

**Region C Water Planning Group  
Mining Demand Projections**

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PREPARED FOR: Region C Water Planning Group  
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**Mining Projections Background**

The 2006 Region C Plan (hereafter referred to as the 2006 Plan) included projections for municipal demands, as well as non-municipal demands such as irrigation, livestock, manufacturing, mining, and steam-electric power. Municipal water demand projections in the 2006 Plan were based on per capita dry-year water use and the adopted population projections. Projections of the mining demand relied on the analysis of historical trends and Texas Water Development Board (TWDB) draft projections. The TWDB projections included water use associated with secondary recovery processes for oil and gas and non-fuel mining operations. However, the TWDB projections did not include water consumption associated with the recent surge in Barnett Shale exploration activities in Region C. Barnett Shale activities occur primarily in the following Region C counties: Cooke, Dallas, Denton, Ellis, Jack, Parker, Tarrant, and Wise. A summary of the mining consumption projections from the 2006 Plan is included in Table 1. The purpose of this memorandum is to examine additional mining water consumption associated with Barnett Shale activities for the purpose of updating mining projections for the 2011 Region C Plan.

**Table 1. 2006 Region C Mining Water Consumption Projections**

County	Year						
	2000	2010	2020	2030	2040	2050	2060
Cooke County	289	321	334	341	348	355	361
Dallas County	2,910	2,910	2,910	2,910	2,910	2,910	2,910
Denton County	139	341	341	341	341	341	341
Ellis County	90	90	90	90	90	90	90
Jack County	433	433	433	433	433	433	433
Parker County	75	98	112	122	132	142	150
Tarrant County	342	433	484	519	554	589	616
Wise County	17,441	23,627	27,824	30,530	33,303	36,168	38,866
All other Region C counties	3,760	1,987	2,033	2,064	2,095	2,127	2,153
<b>Region C Total</b>	<b>25,479</b>	<b>30,240</b>	<b>34,561</b>	<b>37,350</b>	<b>40,206</b>	<b>43,155</b>	<b>45,920</b>

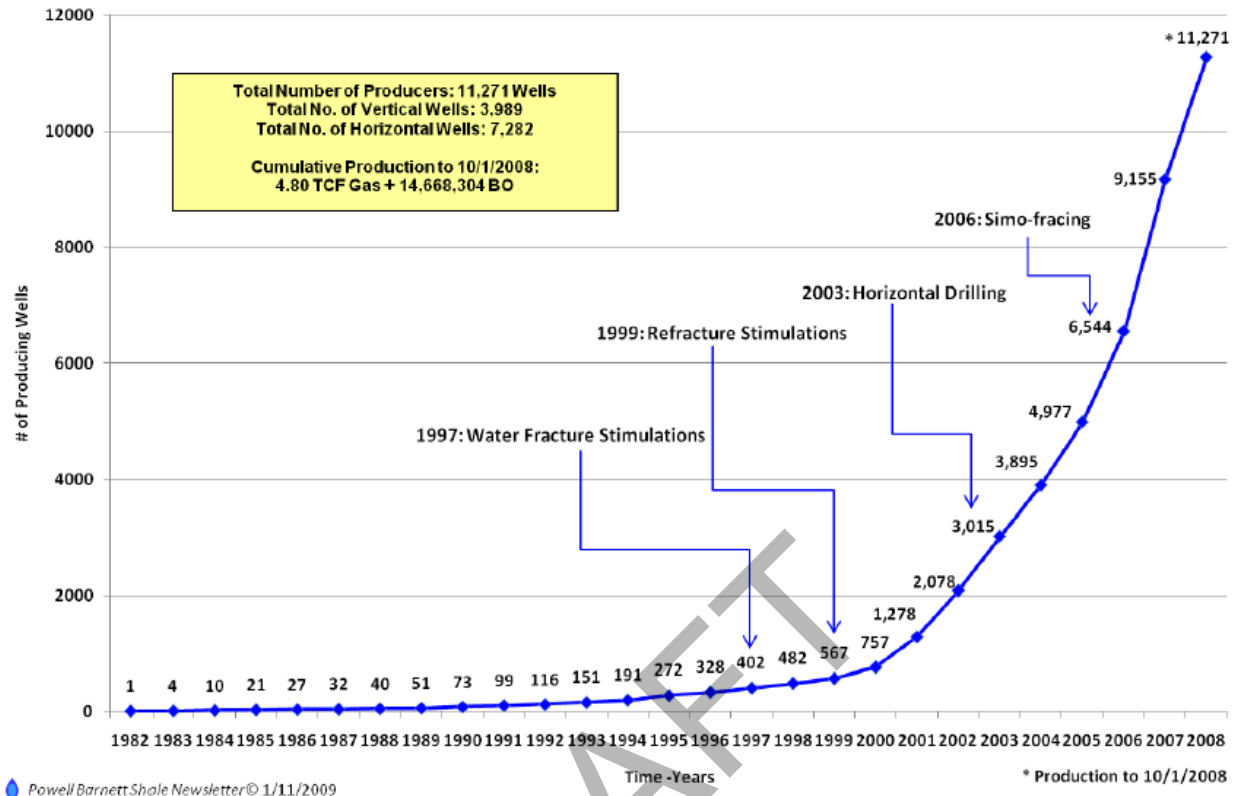
### Barnett Shale Water Use

The water consumption associated with gas drilling operations while short in duration, is significant, with typical vertical completions consuming approximately 1.2 million gallons, and typical horizontal well completions consuming 3.0 to 3.5 million gallons of fresh water.<sup>1</sup> Since the 2006 planning cycle, the number of producing wells in the Barnett Shale has doubled in Region C from 6,544 to 11,271 (see Figure 1)<sup>2</sup>. Several reports have developed or cited both water consumption estimates and short-term projections. A summary of available reports and the information they include is located in Table 2.

<sup>1</sup> TWDB, Northern Trinity/Woodbine GAM Assessment of Groundwater Use in the Northern Trinity Aquifer Due To Urban Growth and Barnett Shale Development, 2007.

<sup>2</sup>The Barnett Shale News, accessed online at <http://barnettshalenews.com/documents/Powell%20Barnett%20Shale%20Newsletter%20January%2012%202009.pdf>

**Figure 1. Number of Producing Barnett Shale Wells as of October 1, 2008\***



\*Graph represents the Fort Worth Basin, which includes counties outside of Region C. The Fort Worth Basin consists of Johnson, Tarrant, Ellis, Dallas, Denton, Wise, Parker, Hill, Somervell, Hood, Jack, Erath, Palo Pinto, Eastland, Montague, Cooke, Clay, Hamilton, Bosque, Stephens, Comanche. The six highest volume of production counties in the Fort Worth Basin are Johnson, Tarrant, Ellis, Dallas, Denton, and Wise counties.

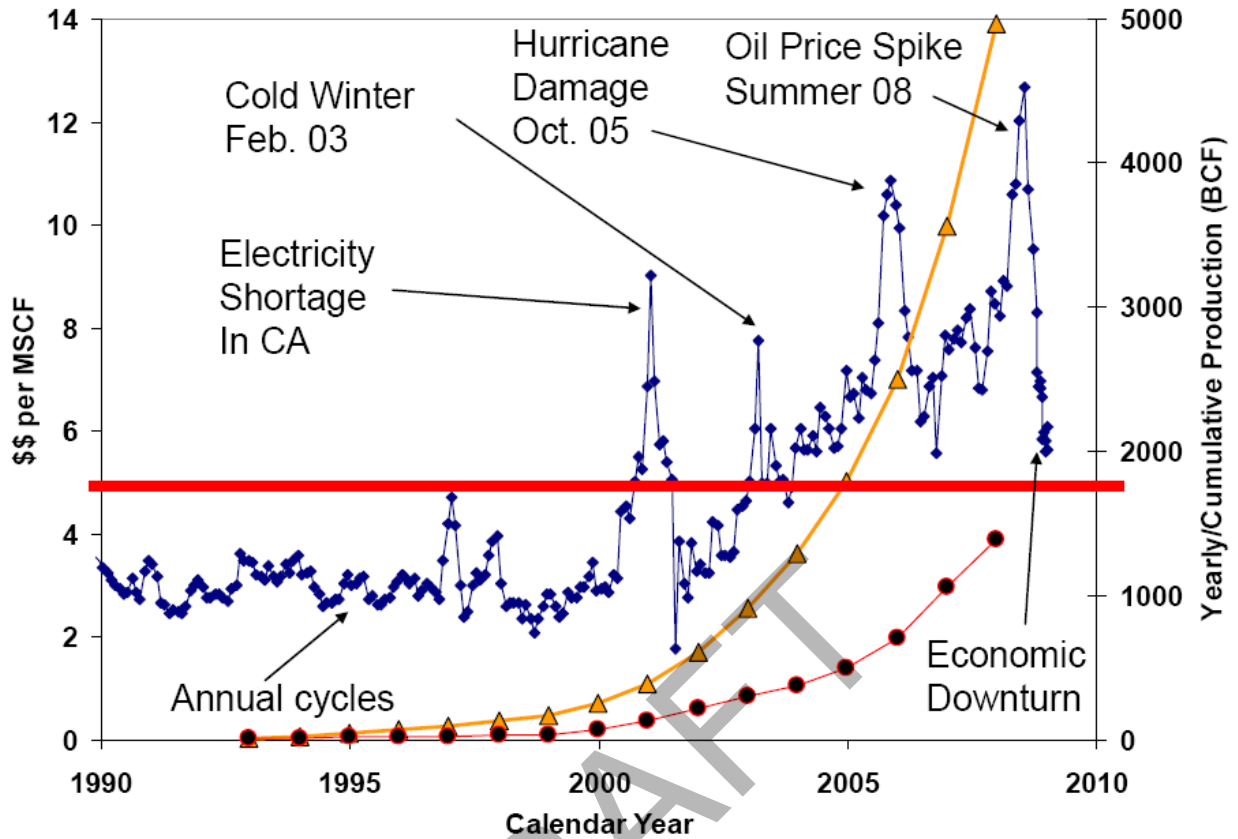
**Table 2. Reference Table**

Reference	Publish Date	Producing Well Count	Historical Consumption	Projections
Powell Barnett Shale Newsletter	monthly	X		
Fort Worth Basin/Barnett Shale Natural Gas Play: An Assessment of Present and Projected Fresh Water Use	April 2007	X	X	X
Northern Trinity/Woodbine GAM Assessment of Groundwater Use in the Northern Trinity Aquifer Due To Urban Growth and Barnett Shale Development	January 2007	X	X	X

In 2007, the TWDB, in conjunction with a research project team consisting of R.W. Harden and Associates, Inc., Freese and Nichols, Inc., and the University of Texas at Austin Bureau of Economic Geology, developed the “Trinity/Woodbine GAM Assessment of Groundwater Use in the Northern Trinity Aquifer Due To Urban Growth and Barnett Shale Development” (hereafter referred to as the 2007 Report). The objective and purpose of this research project was to (1) estimate current and future pumping of groundwater due to urban growth, (2) estimate current and future pumping of groundwater for fracture enhancement to improve gas well production in the Barnett Shale, and (3) simulate how this pumping may affect the Trinity and Woodbine aquifers. Although the study focused on groundwater use, short-term projections were developed for total water use in the Barnett Shale.

Water use projections for gas drilling are highly uncertain and are dependent on the price of gas. In addition, a large amount of statistical data is not available due to the short history of drilling in the Barnett shale. The uncertainty associated with gas prices lead to the development of high, medium, and low scenarios to account for different market conditions in the 2007 Report. Other important factors include geologic risk factors in the Barnett (maturity of the shale, thickness of the formation, presence of features limiting or hampering well completion), technological factors (horizontal vs. vertical wells, water recycling), operational factors (number of well completions that can be done in a year, proximity of a fresh-water source), and regulatory factors. The high scenario cumulates most of the high-end water use of the previous parameters, whereas the low scenario uses the low values of their range. At the time the report was published, gas prices were relatively high (see Figure 2). Since the publish date of the 2007 Report, gas prices have dropped significantly. Figure 3 provides both the high, medium, and low scenarios as well as surveyed historical water usage for 2005, 2006, and 2007. For these three years, the actual water usage fell between the medium and high scenarios and were consistent with the projection scenarios.

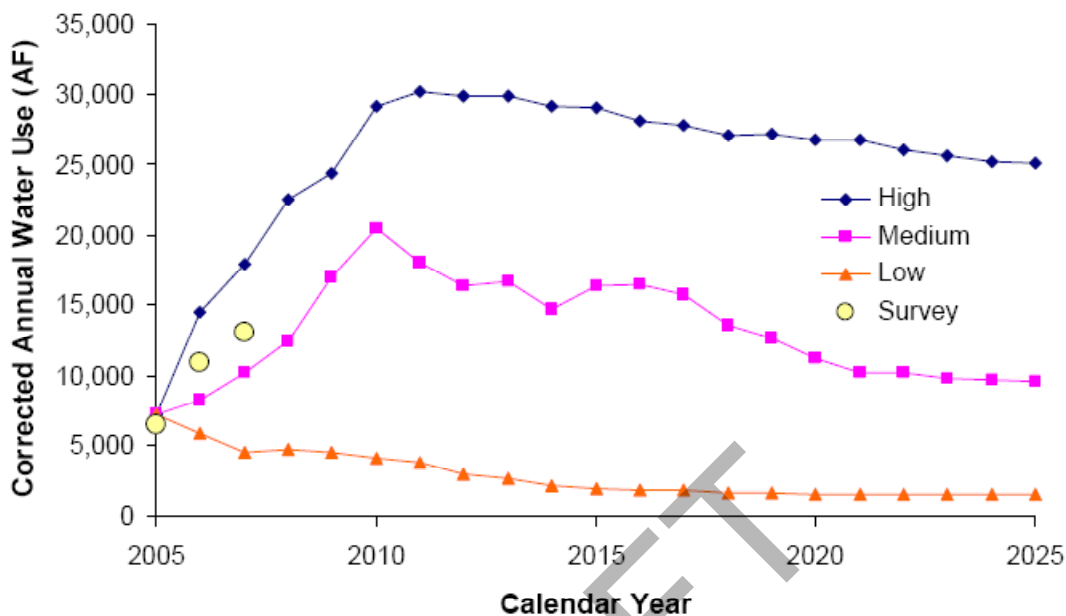
Figure 2. Natural Gas Prices



<sup>3</sup> Notes: The price of natural gas (\$ per thousand cubic feet) and Barnett Shale gas annual (lower smooth line) and cumulative (upper smooth line) production (in billions of cubic feet) since 1990 (EIA and RRC websites). The horizontal line at \$5 represents the usually accepted lower limit. Events explaining natural gas price ups and downs are displayed in the plot.

<sup>3</sup> Jean-Philippe Nicot, Assessment of Industry Water-Use in the Barnett Shale Gas Play (Fort Worth Basin), 2009.

**Figure 3. 2007 Short Term Projects and Surveyed Water Use**



<sup>4</sup> Notes: Water use projections for the high, medium, and low scenario in acre-feet (1 AF = 325,851 gallons) (A) Projected frac total water use (including surface water); and (B) projected frac ground water use. Survey points were obtained from Galusky (2007). The survey points are consistent with initial projection scenarios.

<sup>4</sup> Jean-Philippe Nicot, Assessment of Industry Water-Use in the Barnett Shale Gas Play (Fort Worth Basin), 2009.

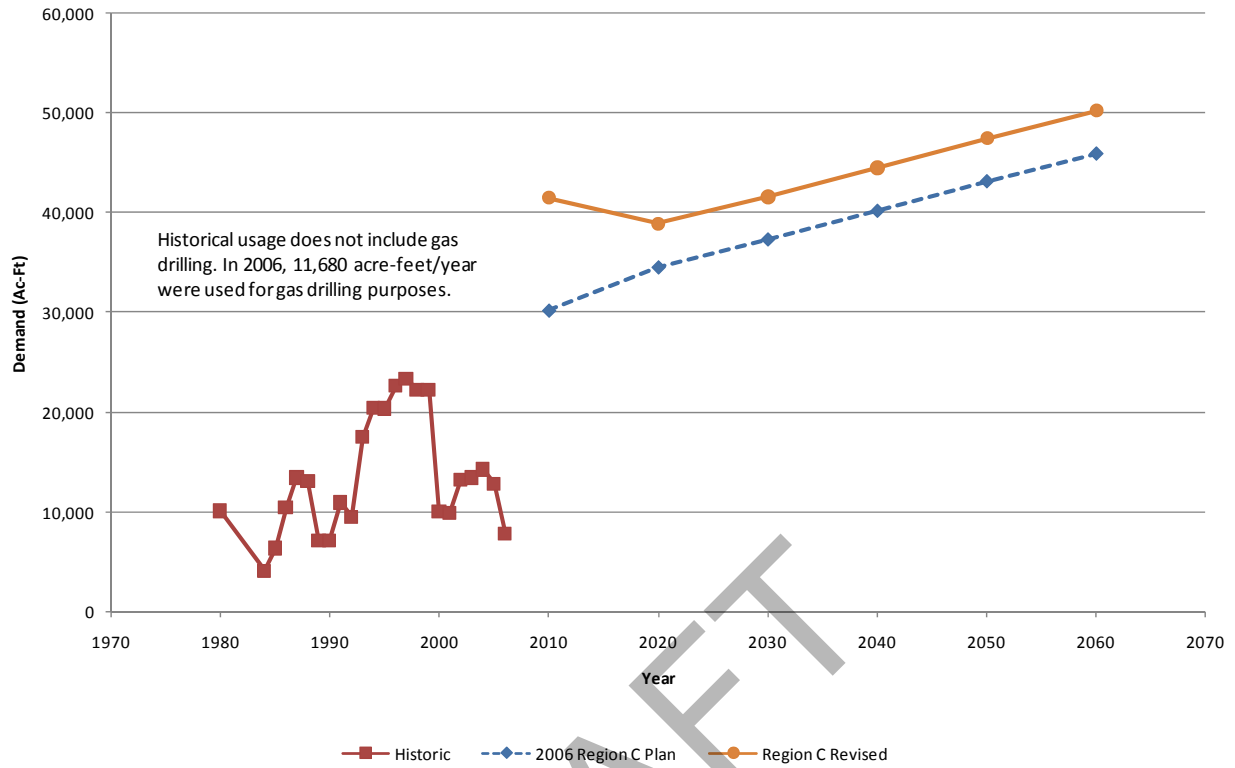
## Proposed Projections

The 2007 Report developed short term projections through the year 2025 for Barnett Shale Water Use. An activity weighting curve was developed and included an initial ramp, a peak, a decrease, and a long tail. The tail extends for 50 years after the initial drilling year until total extraction of the resource has occurred. The tail period starts in Year 11, and the first 10 years account for 27% of the maximum number of completions/maximum water use of the scenario considered. During the tail period, each year accounts for 1.5% of the maximum number of completions/maximum water use of the scenario considered. For Region C counties with Barnett Shale exploration, the 2007 Report's medium projection was used through 2025 because of consistency with surveyed usage in the area. The high projection was not chosen due to the recent decline in production. After 2030, the tail period assumptions were used to extend the projections through the year 2060. It should be noted that the BEG was awarded a study by the TWDB to analyze mining water use throughout the state and develop demand projections for the 50-year planning horizon. These projections should be utilized in subsequent planning cycles.

**Table 7. Proposed 2011 Region C Projections (using High Scenario)**

County	2011 Region C Proposed					
	2010	2020	2030	2040	2050	2060
Collin	341	341	341	341	341	341
Cooke	361	484	421	428	435	441
Dallas	2,980	3,040	3,030	3,030	3,030	3,030
Denton	1,571	751	751	751	751	751
Ellis	210	140	140	140	140	140
Fannin	12	12	12	12	12	12
Freestone	116	126	132	138	144	149
Grayson	1,052	1,050	1,049	1,048	1,047	1,046
Henderson	265	302	327	352	378	399
Jack	993	983	973	973	973	973
Kaufman	79	80	81	82	83	84
Navarro	89	89	89	89	89	89
Parker	5,868	1,702	1,692	1,702	1,712	1,720
Rockwall	33	33	33	33	33	33
Tarrant	1,073	904	939	974	1,009	1,036
Wise	26,477	28,924	31,620	34,393	37,258	39,956
<b>Region C Total</b>	<b>41,520</b>	<b>38,961</b>	<b>41,630</b>	<b>44,486</b>	<b>47,435</b>	<b>50,200</b>
<b>2006 Plan Region C Total</b>	<b>30,240</b>	<b>34,561</b>	<b>37,350</b>	<b>40,206</b>	<b>43,155</b>	<b>45,920</b>

**Figure 2. Comparison of Region C Steam Electric Water Use Projections**



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**Attachment A**  
**Projection Comparisons**  
**Including Proposed Region C 2011 Projections**

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**Figure A-1. Region C Mining Demands**

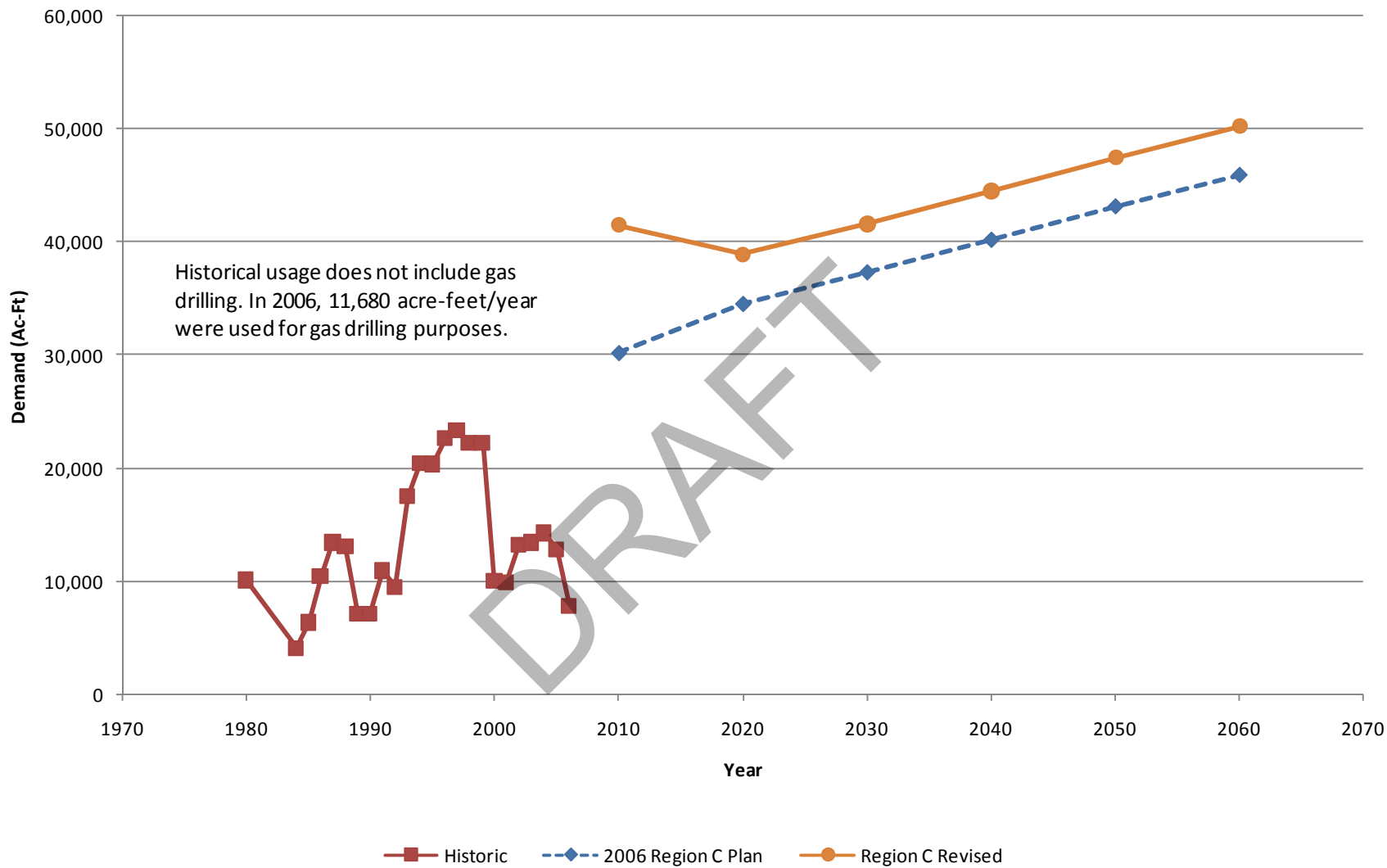
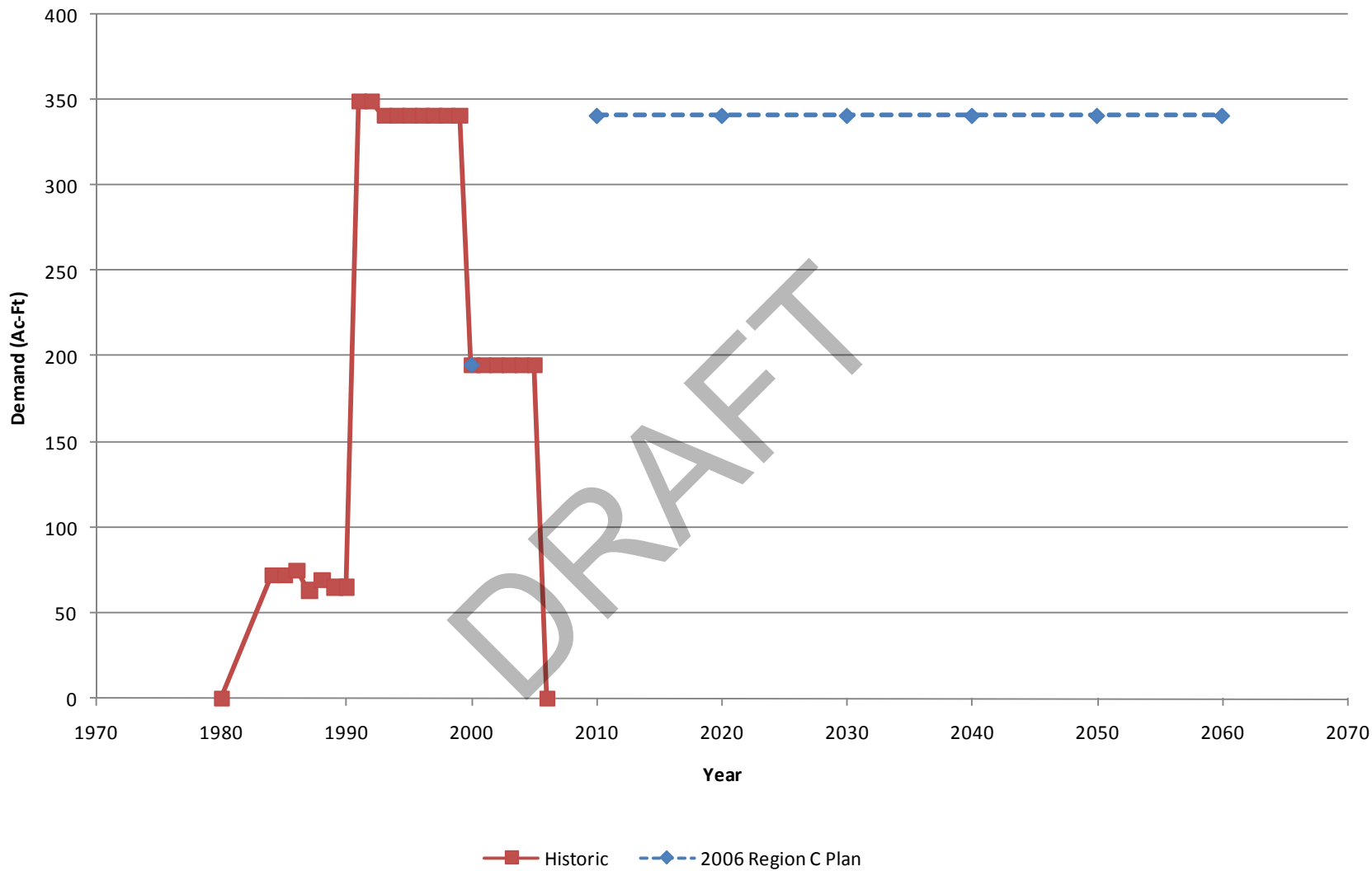


Figure A-2. Collin County Mining Demands



**Figure A-3. Cooke County Mining Demands**

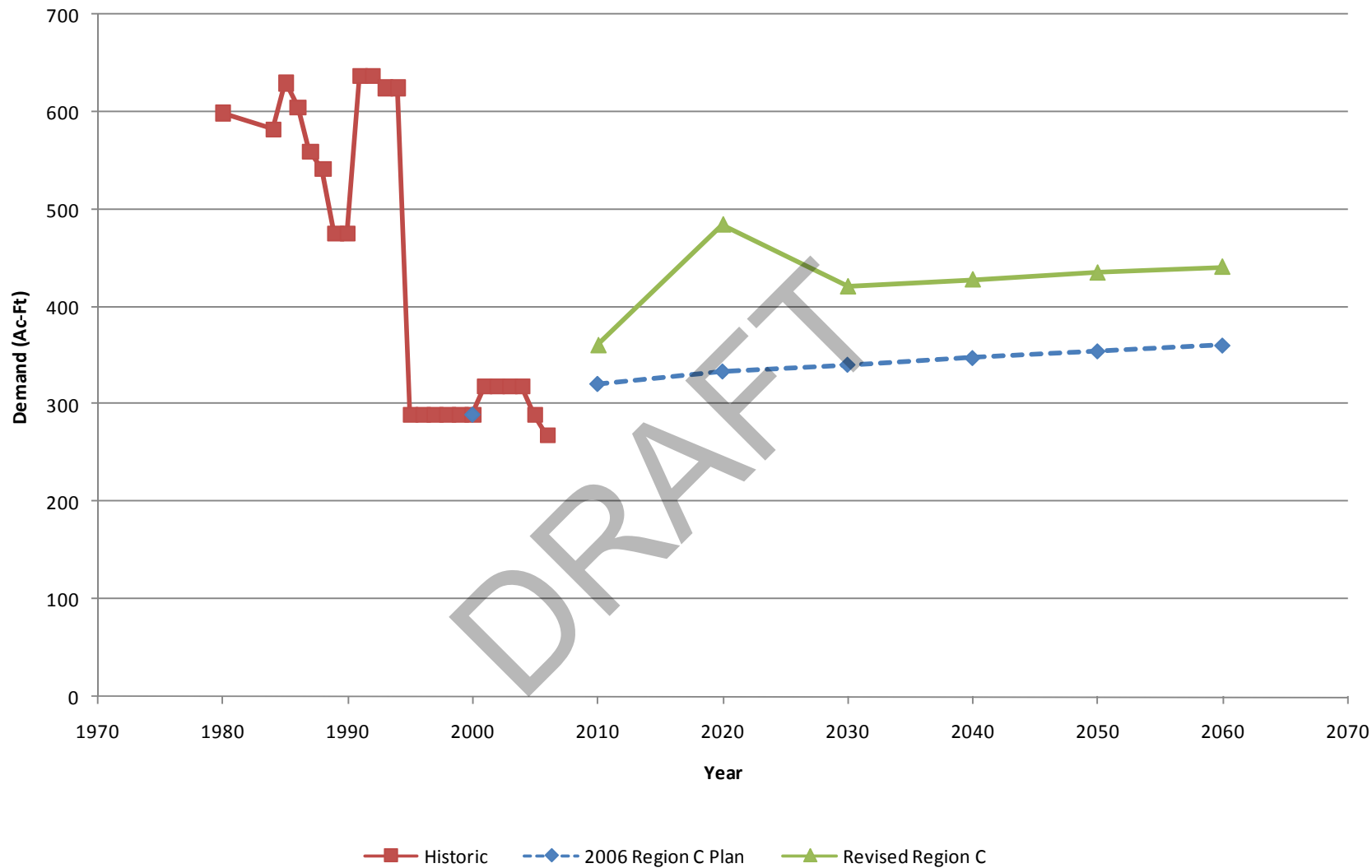


Figure A-4. Dallas County Mining Demands

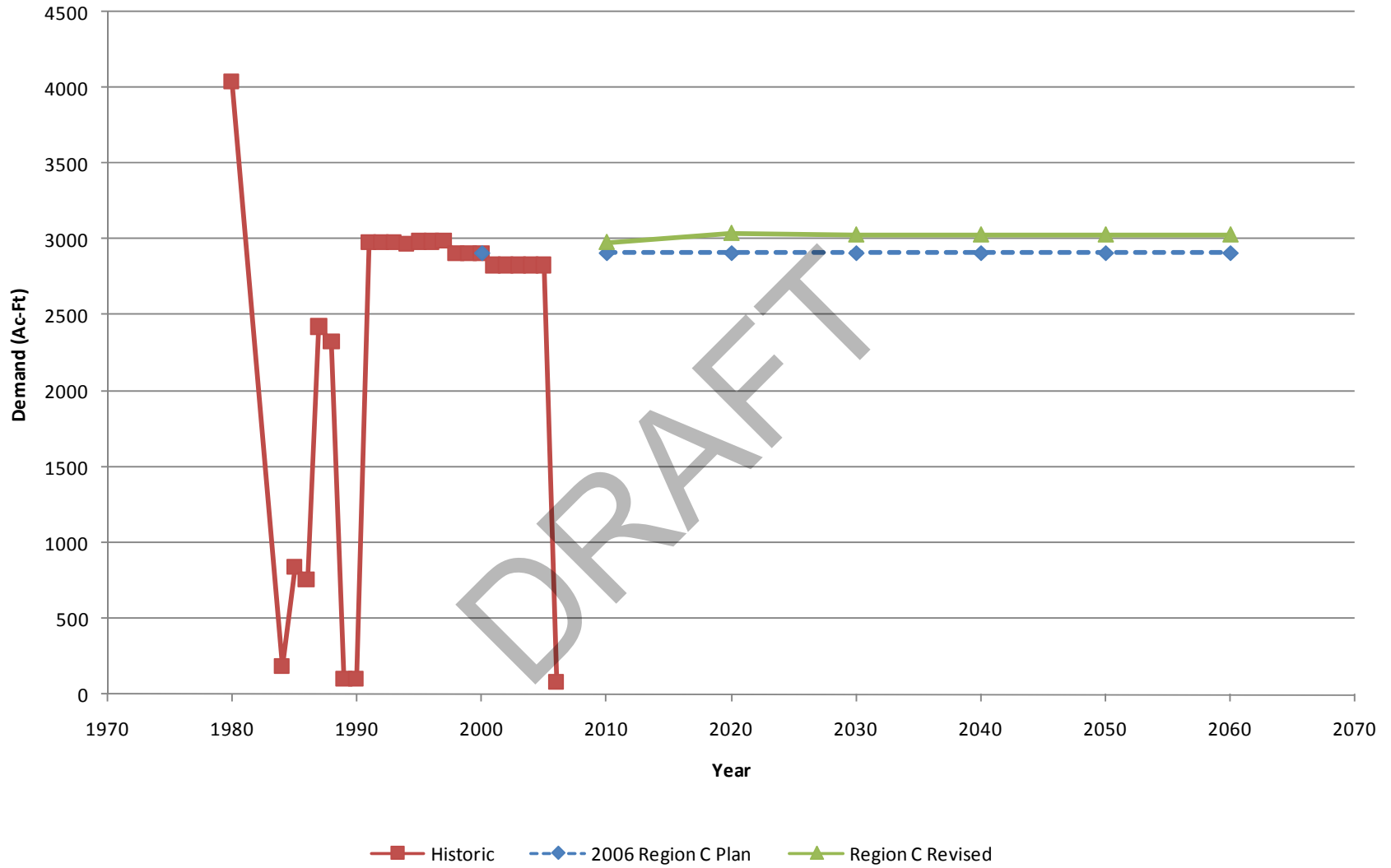


Figure A-5. Denton County Mining Demands



Figure A-6. Ellis County Mining Demands



Figure A-7. Fannin County Mining Demands

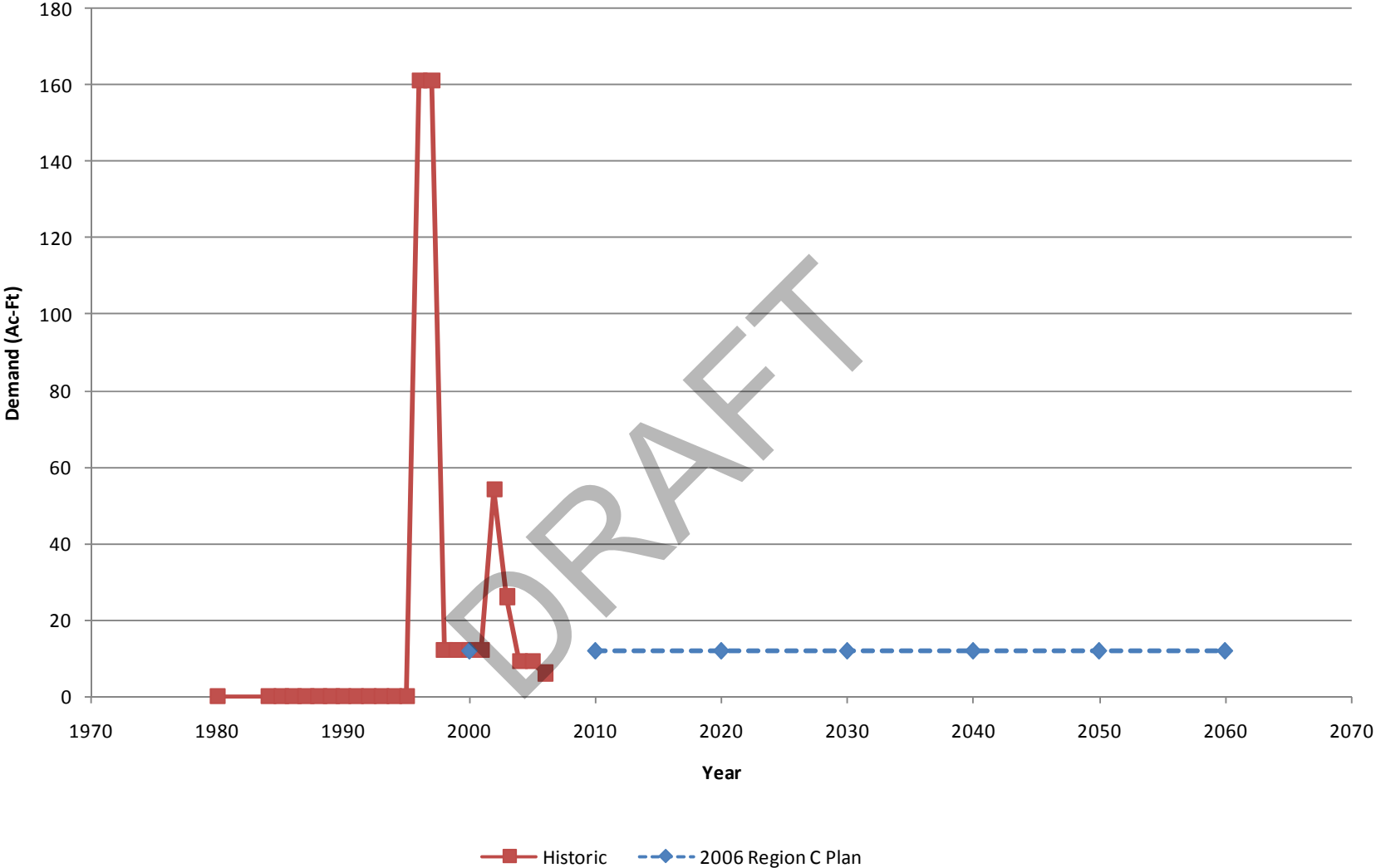
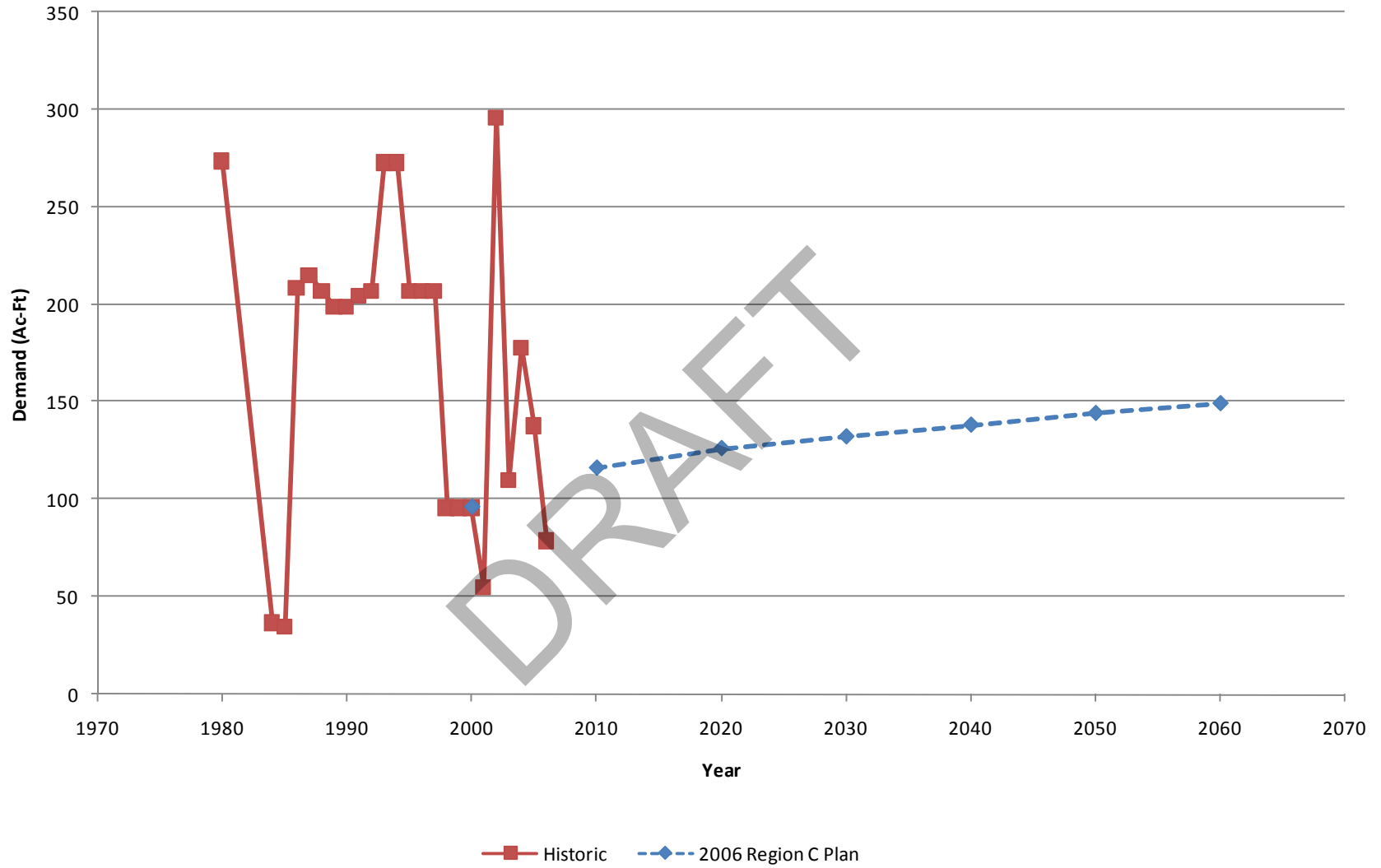




Figure A-8. Freestone County Mining Demands



**Figure A-9. Grayson County Mining Demands**

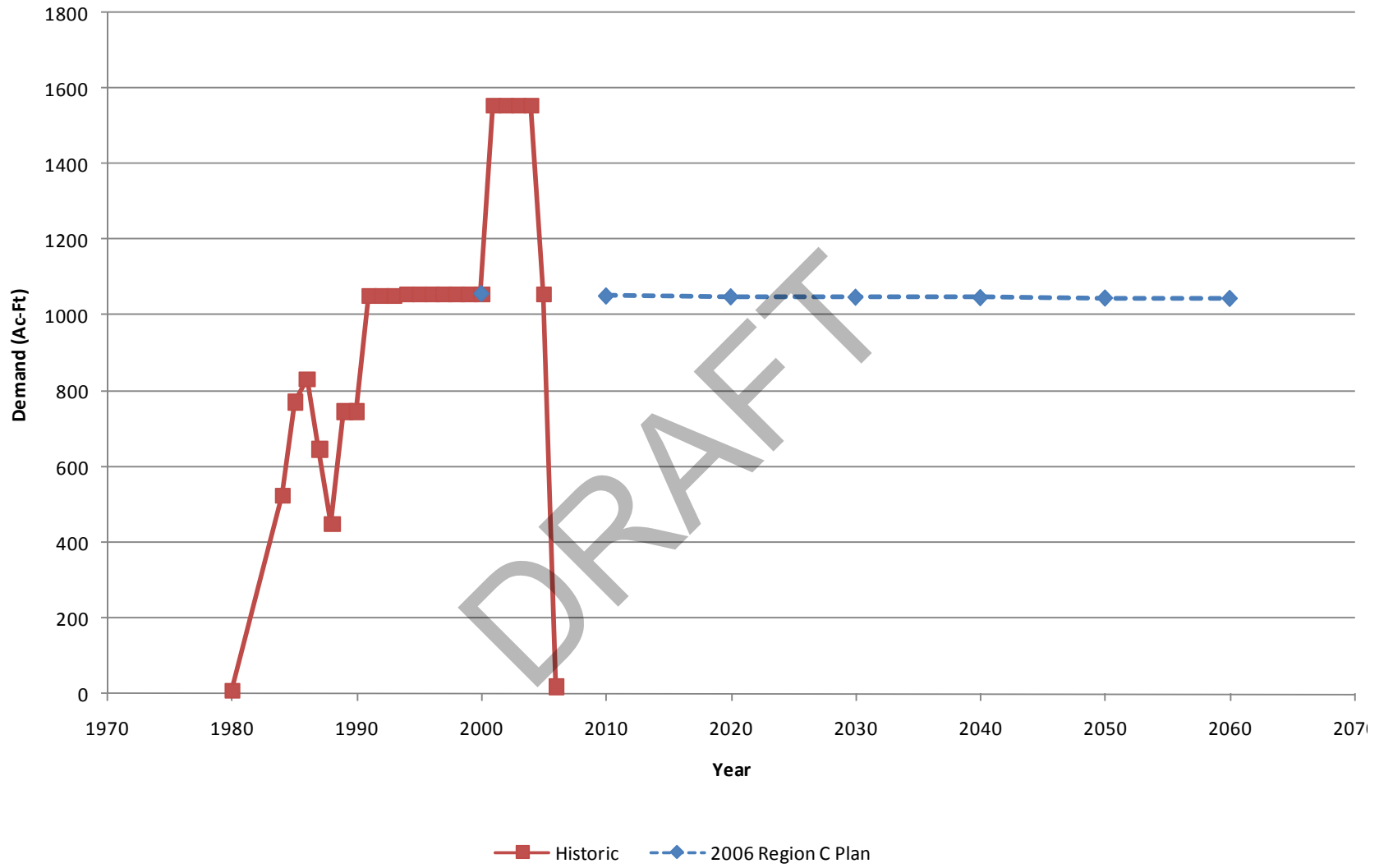
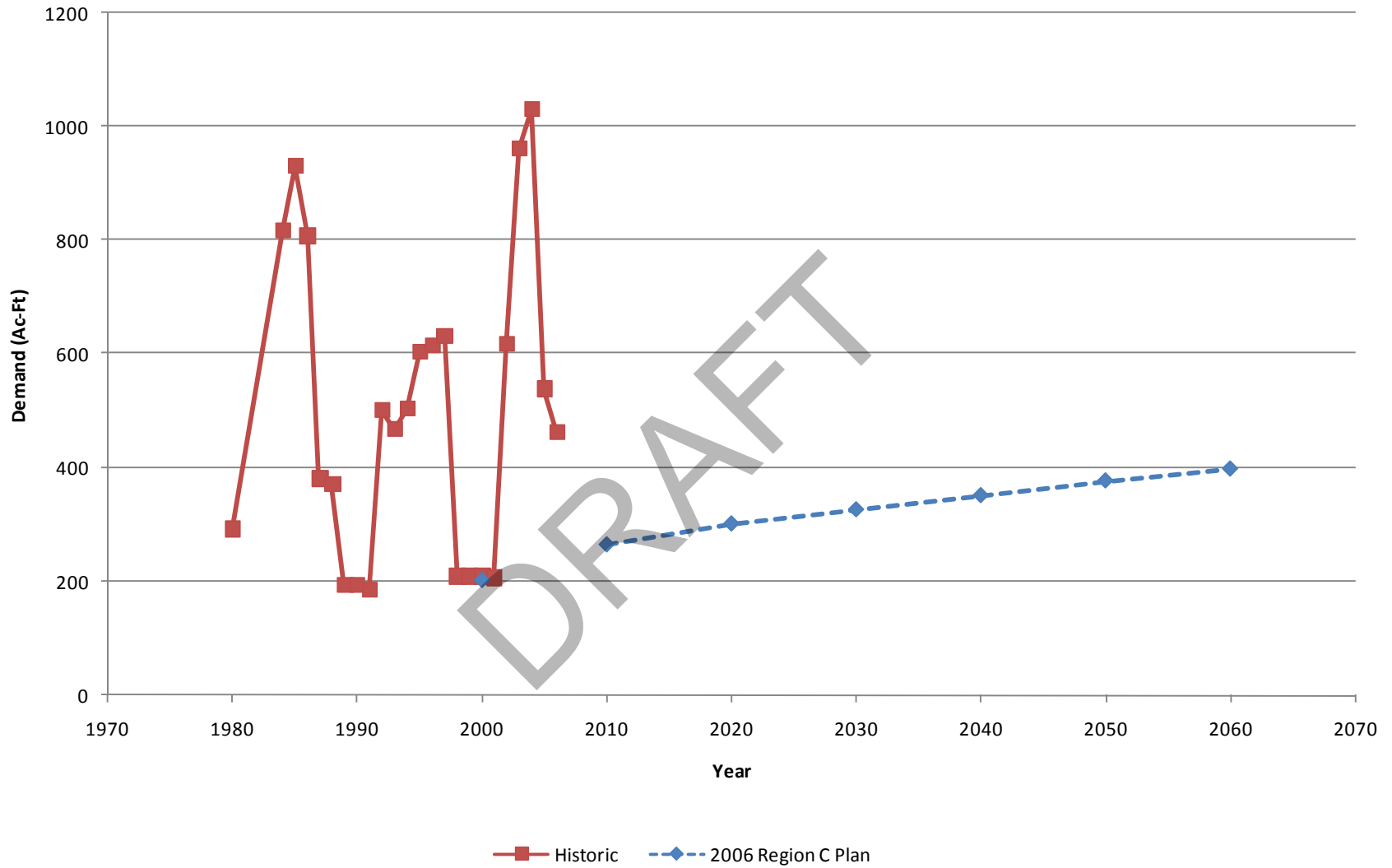


Figure A-10. Henderson County Mining Demands



**Figure A-11. Jack County Mining Demands**

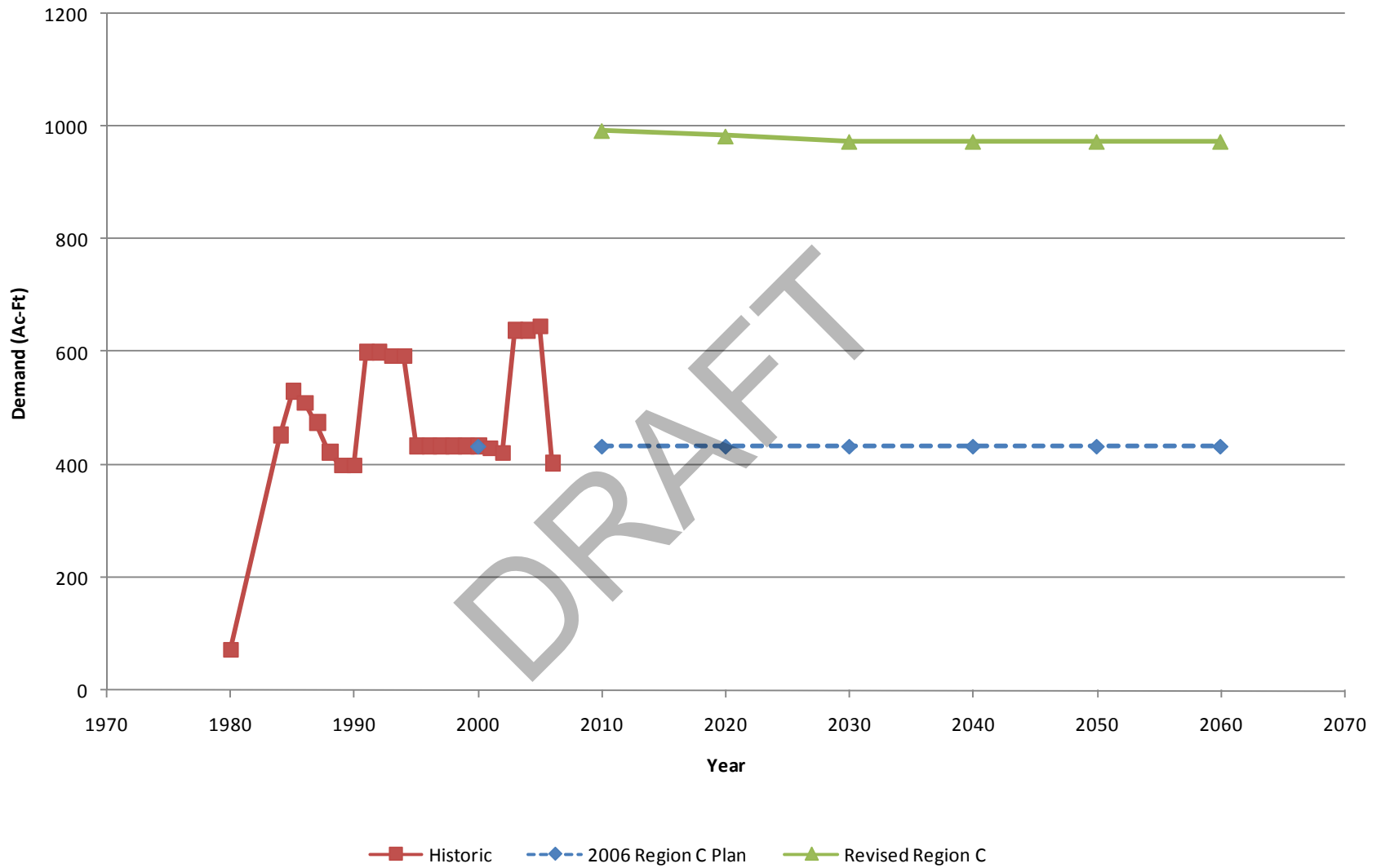


Figure A-12. Kaufman County Mining Demands

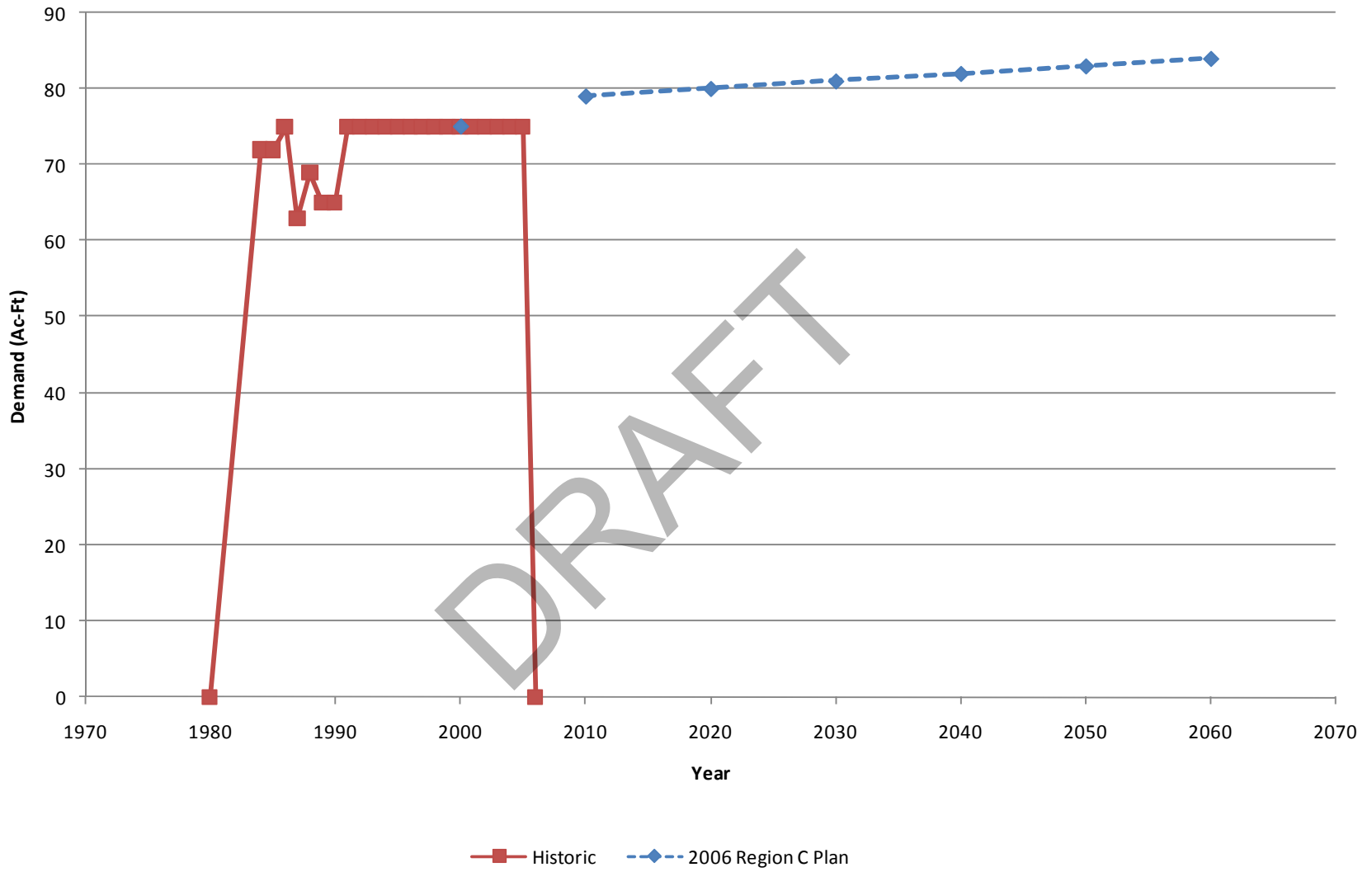
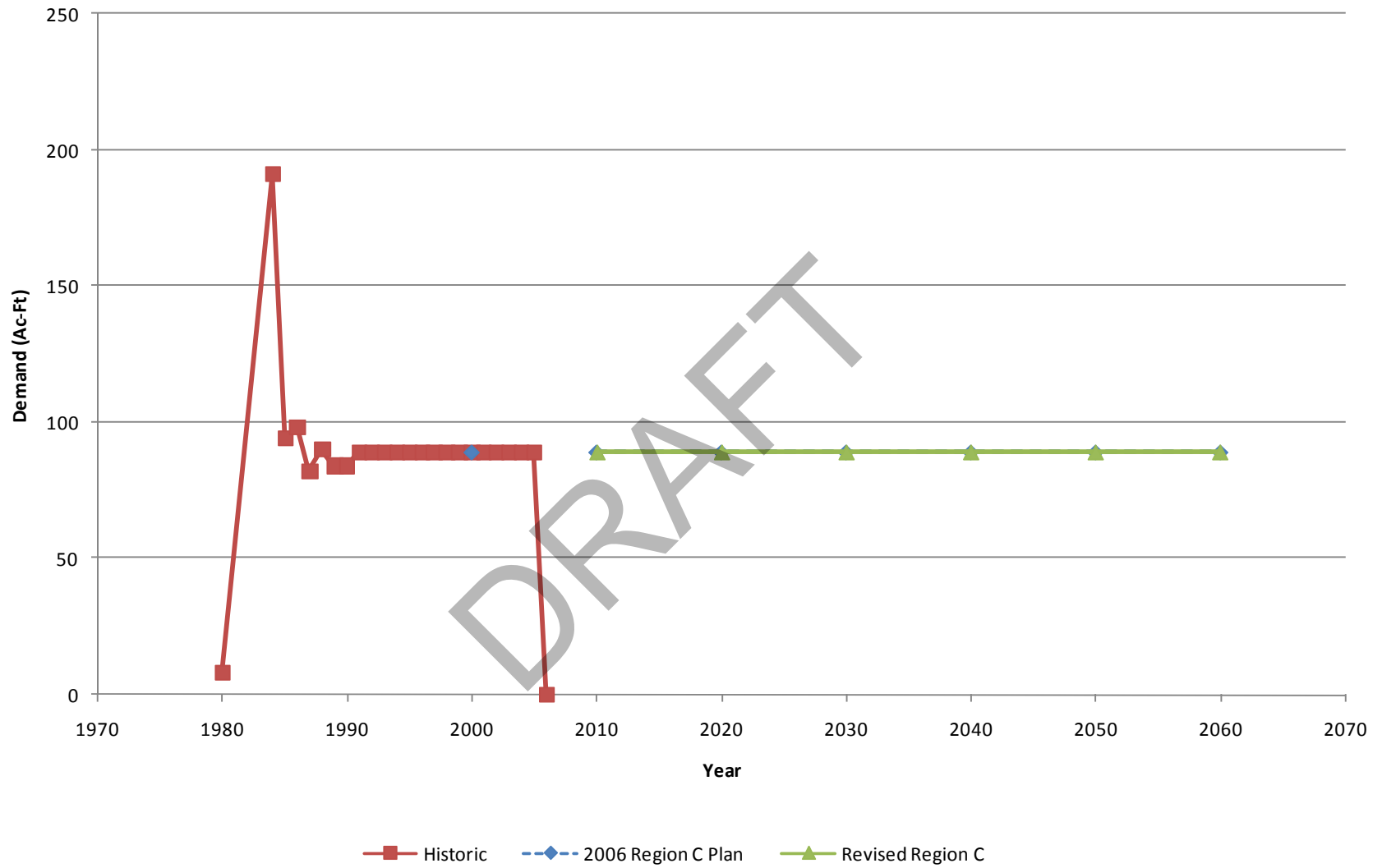


Figure A-13. Navarro County Mining Demands



**Figure A-14. Parker County Mining Demands**

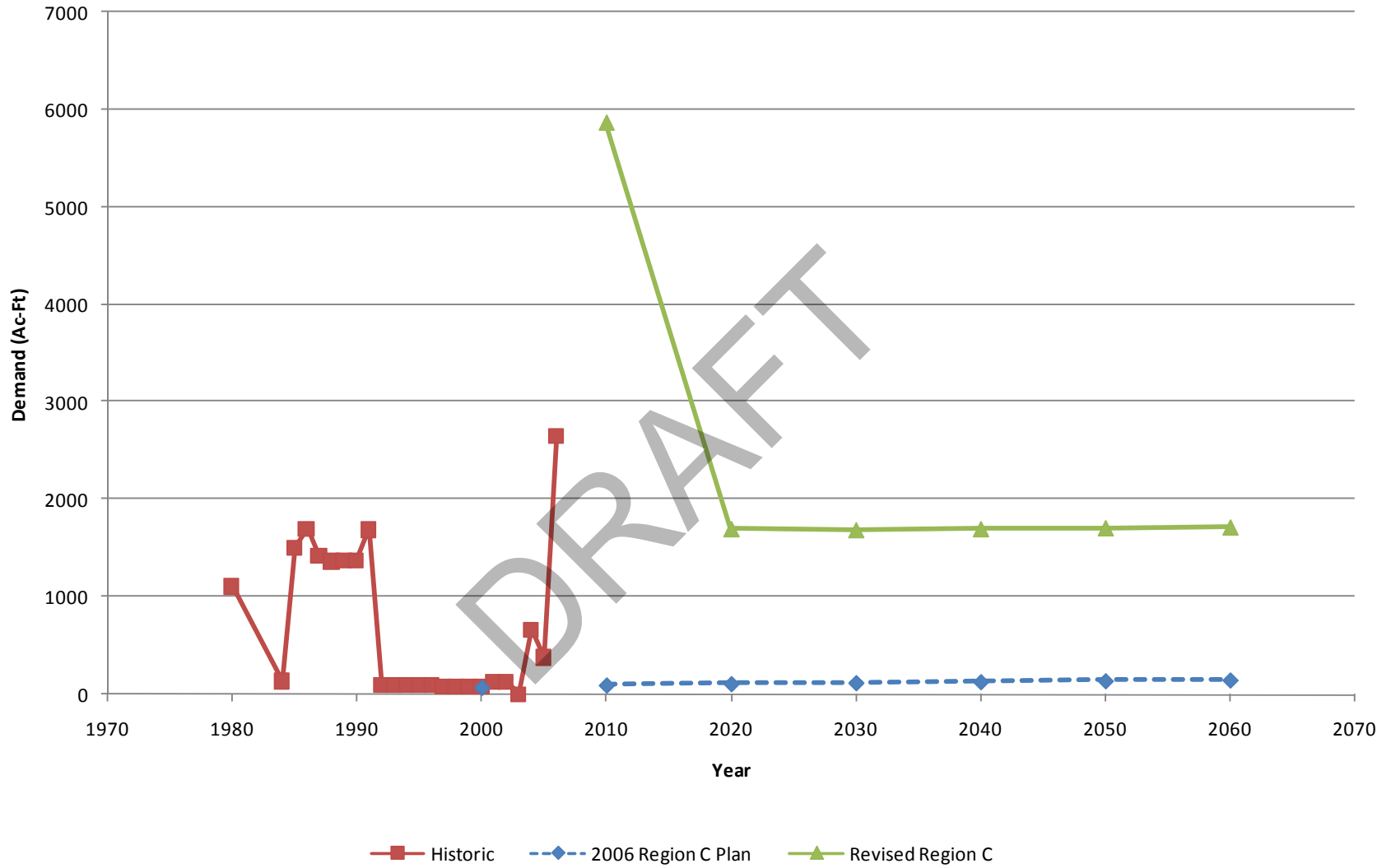


Figure A-15. Rockwall County Mining Demands

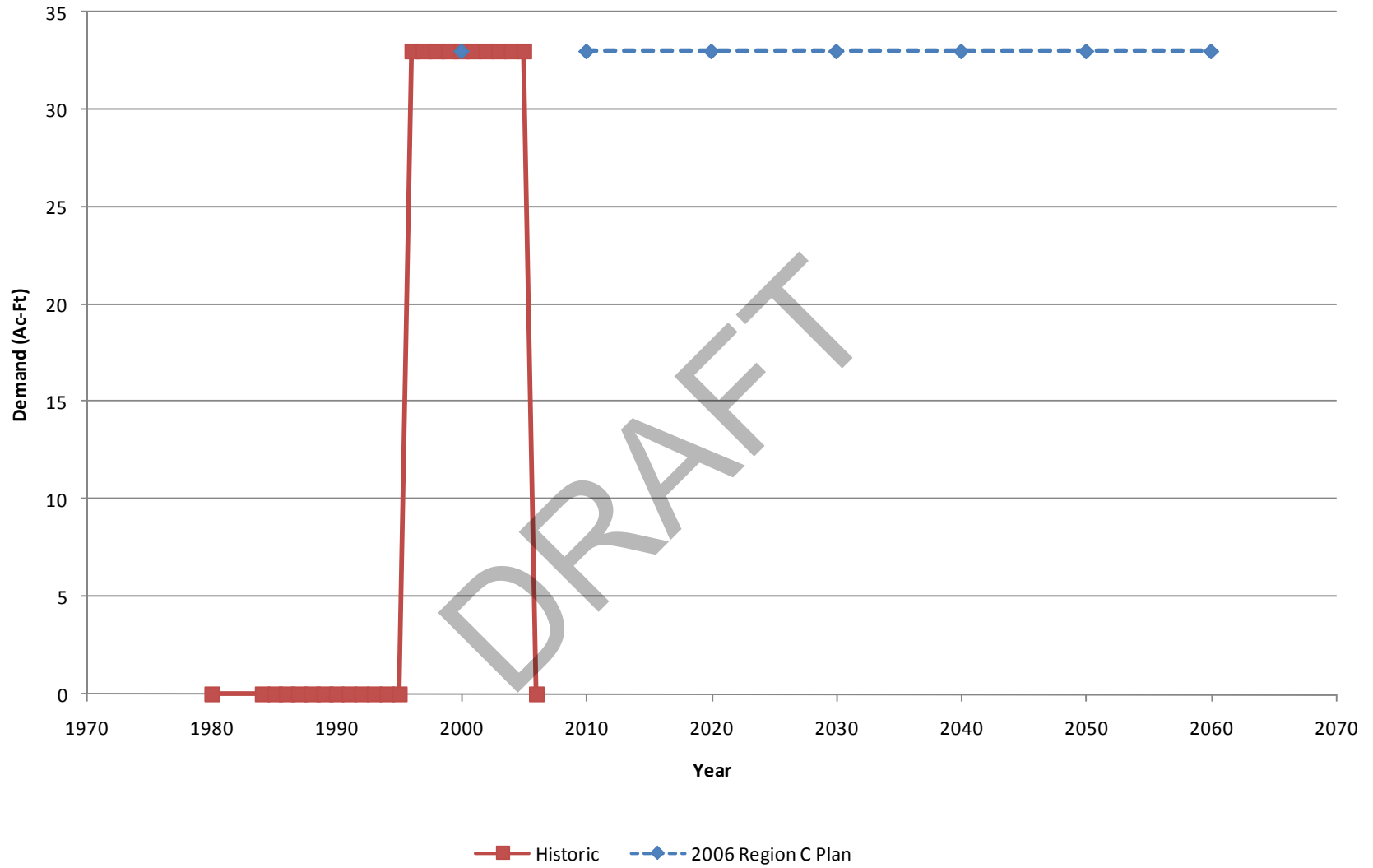




Figure A-16. Tarrant County Mining Demands



**Figure A-17. Wise County Mining Demands**

