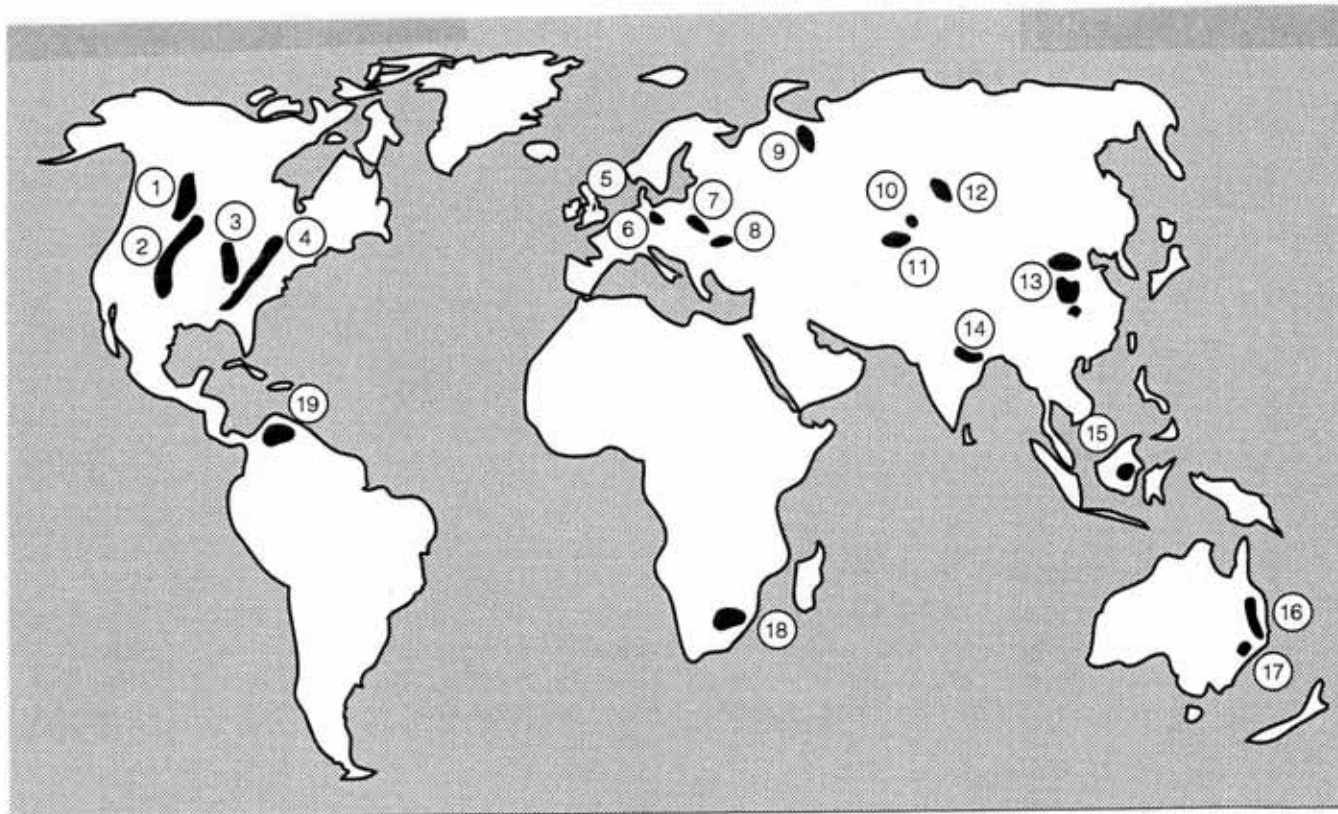


**ADVANCING MINE SAFETY
AND
ENERGY PRODUCTION
THROUGH
COAL-BED METHANE PRODUCTION**

PRAMOD THAKUR



CONSOL ENERGY



- 1 Western Canada
- 2 Western USA
- 3 Illinois
- 4 Appalachian
- 5 East Pennine
- 6 Ruhr
- 7 Upper Silesia

- 8 Donetsk
- 9 Pechora
- 10 Ekibastuz
- 11 Karaganda
- 12 Kuznetsk
- 13 China
- 14 Raniganj/Jharia

- 15 Kalimantan
- 16 Bowen
- 17 Sydney
- 18 Karoo
- 19 Northern Colombia/Venezuela

- **INDICATED COAL RESERVE: 17 - 30 Tt**
- **PROVEN COAL RESERVE: 1 Tt**
- **CURRENT PRODUCTION: 5000 Mt**
- **PRODUCTION IN 2020: 6500 Mt**

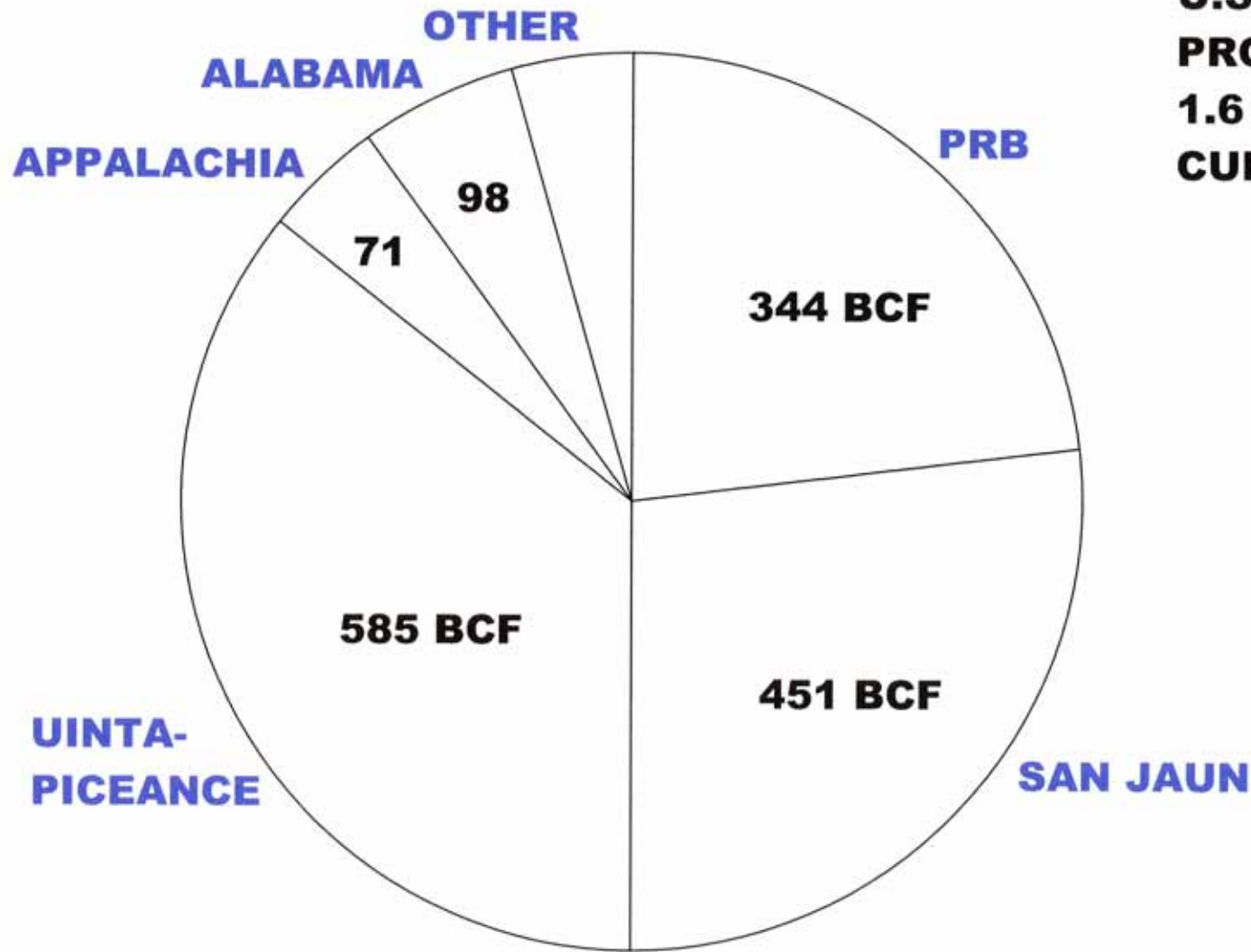
Country	1992 Est. by Kuuskra (Tm ³)	1997 Est. by Cairns Point Publishing (Tm ³)
U.S.A.	11	30 – 41
C.I.S.	20 – 166	720 – 790
China	20 – 35	31
Australia	8 – 14	--
Germany	3	2.83
India	1	0.7
South Africa	1	--
Poland	3	0.4 – 1.5
Canada	6 – 76	92
Other Countries	5 – 10	--
Total (GIP)	78 – 320	877 – 959

Recoverable Reserve – 30 to 60 percent of GIP

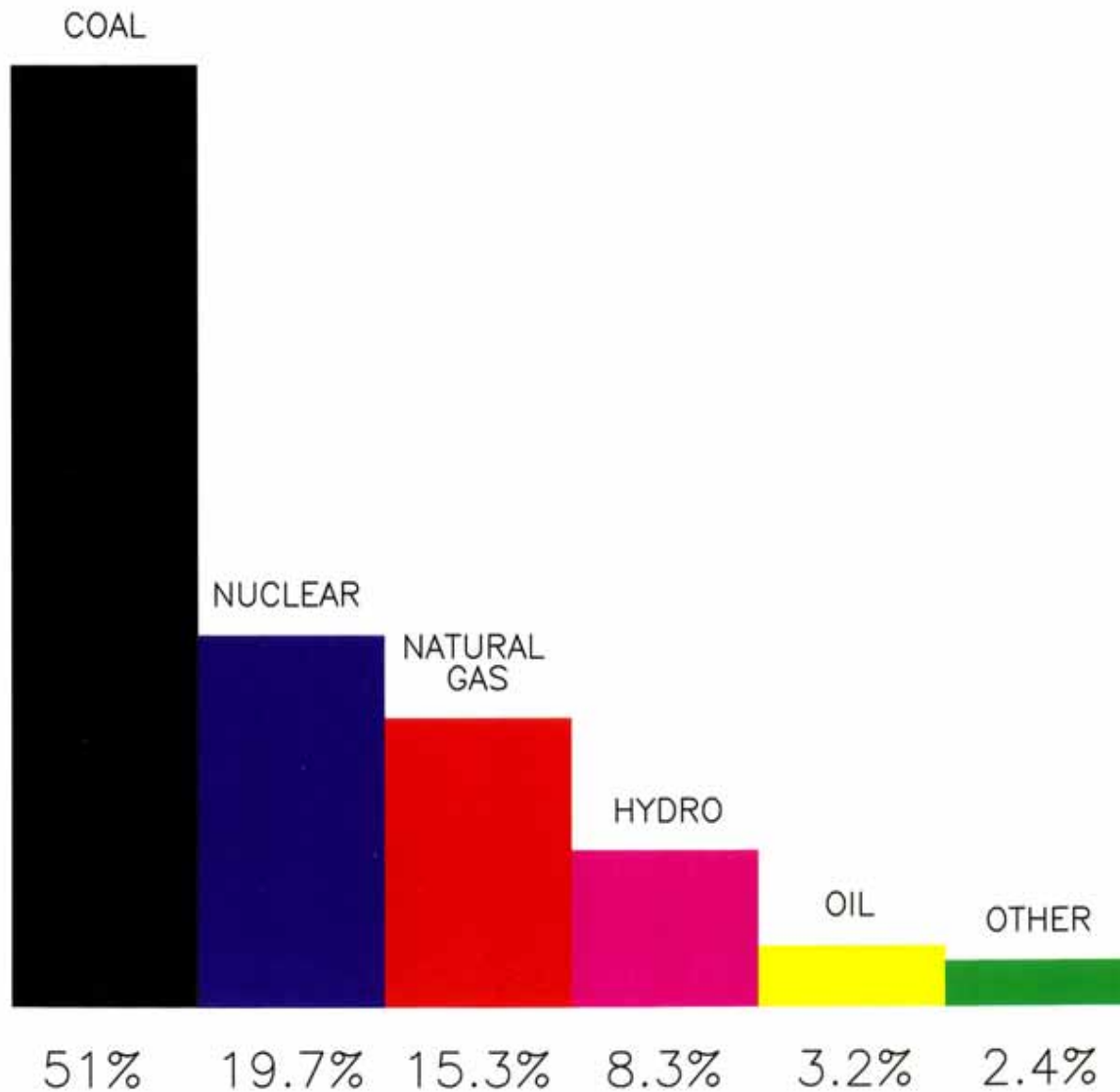
U.S. Conventional Gas Reserve = 25 Tm³

COALBED METHANE PRODUCTION

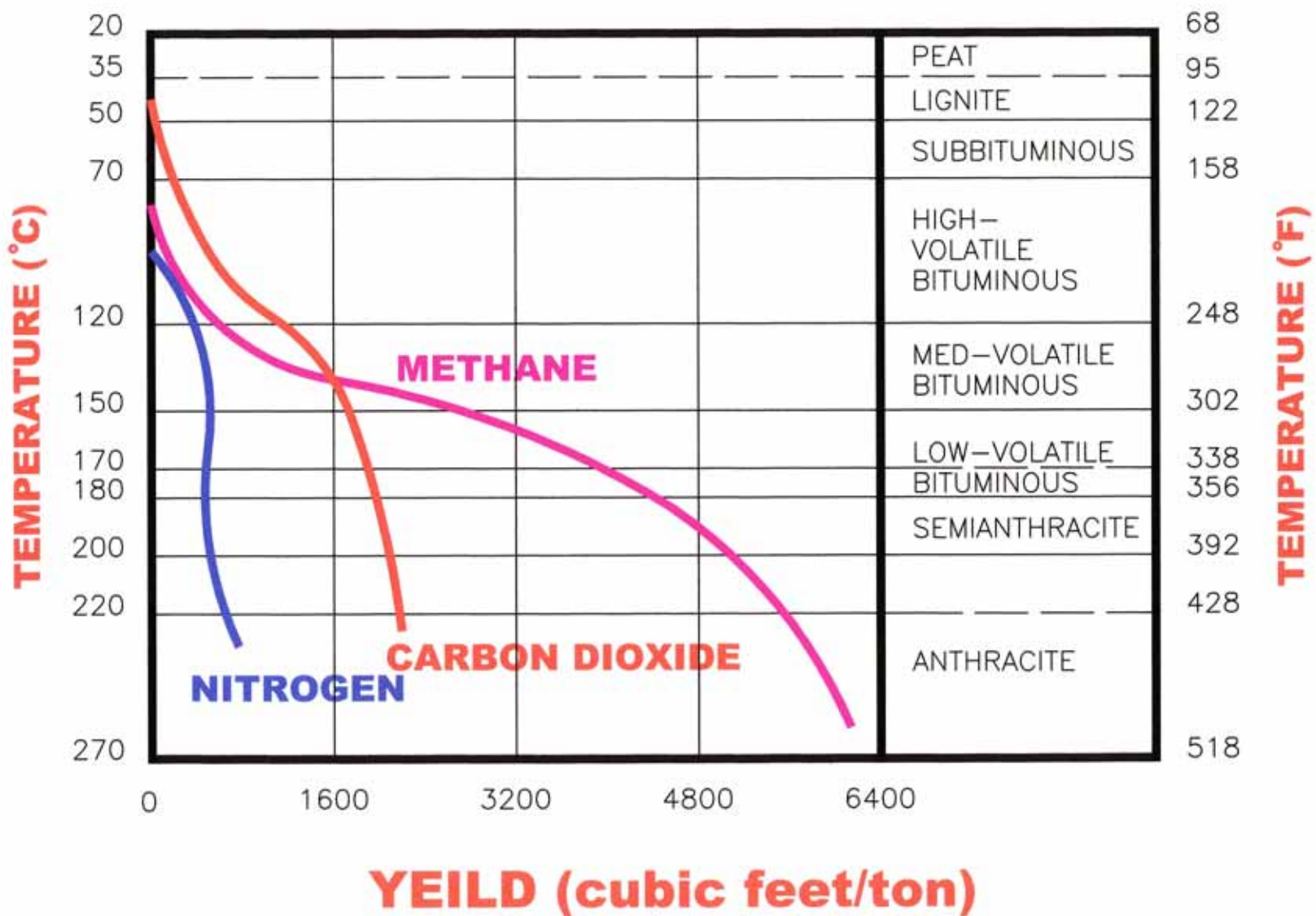
**TOTAL 2003
U.S. CBM
PRODUCTION =
1.6 TRILLION
CUBIC FEET (TCF)**



999 ELECTRIC POWER GENERATION BY ENERGY SOURCE

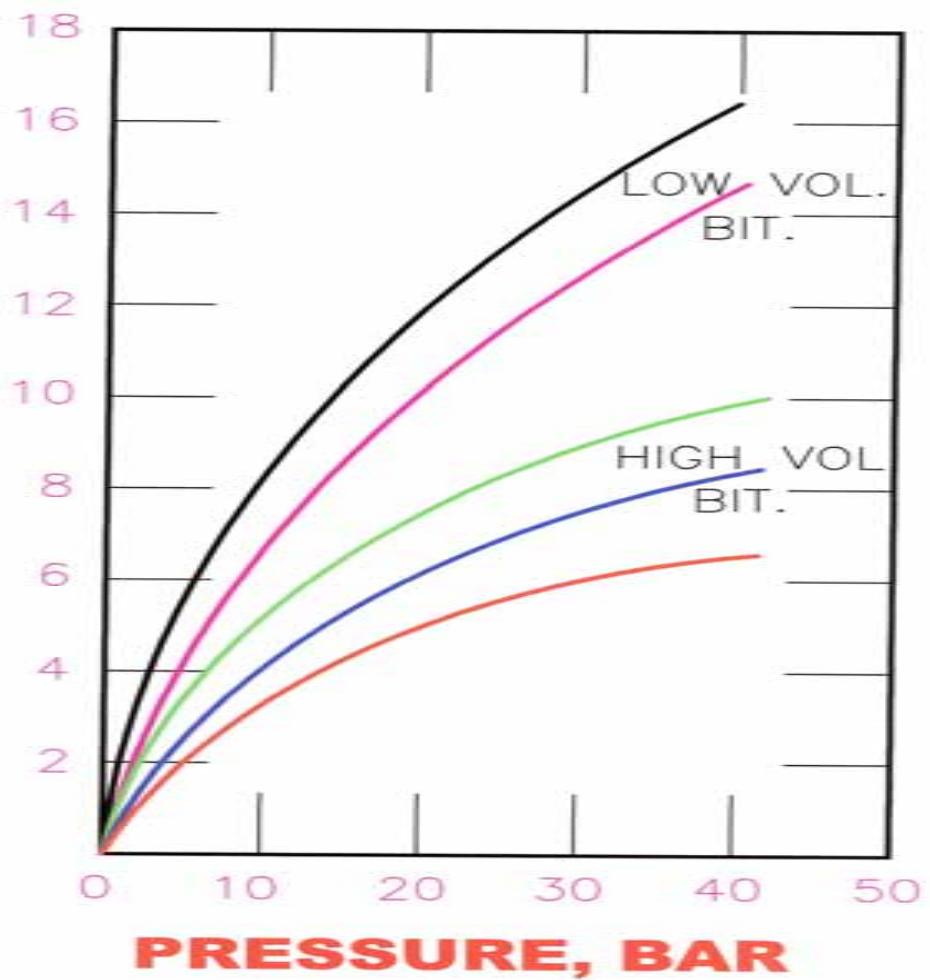


COALIFICATION GAS LOSSES

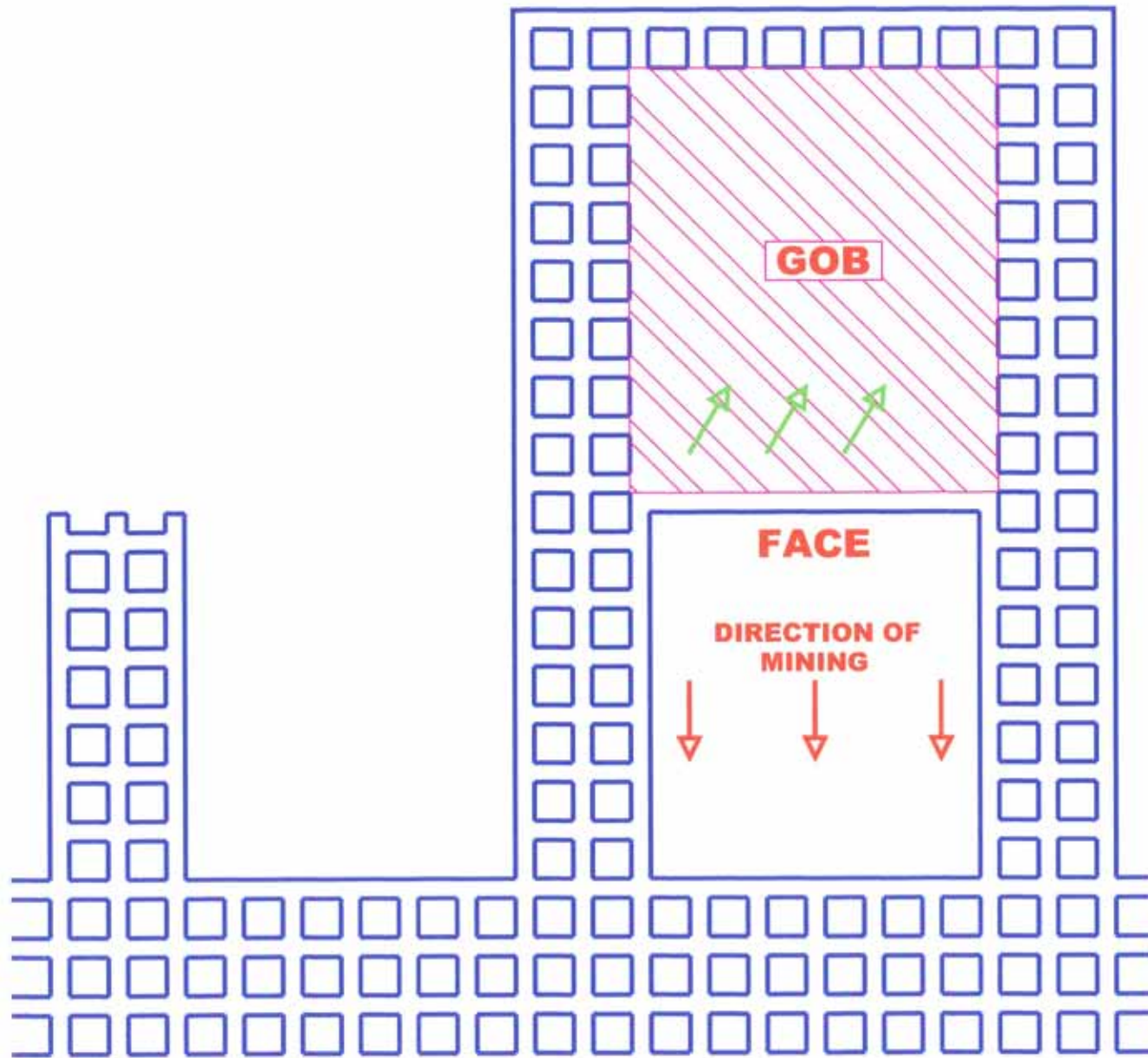


VOLUME ABSORBED, CUBIC METERS PER TON

- HARTSHORNE
- POCAHONTAS No. 3
- PITTSBURGH
- CASTLEGATE
- ILLINOIS No. 6



**ALL COAL SEAMS ARE GASSY
METHANE DRAINAGE NEEDED
WHEN SPECIFIC METHANE
EMISSION EXCEEDS 30 m³/t**



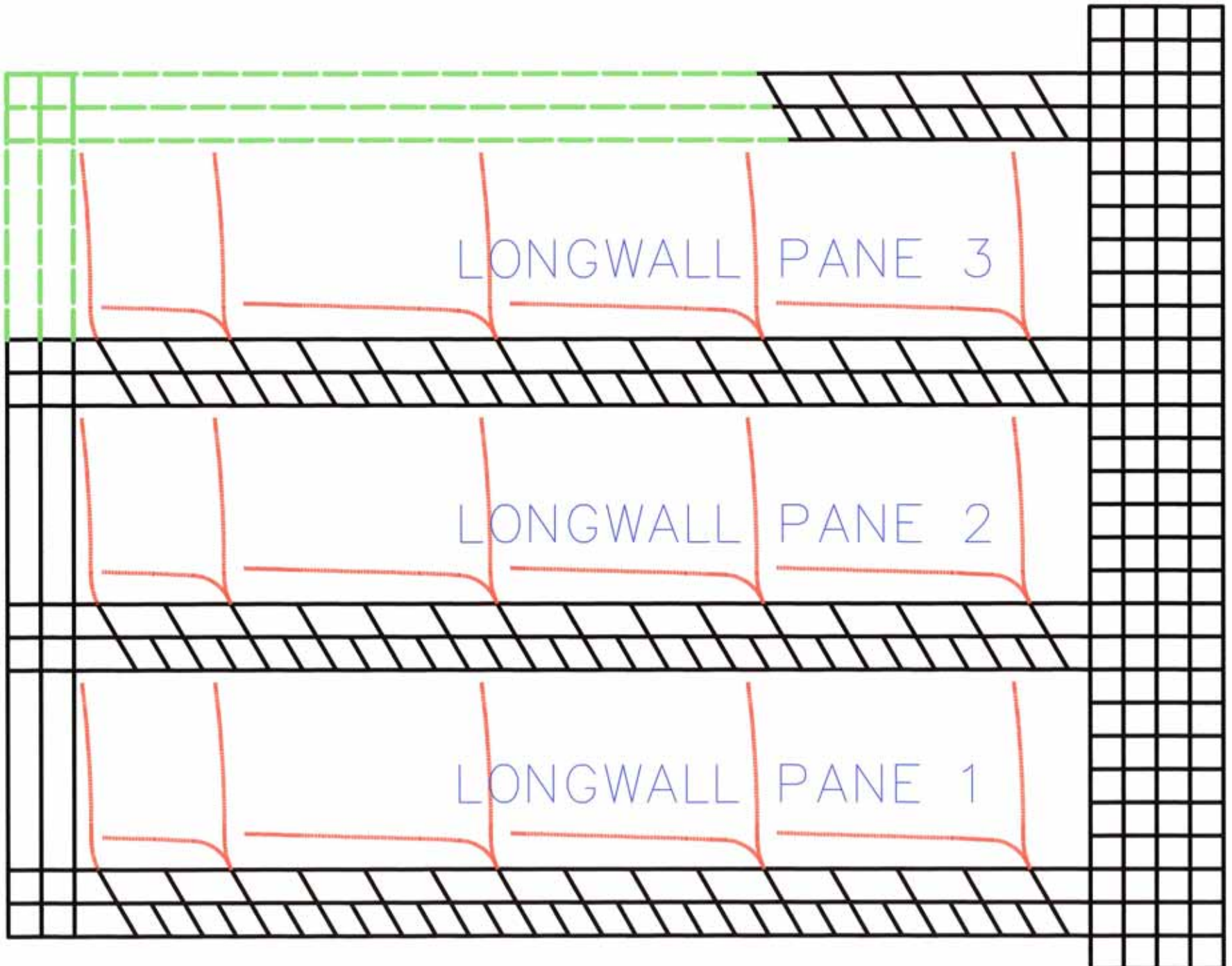
TYPICAL LONGWALL PANEL

COAL SEAM DEGASIFICATION

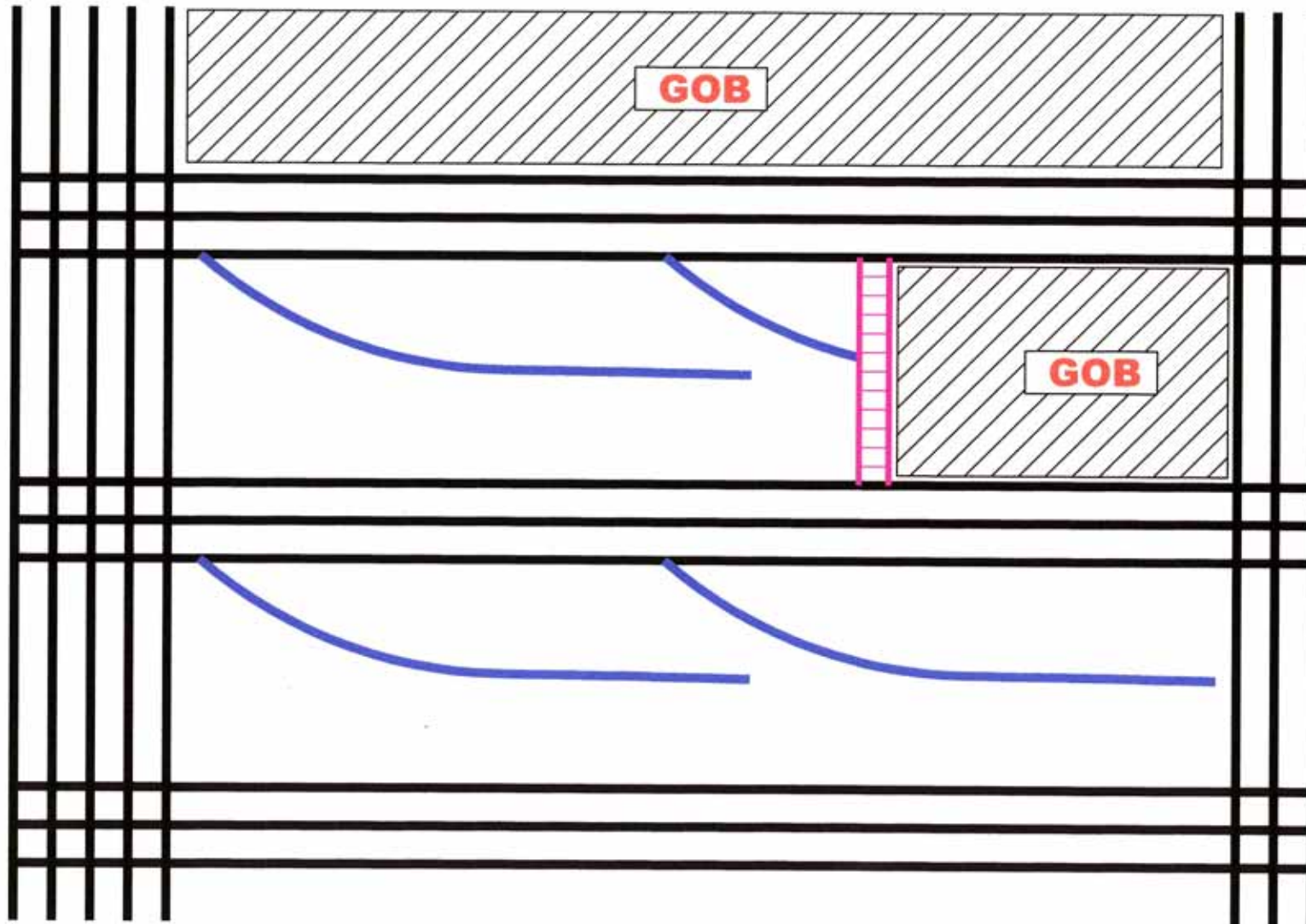
- **PRE-MINING**
- **POST-MINING**

PRE-MINING

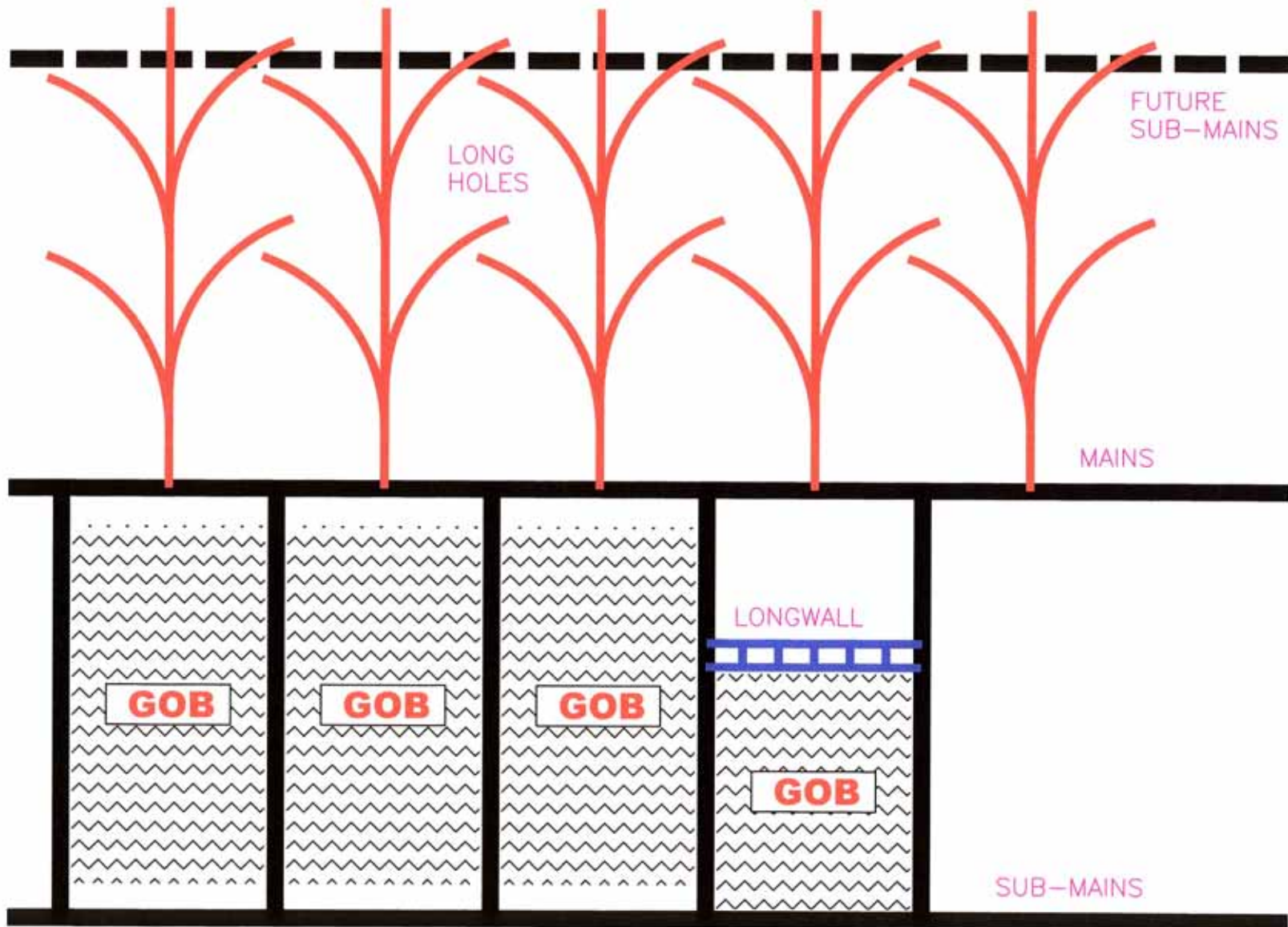
- **IN-MINE HORIZONTAL DRILLING**
- **VERTICAL WELL WITH FRACING**
- **HORIZONTAL DRILLING FROM SURFACE**



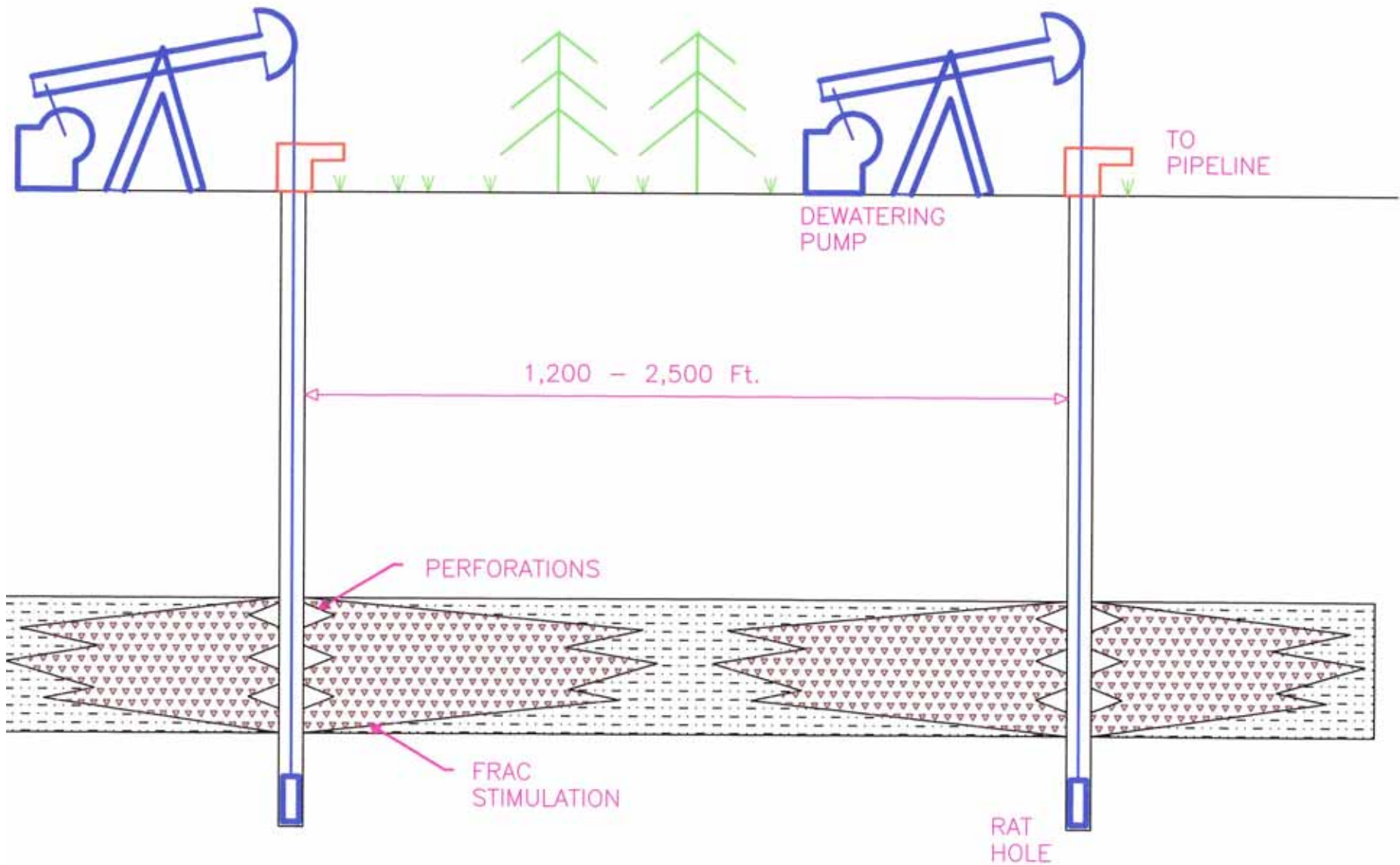
DIRECTIONAL HORIZONTAL HOLES



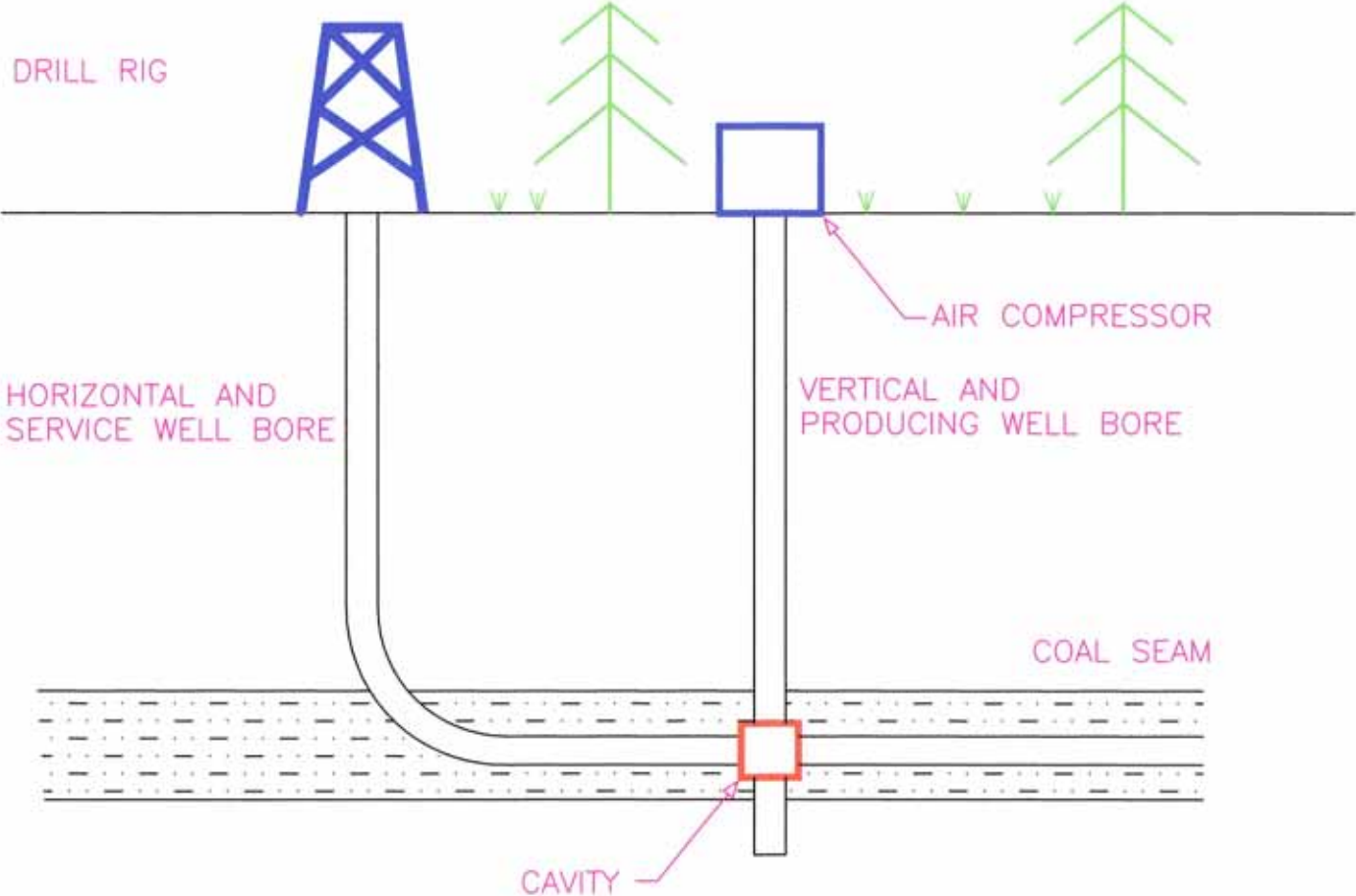
LONG IN-SEAM HOLES

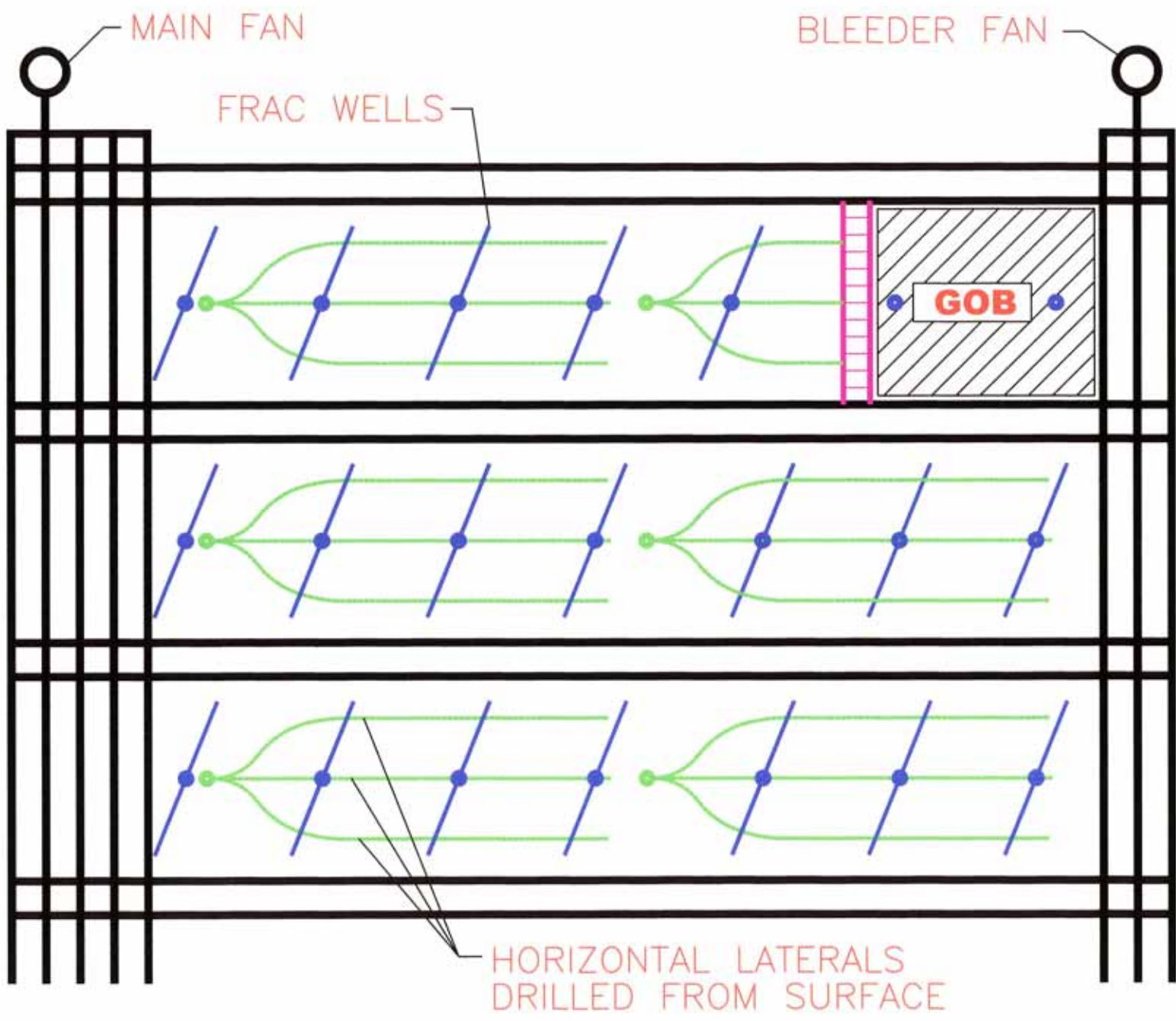


VERTICAL FRAC WELLS



VERTICAL ARTICULATED HOLES





MAIN FAN

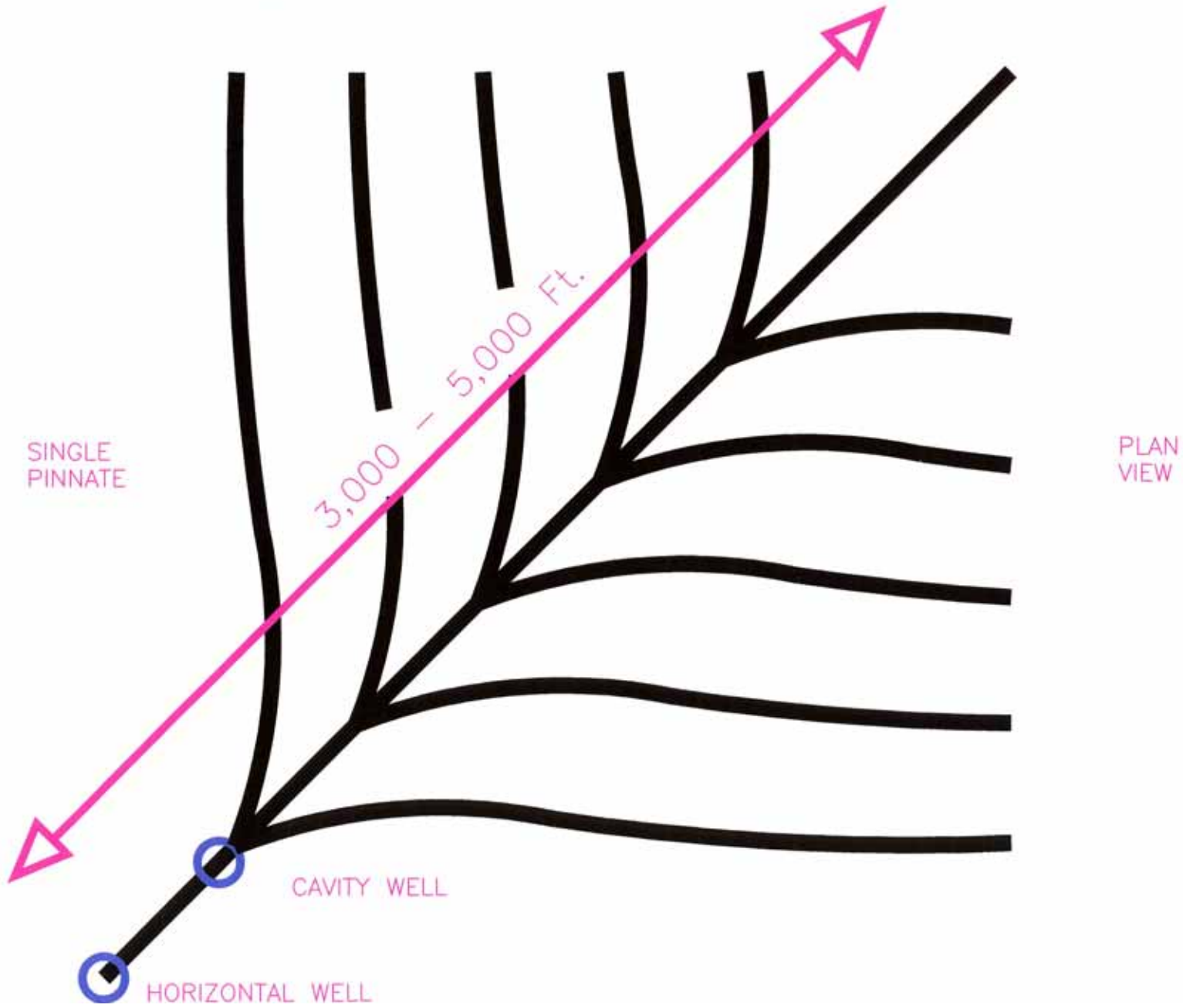
BLEEDER FAN

FRAC WELLS

GOB

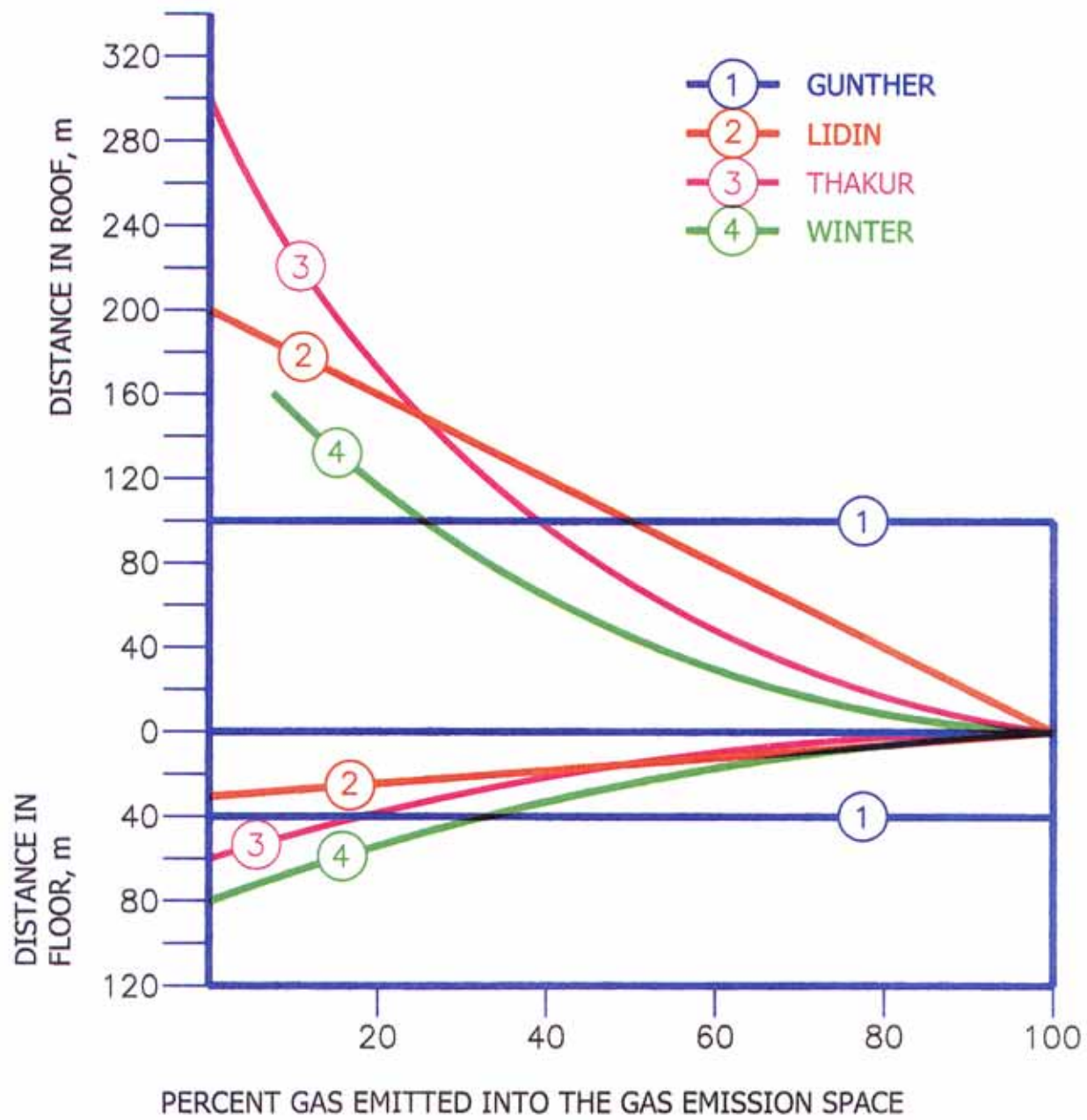
HORIZONTAL LATERALS
DRILLED FROM SURFACE

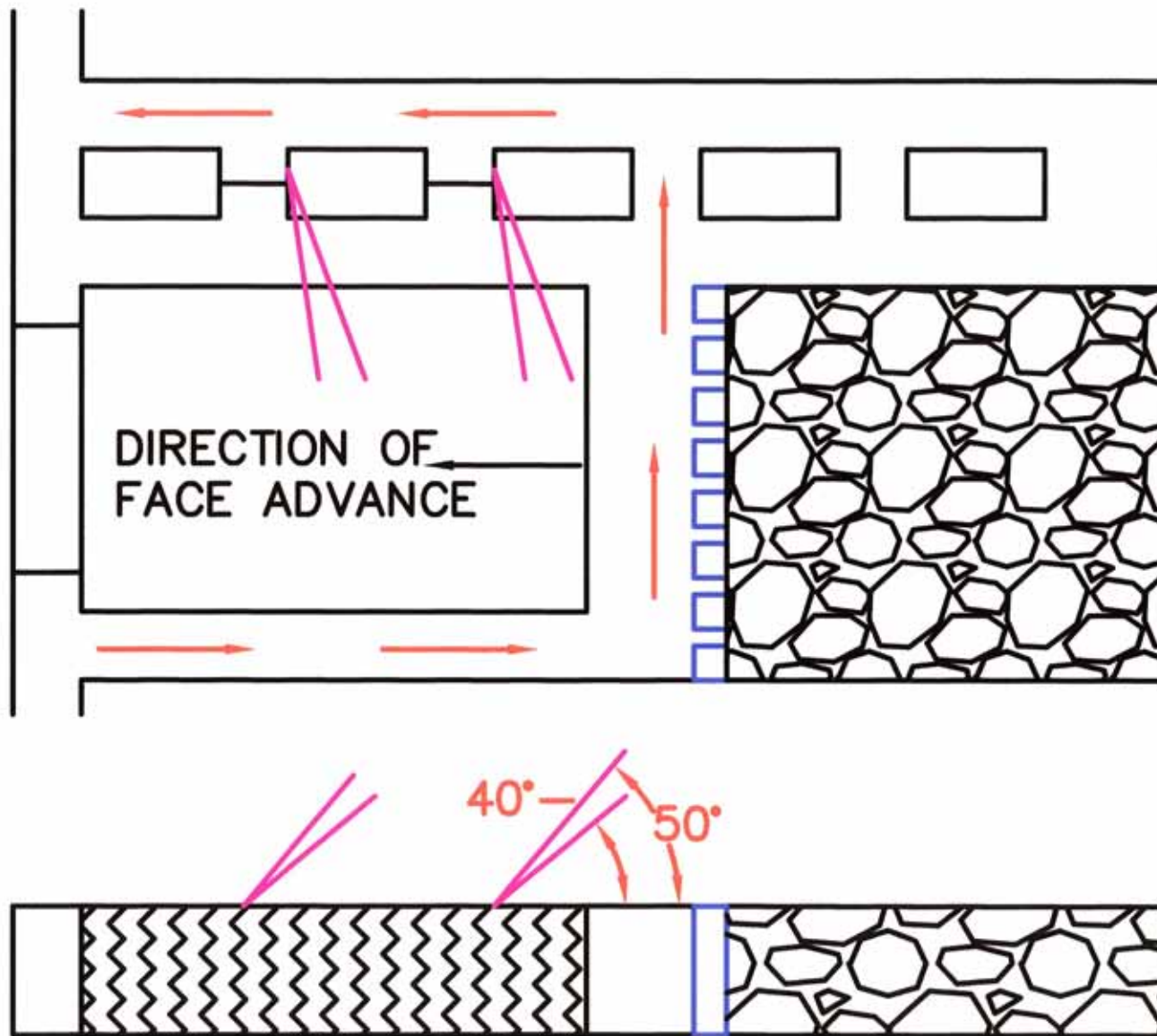
VERTICAL ARTICULATED HOLES



POST-MINING DRAINAGE

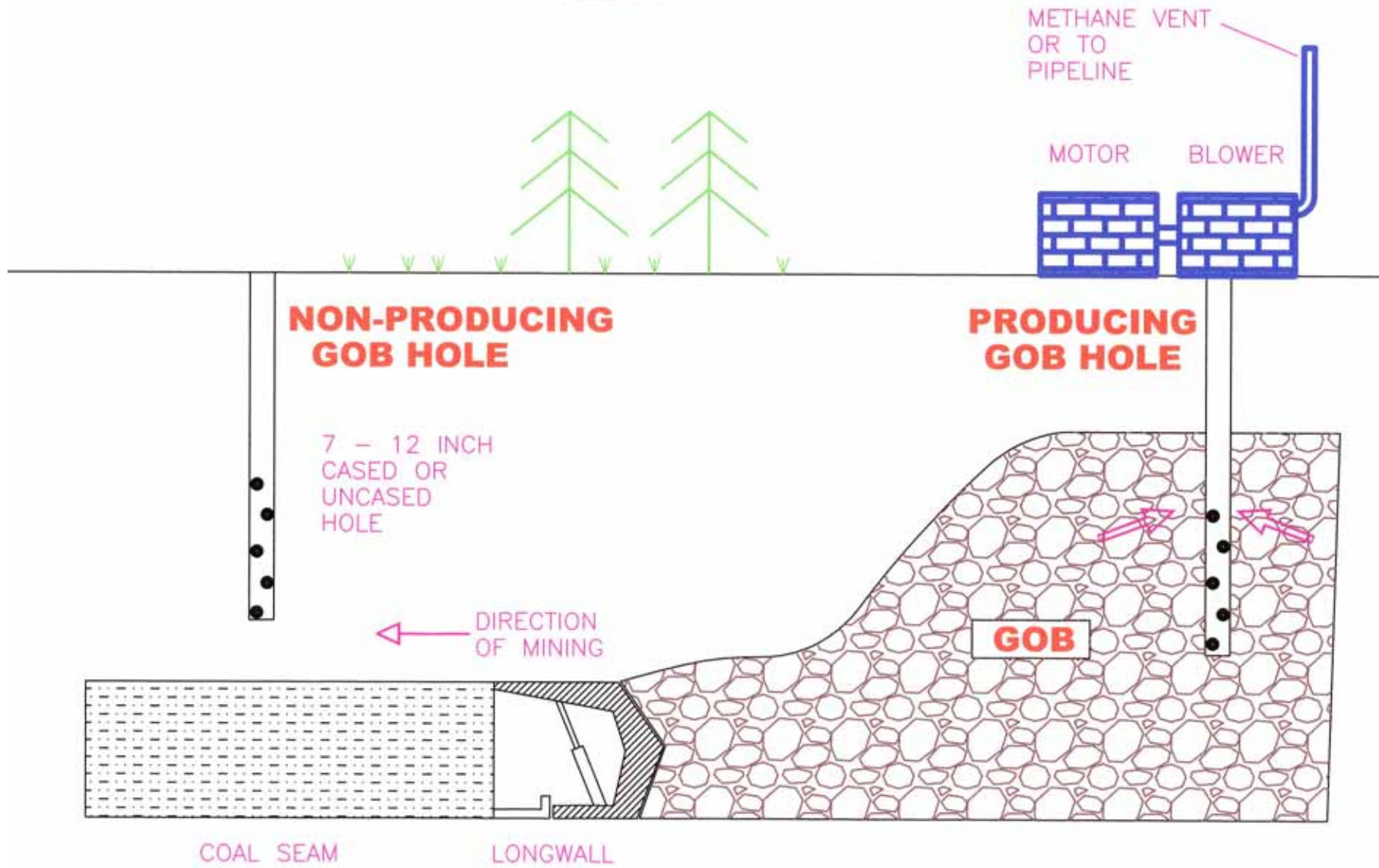
- **CROSS-MEASURE BOREHOLES**
- **VERTICAL GOB WELLS**

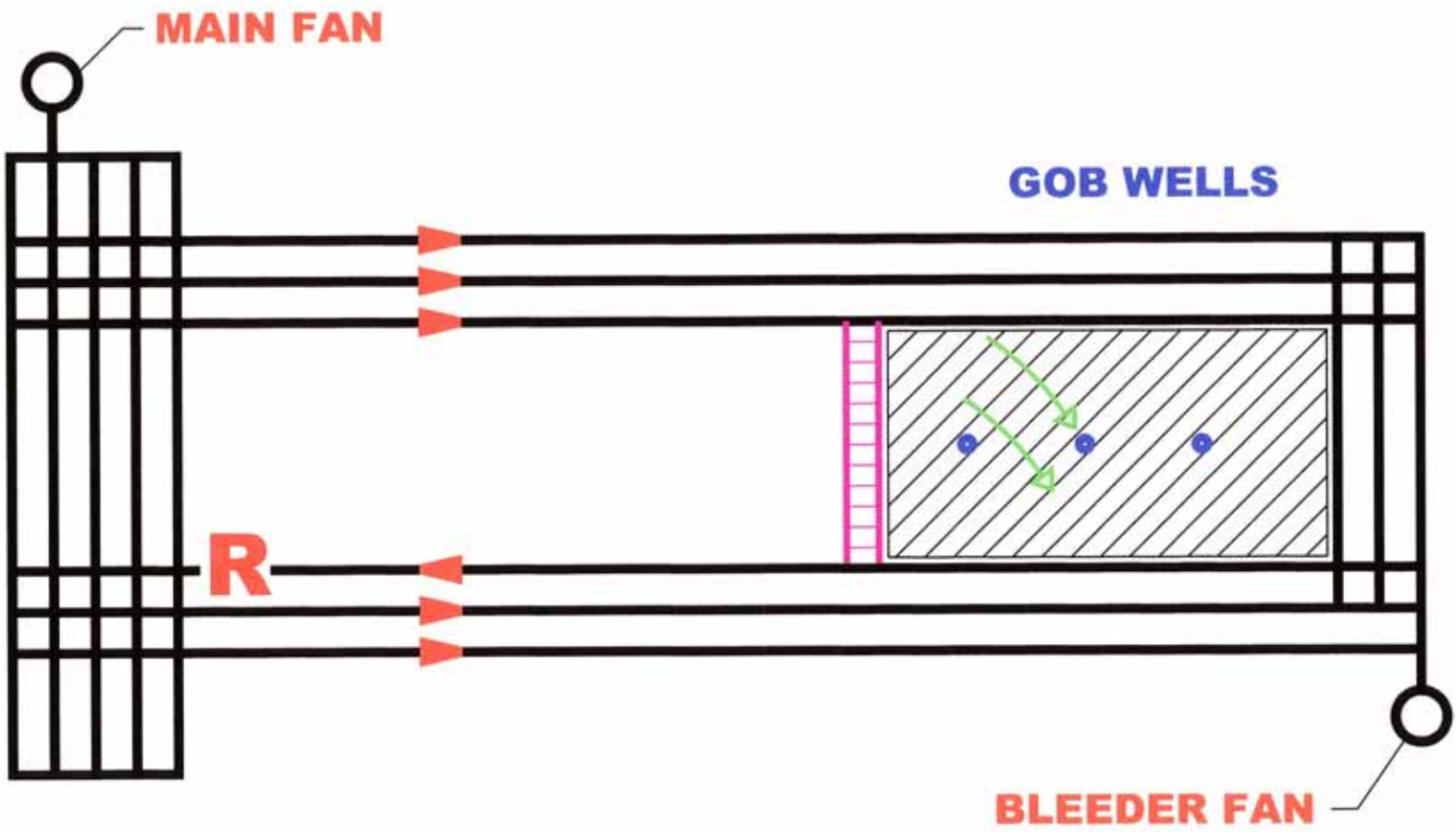




METHANE DRAINAGE WITH
CROSS-MEASURE BOREHOLES

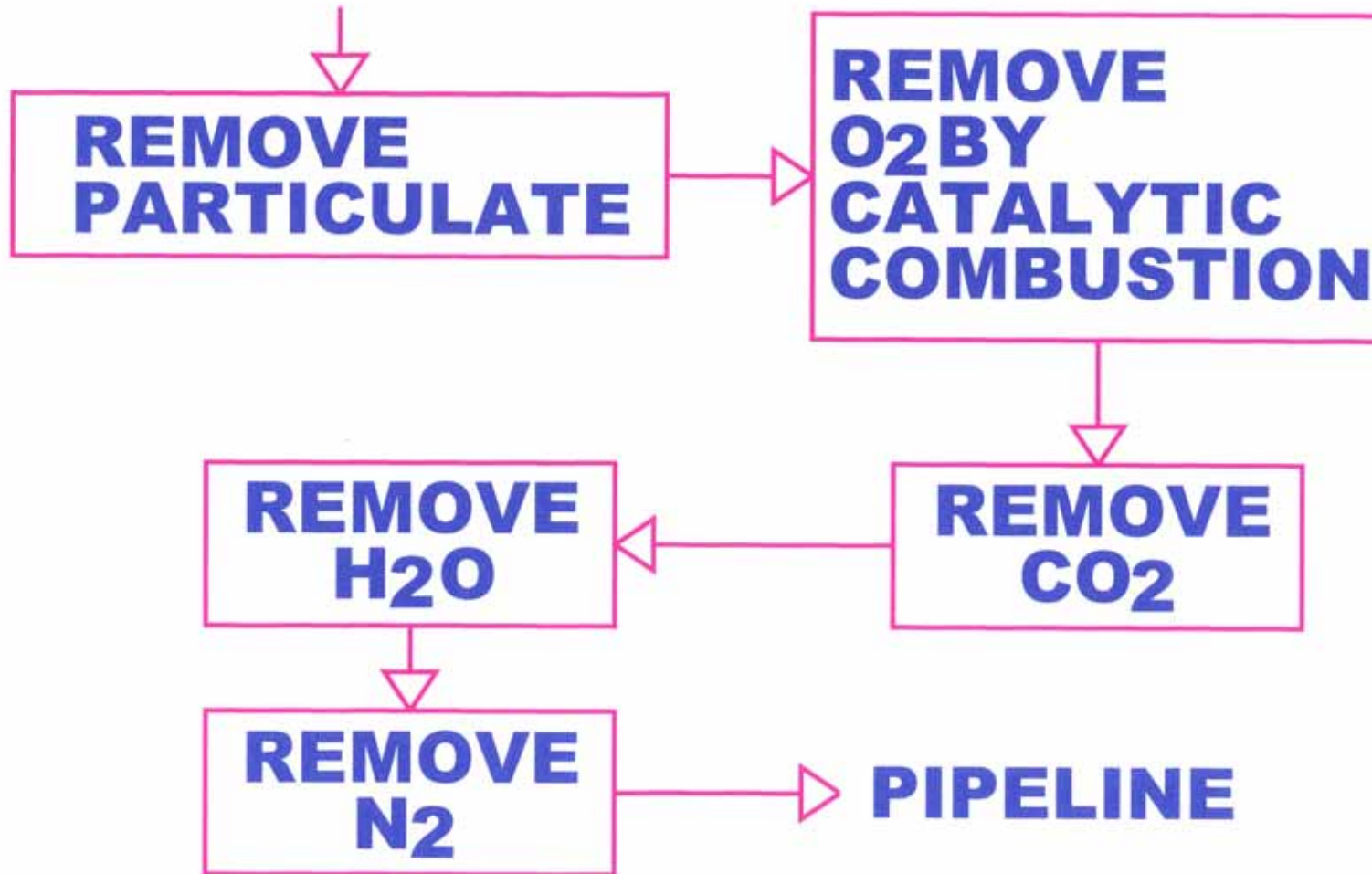
GOB HOLES





PROCESSING COAL-BED METHANE

**RAW
GAS**



FUTURE OF COAL-BED METHANE PRODUCTION

- **HORIZONTAL DRILLING FROM SURFACE
USING COILED TUBING AND
REAL-TIME INSTRUMENTS**
- **EXTRACTION OF CBM FROM DEEPER,
LESS PERMEABLE COAL SEAMS**
- **CO₂ SEQUESTRATION IN COAL-SEAM
AND ENHANCED CBM RECOVERY**

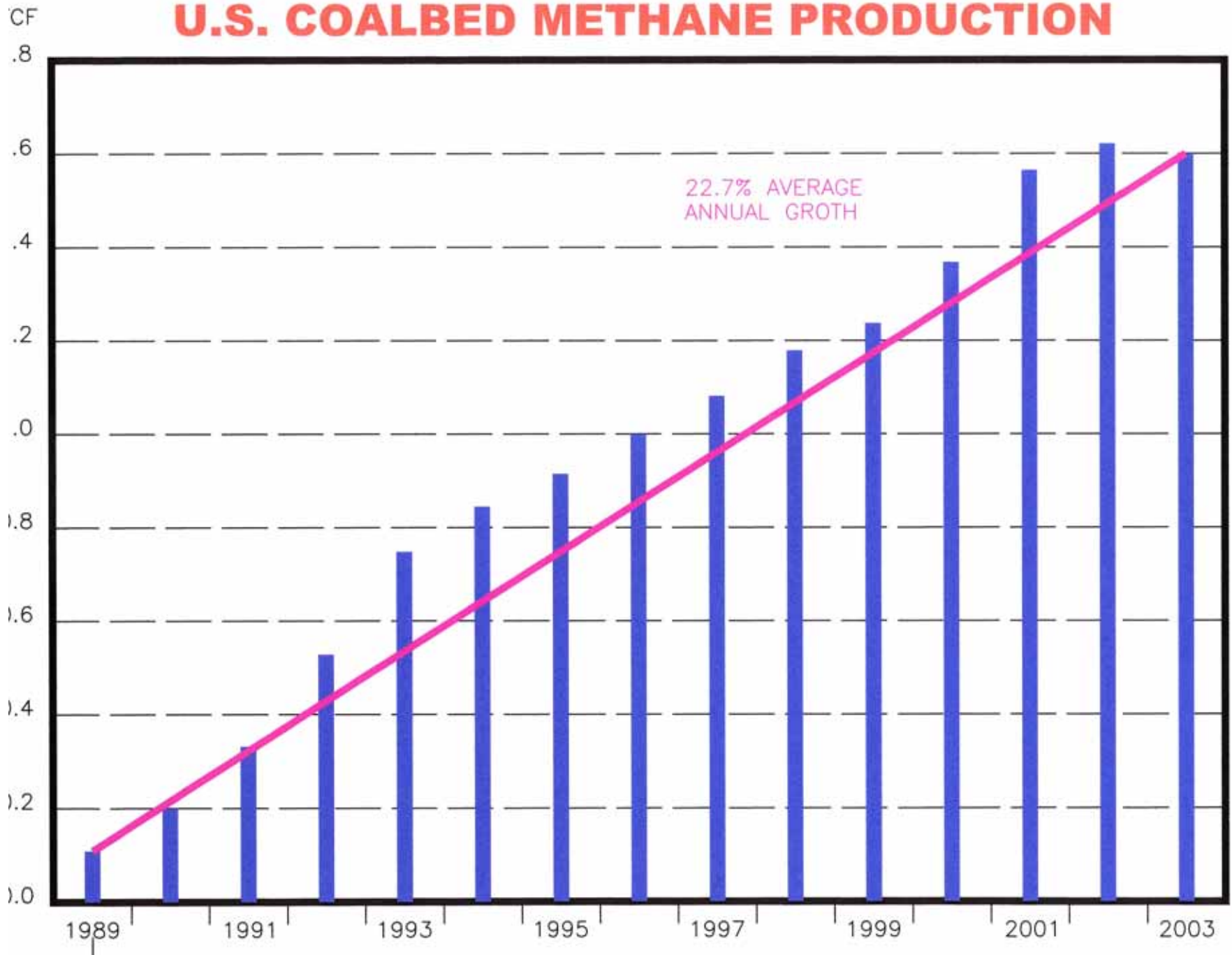
BENEFITS OF COAL-BED METHANE DRAINAGE

- **IMPROVED MINE SAFETY- REDUCED FACE IGNITION, MINE EXPLOSION**
- **IMPROVED COAL PRODUCTION -REDUCED COST/ton**
- **REDUCED VENTILATION REQUIREMENTS AIRWAYS, SHAFTS**
- **REVENUE FROM GAS SALES**
- **ADVANCE EXPLORATION; GEOPHYSICAL MAPPING OF LONGWALLS**
- **HORIZONTAL BOREHOLES USED FOR WATER INFUSION FOR RESPIRABLE DUST CONTROL**

**THANK YOU
(SHYEH-SHYEH)**

ANY QUESTIONS?

U.S. COALBED METHANE PRODUCTION



Year	Mine	Deaths
2001	Blue Creek #5 Mine; Brookwood, AL.....	13
1992	No. 3 Mine; Norton, VA.....	8
1989	William Station #9 Mine; Wheatcroft, KY.....	10
1983	McClure #1 Mine; McClure, VA.....	7
1982	No. 1 Mine; Craynor, KY.....	7
1981	No. 21 Mine; Whitwell, TN.....	13
1981	No. 11 Mine; Kite, KY.....	8
1981	Dutch Creek No. 1; Red Stone, CO.....	15
1980	Ferrel #17; Uneeda, WV.....	5
1976	Scotia Mine; Oven Fork, KY.....	26
1972	Itman No. 3 Mine; Itman, WV.....	5
1970	No. 15 & 16 Mines; Hyden, KY.....	38