas production historical data (from the IHS database) for Rio Blanco County and projections to 2012. [9]

A methodology similar to Equation (1) was used for Rio Blanco County gas production projections in 2007 – 2012. The same Rulison-type curve for gas well production decline over the life of a typical well was used in the analysis for Rio Blanco County. As with Garfield County, an analysis was conducted to determine the ability of this projection methodology to accurately back-cast gas production in Rio Blanco County. An optimized correlation factor was selected for Rio Blanco County to provide a best fit for the back-cast data comparison. The correlation factor selected for Rio Blanco County was 1.1. The results of the back-casting analysis are shown below in Table 3.

Table 3. Comparison of actual and predicted gas production volumes for Rio Blanco County for the years 1999 – 2006 using the Rulison-type projection analysis.

Year	Actual Rio Blanco County Gas Production [MCF]	Predicted Rio Blanco County Gas Production [MCF]	Percentage Difference
1999	27,732,550	27,439,433	1.1%
2000	30,828,314	34,048,447	10.4%
2001	31,318,584	30,627,071	2.2%
2002	36,255,332	27,904,033	23.0%
2003	34,282,392	29,431,521	14.1%
2004	33,553,262	29,846,380	11.0%
2005	36,625,402	35,483,626	3.1%
2006	43,633,074	42,560,353	2.5%

[9] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Table 3 shows a significantly higher deviation from predicted values for Rio Blanco County than for Garfield County. The deviation may be due to external factors not directly associated with this Rulison-type analysis. Rio Blanco County has significant oil production and some of the county-level gas production is associated production from these oil wells. This production is not expected to follow this analysis. It should also be noted that historic gas production in Rio Blanco County in the period 1999 – 2006 is erratic, indicating that other external factors are influencing total gas production in the county. Despite these deviations, this analysis was used to project gas production for the period 2007 – 2012 following the same methodology as used for Garfield County.

Condensate Production – Condensate production in Rio Blanco County has been plotted for the years 1970 – 2006 below in Figure 10, including projections to 2012.

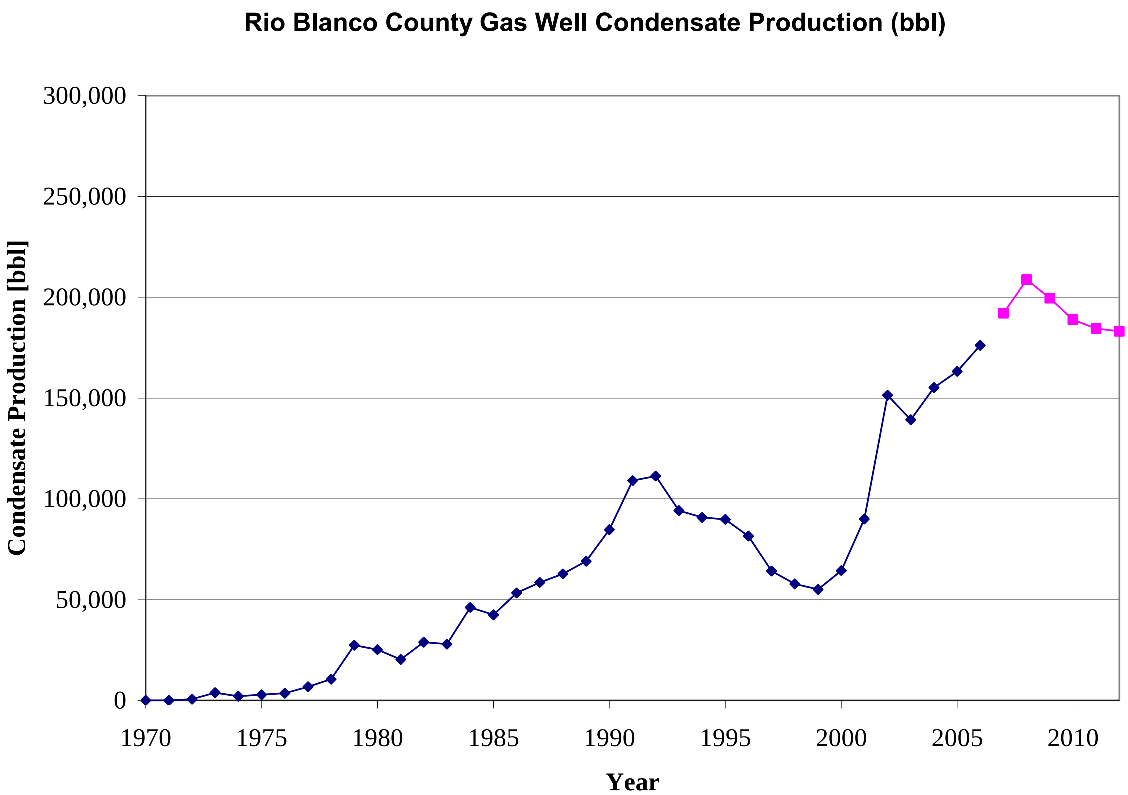

Figure 10. Condensate production historical data (from the IHS database) for Rio Blanco County and projections to 2012. [10]

Similar to the methodology used for Garfield County, the Rio Blanco County condensate production for the period 2007 – 2012 was projected using scaling factors derived from the gas production projections for Rio Blanco County, as shown in Figure 9. The trends are therefore identical for both gas and condensate production projections in Rio Blanco County for this period.

[10] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Oil Production – Oil production in Rio Blanco County has been plotted for the years 1970 – 2006 below in Figure 11, including projections to 2012.

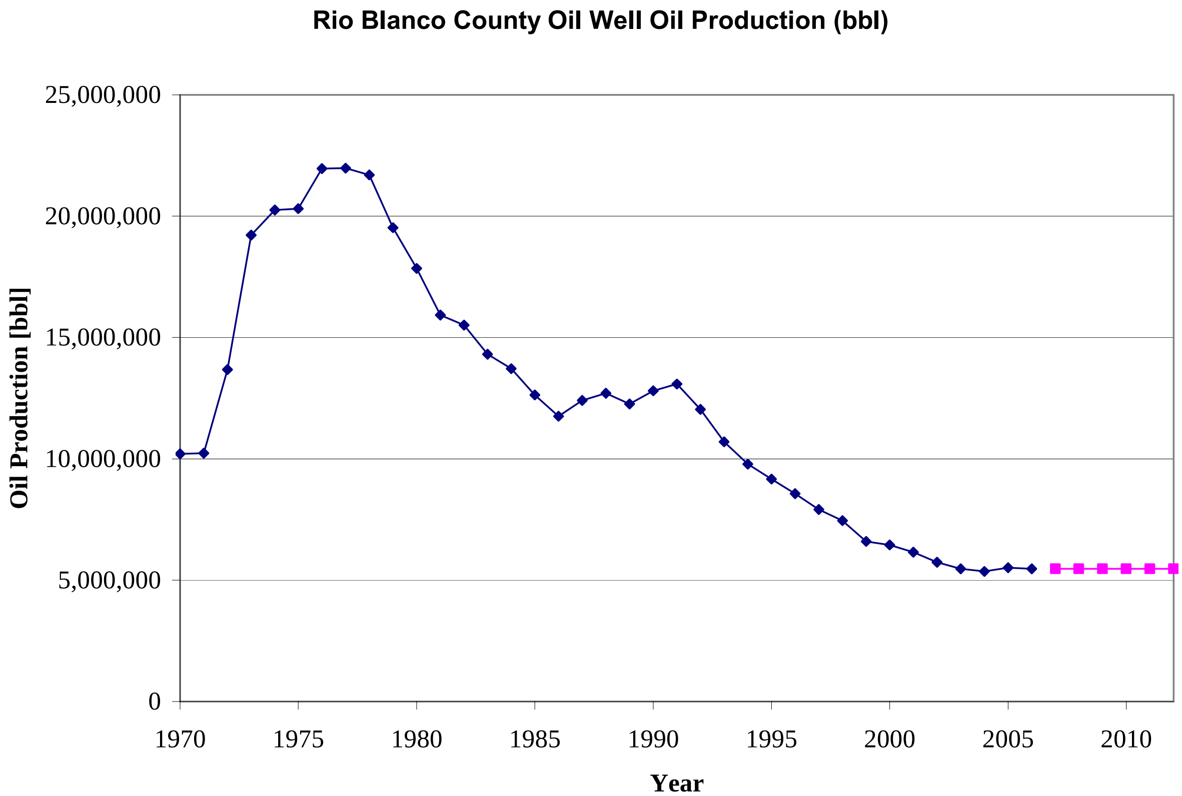

Figure 11. Oil production historical data (from the IHS database) for Rio Blanco County and projections to 2012. [11]

Oil production in Rio Blanco County has historically been declining from a peak production level in 1977 of approximately 22,000,000 barrels annually. In the recent past, in the period 2002 – 2006 oil production has been relatively constant at a rate of approximately 5,000,000 bbl/year. It is conservatively projected that oil production would continue to remain at this annual level for the period 2007 – 2012.

[11] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Mesa County

Well Counts – Well counts in Mesa County have been plotted for the years 1970 – 2006 below in Figure 12, including projections to 2012.

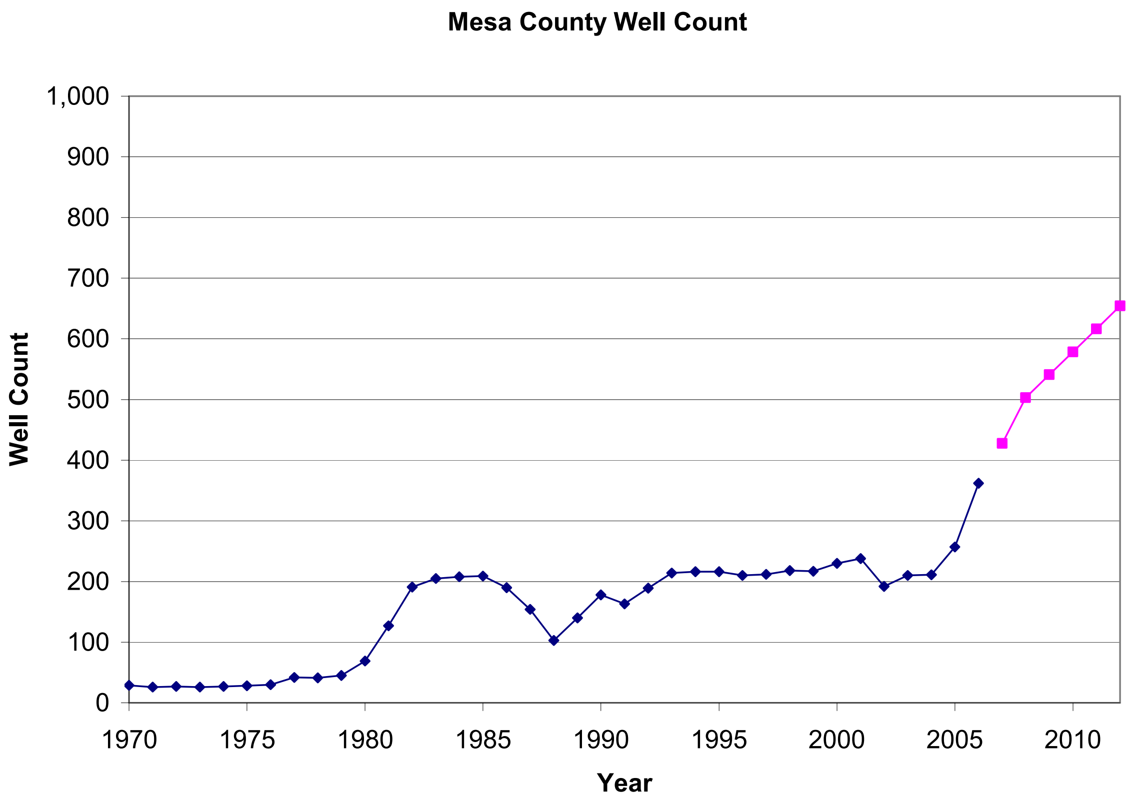

Figure 12. Well count historical data (from the IHS database) for Mesa County and projections to 2012. [12]

Similar to the methodology for well count projections for Garfield County, well counts were linearly projected for Mesa County based on data from 2004 – 2006. A best-fit linear projection was used for projecting well counts in 2007 – 2008, and then the slope of this linear projection was reduced by 50% and a second linear projection was used for 2009 – 2012. Similar to Garfield County, the well count projections were reduced in 2009 – 2012 to account for an anticipated decline in activity in this county based on data provided by participating companies.

[12] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Spud Counts – Spud counts in Mesa County have been plotted for the years 1970 – 2006 below in Figure 13, including projections to 2012.

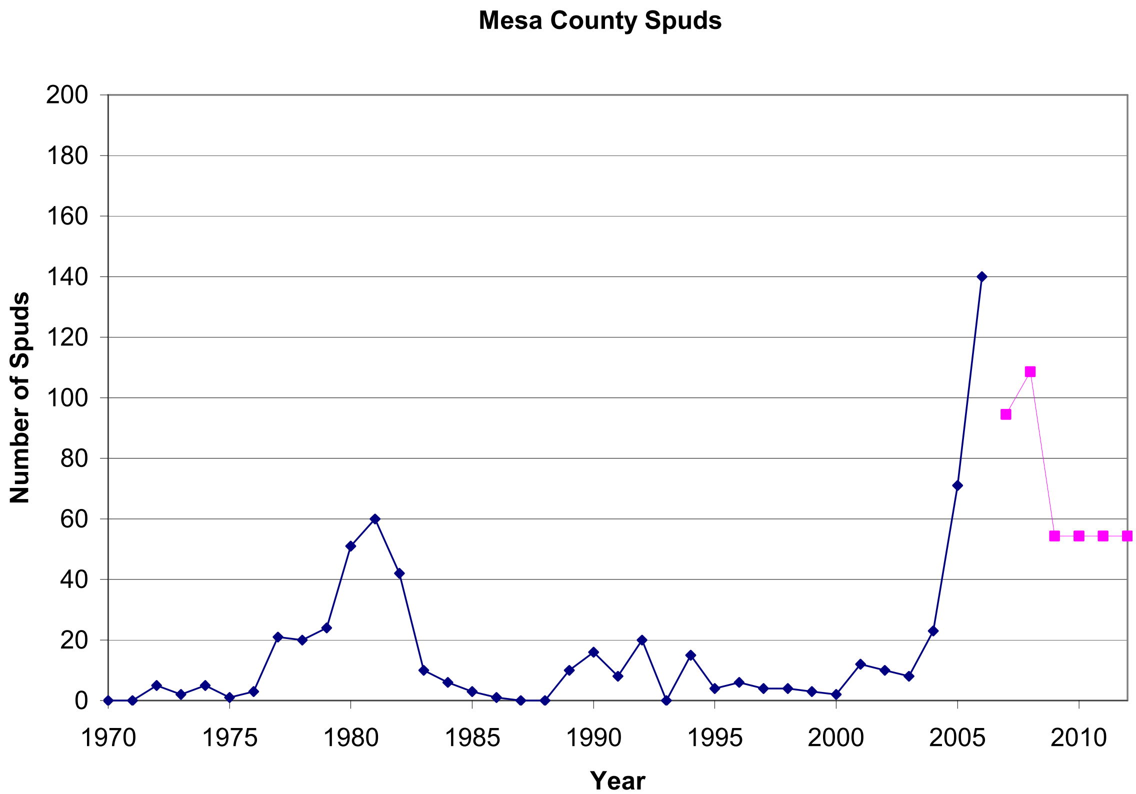

Figure 13. Spud count historical data (from the IHS database) for Mesa County and projections to 2012. [13]

Similar to the methodology used to develop spud count projections for Garfield County, an average drilling rate in Mesa County relative to the number of new wells added in the County was developed for the years 2005 – 2006. This factor was determined to be 1.438 for Mesa County. Similar to Garfield County, the Mesa County spud count projections display a discontinuity due to the well count-based methodology used to project spud counts. Also similar to Garfield County, the Mesa County spud counts are constant for the period 2009 – 2012 since the well counts are linearly projected.

[13] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Gas Production – Gas production in Mesa County has been plotted for the years 1970 – 2006 below in Figure 14, including projections to 2012.

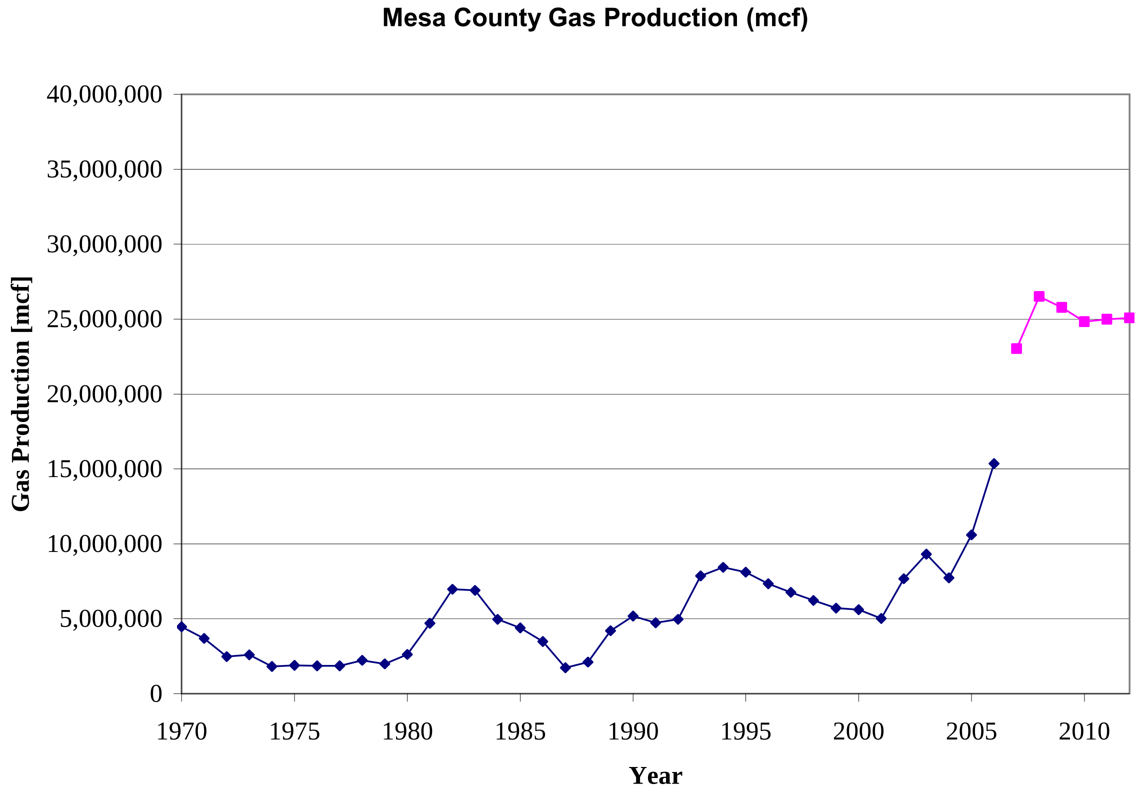

Figure 14. Gas production historical data (from the IHS database) for Mesa County and projections to 2012. [14]

A methodology similar to Equation (1) was used for Mesa County gas production projections in 2007 – 2012. The same Rulison-type curve for gas well production decline over the life of a typical well was used in the analysis for Mesa County. As with Garfield County, an analysis was conducted to determine the ability of this projection methodology to accurately back-cast gas production in Mesa County. An optimized correlation factor was selected for Mesa County to provide a best fit for the back-cast data comparison. The correlation factor selected for Mesa County was 0.53. The results of the back-casting analysis are shown below in Table 4.

Table 4. Comparison of actual and predicted gas production volumes for Mesa County for the years 1999 – 2006 using the Rulison-type projection analysis.

Year	Actual Mesa County Gas Production [MCF]	Predicted Mesa County Gas Production [MCF]	Percentage Difference
1999	5,709,569	7,046,807	23.4%
2000	5,599,412	7,338,168	31.1%
2001	5,017,255	6,839,407	36.3%
2002	7,675,838	5,324,341	30.6%
2003	9,313,157	6,234,402	33.1%
2004	7,725,671	5,744,337	25.6%
2005	10,599,890	9,363,378	11.7%
2006	15,359,972	18,734,154	22.0%

[14] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Table 4 shows a significantly higher deviation from predicted values for Mesa County than for either Garfield or Rio Blanco Counties. Historic gas production in Mesa County in the period 1999 – 2006 is erratic (similar to Rio Blanco County), indicating that other external factors are influencing total gas production in the county. However, it should also be noted that the total gas production in Mesa County in 2006 accounts for only approximately 3.5% of total gas production in the Piceance Basin. Therefore the deviation from historic data was not determined to be a significant deterrent to using this methodology for future year projections for the period 2007 – 2012 following the same methodology as used for Garfield and Rio Blanco Counties. The trend line of the projections for Mesa was similar to those of Rio Blanco and Garfield, with a peak in 2008 followed by a decline to 2012.

Condensate Production – Condensate production in Mesa County has been plotted for the years 1970 – 2006 below in Figure 15, including projections to 2012.

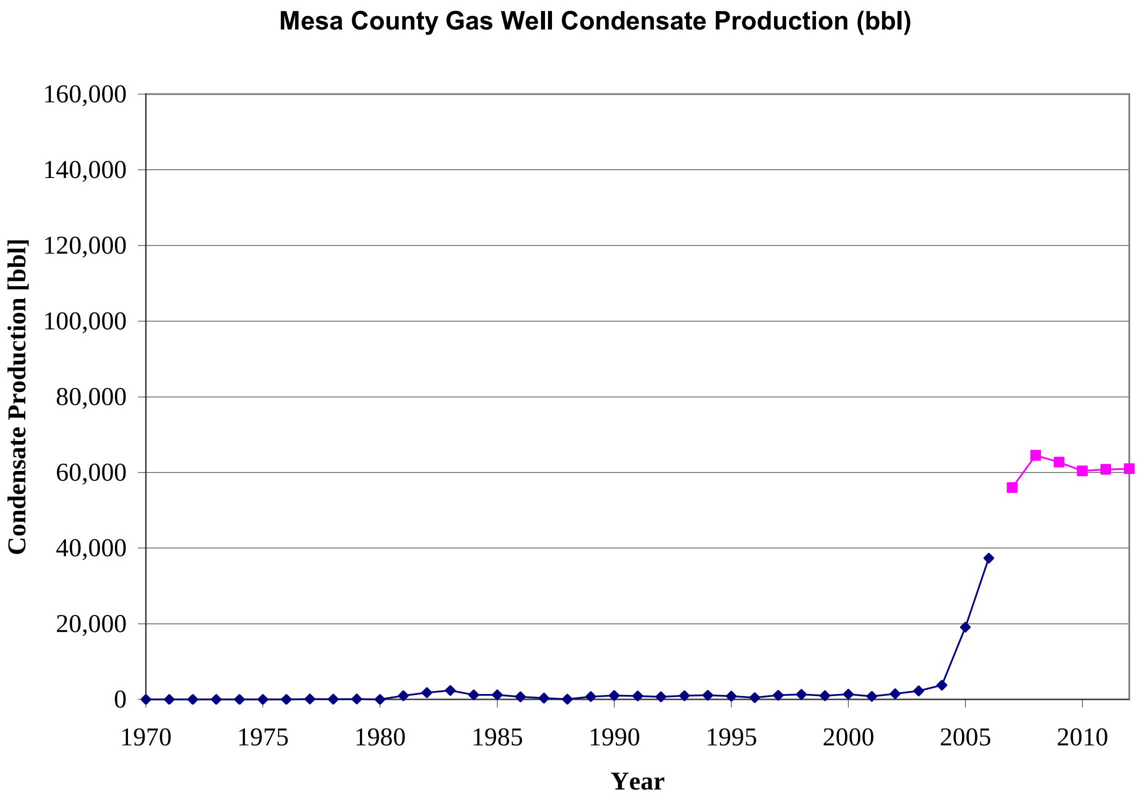

Figure 15. Condensate production historical data (from the IHS database) for Mesa County and projections to 2012. [15]

Similar to the methodology used for Garfield and Rio Blanco Counties, the Mesa County condensate production for the period 2007 – 2012 was projected using scaling factors derived from the gas production projections for Mesa County, as shown in Figure 14. The trends are therefore identical for both gas and condensate production projections in Mesa County for this period.

[15] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Oil Production – Oil production in Mesa County has been plotted for the years 1970 – 2006 below in Figure 16, including projections to 2012.

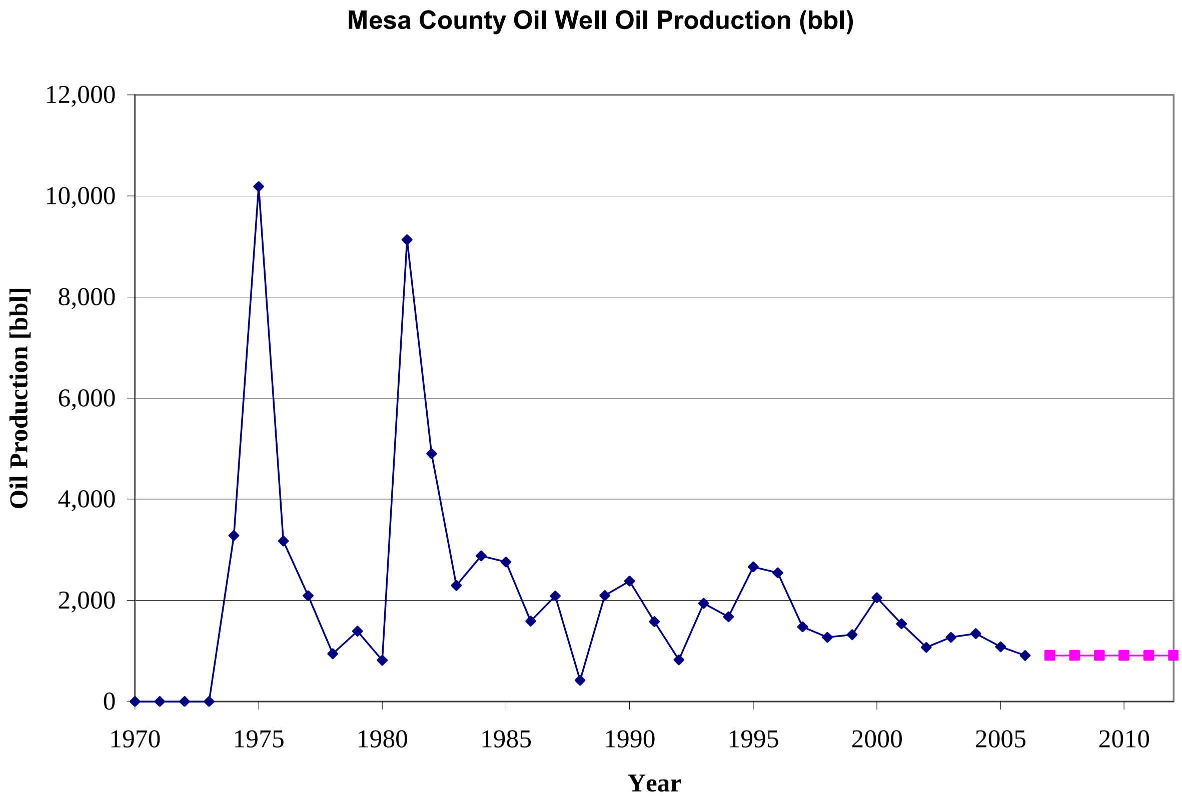

Figure 16. Oil production historical data (from the IHS database) for Mesa County and projections to 2012. [16]

Although erratic, oil production in Mesa County has generally been declining from a peak production level in 1975 of just over 10,000 barrels annually. Given no additional information on oil production in Mesa County, and considering the relatively small contribution of Mesa County to the total oil production for the Piceance Basin, it was conservatively projected that oil production would continue to remain at the annual production level in 2006 (the last year for which a full data set was available) for the projection period of 2007 – 2012.

[16] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Moffat County

Well Counts – Well counts in Moffat County have been plotted for the years 1970 – 2006 below in Figure 17, including projections to 2012.

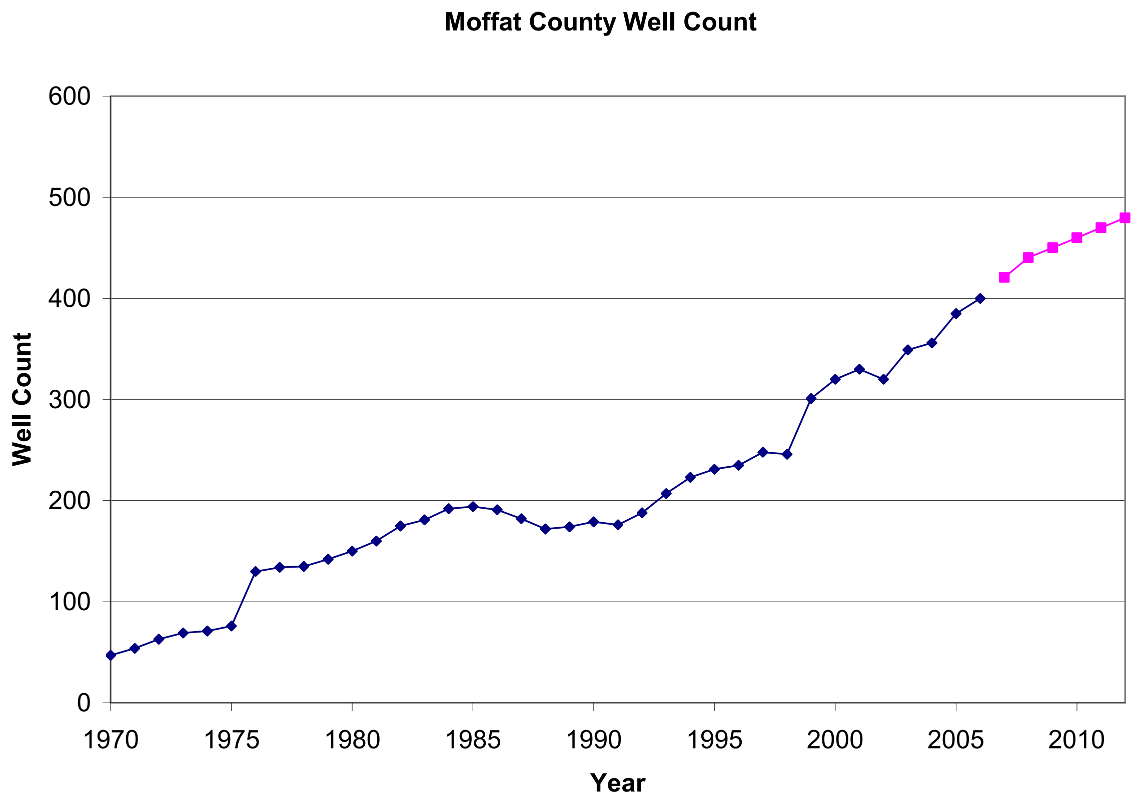

Figure 17. Well count historical data (from the IHS database) for Moffat County and projections to 2012. [17]

Similar to the methodology for well count projections for Garfield County, well counts were linearly projected for Moffat County based on data from 2002 – 2006. A best-fit linear projection was used for projecting well counts in 2007 – 2008, and then the slope of this linear projection was reduced by 50% and a second linear projection was used for 2009 – 2012. Similar to Garfield County, the well count projections were reduced in 2010 – 2012 to account for an anticipated decline in activity in this county based on data provided by participating companies.

[17] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Spud Counts – Spud counts in Moffat County have been plotted for the years 1970 – 2006 below in Figure 18, including projections to 2012.

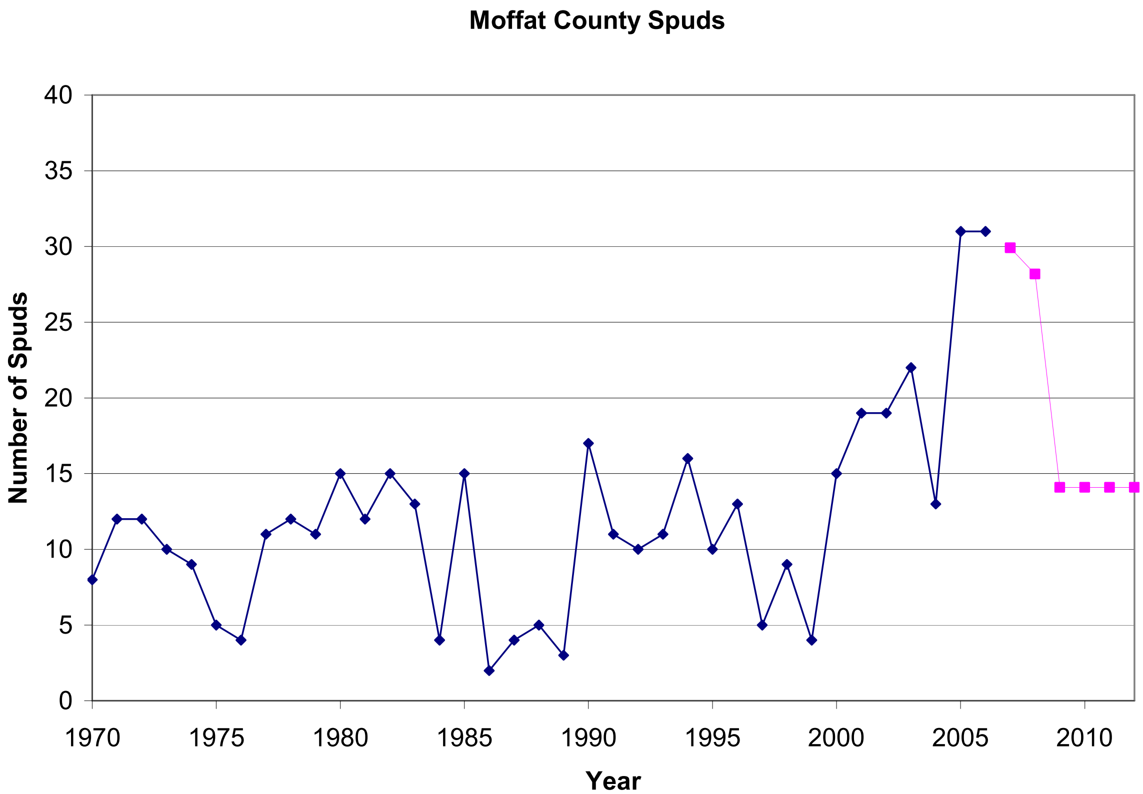

Figure 18. Spud count historical data (from the IHS database) for Moffat County and projections to 2012. [18]

Similar to the methodology used to develop spud count projections for Garfield County, an average drilling rate in Moffat County relative to the number of new wells added in the County was developed for the years 2003 – 2006. This factor was determined to be 1.438 for Moffat County. Similar to Garfield County, the Moffat County spud count projections display a discontinuity due to the well count-based methodology used to project spud counts. Also similar to Garfield County, the Moffat County spud counts are constant for the period 2009 – 2012 since the well counts are linearly projected.

[18] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Gas Production – Gas production in Moffat County has been plotted for the years 1970 – 2006 below in Figure 19, including projections to 2012.

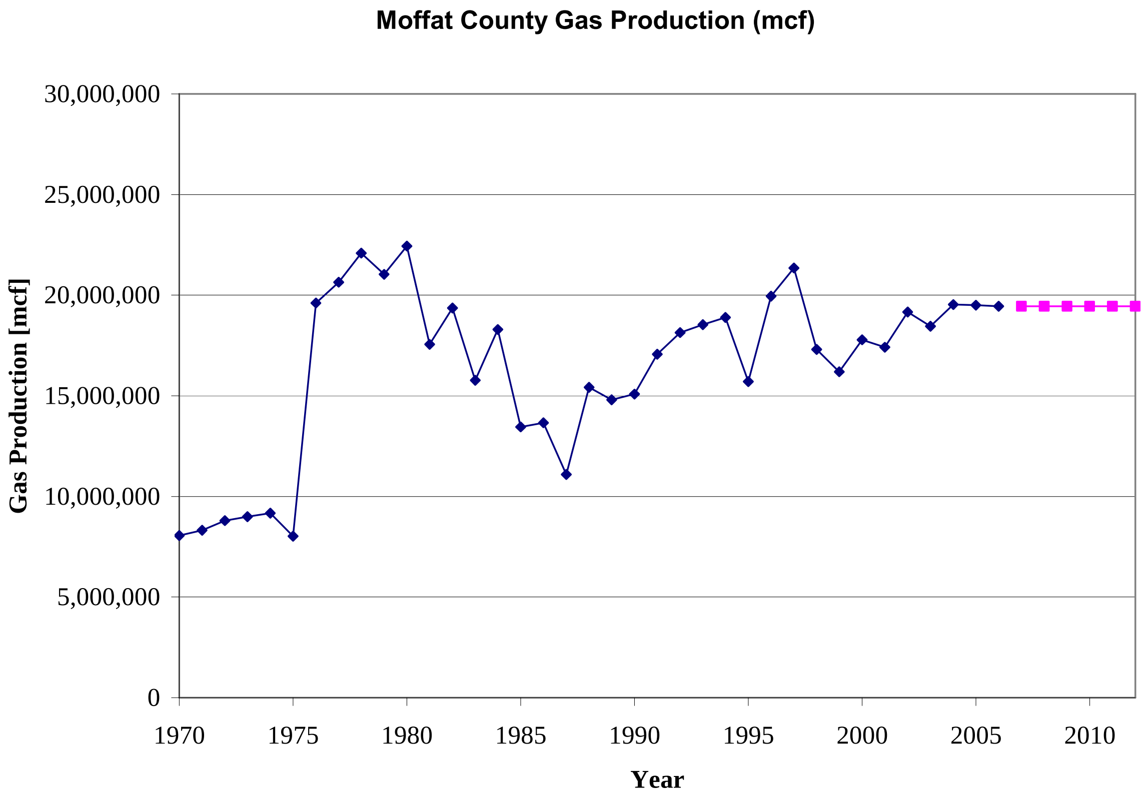

Figure 19. Gas production historical data (from the IHS database) for Moffat County and projections to 2012.

Historic gas production in Moffat County was determined to be too variable to predict future year production levels with any reasonable accuracy. Given the low levels of activity in Moffat County, and the fact that Moffat County gas production in 2006 contributed only 4.6% to the total Piceance Basin gas production, it was assumed that gas production would remain constant at 2006 levels for the period 2007 – 2012. Given the erratic historical production levels, it should be noted that gas production in this county could be expected to either decline, or to grow, or to both decline and grow in the period 2007 – 2012.

Condensate Production – Condensate production in Moffat County has been plotted for the years 1970 – 2006 below in Figure 20, including projections to 2012.

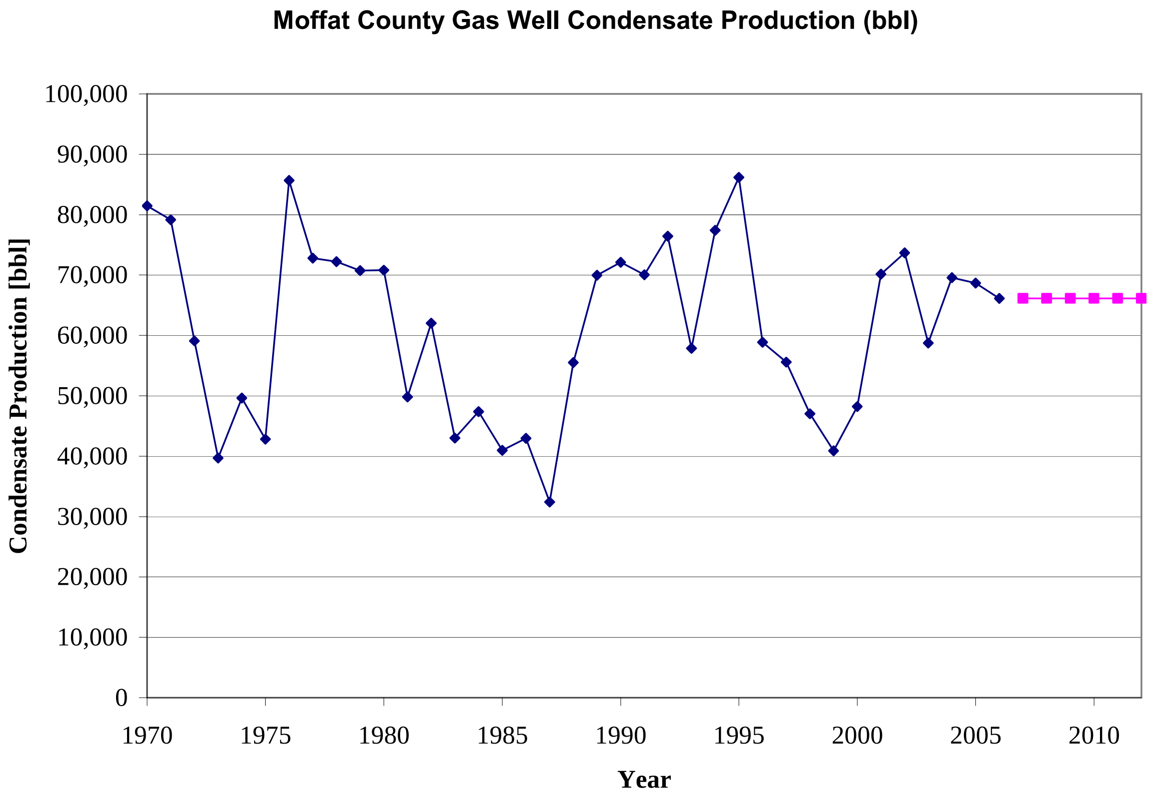

Figure 20. Condensate production historical data (from the IHS database) for Moffat County and projections to 2012. [19]

Similar to the methodology used for gas production in Moffat County, as described above, condensate production for the period 2007 – 2012 was projected to remain at 2006 levels. Similar to gas production, the condensate production is highly variable and determined to be too difficult to reasonably project. Given the related nature of condensate and gas production, it was considered a reasonable assumption to project condensate production similarly to gas production.

[19] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Oil Production – Oil production in Moffat County has been plotted for the years 1970 – 2006 below in Figure 21, including projections to 2012.

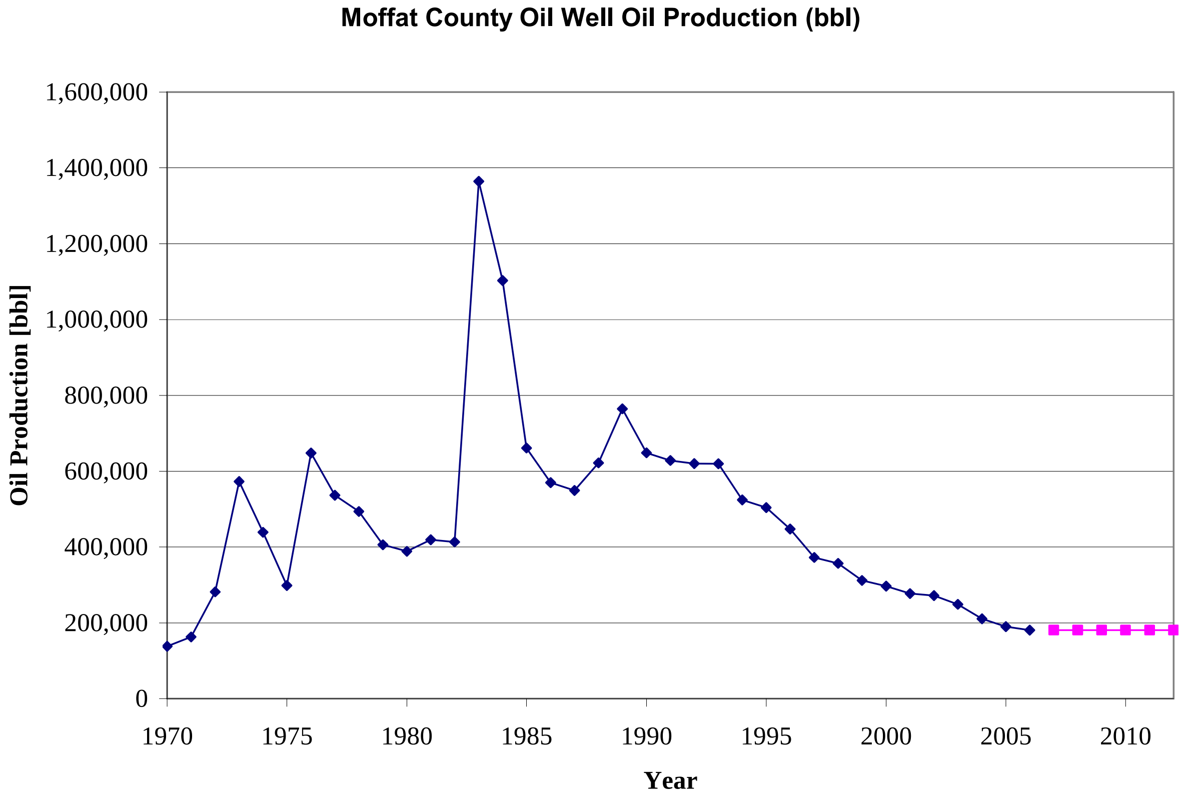

Figure 21. Oil production historical data (from the IHS database) for Moffat County and projections to 2012. [20]

Oil production in Moffat County has generally been declining since 1989 (although peak production levels occurred in 1983 at approximately 1.36 million barrels annually). Similar to Mesa County, no additional information on planned future oil production in Moffat County was provided by participating companies, therefore it was conservatively projected that oil production would continue to remain at the annual production level in 2006 (the last year for which a full data set was available) for the projection period of 2007 – 2012.

[20] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Routt County

Well Counts – Well counts in Routt County have been plotted for the years 1970 – 2006 below in Figure 22, including projections to 2012.

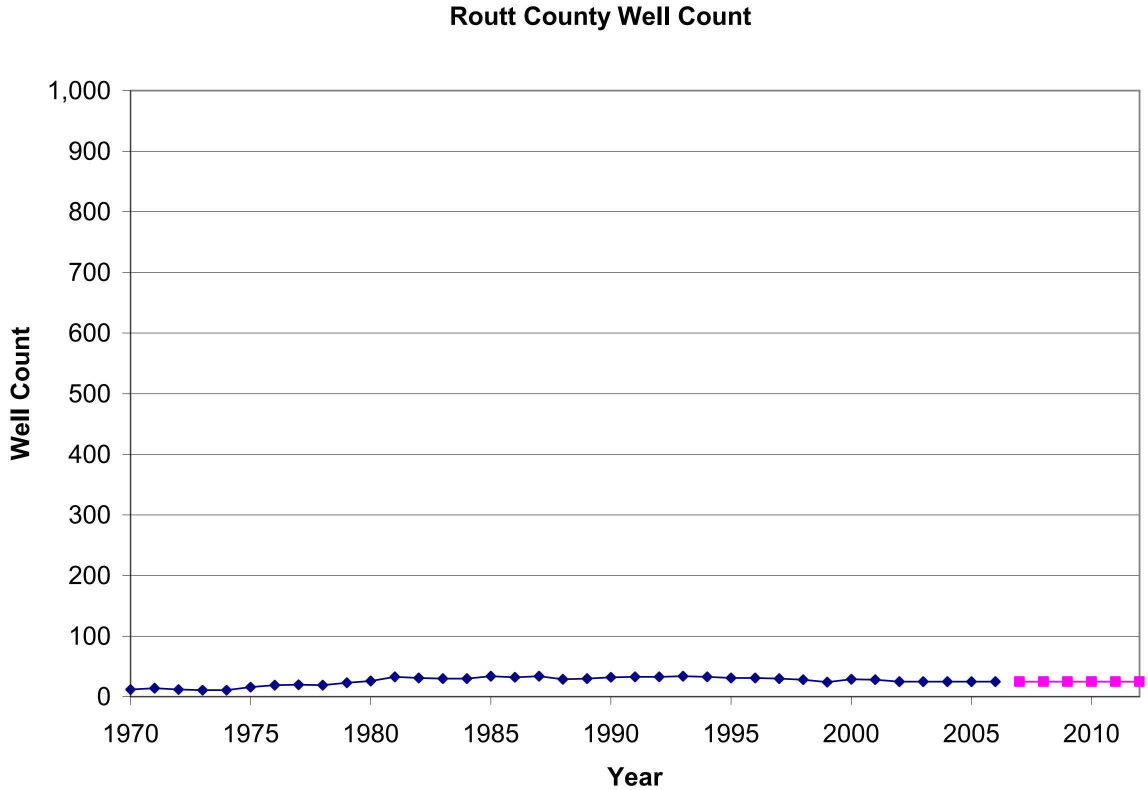

Figure 22. Well count historical data (from the IHS database) for Routt County and projections to 2012. [21]

Well counts in Routt County have been small relative to the other counties described in this analysis, and therefore were conservatively projected to remain at 2006 counts for the period 2007 – 2012.

[21] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Spud Counts – Spud counts in Routt County have been plotted for the years 1970 – 2006 below in Figure 23, including projections to 2012.

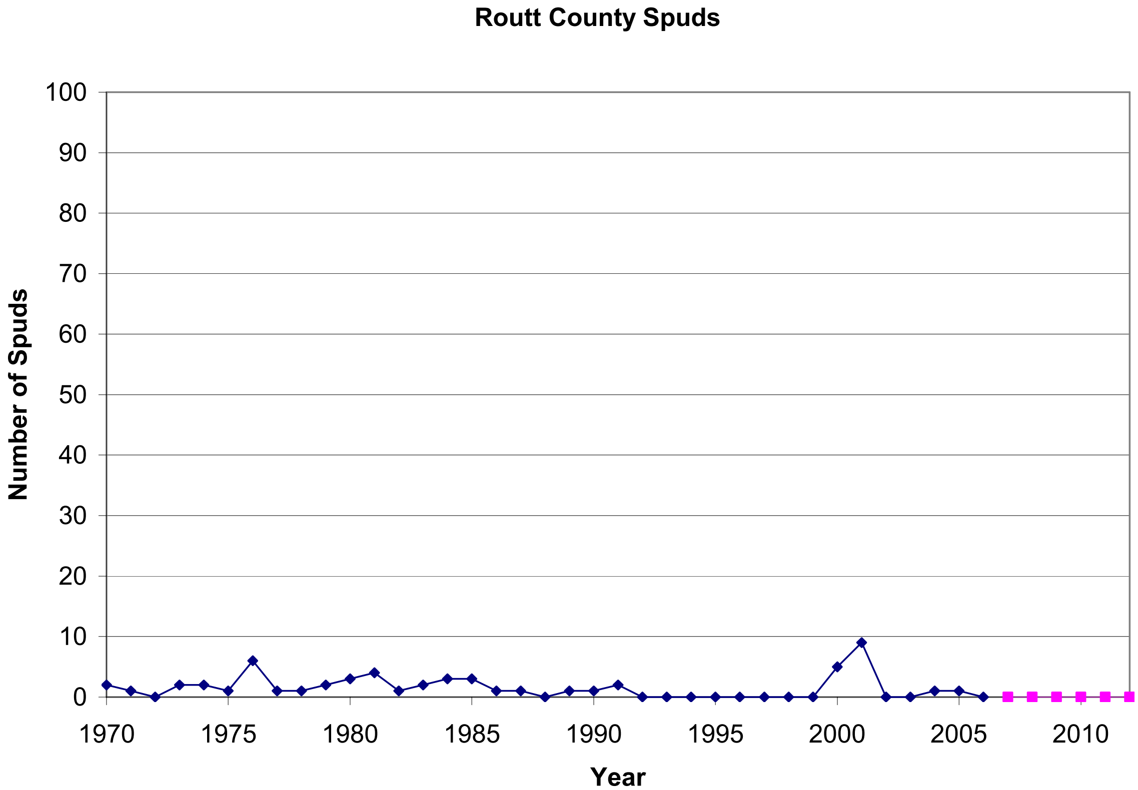

Figure 23. Spud count historical data (from the IHS database) for Routt County and projections to 2012. [22]

In the period 1992 – 2006 there have been only 16 spuds total in Routt County, the majority of these occurring only in 2000 and 2001. For the remaining years in the period 1992 – 2006 there have been no annual spuds in the County. Therefore it was assumed that there would be no additional spuds in the period 2007 – 2012.

[22] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Gas Production – Gas production in Routt County has been plotted for the years 1970 – 2006 below in Figure 24, including projections to 2012.

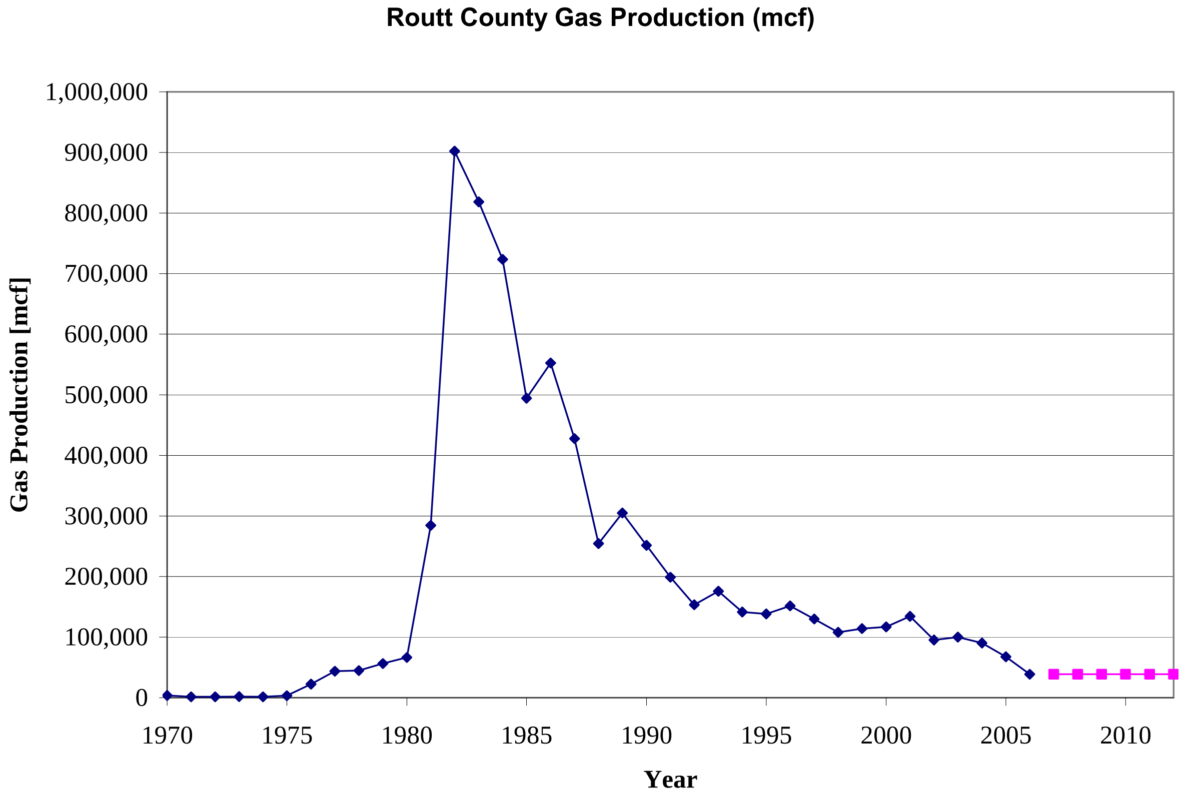

Figure 24. Gas production historical data (from the IHS database) for Routt County and projections to 2012. [23]

Gas production in Routt County has been in significant decline since reaching a peak of approximately 900,000 mcf in 1982. Given the small amount of gas production in Routt County (only a small fraction of a percent of total Piceance Basin gas production), it was conservatively assumed that gas production would remain at 2006 annual levels for the period 2007 – 2012.

[23] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Condensate Production – Condensate production in Routt County has been plotted for the years 1970 – 2006 below in Figure 25, including projections to 2012.

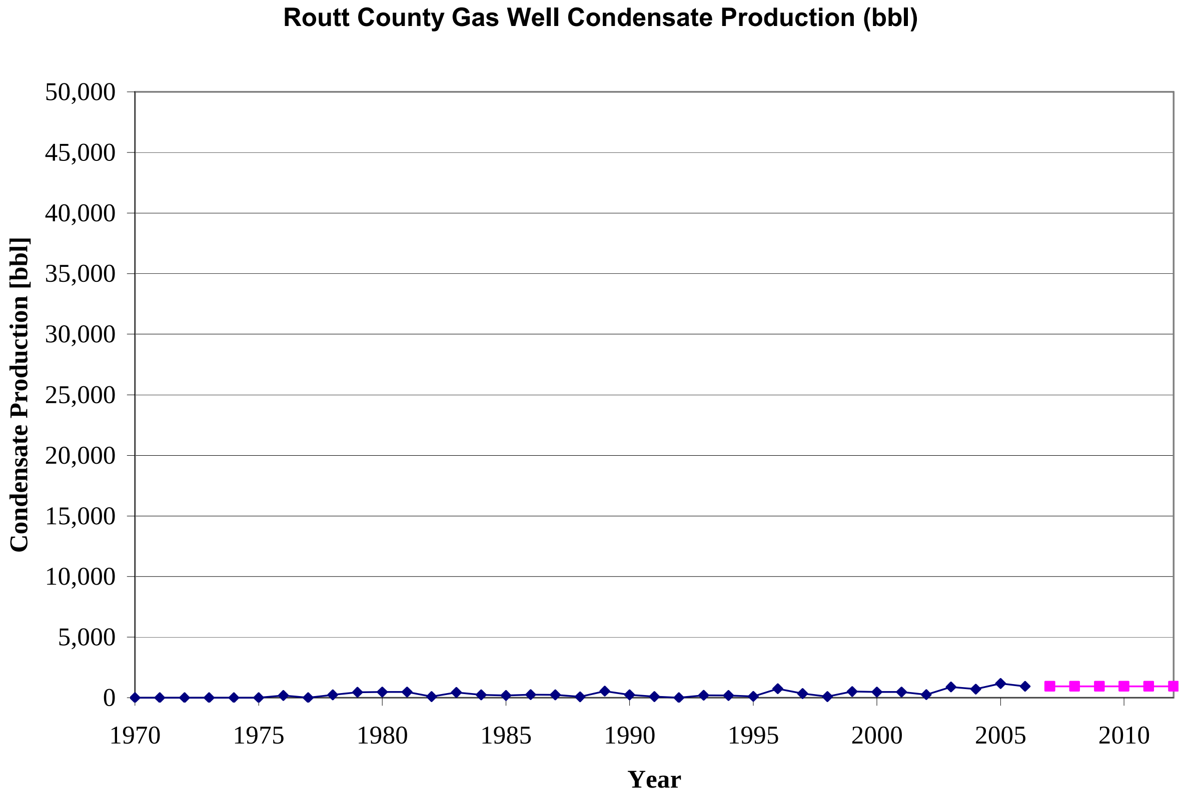

Figure 25. Condensate production historical data (from the IHS database) for Routt County and projections to 2012. [24]

Condensate production in Routt County has historically been negligibly small. The period 2003 – 2006 has seen a negligible but non-zero annual condensate production, and therefore it was conservatively assumed that condensate production would remain at the 2006 annual level for the period 2007 – 2012.

[24] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Oil Production – Oil production in Routt County has been plotted for the years 1970 – 2006 below in Figure 26, including projections to 2012.

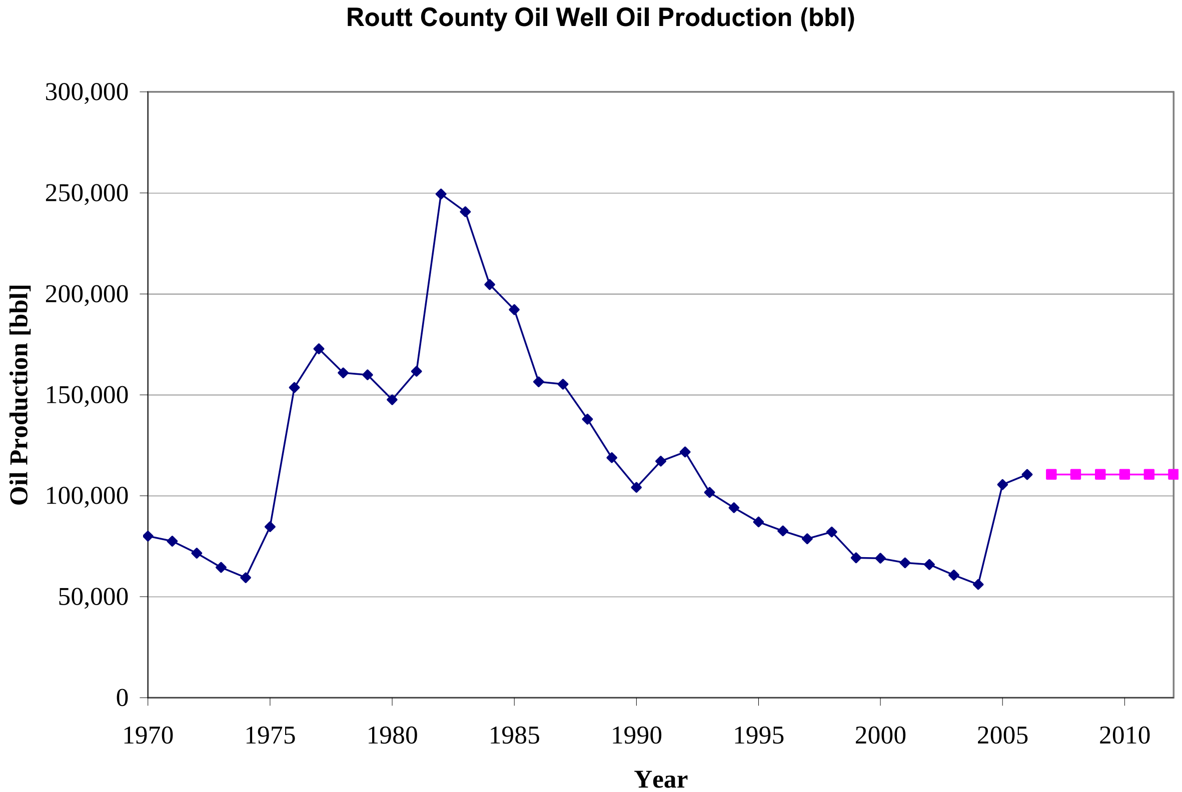

Figure 26. Oil production historical data (from the IHS database) for Routt County and projections to 2012. [25]

Oil production in Routt County has historically been somewhat variable. From a peak in 1982 of approximately 250,000 barrels annually, the county-level oil production has been declining to a minimum of 56,000 barrels annually in 2004. However, in both 2005 and 2006 there has been an increase in oil production, and given no additional information from participating companies, it was conservatively assumed that oil production would remain at the 2006 level for the period 2007 – 2012.

[25] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

All Other Counties

Well Count – Well counts in all other Piceance Basin production counties combined have been plotted for the years 1970 – 2006 below in Figure 27, including projections to 2012.

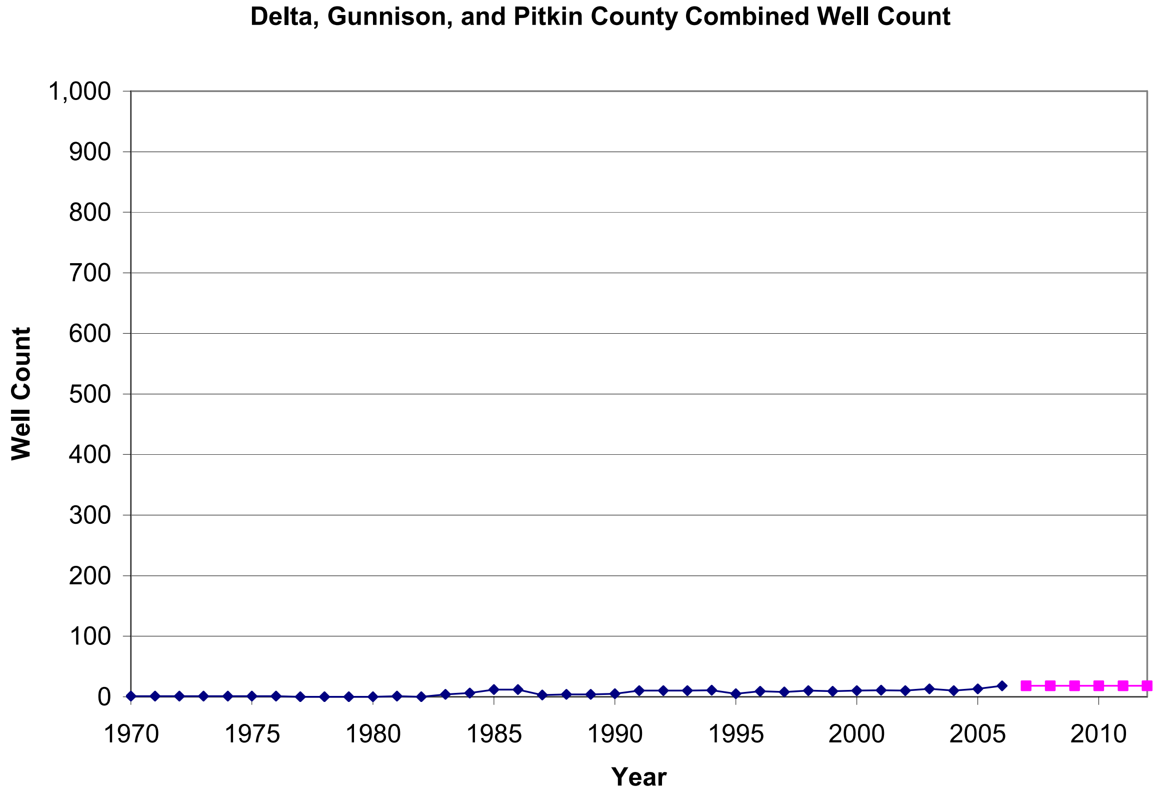

Figure 27. Well count historical data (from the IHS database) for all other production counties in the Piceance Basin combined and projections to 2012. [26]

Combined well counts for Delta, Gunnison and Pitkin Counties have historically been zero or negligibly small. However, as a conservative estimate, well counts are assumed to remain at the 2006 count in the period 2007 – 2012. Well counts are distributed into each of these three counties according to each of their 2006 fractions of total well counts in this combined geographic grouping.

[26] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Spud Counts – Spud counts in all other Piceance Basin production counties combined have been plotted for the years 1970 – 2006 below in Figure 28, including projections to 2012.

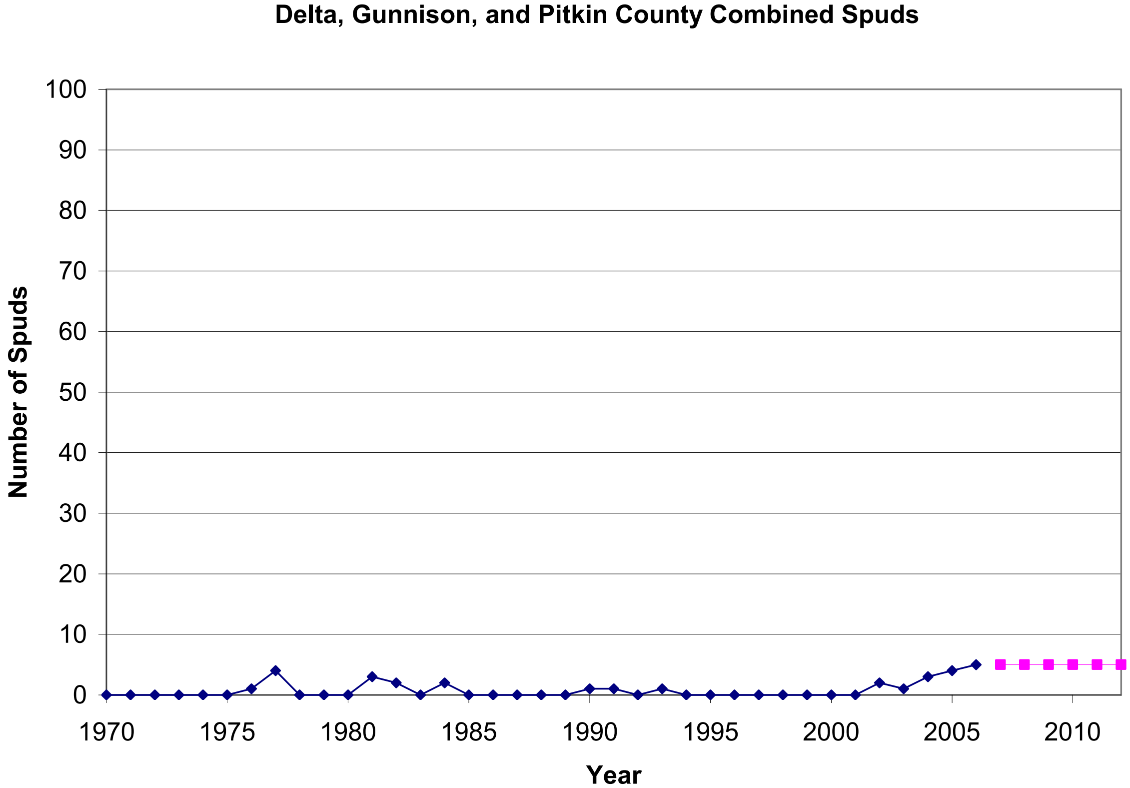

Figure 28. Spud count historical data (from the IHS database) for all other production counties in the Piceance Basin combined and projections to 2012. [27]

Combined spud counts for Delta, Gunnison and Pitkin Counties have historically been zero or negligibly small. However, there has been an increase in the number of annual spuds in the combined county grouping in the period 2003 – 2006, therefore it is conservatively estimated that spud counts in the combined county grouping remain at the 2006 count for the period 2007 – 2012. Spud counts are distributed into each of these three counties according to each of their 2006 fractions of total spud counts in this combined geographic grouping.

[27] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Gas Production – Gas production in all other Piceance Basin production counties combined has been plotted for the years 1970 – 2006 below in Figure 29, including projections to 2012.

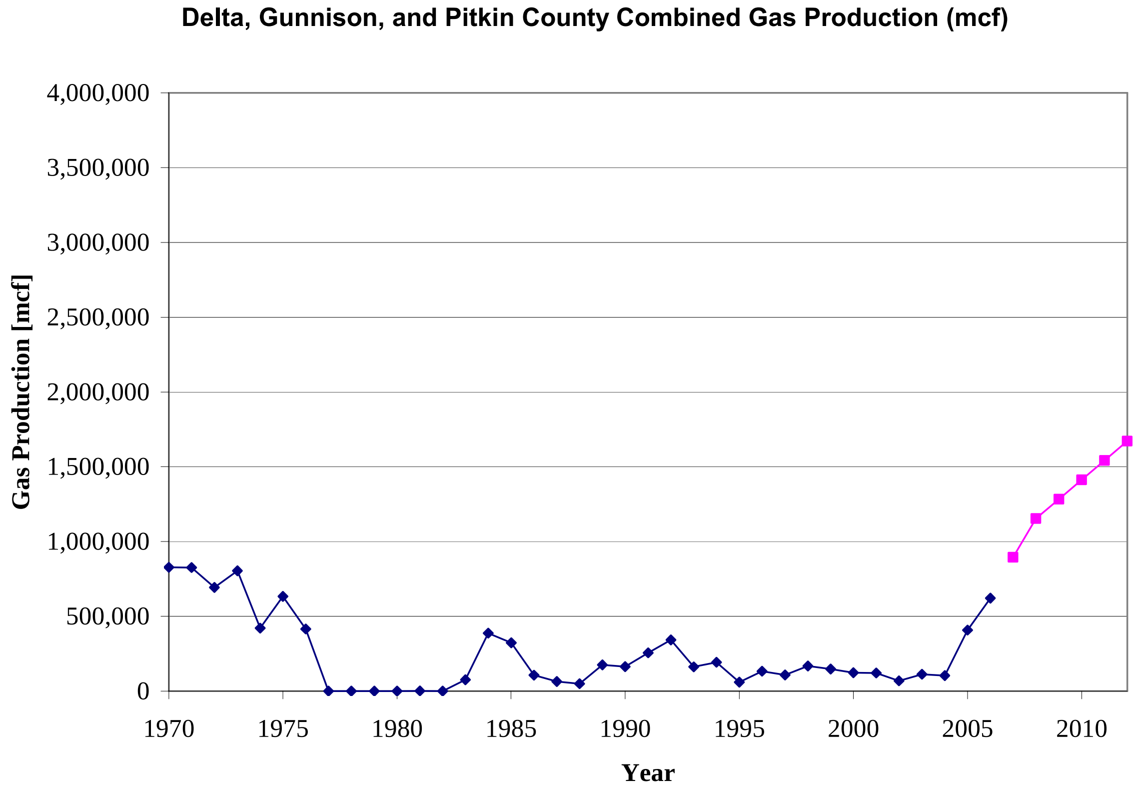

Figure 29. Gas production historical data (from the IHS database) for all other production counties in the Piceance Basin combined and projections to 2012. [28]

Combined gas production for Delta, Gunnison and Pitkin Counties has historically been quite variable and often negligibly small in the period 1970 – 2004. In the period 2004 – 2006 there has been an increase in gas production in this combined county grouping (although this geographic grouping only represents 0.1% of total 2006 Piceance Basin gas production), likely driven by the small increase in drilling in this period. This increase is projected to continue, and a linear best-fit projection is used for the period 2007 – 2008. Similar to Garfield and Rio Blanco Counties, it is projected that this level of activity will decrease in the period 2009 – 2012, and therefore a second linear projection is used for this period with a slope that is reduced 50% from the linear projection for 2007 – 2008.

[28] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Condensate Production – Condensate production in all other Piceance Basin production counties combined has been plotted for the years 1970 – 2006 below in Figure 30, including projections to 2012.

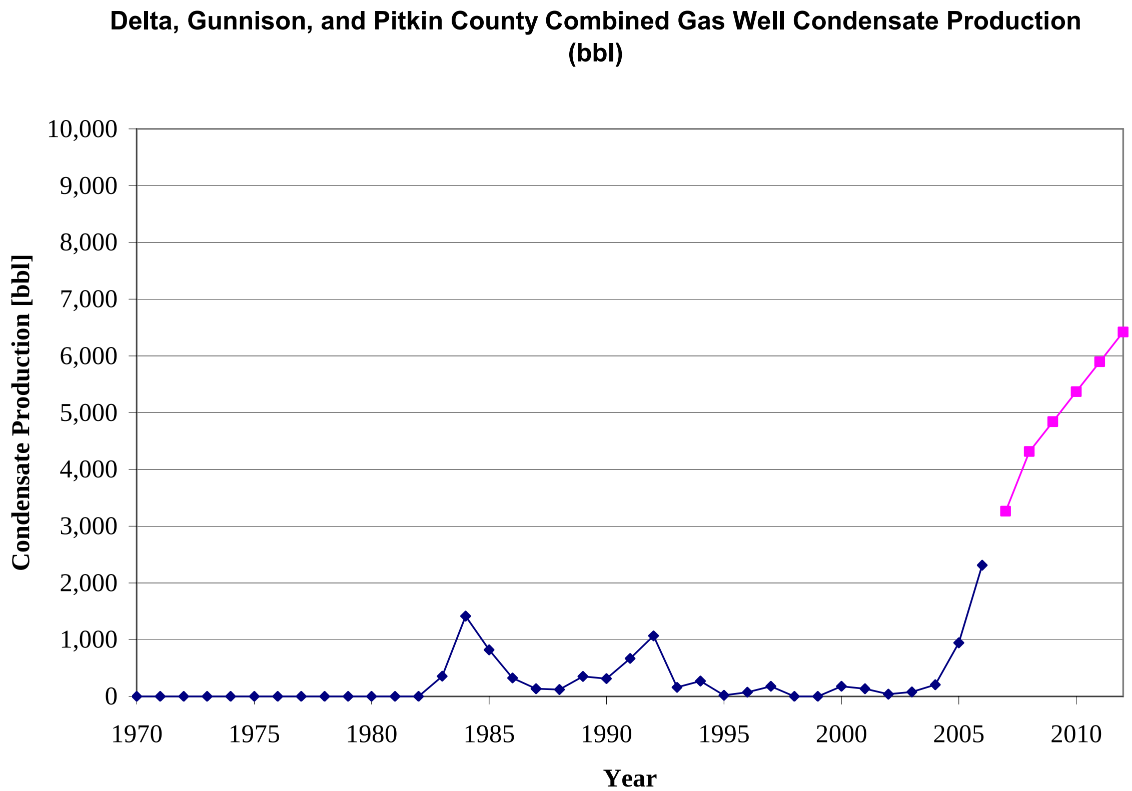

Figure 30. Condensate production historical data (from the IHS database) for all other production counties in the Piceance Basin combined and projections to 2012. [29]

For consistency, the same methodology is used to develop projections for condensate production in Delta, Gunnison and Pitkin Counties in the period 2007 – 2012 as for gas production in this combined county grouping (as shown in Figure 29).

[29] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

Oil Production – Oil production in all other Piceance Basin production counties combined has been plotted for the years 1970 – 2006 below in Figure 31, including projections to 2012.

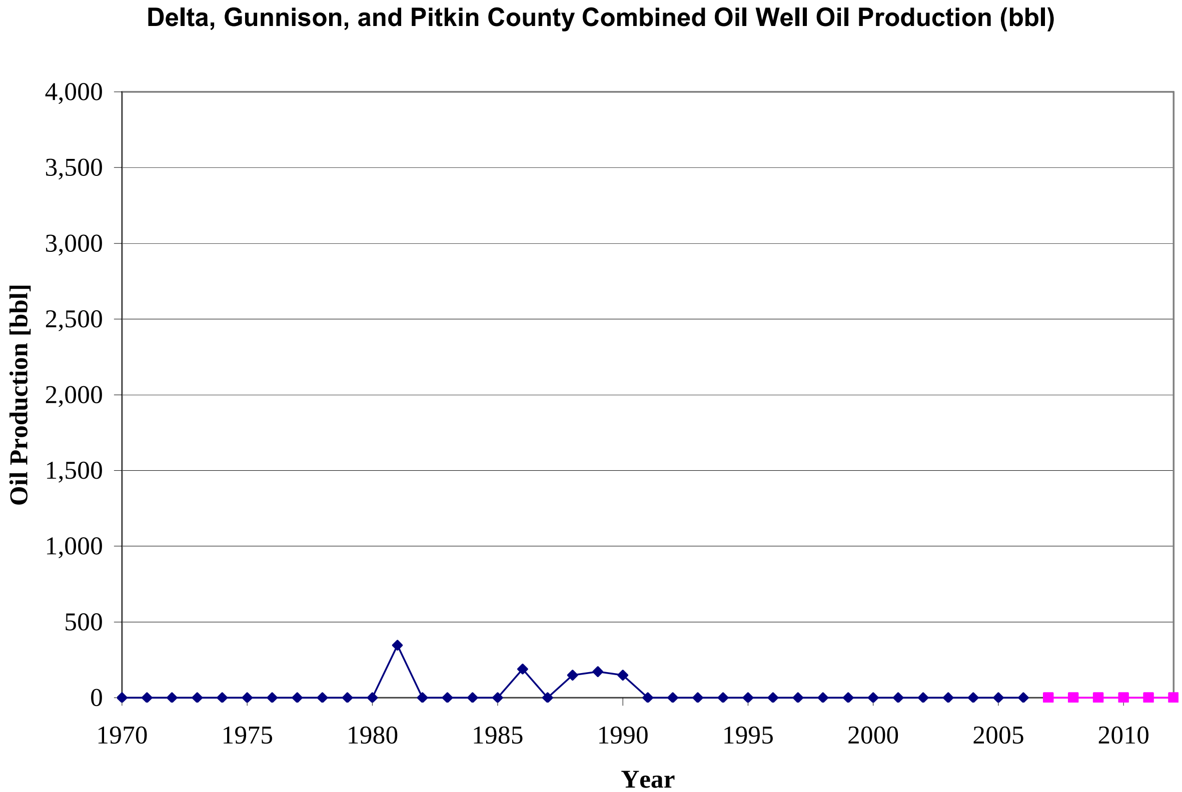

Figure 31. Oil production historical data (from the IHS database) for all other production counties in the Piceance Basin combined and projections to 2012. [30]

Oil production has historically been negligible in the combined county grouping of Delta, Gunnison and Pitkin Counties, and is projected to remain zero throughout the period 2007 – 2012.

[30] (Includes data supplied by IHS Inc., its subsidiary and affiliated companies; Copyright (2009) all rights reserved).

SCALING FACTOR DEVELOPMENT AND UNCONTROLLED 2012 EMISSIONS

Scaling factors were generated for each geographic grouping for each parameter considered here: well count, spud count, gas production, condensate production and oil production. The ratio of the value of each of these parameters in each geographic grouping in 2012 to their values in 2006 is the scaling factor for that parameter for purposes of this projection. A more detailed description is given below for each geographic grouping.

Garfield, Rio Blanco, Mesa, Moffat and Routt Counties

The projected 2012 values of each of the five parameters for Garfield, Rio Blanco, Mesa, Moffat and Routt Counties were ratioed to the value of the respective parameter in 2006, following Equation (2):

Equation (2) $$f_i = W_{2012} / W_{2006}$$

where:

f_i is the scaling factor for Garfield, Rio Blanco, Mesa, Moffat or Routt Counties for parameter i (well count, spud count, gas production, condensate production, or oil production)
W_{2006} is the value of parameter i in 2006
W_{2012} is the projected value of parameter i in 2012

All Other Production Counties in the Piceance Basin

Because all other production counties were combined for purposes of projecting well counts, spud counts, gas production, condensate production and oil production, the projected parameters were apportioned to each county in this grouping based on the 2006 fractions of that county's well count, spud count, gas production, condensate production or oil production. The scaling factors for each county in this grouping are estimated according to Equation (3):

Equation (3) $$f_i = c_{i,county} \times \left(Q_{2012} / Q_{2006} \right)$$

where:

f_i is the scaling factor for each county in the "combined counties" grouping for parameter i (well count, spud count, gas production, condensate production or oil production)
$c_{i,county}$ is the fraction of parameter i for all combined counties that is assigned to each specific county based on 2006 data
Q_{2006} is the value of parameter i in 2006 for all other combined counties
Q_{2012} is the projected value of parameter i in 2012 for all other combined counties

Emissions were therefore projected to 2012 for each county in the Piceance Basin using the scaling factors derived above for each county. Uncontrolled 2012 emissions were estimated according to Equation (4):

Equation (4) $E_{j,county,2012} = f_{i,county} \times E_{j,county,2006}$

where:

$E_{j,county,2012}$ are the projected emissions in a specific county in 2012 for source category *j*
$E_{j,county,2006}$ are the 2006 baseline emissions in a specific county for source category *j*
f_i is the scaling factor for each county for parameter *i* (well count, spud count, gas production, condensate production or oil production)

The scaling factor based on the appropriate parameter (well count, spud count, gas production, condensate production, or oil production) is selected for each source category as described in Table 1. The scaling factors for the five parameters used in this analysis for each of the six geographic groupings in the Piceance Basin are presented in Table 5 below.

Table 5. Scaling factors for the five parameters used in the projection analysis for the six geographic groupings in the Piceance Basin.

Geographic Grouping	Well Count	Spud Count	Gas Production	Condensate Production	Oil Production
Garfield County	1.68	0.41	1.12	1.12	0.00
Rio Blanco County	1.12	0.79	1.04	1.04	1.00
Mesa County	1.81	0.39	1.63	1.63	1.00
Moffat County	1.20	0.45	1.00	1.00	1.00
Routt County	1.00	0.00	1.00	1.00	1.00
All Other Production Counties Combined	1.00	1.00	2.69	2.78	0.00

CONTROLLED 2012 EMISSIONS

This methodology considered any "on-the-books" federal or state regulations that would affect the uncontrolled 2012 emissions projections described above.

Table 6 below lists the "on-the-books" federal and state regulations that affect emissions source categories in the oil and gas industry, and the action taken to adjust the 2012 emissions inventory appropriately. A more detailed description follows of the methodology used to address each of these regulations as they affected the uncontrolled 2012 Piceance Basin emissions projections.

The uncontrolled 2012 emissions were adjusted based on the proposed actions or control factors developed for each regulation described in Table 6 to account for how these regulations may affect any oil and gas source category considered in this inventory. The methodology recognizes that there are a number of voluntary and/or required control measures that have been partially implemented since 2006, and/or will be implemented completely by the calendar year 2012. However, these controls were not incorporated into this base case 2012 projection, but rather could form part of the controls to be included in a future control scenario.

Table 6. Summary of federal and state "on-the-books" regulations affecting the oil and gas source categories considered in this inventory.

Source Category	Regulation	Enforcing Agency	Effective Date	Implementation in the 2012 Piceance Basin Emissions Projections
Federal				
Drill Rigs, Workover Rigs	Nonroad engine Tier standards (1-4) (EPA, 2005)	US EPA	Phase in from 1996 - 2014	EPA NONROAD model used to create county-level control factors for the drill rig SCC to account for fleet turnover.
Drill Rigs, Workover Rigs	Nonroad diesel fuel sulfur standards (EPA, 2006)	US EPA	Phase in beginning in 2010	Assume 15 ppm sulfur in nonroad diesel fuel throughout Piceance Basin. Control factors derived from EPA NONROAD model (see above).
All New Spark-Ignited Stationary Engines	New Source Performance Stds. (NSPS) (EPA, 2008)	US EPA	Phase in from 2008 - 2011	Control factors developed considering the specific composition of engines in the inventory but determined to not be applicable to the Piceance Basin engine inventory due to gas production decline (see below).
State				
Engines	Regulation 7 (CDPHE, 2008)	CDPHE	Phase in from 2007 – 2011	NOx and VOC controls required for new or relocated engines in Colorado on a phase-in schedule. However, by 2012 the federal NSPS is fully phased in and equally stringent, so this regulation was not applied.
Glycol Dehydrators	Regulation 7 (CDPHE, 2008)	CDPHE	May 2008	Apply a control factor of 90% on still vent emissions for any glycol dehydrator emitting more than 15 tpy VOC.
Condensate Tanks	Regulation 7 (CDPHE, 2008)	CDPHE	May 2008	Apply 95% control to any tank emitting more than 20 tpy VOC.

Nonroad Diesel Engine Standards and Fuel Sulfur Standards

The EPA NONROAD2005 model was run with fuel inputs based on a 2002 study entitled "WRAP Mobile Sources Emission Inventory Update" (Pollack, et al., 2006). The model outputs were used to develop county-level emissions per unit population for "other oil field equipment" (SCC 2270010010) for the calendar year 2006, and then separately for the calendar year 2012. These emissions per unit population reflect the predicted fleet mix of engines – for various tier standards from baseline uncontrolled engines through Tier IV engines – and are used as a representation of fleet turnover for drilling rigs and workover rigs. The ratios of the per unit emissions in 2012 to those in 2006 for each county of interest were taken to be the control factors accounting for federal non-road tier standards.

In addition, the NONROAD model runs with the fuel inputs used for developing the tier standards control factors were also used to develop the control factors for SOx emissions factors for drilling rigs and workover rigs. The model is capable of tracking the expected reduction in fuel sulfur content from the baseline 2006 year – assumed to be the same as the WRAP 2002 inventory – and the 2012 future year. A similar approach was used as for the federal tier standards to develop control factors. The ratio of per unit SOx emissions in 2012 to those in 2006 were taken to be a control factor to apply to uncontrolled 2012 SOx emissions for drilling rigs and workover rigs to account for federal non-road diesel fuel standards.

New Source Performance Standards for Stationary Spark-Ignited Engines

The EPA has promulgated a new regulation covering new stationary, spark-ignited engines of various horsepower classes. The regulation is assumed to apply to central compressor engines, wellhead and lateral compressor engines, and artificial lift engines as well as any other miscellaneous APEN exempt engines that are stationary, spark-ignited natural gas engines. The regulation requires new engines of various horsepower classes to meet increasingly stringent NOx and VOC emission standards over the phase-in period of the regulation.

For engines less than 25 horsepower, Table 7 shows the requirements of the NSPS regulation.

Table 7. Federal NSPS emissions standards for engines less than 25 horsepower.

HP Range[a]	Emissions Standards Requirement in (g/hp-hr)[b]		
	HC + NOx	NMHC + NOx[c]	CO
≤ 25 Hp			
Class I	16.1 (12.0)	14.8 (11.0)	610 (455)
Class I -A	50-37	-	-
Class I -B	40 (30)	37 (27.6)	
Class II	12.1 (9.0)	11.3 (8.4)	

[a] Class I-A: Engines with displacement less than 66 cubic centimeters (cc); Class 1-B: Engines with displacement greater than or equal to 66cc and less than 100cc; Class I: Engines with displacement greater than or equal to 100 cc and less than 225 cc

[b] Modified and reconstructed engines manufactured prior to July 1, 2008, must meet the standards applicable to engines manufactured after July 1, 2008

[c] NMHC+NOX standards are applicable only to natural gas fueled engines at the option of the manufacturer, in lieu of HC+NOX standards

For engines in the horsepower range 25 – 100 horsepower, Table 8 shows the requirements of the NSPS regulation.

Table 8. Federal NSPS emissions standards for engines greater than 25 horsepower but less than 100 horsepower.

HP Range	Manufacture Date	Emissions Standards Requirement (g/hp-hr)	
		HC + NOx	CO
25<HP<100	1-Jul-08	3.8	6.5
	1-Jul-08 (severe duty)	3.8	200

For engines in the horsepower range 100 – 1,350 horsepower, Table 9 shows the requirements of the NSPS regulation.

Table 9. Federal NSPS emissions standards for engines greater than 25 horsepower but less than 100 horsepower.

Engine Type and Fuel	HP Range	Manufacture Date	Emissions Standards Requirement (g/hp-hr)		
			NOx	CO	VOC
Non-Emergency SI Natural Gas and Non-Emergency SI Lean Burn LPG	100≤HP<500	1-Jul-08	2	4	1
		1-Jan-11	1	2	1
Non-Emergency SI Lean Burn Natural Gas and LPG	500≥HP<1350	1-Jan-08	2	4	1
		1-Jul-10	1	2	1
Non-Emergency SI Natural Gas and Non-Emergency SI Lean Burn LPG (except lean burn 500≥HP<1350)	HP≥500	1-Jul-07	2	4	1

A detailed analysis was carried forward to analyze the effects of this rule on the permitted and unpermitted engine fleet in the Piceance Basin. The analysis assumed that new compressors were added if new compression was needed, and that the driver for new compression requirement is growth in gas production. The analysis further assumed that if there was no growth in gas production or a decline in gas production for any part of the 2007 – 2012 time period, that no new compression would be installed and existing compressors would continue to operate (i.e. that no engine turnover would occur). This is a conservative assumption, but was considered reasonable based on information from participating companies on the typical in-use service life of compressor engines. However, this analysis recognizes that further study is needed to better quantify typical in-use median life for gas compressor engines of various size ranges, and this analysis should be revised if additional data becomes available.

The detailed engine-level analysis to quantify the effects of the NSPS on the Piceance Basin fleet concluded that the small effect of the NSPS on the fleet during the period from Jan. 2008 – Jul. 2008 was outweighed by the subsequent decline in gas production projected for the basin from Jul. 2008 – 2012. The resulting control factor was sufficiently close to 1 to be considered negligible for this analysis, and therefore no additional effects of the NSPS regulation were considered.

State of Colorado Regulation 7 – Glycol Dehydrators

As part of the State of Colorado Regulation 7 – the regulation to control VOC emissions – there are control requirements for large glycol dehydrators emitting 15 tpy or greater of VOC. To implement this rule the APENs database was used, since it is assumed that any glycol dehydrator emitting greater than 15 tpy would be permitted in Colorado. The regulation requires a 90% control of VOC emissions from existing and new dehydrators that meet the emissions requirement, beginning in May 2008. For purposes of this inventory it was assumed that the regulation would be fully implemented by the 2012 projection year, with a rule effectiveness of 1. The still vent emissions for any glycol dehydrator whose total VOC emissions were equal to or greater than 15 tpy were identified, and controlled by 90% per the requirements of the regulation.

State of Colorado Regulation 7 – Condensate Tanks

This part of the State of Colorado Regulation 7 requires that new and existing condensate tanks emitting greater than 20 tpy VOC would be required to install controls meeting a 95% VOC control efficiency (i.e. flaring or equivalent control system) beginning in May of 2008. Because condensate tanks were treated wholly as an unpermitted source category for purposes of this inventory, an analysis was conducted to determine the portion of the baseline 2006 condensate tank emissions and the projection year 2012 uncontrolled emissions that would be applicable to this regulation. For existing condensate tanks, the APENs database was used to determine the fraction of tanks by number with emissions exceeding the 20 tpy VOC threshold for the regulation. This was determined to be 51.7% for the Piceance Basin. A control factor of 95% was applied to the portion of condensate tank emissions corresponding to the base year 2006 emissions. For additional emissions arising from growth in condensate production in the Piceance Basin in the period 2007 – 2012, COGCC data was used to determine that approximately 63% of new wells drilled were multiple wells drilled from a single pad (Colorado Oil & Gas Conservation Commission, 2008). It was assumed that these would be routed to a large tank battery capable of storing condensate production from multiple wells. The remaining 37% of new wells drilled would be served by a single, stand-along condensate tank. It was conservatively assumed that for all 63% of wells with large tank batteries these tanks would emit greater than 20 tpy, and thus be applicable to the regulation. A control factor of 95% was applied to 63% of the additional per well condensate tank emissions resulting from growth in condensate production from the baseline year of 2006.

SUMMARY RESULTS

The scaling factors were applied to the baseline 2006 inventory, and "on-the-books" regulations were applied to the uncontrolled 2012 emissions projections to generate the final 2012 emissions projections and results are presented below.

Figure 32 shows that Garfield and Rio Blanco Counties account for the majority of Piceance Basin projected NOx emissions in 2012, with minor NOx emissions contributions from Mesa and Moffat Counties. This is consistent with the county-level NOx emissions fractional allocation in 2006. Figure 33 shows that Garfield County alone accounts for the large majority of projected VOC emissions in 2012.

Figure 34 shows that compressor engines are the predominant NOx emissions source category in 2012, accounting for approximately 64% of total basin-wide NOx emissions. The proportional contribution of drill rigs to the NOx inventory in 2012 is smaller than in 2006, likely because of the projection of decreased drilling activity in the Piceance Basin in this period. Figure 35 shows that venting from initial completions and blowdowns and VOC emissions from glycol dehydrators and pneumatic devices combined make up approximately 60% of total VOC emissions in the Piceance Basin in 2012. Similar to the baseline 2006 inventory, venting from initial completions remains the largest VOC source category.

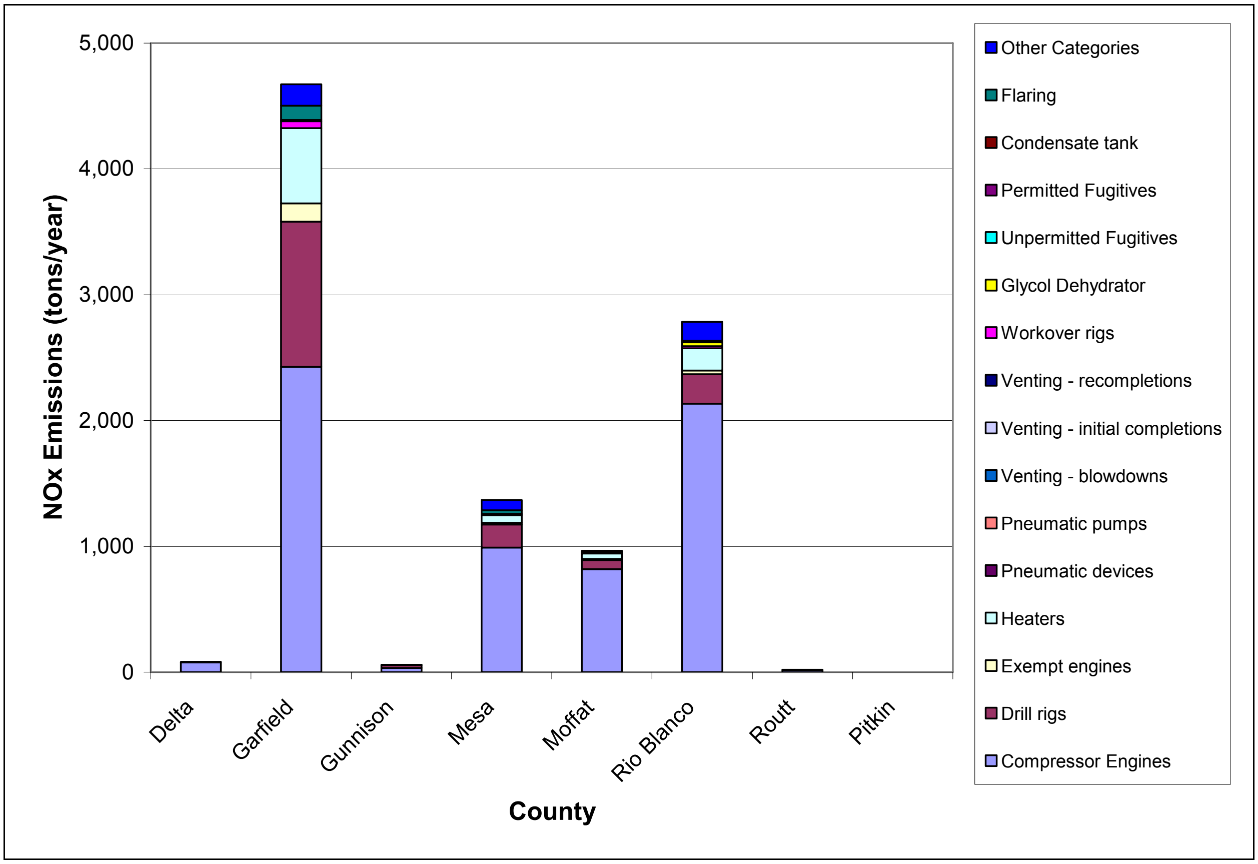

Figure 32. 2012 NOx emissions by source category and by county in the Piceance Basin.

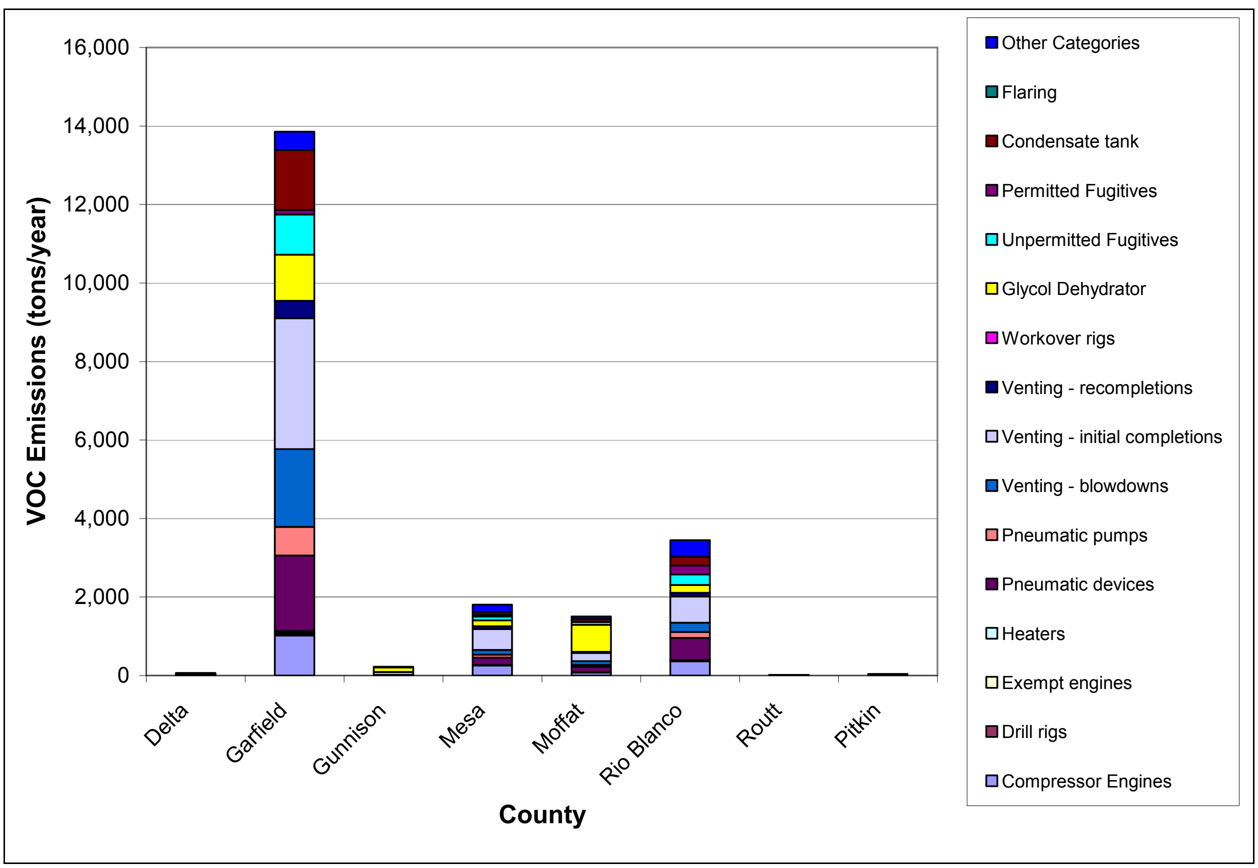

Figure 33. 2012 VOC emissions by source category and by county in the Piceance Basin.

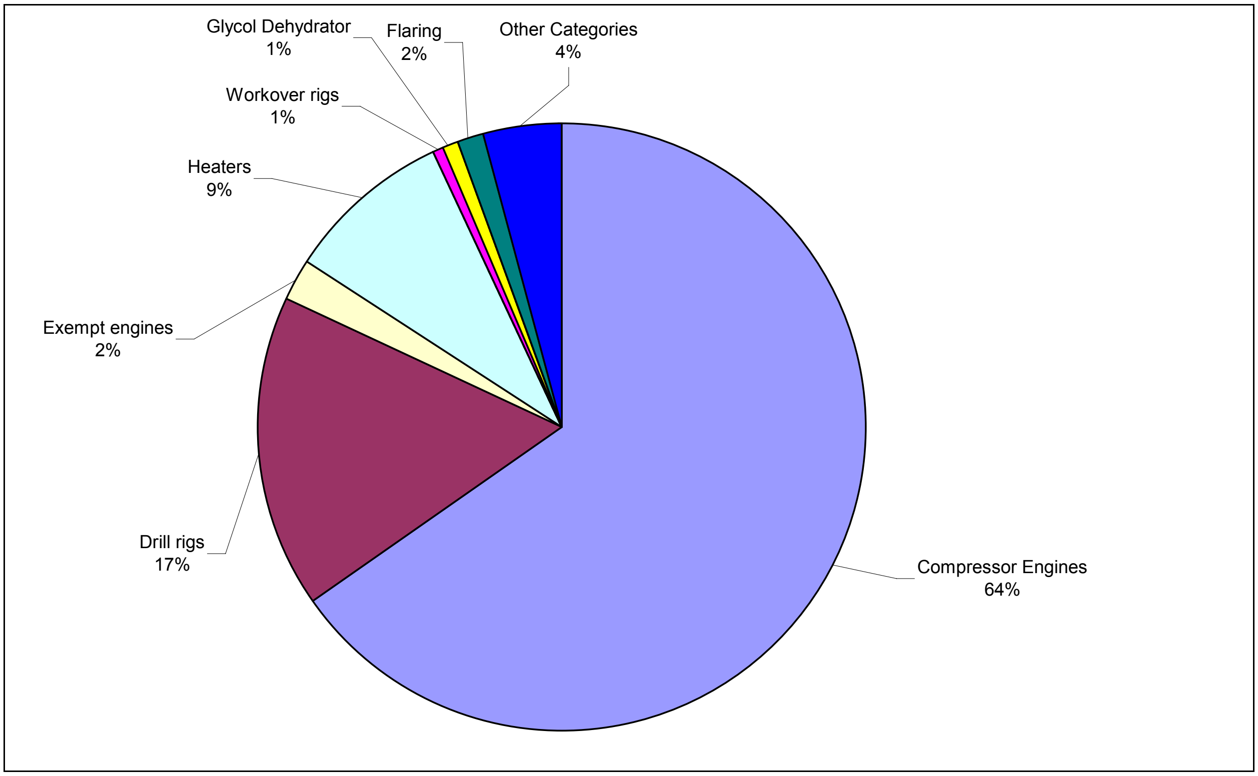

Figure 34. 2012 NOx emissions contributions by source category in the Piceance Basin.

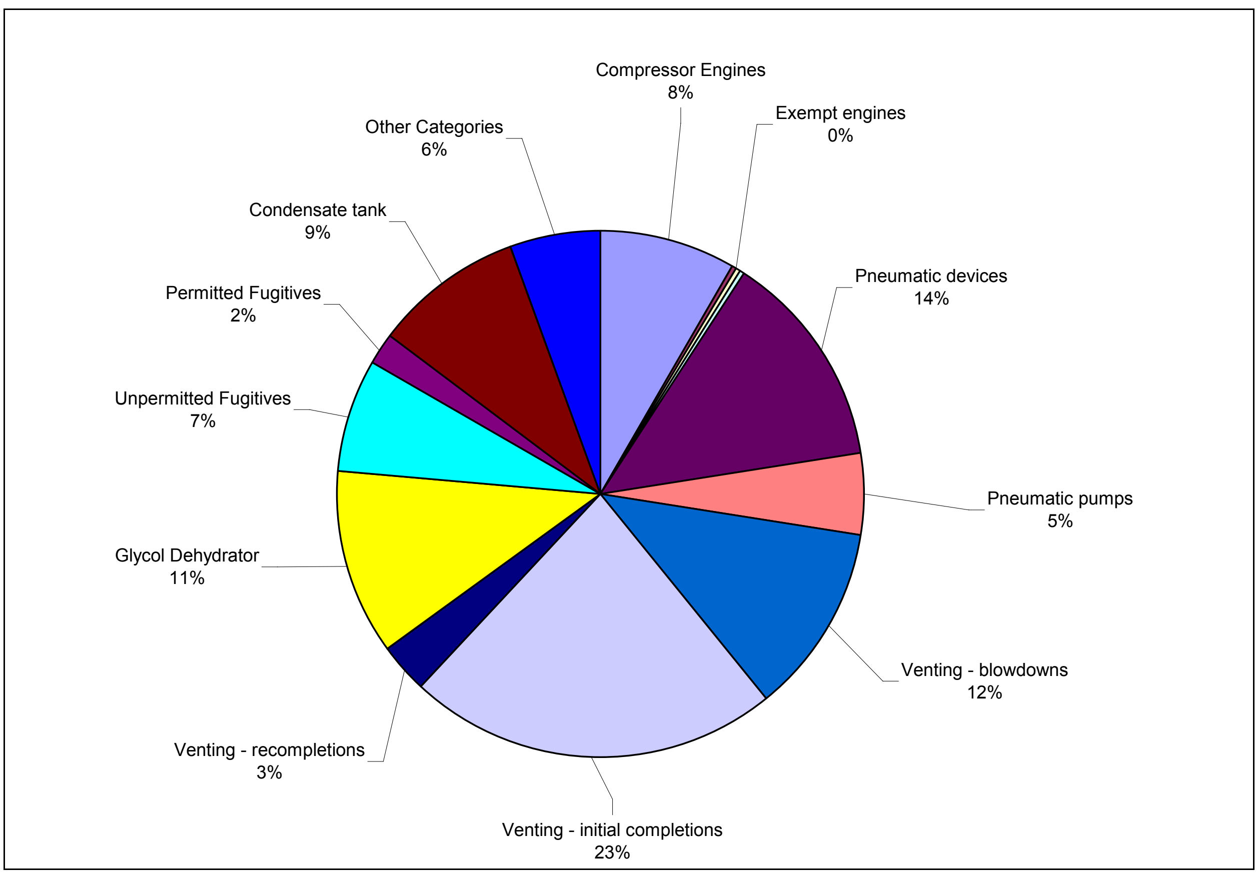

Figure 35. 2012 VOC emissions contributions by source category in the Piceance Basin.

Table 10. 2012 emissions of all criteria pollutants by county for the Piceance Basin.

County	NOx [tons/yr]	VOC [tons/yr]	CO [tons/yr]	SOx [tons/yr]	PM [tons/yr]
Chaffee	0	0	0	0	0
Delta	82	66	120	0	2
Eagle	0	0	0	0	0
Garfield	4,672	13,854	3,583	5	188
Gunnison	59	226	46	0	2
Lake	0	0	0	0	0
Mesa	1,368	1,807	1,236	3	39
Moffat	965	1,508	726	1	21
Pitkin	0	41	0	0	0
Rio Blanco	2,785	3,445	1,948	67	122
Routt	20	15	9	0	0
Totals	**9,951**	**20,962**	**7,668**	**77**	**374**

Table 11. 2012 NOx emissions [ton/yr] by county and by source category for the Piceance Basin**.**

County	Compressor Engines	Drill Rigs	Exempt engines	Heaters	Workover Rigs	Glycol Dehydrators	Flaring	Other Categories	Totals
Chaffee	0	0	0	0	0	0	0	0	0
Delta	78	3	0	1	0	0	0	0	82
Eagle	0	0	0	0	0	0	0	0	0
Garfield	2,426	1,155	145	600	54	10	114	170	4,672
Gunnison	33	22	0	1	0	1	2	0	59
Lake	0	0	0	0	0	0	0	0	0
Mesa	990	183	14	59	5	6	27	83	1,368
Moffat	819	72	9	45	4	9	6	1	965
Pitkin	0	0	0	0	0	0	0	0	0
Rio Blanco	2,134	233	29	178	16	32	11	151	2,785
Routt	17	0	0	2	0	0	0	0	20
Totals	**6,497**	**1,668**	**197**	**886**	**79**	**58**	**161**	**405**	**9,951**

Table 12. 2012 VOC emissions [ton/yr] by county and by source category for the Piceance Basin.

County	Compressor Engines	Pneumatic devices	Pneumatic pumps	Venting – blowdowns	Venting – initial completions	Venting – recompletions	Glycol Dehydrator	Unpermitted Fugitives	Permitted Fugitives	Condensate Tanks	Other Categories	Totals
Chaffee	0	0	0	0	0	0	0	0	0	0	0	0
Delta	19	2	1	1	9	1	7	1	0	0	24	66
Eagle	0	0	0	0	0	0	0	0	0	0	0	0
Garfield	1019	1,919	734	1977	3,336	441	1,173	1,023	121	1521	592	13,854
Gunnison	5	3	1	8	64	9	113	2	0	7	15	226
Lake	0	0	0	0	0	0	0	0	0	0	0	0
Mesa	253	190	72	125	529	70	150	101	47	66	205	1,807
Moffat	74	143	45	100	208	28	687	71	8	77	70	1,508
Pitkin	0	0	0	0	0	0	41	0	0	0	0	41
Rio Blanco	364	569	149	233	674	89	200	268	227	223	448	3,445
Routt	3	8	0	0	0	0	0	3	0	1	0	15
Totals	**1,736**	**2,833**	**1,002**	**2,444**	**4,820**	**637**	**2,371**	**1,468**	**403**	**1,895**	**1,354**	**20,962**

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