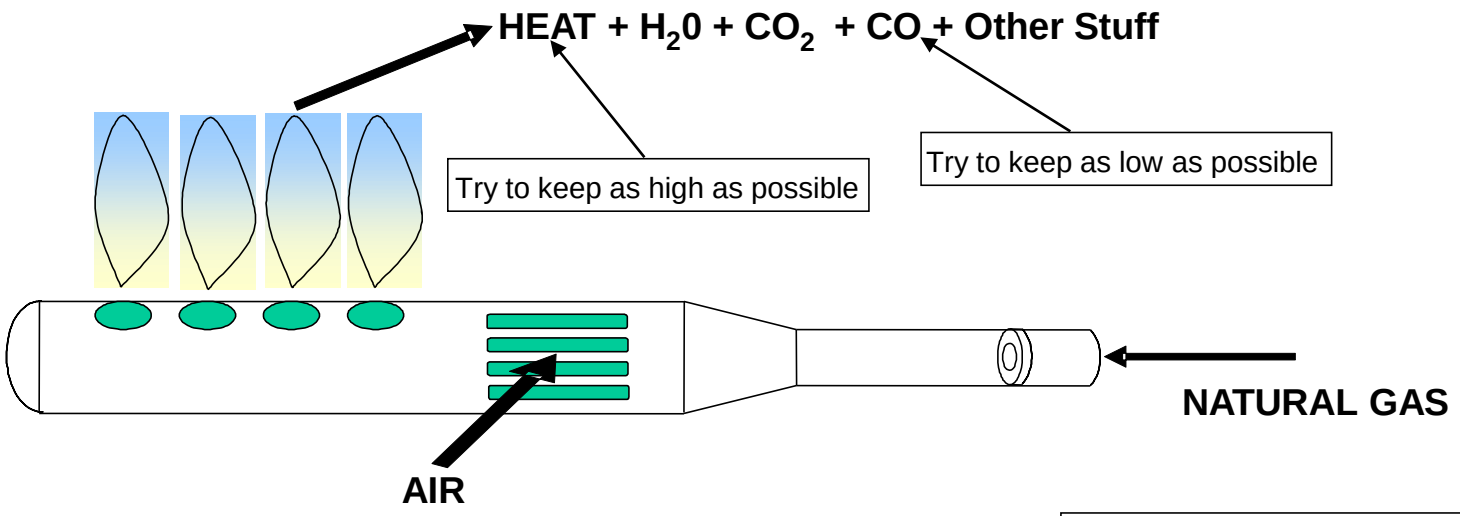
GAS QUALITY:
HOW IT IMPACTS QUESTAR GAS

Docket 04-057-09
October 13, 2004

COMBUSTION THEORY 101



Orifice size adjusted for specific installation conditions:
- Altitude
- Gas Composition

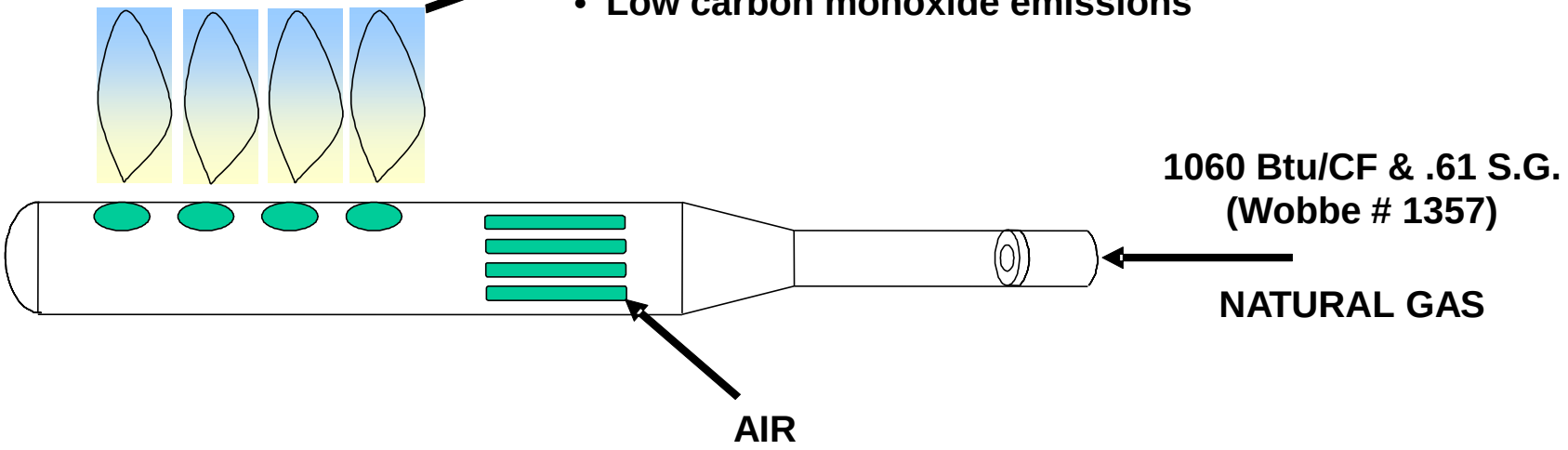
- **Efficient and safe combustion requires the correct ratio of oxygen and fuel**
- **The ability of an appliance to properly combust a fuel different than what it was adjusted for depends on the heating value and specific gravity of the fuel**

$$\text{Wobbe Number} = \frac{\text{Heating Value}}{\sqrt{\text{Specific Gravity}}}$$

IMPACT OF GAS QUALITY CHANGE ON APPLIANCE PERFORMANCE
Case 1: Ideal Conditions

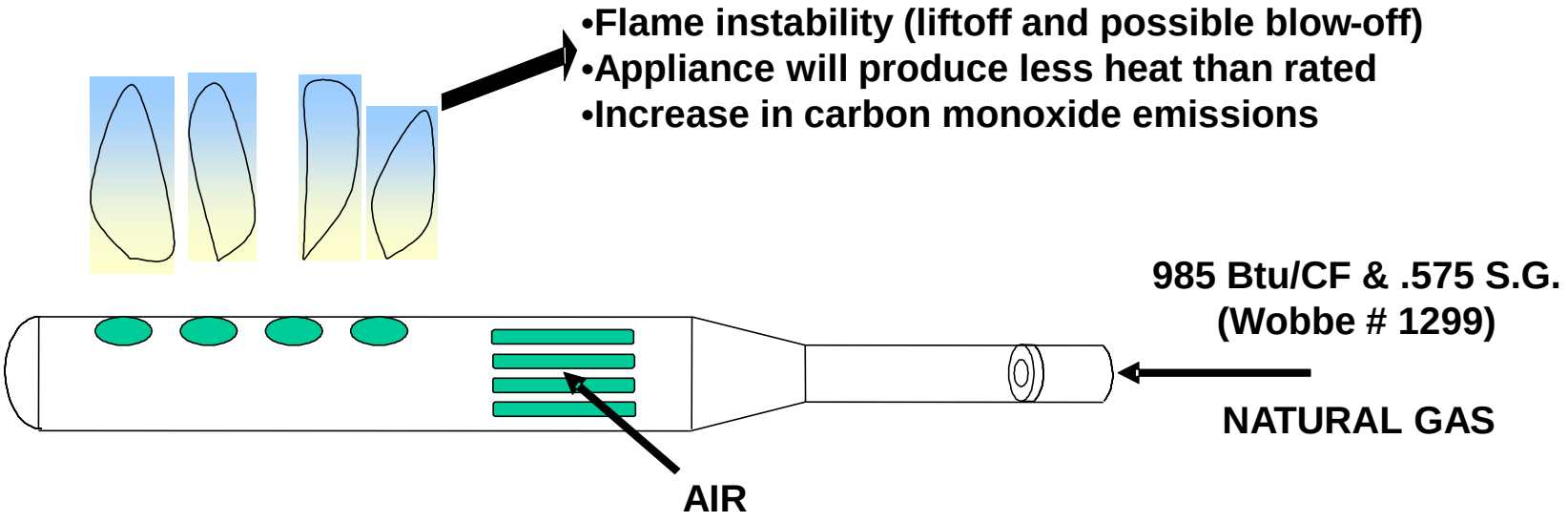
Appliance Properly Adjusted for Altitude and 1088 Btu/CF & .62 Specific Gravity (Wobbe # 1382)

- **Proper flame characteristics**
- **Appliance will perform as rated**
- **Low carbon monoxide emissions**



IMPACT OF GAS QUALITY CHANGE ON APPLIANCE PERFORMANCE
Case 2: Introduction of Coal Seam Gas

Appliance Properly Adjusted for Altitude and 1088 Btu/CF & .62 Specific Gravity Gas (Wobbe # 1382)

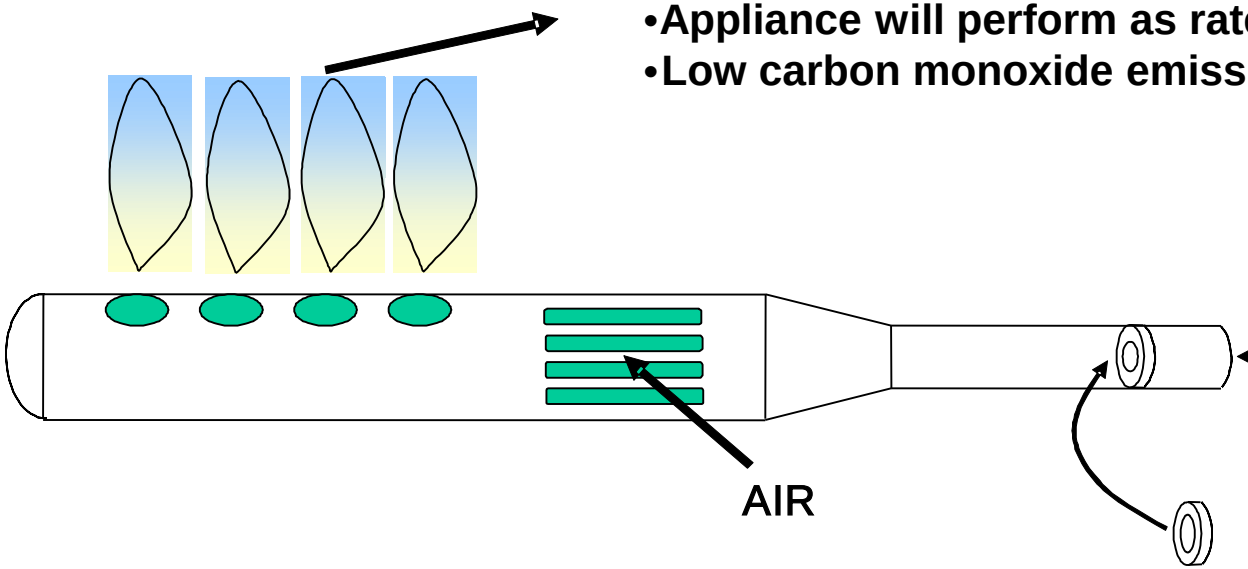


IMPACT OF GAS QUALITY CHANGE ON APPLIANCE PERFORMANCE

Case 3: Re-Orifice Appliance Southern System Set-Point

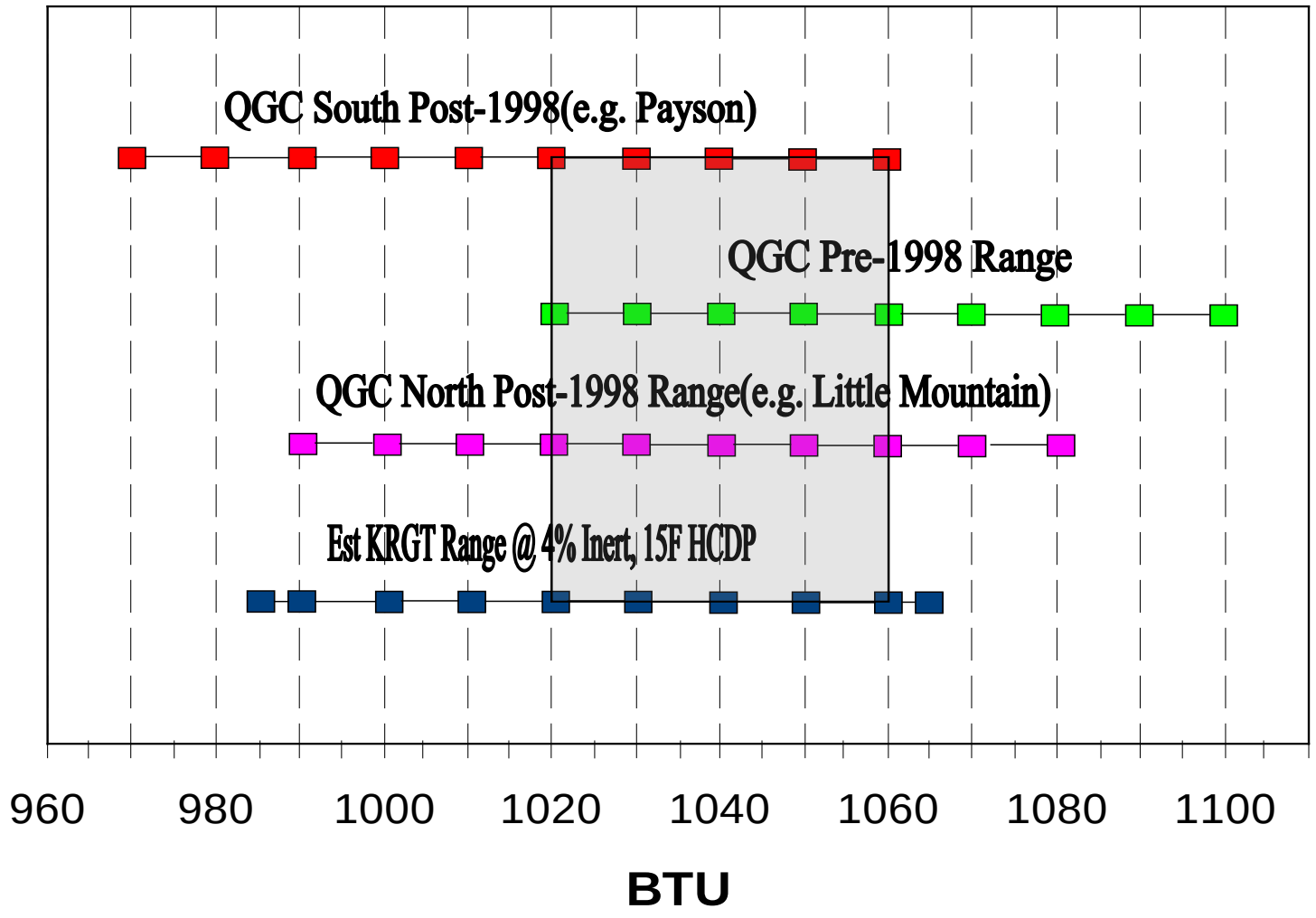
Appliance Properly Adjusted for Altitude and 1003 Btu/CF & .56 Specific Gravity Gas (Wobbe #1340)

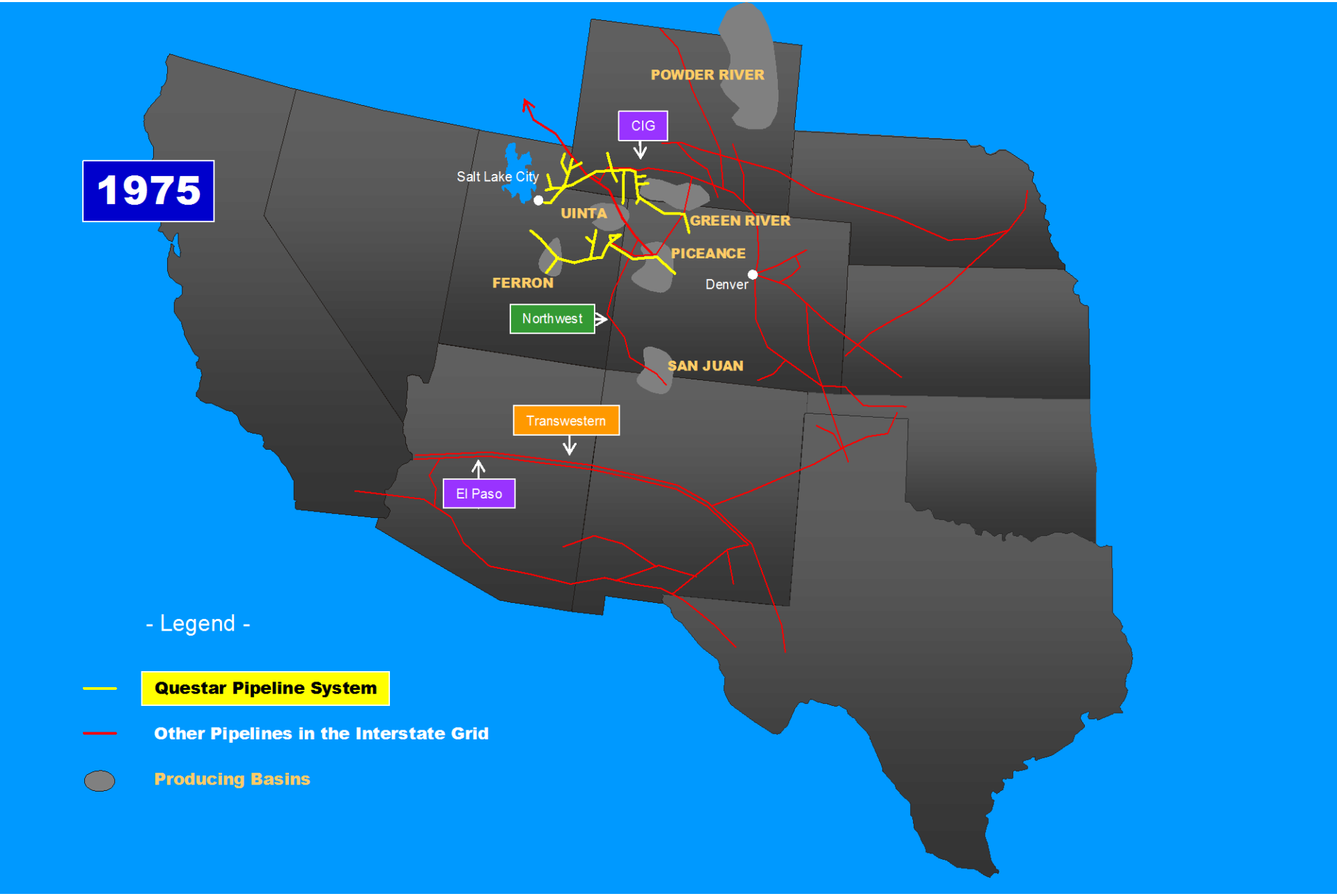
- Proper flame characteristics
- Appliance will perform as rated
- Low carbon monoxide emissions

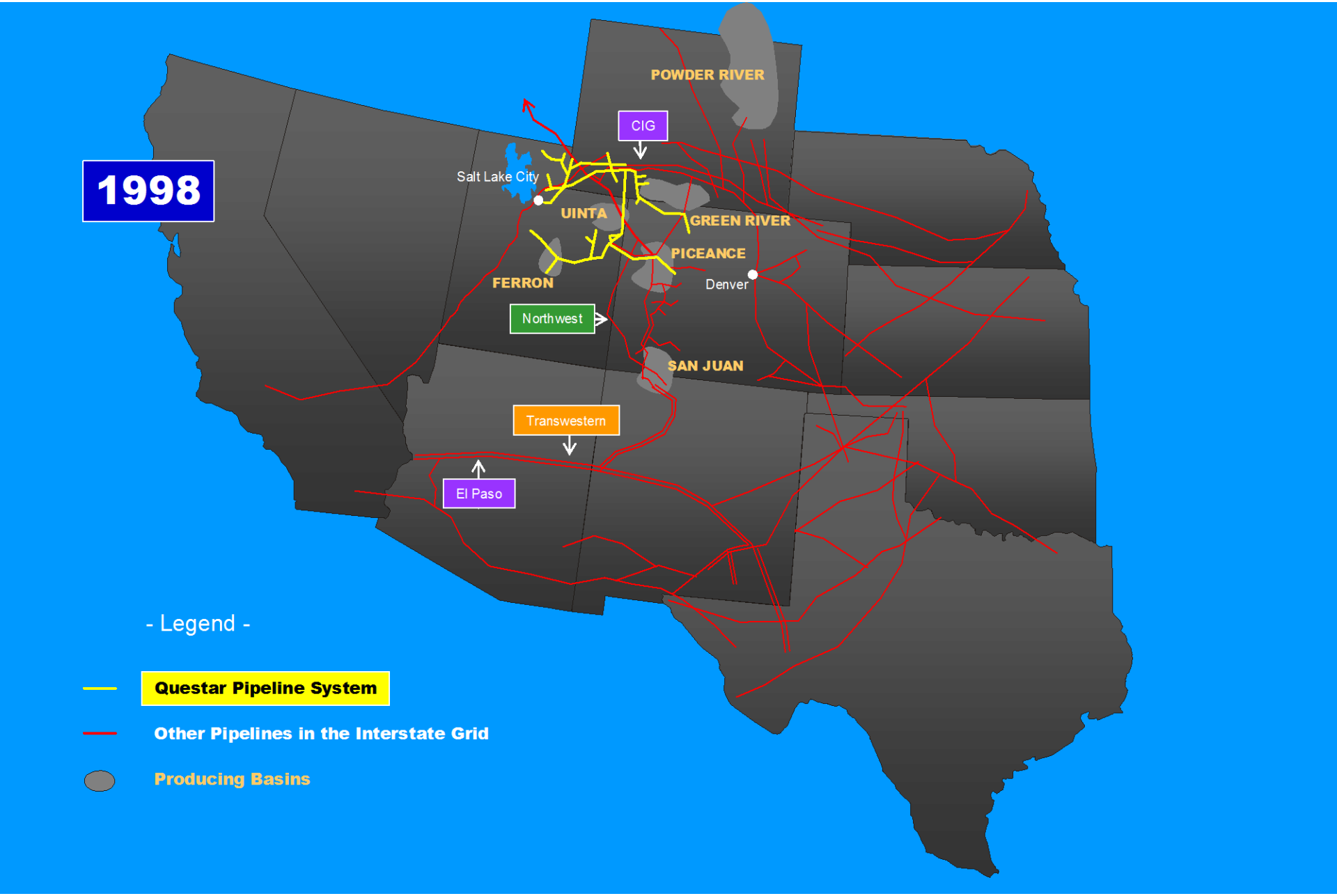


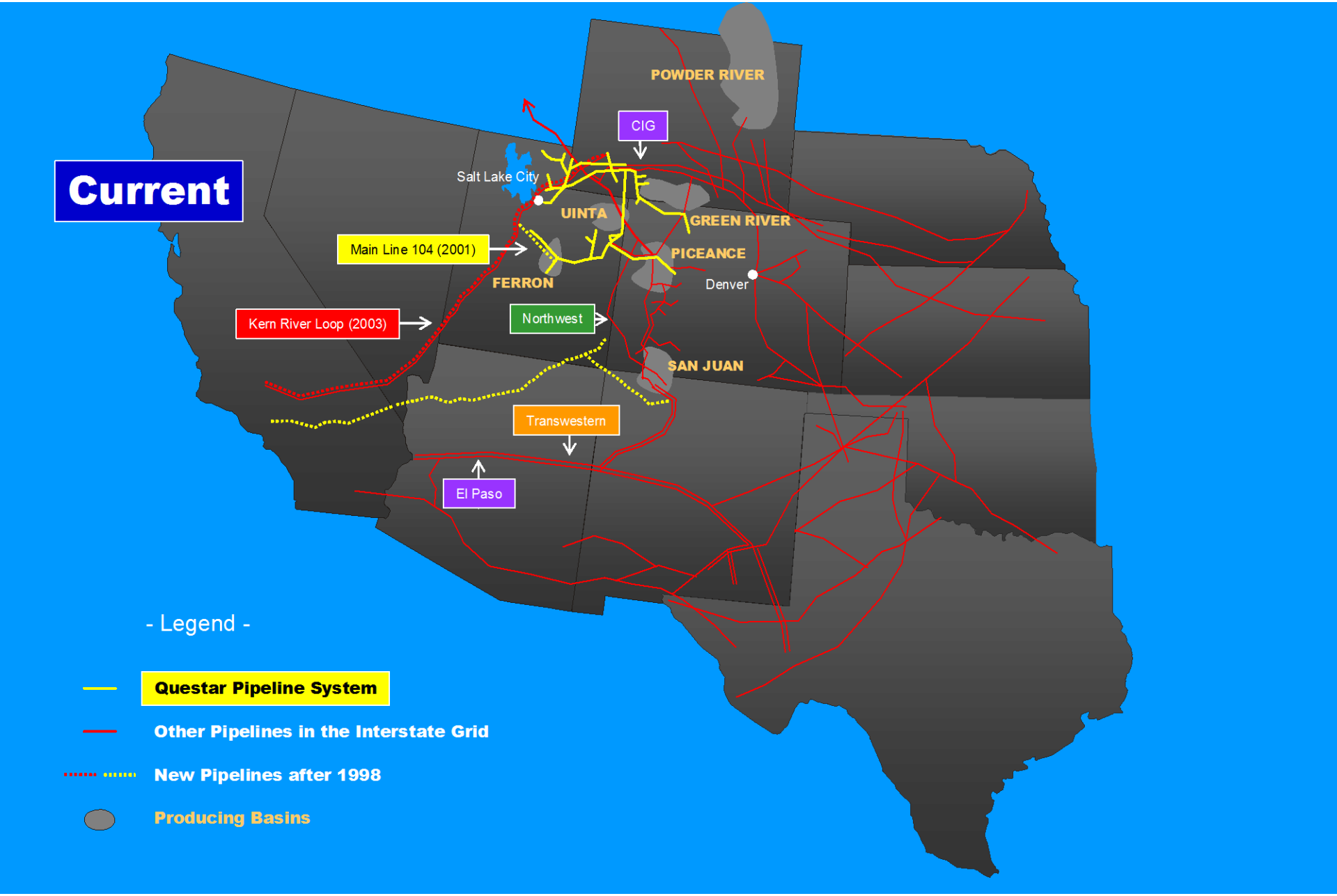
Change orifice out with larger diameter orifice

Approximate Interchangeability Ranges




1975
POWDER RIVER
CIG
Salt Lake City
UINTA
GREEN RIVER
PICEANCE
FERRON
Denver
Northwest
SAN JUAN
Transwestern
El Paso
- Legend -
Questar Pipeline System
Other Pipelines in the Interstate Grid
Producing Basins

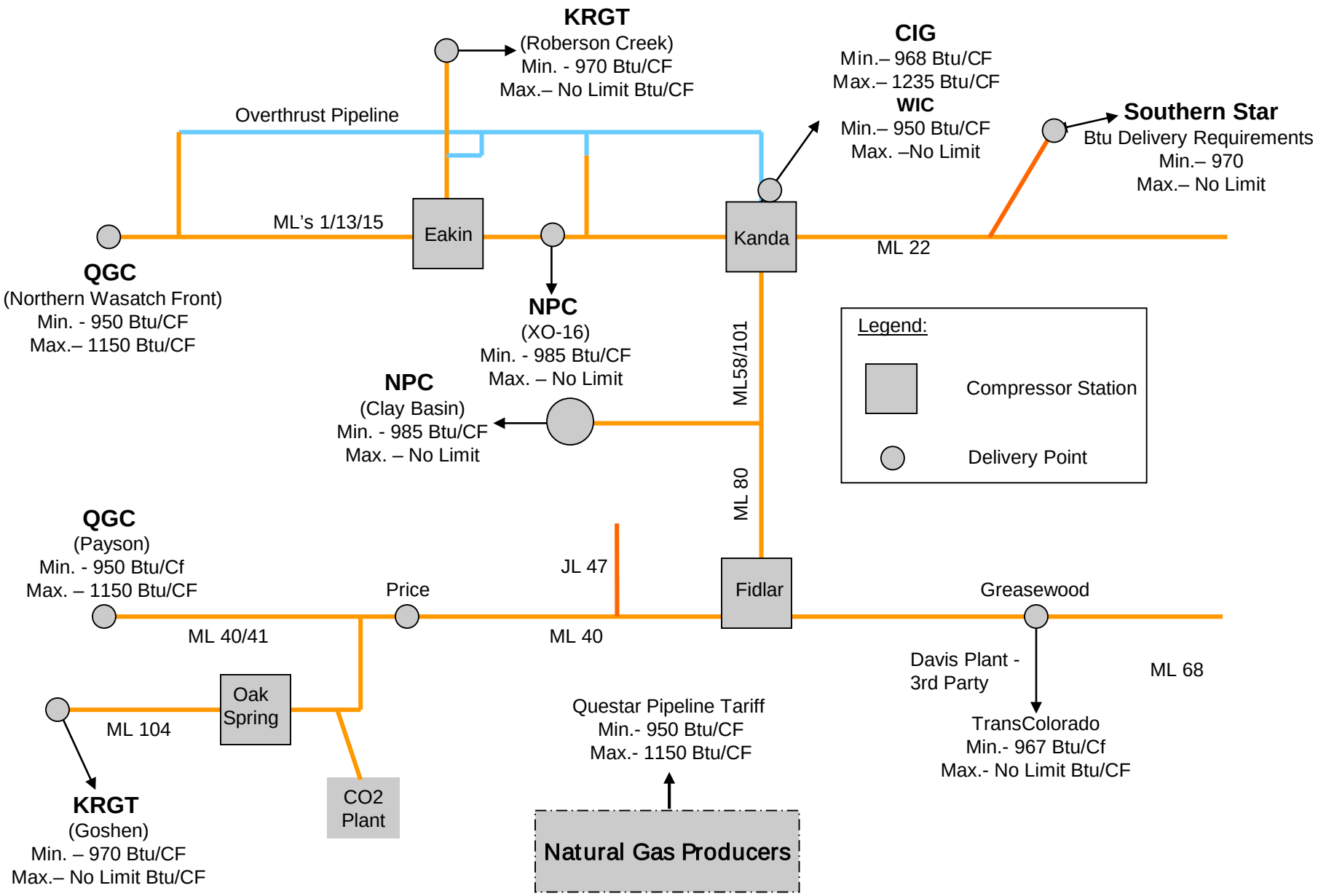

1998
POWDER RIVER
CIG
Salt Lake City
UINTA
GREEN RIVER
PICEANCE
Denver
FERRON
Northwest
SAN JUAN
Transwestern
El Paso
- Legend -
Questar Pipeline System
Other Pipelines in the Interstate Grid
Producing Basins

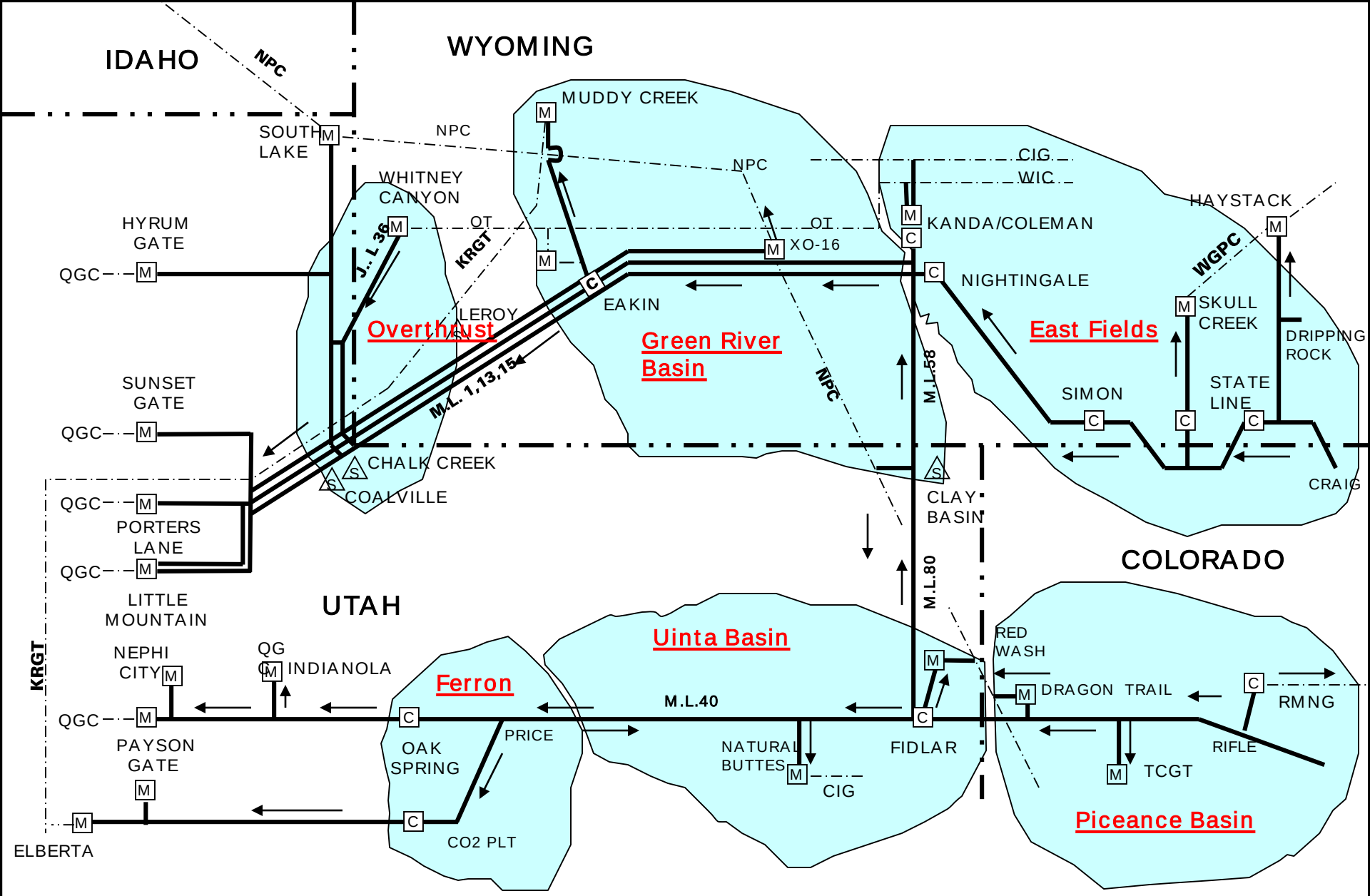

Current
POWDER RIVER
CIG
Salt Lake City
UINTA
GREEN RIVER
Main Line 104 (2001)
PICEANCE
FERRON
Denver
Kern River Loop (2003)
Northwest
SAN JUAN
Transwestern
El Paso
- Legend -
Questar Pipeline System
Other Pipelines in the Interstate Grid
New Pipelines after 1998
Producing Basins

PIPELINE BTU SPECIFICATIONS
(September, 2004)

PIPELINE COMPANY	MINIMUM BTU	MAXIMUM BTU
ANR	967	1200
CIG	968	1235
Columbia Gulf	978	None
El Paso Natural Gas	967	None
Florida Gas Transmission	1000	None
NGPL	950	None
Northern Border	967	None
Northwest Pipeline	985	None
Panhandle Energy	950	1200
Sonat	950	None
Kern River	970	None
Tennessee	967	1100
Texas Eastern	967	None
Trailblazer	950	None
Transco	980	1100
TransWestern	970	None
Trunkline	950	1200
Questar	**950**	**1150**

Questar Pipeline – Downstream Btu Delivery Specs.

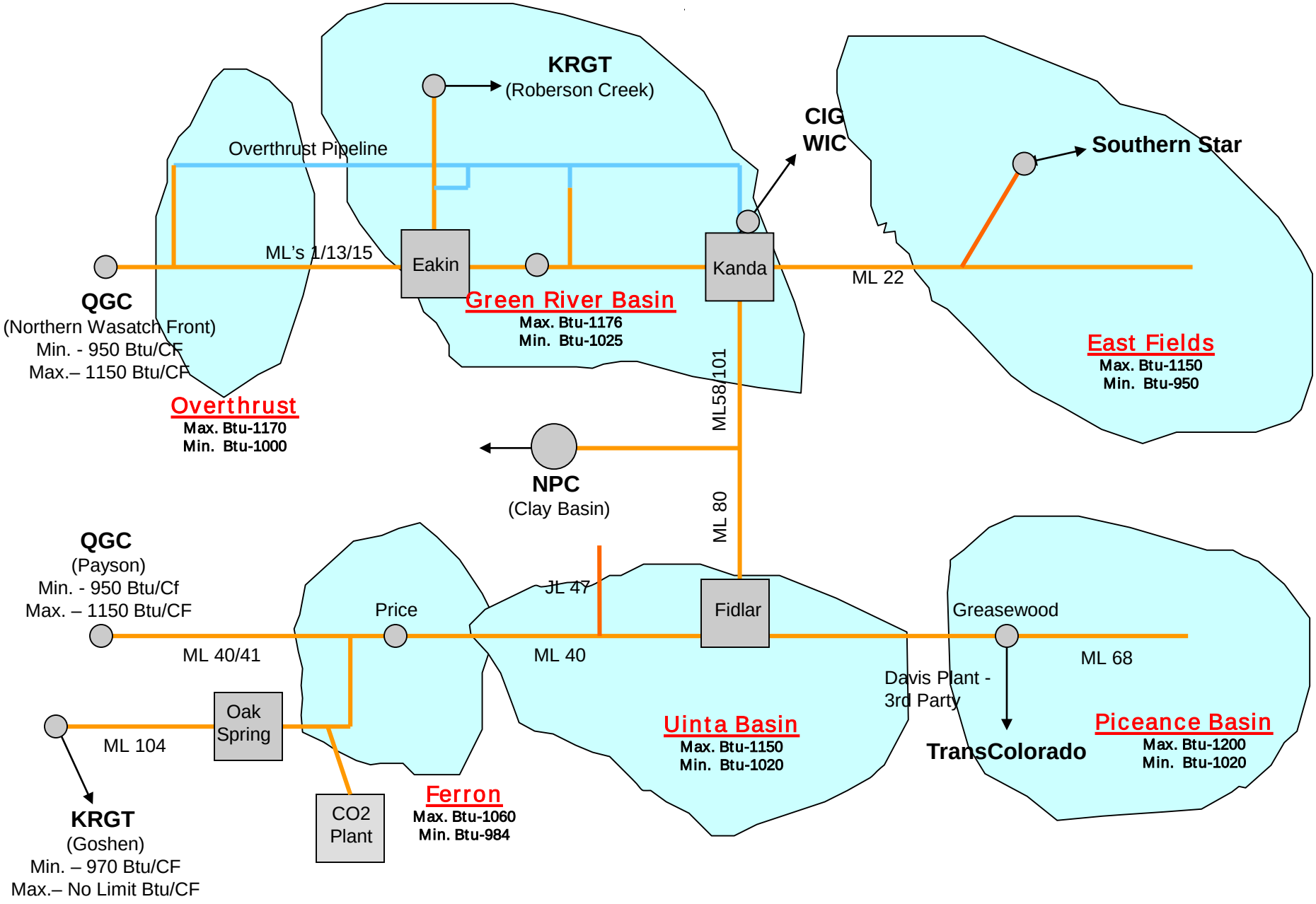




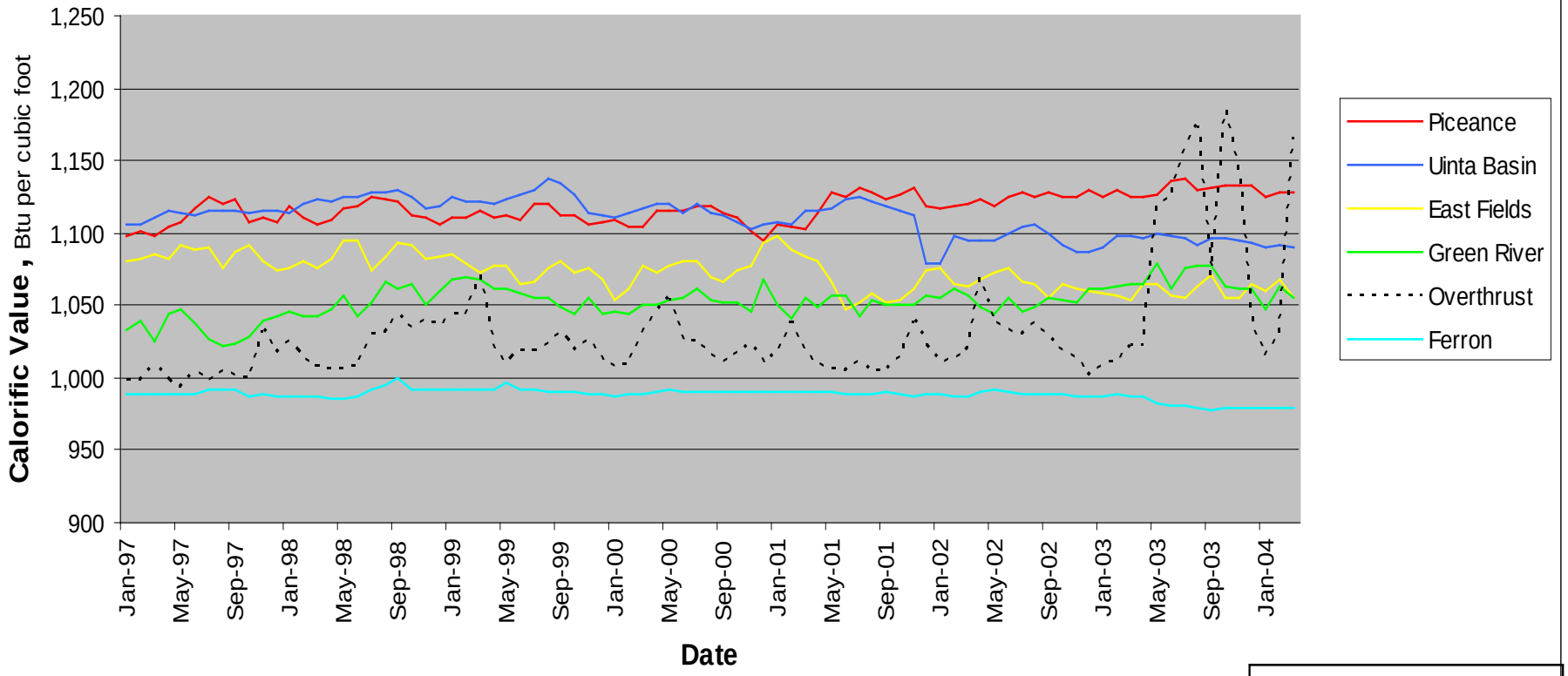
QUESTAR Pipeline

Basin Map

Questar Pipeline – Gas Quality Distribution

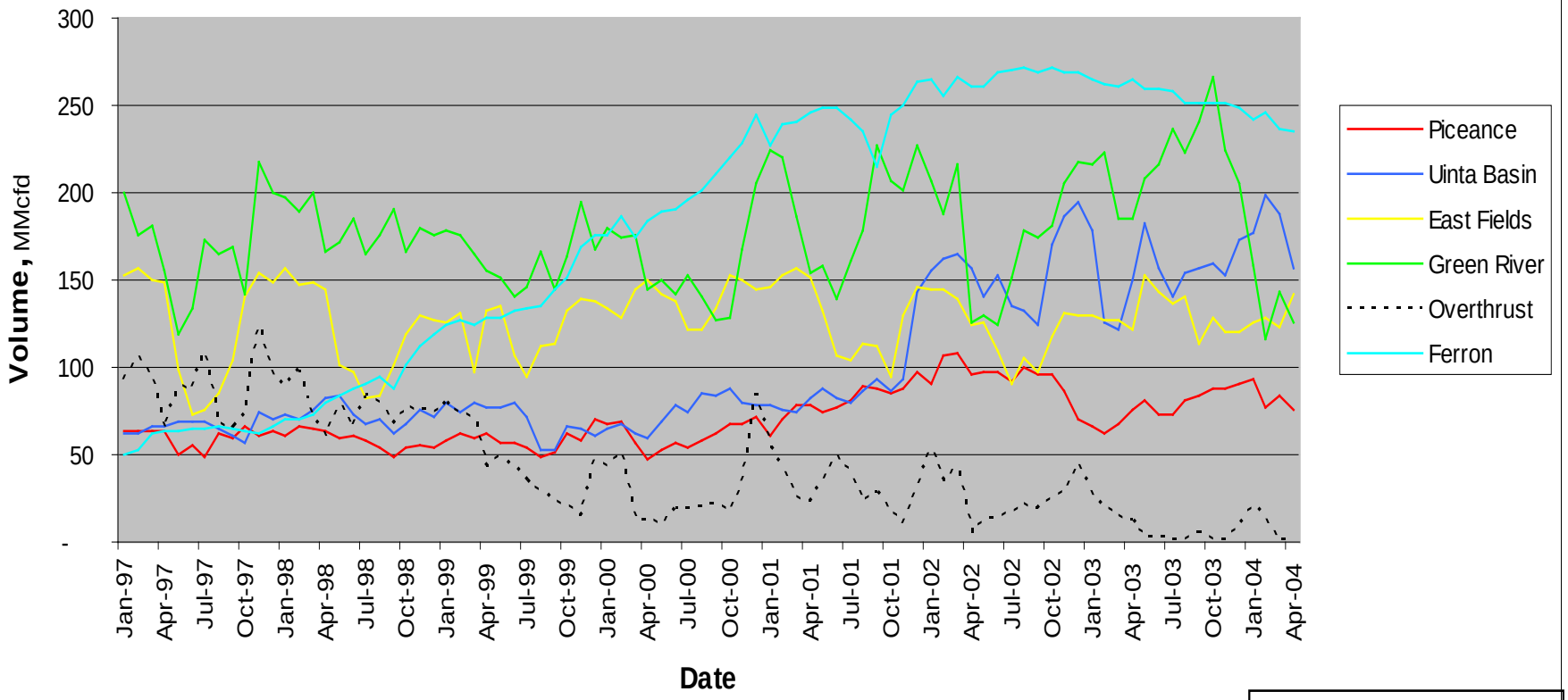


Historical Basin Heating Value



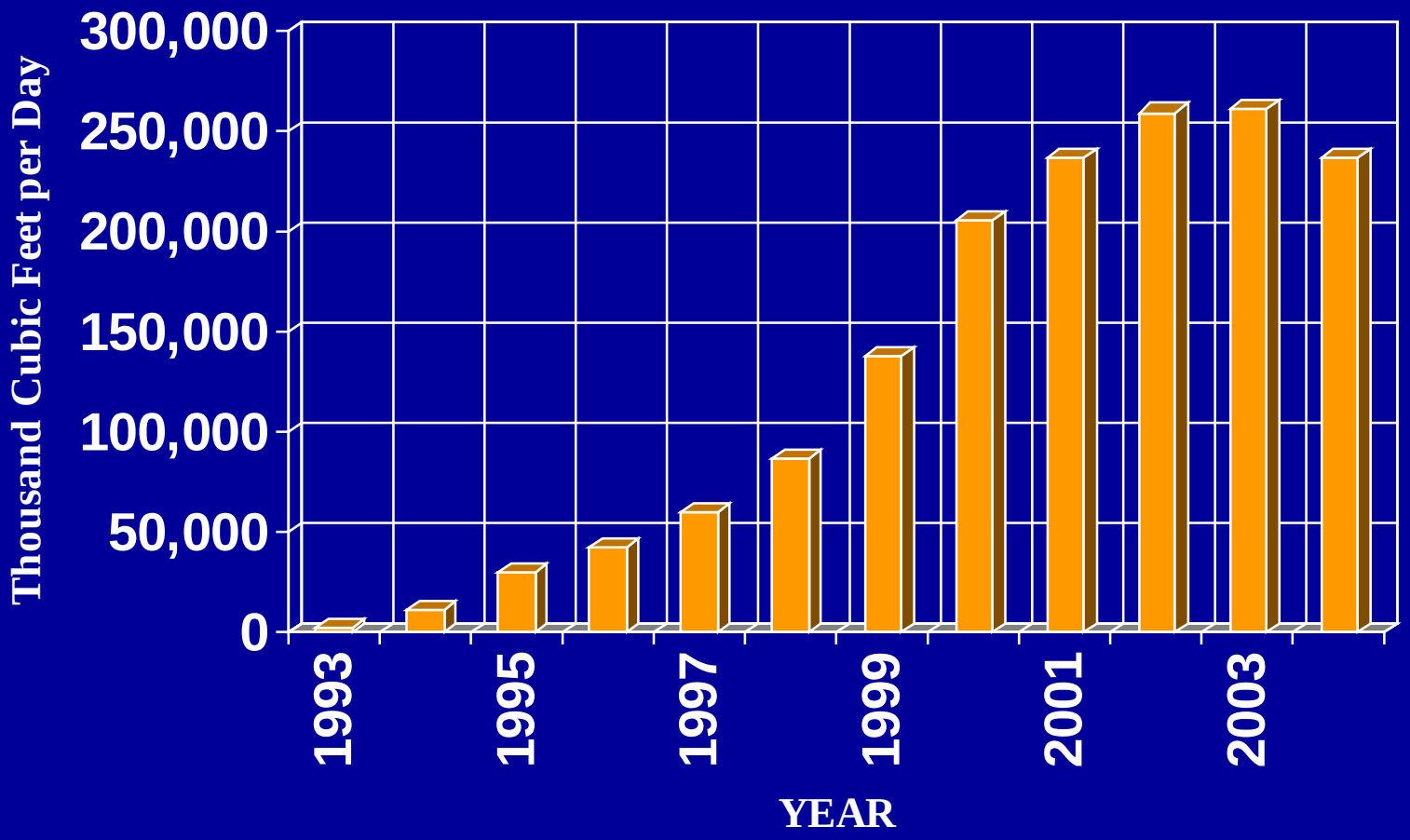
Updated on: May 5,2004

Historical Basin Daily Volume



Updated on: May 5,2004

PRICE AREA COAL BED PRODUCTION HISTORY



TYPES OF NATURAL GAS

Supply Source	Btu Range
Traditional Supplies	970 – 1250
• Associated Gas	
• Dry Gas	
• Sour Gas	
Current/Future Supplies	
• Coal Seam Gas	970 - 1030
• LNG	1040 - 1200
Manufactured Gas	500 – 1000
• Coal Gasification	
• Landfill/Biomass	

WOBBE - INDEX
Its Importance to Gas Interchangeability

- Wobbe Number – Relationship between the heating Value and Specific Gravity, defined as

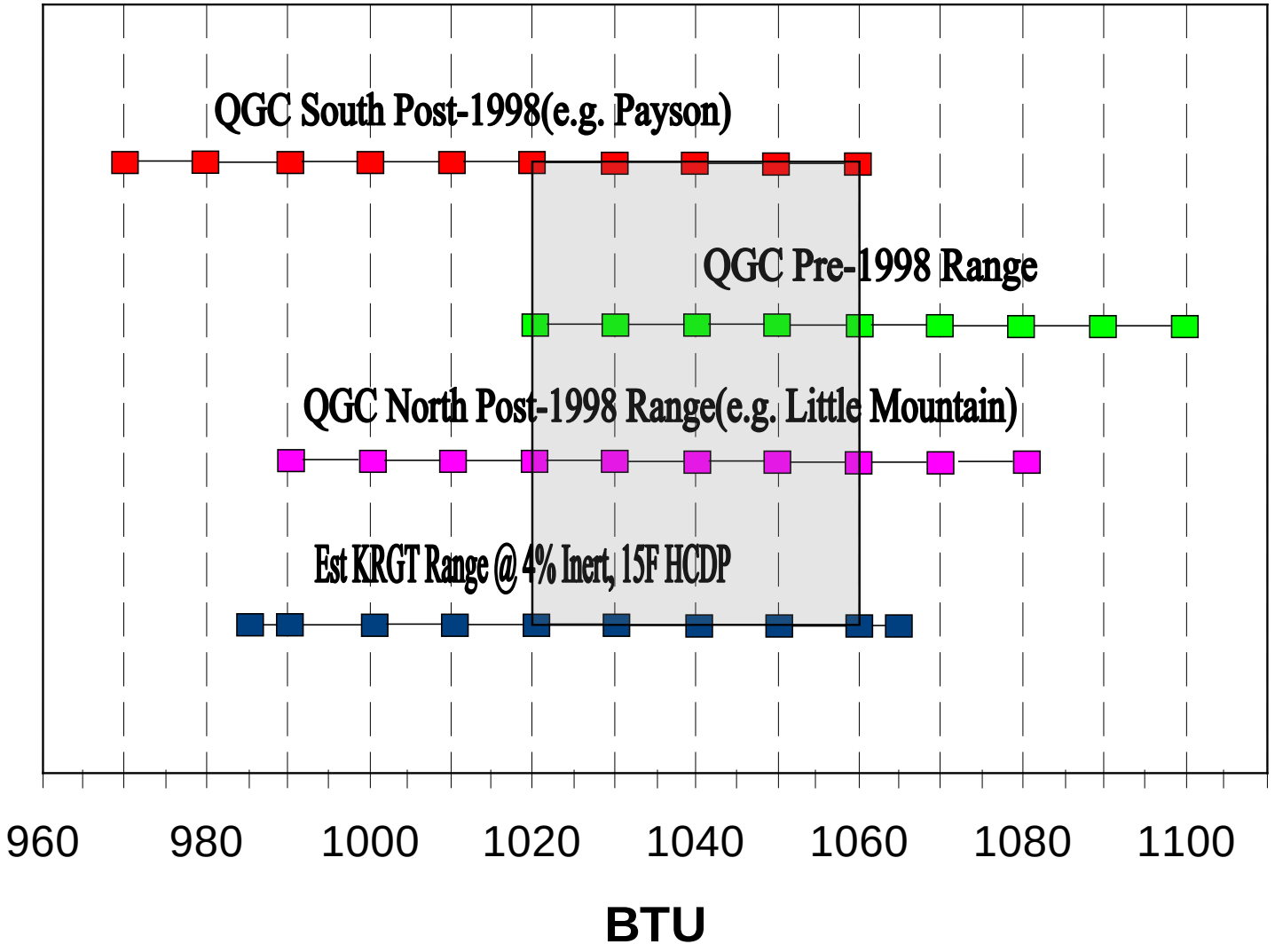
$$\text{Wobbe Number} = \frac{\text{Heating Value}}{\sqrt{\text{Specific Gravity}}}$$

- Wobbe Number is a good first-order predictor of appliance performance relative to a base or adjustment gas
- Wobbe Number is used throughout the world as the most common interchangeability metric
- Gas is generally considered interchangeable when the Wobbe number lies within a +/- 5% tolerance band around a set-point

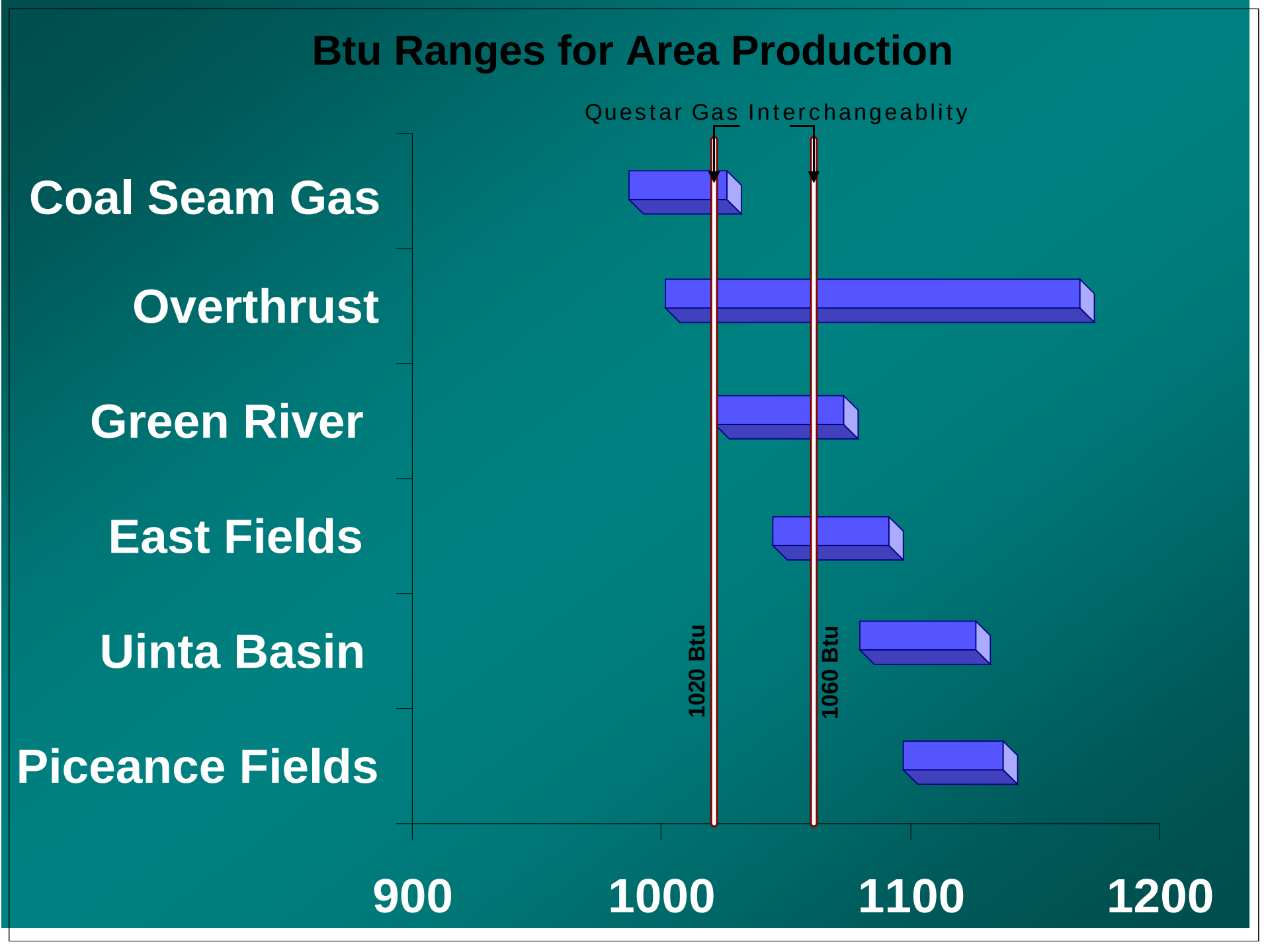
Gas Composition

	Coal Seam Gas	Uinta Basin Gas	Northern Gates Gas
Representative Btu	**984**	**1115**	**1070**
Specific Gravity	**0.588**	**0.632**	**0.616**
Percent Methane(1010 Btu/Scf)	**96.4%**	**90.7%**	**92.0%**
Percent Ethane(1789 Btu/Scf)	**0.27%**	**5.06%**	**4.35%**
Percent Propane(2516 Btu/Scf)	**0.0543%**	**1.95%**	**1.20%**
Percent Butane(3250 Btu/Scf)	**0.0139%**	**0.863%**	**0.491%**
Percent C5+(5500+ Btu/Scf)	**0.0018%**	**0.5923%**	**0.315%**
Percent Inerts(CO_2, etc.)	**2.5%**	**0.629%**	**0.629%**
Hydrocarbon Dewpoint	**-110.5°**	**70.4°**	**40.9°**
Percent Nitrogen	**0.18%**	**0.24%**	**0.48%**
Wobbe ($W = HV/\sqrt{G}$)	**1283**	**1402**	**1363**

Approximate Interchangeability Ranges



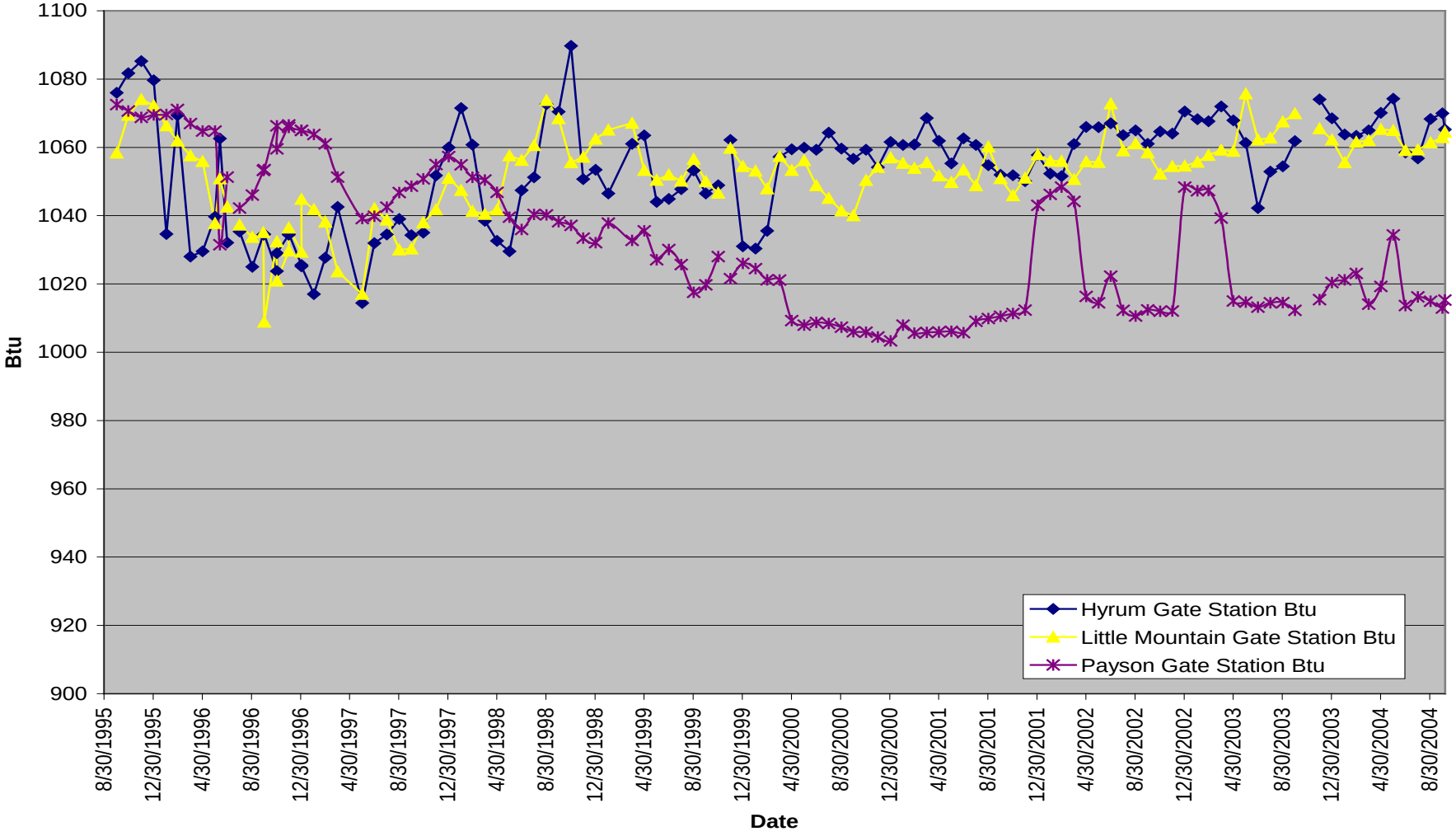
Btu Ranges for Area Production



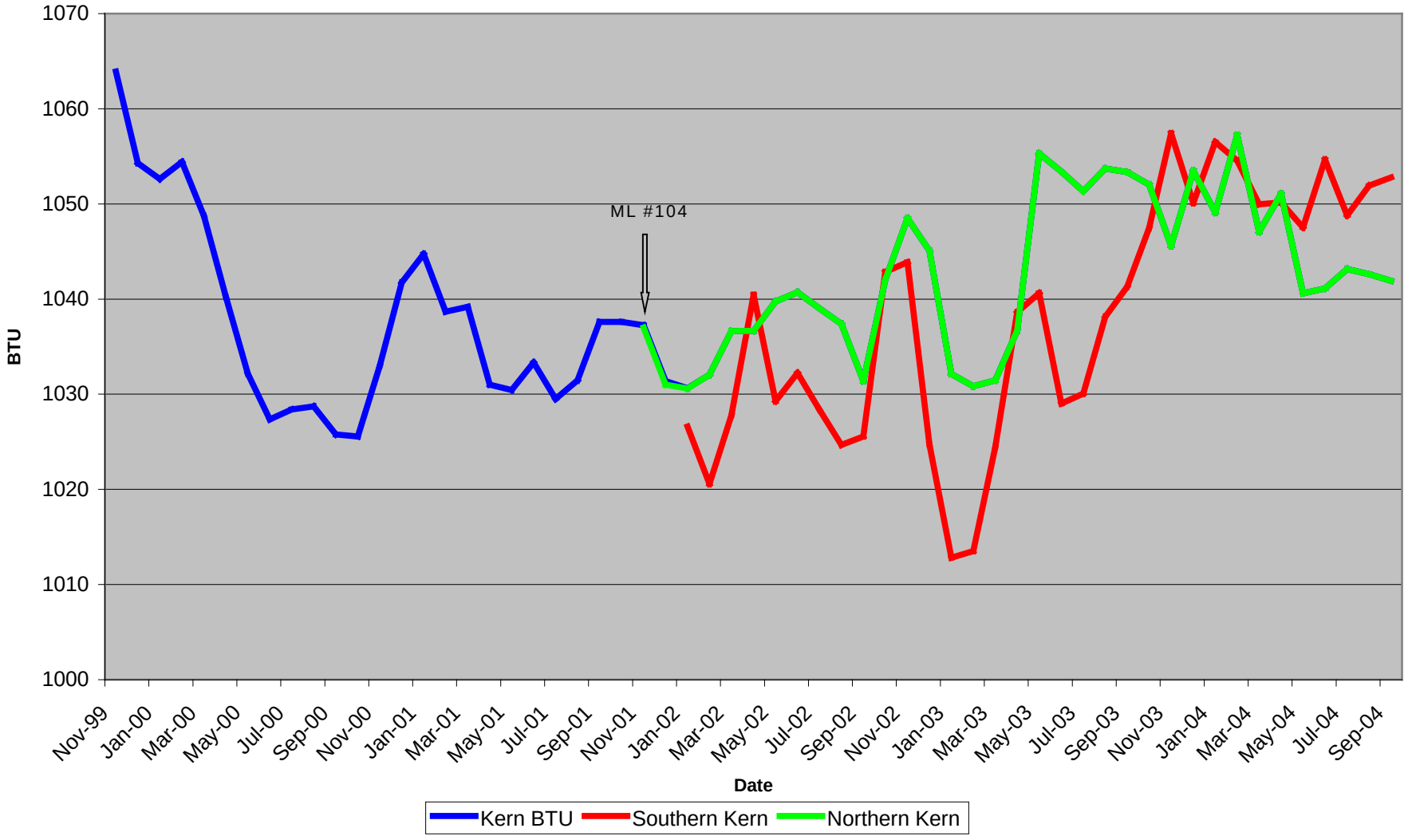
SLC Historical Gas Btu Trend

Questar Gas Company
98-057-___
Exhibit 1

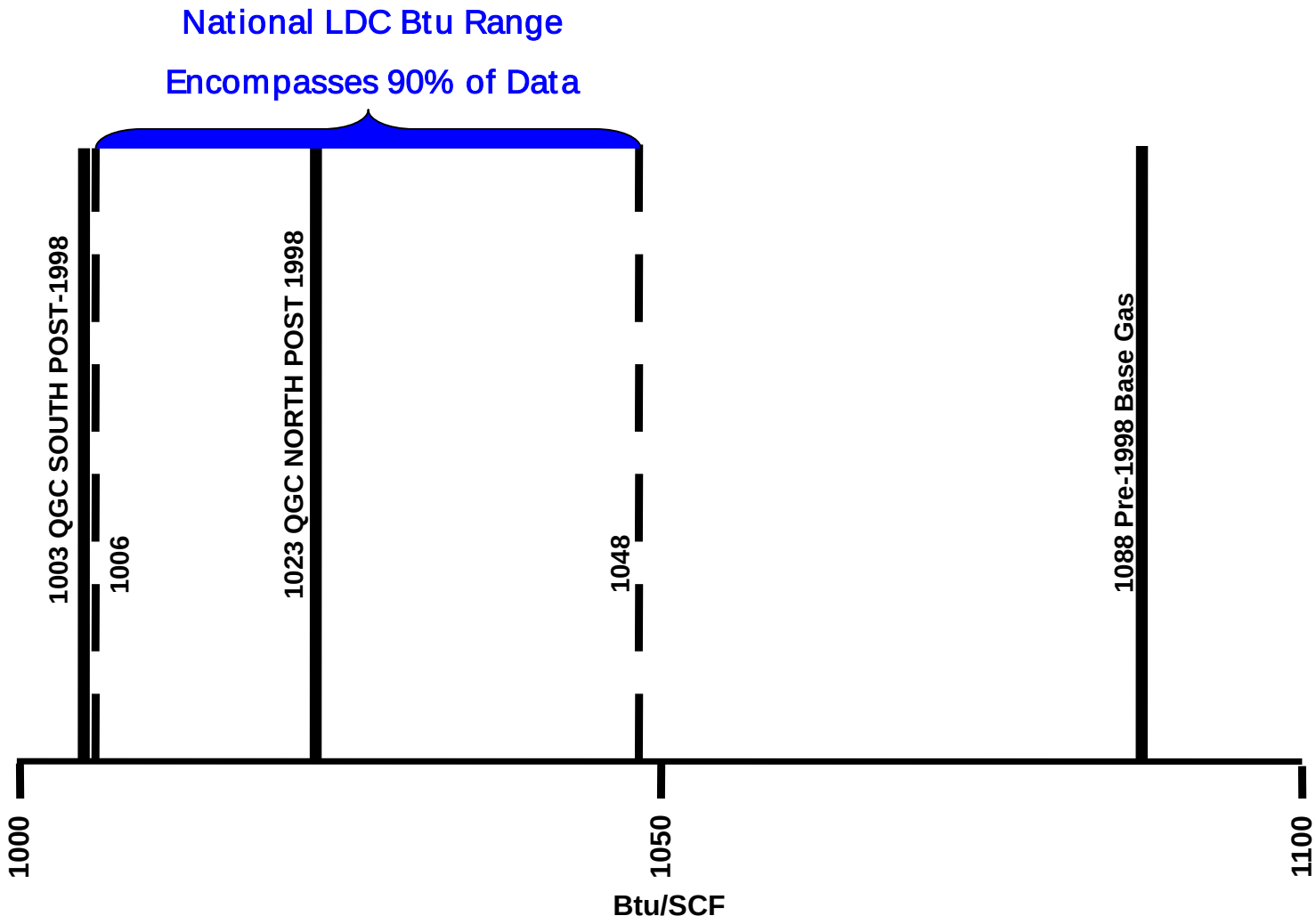
Questar Gas Btu Delivery Ranges (1995 – Present)



Kern Gas Quality to QGC



QGC BTU SET-POINTS RELATIVE TO BTU OF GAS DELIVERED TO 26 MAJOR URBAN AREAS[1/]



1/"Variability of Natural Gas Composition in Select Major Metropolitan Areas of the United States," prepared by the American Gas Association Laboratories for Gas Research Institute, GRI-92/0123, March 1992

Questar Gas Position Points

1. **An improperly adjusted appliance creates a safety hazard.**

2. **QGC and QPC constantly manage heat content and other gas quality criteria for safe, reliable use.**

3. **Post FERC regulations, Rocky Mountain pipelines have adopted national interstate grid gas quality specifications.**

4. **QGC's gas sources (QPC & Kern River), as part of the interstate pipeline grid, supply volumes whose gas quality is aligned to the national market.**

5. **Markets, beyond the Rocky Mountains, have a major influence on gas quality and the physical flows of Rocky Mountain production.**