# Managed Pressure Drilling

SURFACE TO IN-SEAM

DyMAXion DRILLING

Mitchell DRILLING CONTRACTORS

# Importance of Coal Seam Drilling

- Coal Bed Methane (CBM) is fast becoming a significant resource in Australia and Internationally
- CBM is becoming a sought after power source
- Surface to Inseam (SIS) drilling is a reliable method for extracting CBM

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# Benefits of Improving Techniques

- Because of the expanding market, it is in the industries best interest to continually refine and improve the drilling techniques
- Improved techniques and methods allow for what were marginal seams to become profitable for the client
- Continuous improvement facilitates more reliable drilling, safer working environments, and less environmental impact

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# Benefits of Improving Techniques

- Motivated by the revival interest in coal seam gas (CSG) liberation in the late 1990s, Mitchell Drilling developed the revolutionary Dymaxion drilling method
- Dymaxion is the result of considerable Research & Development
- It is now recognised as one of the most efficient drilling methods for coal bed methane gas
- Dymaxion was the first to bridge the two systems of vertical and horizontal drilling by adding a vertical intersect well at the end of the horizontal well
- The first Australian Dymaxion drilled well was in January 2000 for CH4 at Moranbah
- Mitchell Drilling have drilled over 200 wells – that's over 1,000,000 feet of directional drilling

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# Concentric Drilling Options

- **Parasite string.** This method employs a manifold within casing above the float collar that tubing (1” – 1.5”) is terminated in. The endless tubing is then run into the annulus with the production casing and cemented in place. A wellhead modification is made to accommodate the tubing at surface. Then once the shoe has been drilled out gas is continually injected down the parasite string gasifying the liquids as the reach the injection point above the shoe.

- **Slave Casing -** This method employs an uncemented liner used as a conduit for fluid returns while the annulus is used for continuous gas injection. A dummy wellhead is prepared to land the redundant casing string in, and retrieved after the well has been completed

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# Benefits of Concentric Drilling

- Drill crews are able to make and break connections as per standard procedures
- There is no need for additional drill string floats
- There is continuous flow in the largest annulus in the hole
- Vibration is limited at the BHA, when compared to two phase/foam injection
- There is no issue with motor lubrication
- No risk of hydrocarbon flow up the drill string
- Faster tripping times

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# Well Length Applications

- The goals of Drilling Contractors and Operators are often at odds. Drilling to target in the least amount of time. Without getting stuck and preserving the well bore integrity-may damage the formation and impair production for the operator

- Likewise what is the value in trying to drill a well with a technique designed to limit formation damage and maximize production when BHAs are lost due to inadequate hole cleaning or hole instability

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# Well Length Applications

- The combined depleting effect of dewatering through degassing and mining can substantially increase of challenge of drilling wells

- There has been a direct correlation between reduced pore pressure and drilling problems. To understand these problems it is important to identify the stresses placed on coal and the factors which impair production

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# Choices of Drilling Applications

Hole size & Length need to be carefully considered in relation to:

- Wellbore - Mechanical, Hydraulic & Reservoir Modeling
- A drilling design that is effective in one reservoir – may not be able to be applied to another
- Coal inseam integrity (Large hole sizes may collapse in some seams)
- Cost in relation to potential benefits of resource recovery benefits

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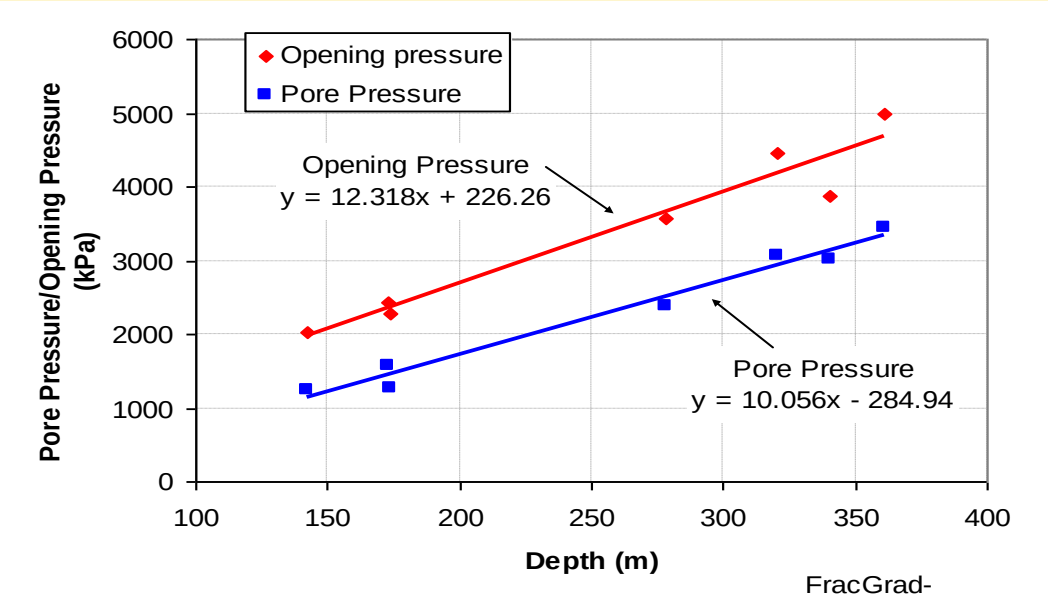
# Reservoirs that Benefit from MPD

- Formations that usually suffer major formation damage during drilling or completion operations
- Formations that exhibit regions of high loss circulation or fluid invasion during drilling or completing (e.g. Water depleted coal seams)
- Formations that exhibit tendencies for differential sticking
- Low permeability wells
- Wells with large macroscopic fractures

# Pressure Target for Drilling

Bottom Hole Pressure (BHP), should always remain above the Pore Pressure. Effective stress will increase thus reducing permeability.
The upper limit target Pore Opening pressure will at times prove to be a difficult boundary – the effect of exceeding this boundary will initially be production impairment and will eventually lead to losses as the coal will plastically open and allow itself to be invaded.




**1000 kpa = 145 psi**

**3000 kpa = 435 psi**

**5000 kpa = 725 psi**

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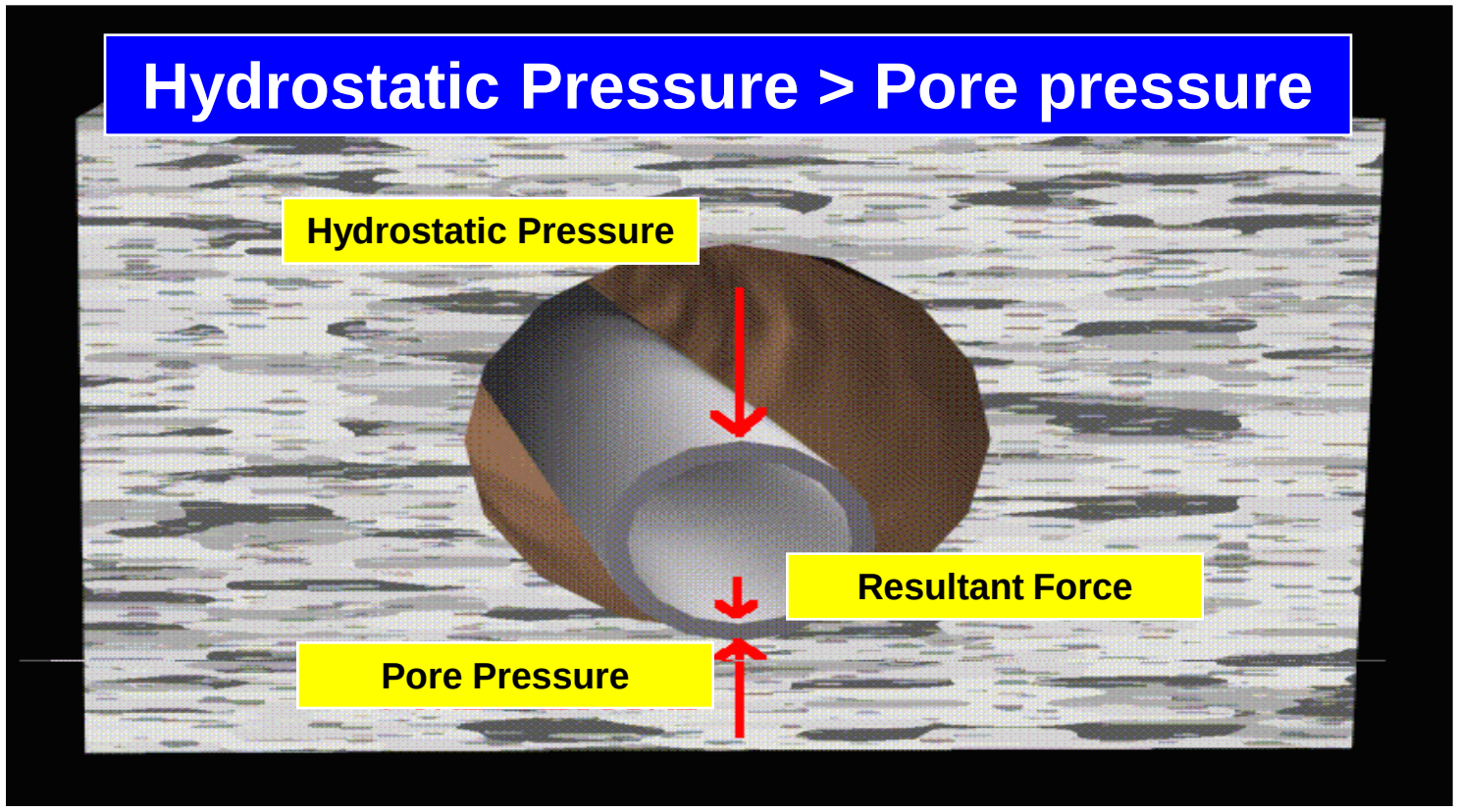
# Well Length

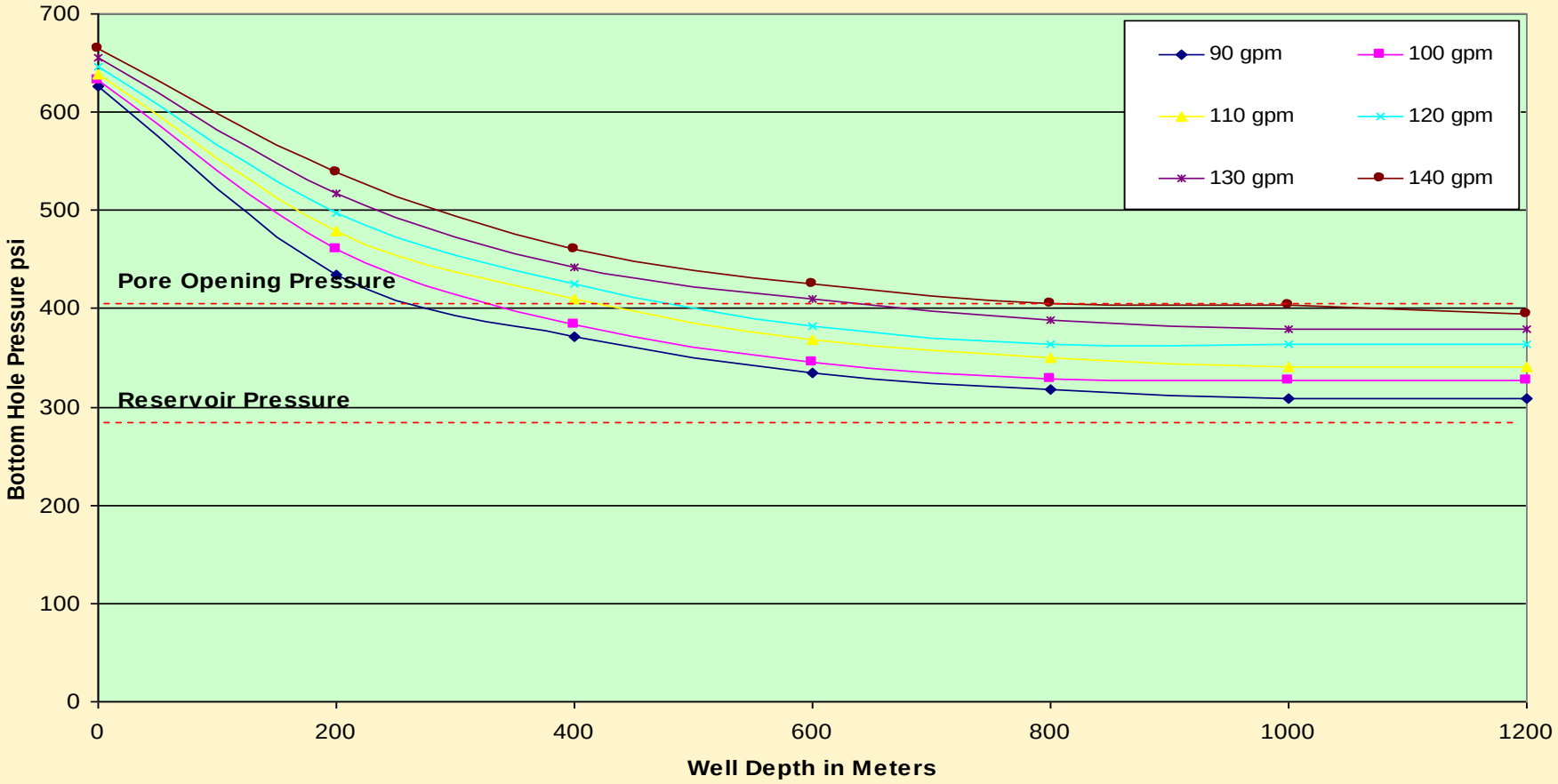
- Well length should be established on the ability to stay between the Pore Opening and Pore Pressure

- The exception to this would be if the Pore Pressure was much greater than the desorption pressure – then UB could be used. Then the upper boundary becomes the pore pressure

# Differential Sticking



# Managed Pressure Drilling
# 2.375” DP inside 4.75” Hole



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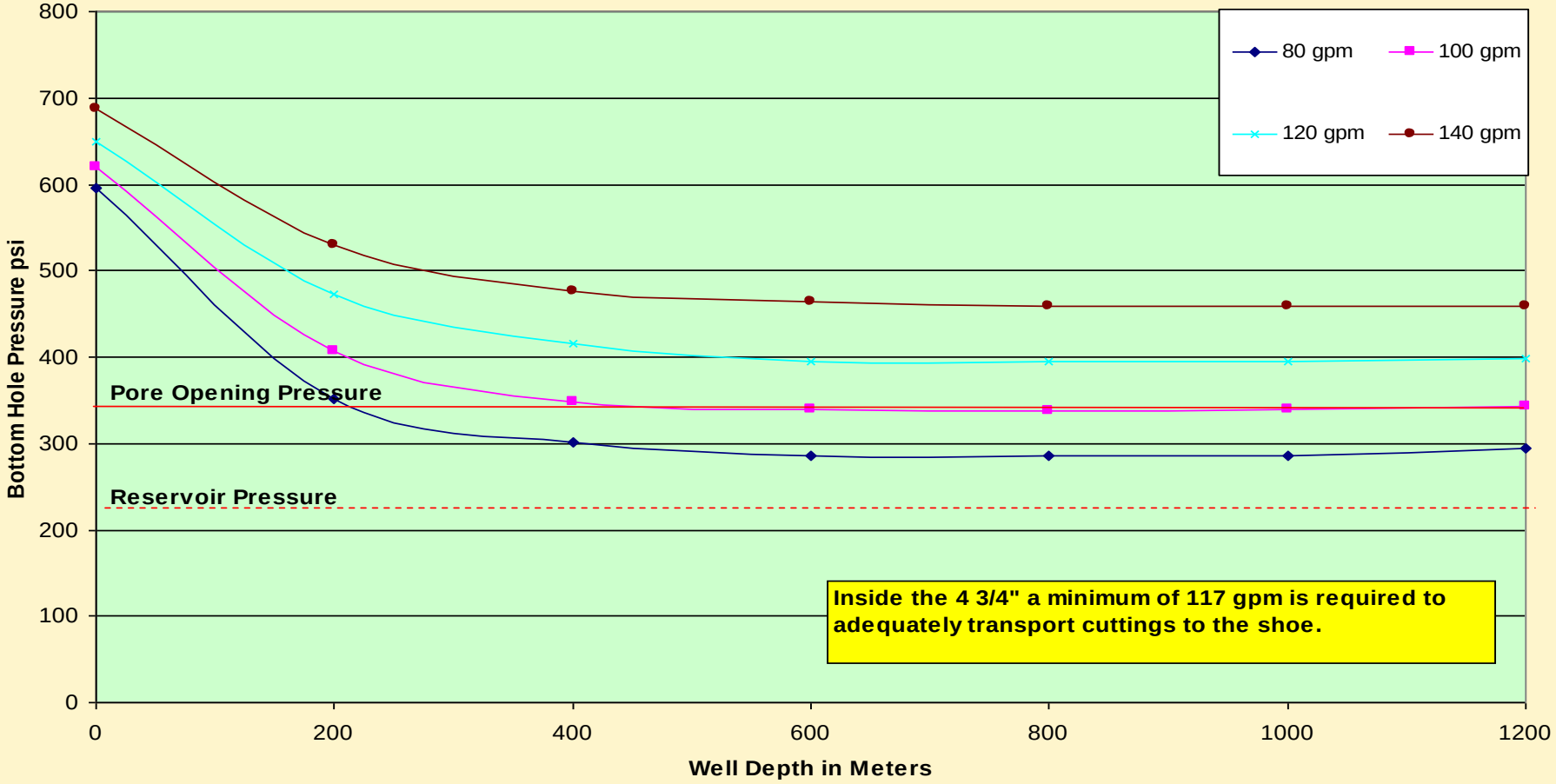
# Managed Pressure Drilling
# 2.875” DP inside 4.75” Hole



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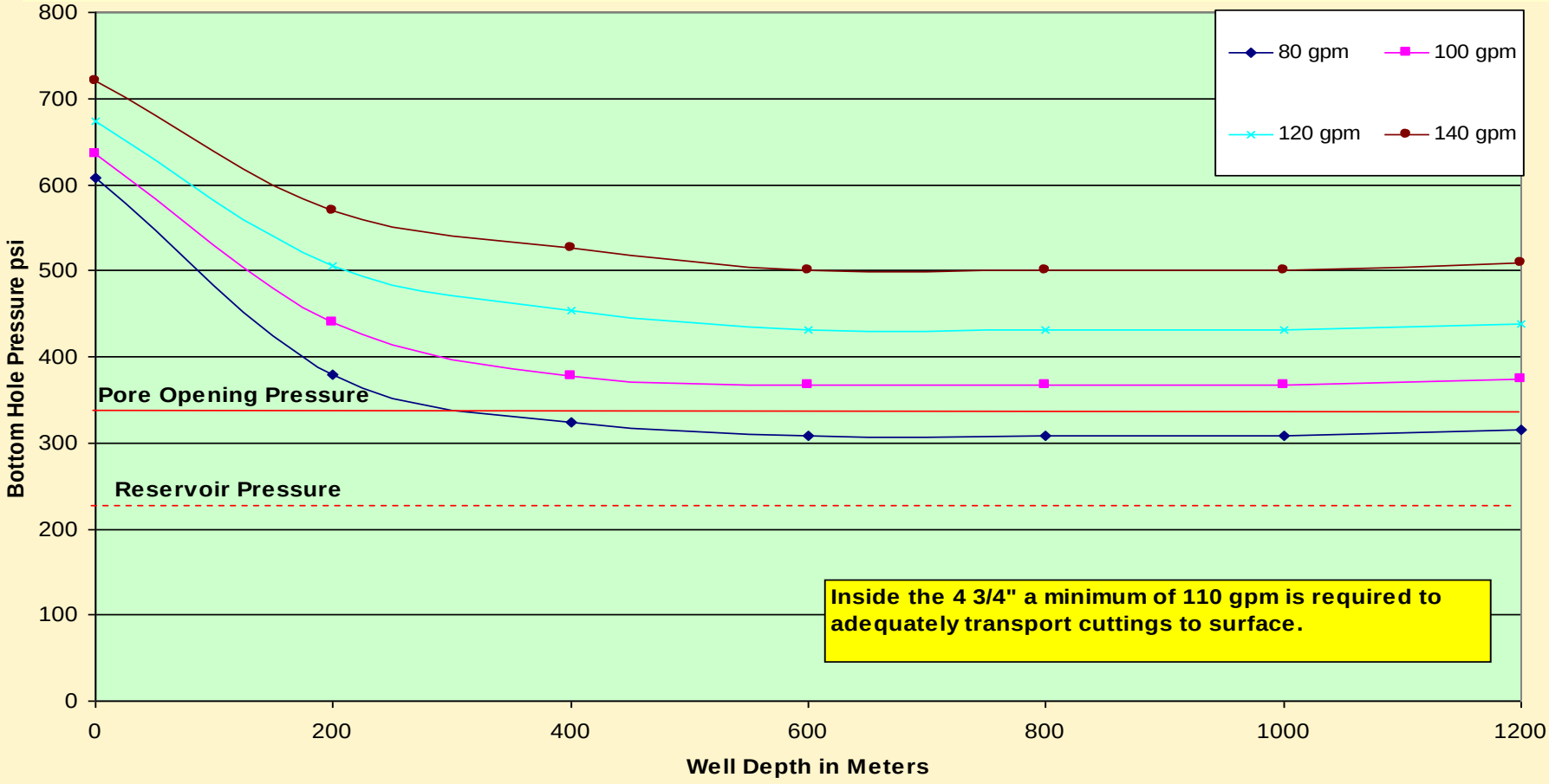
# Managed Pressure Drilling
# 3” DP inside 4.75” Hole



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# Hydraulic vs Mechanical Applications

- Prior to any drilling is to commenced, Hydraulic and Mechanical Modeling has to be conducted
- What looks good mechanically may not be achievable hydraulically
- In most applications the length of the well has to become a compromise between these factors

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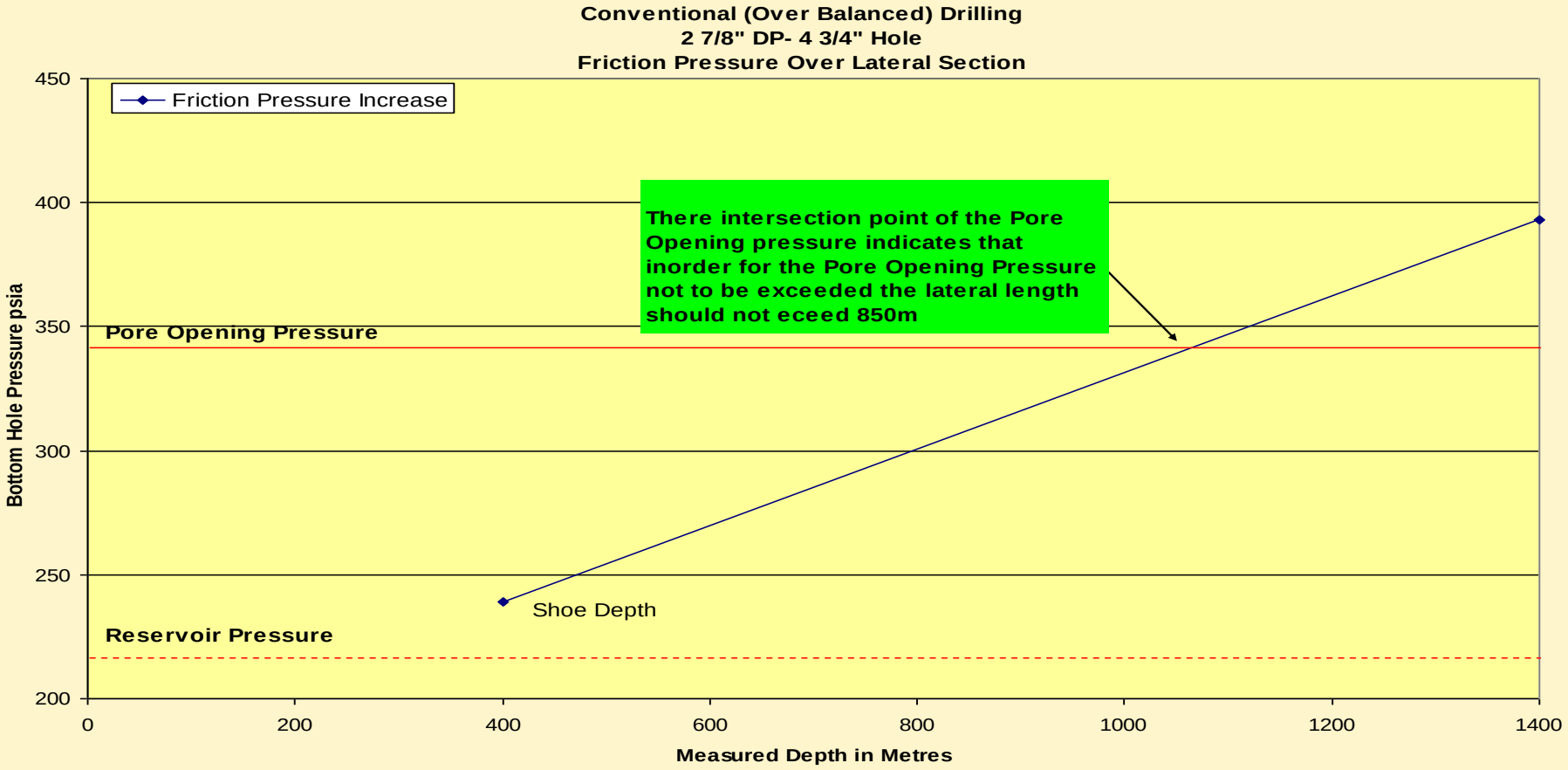
# Heel Toe Effect



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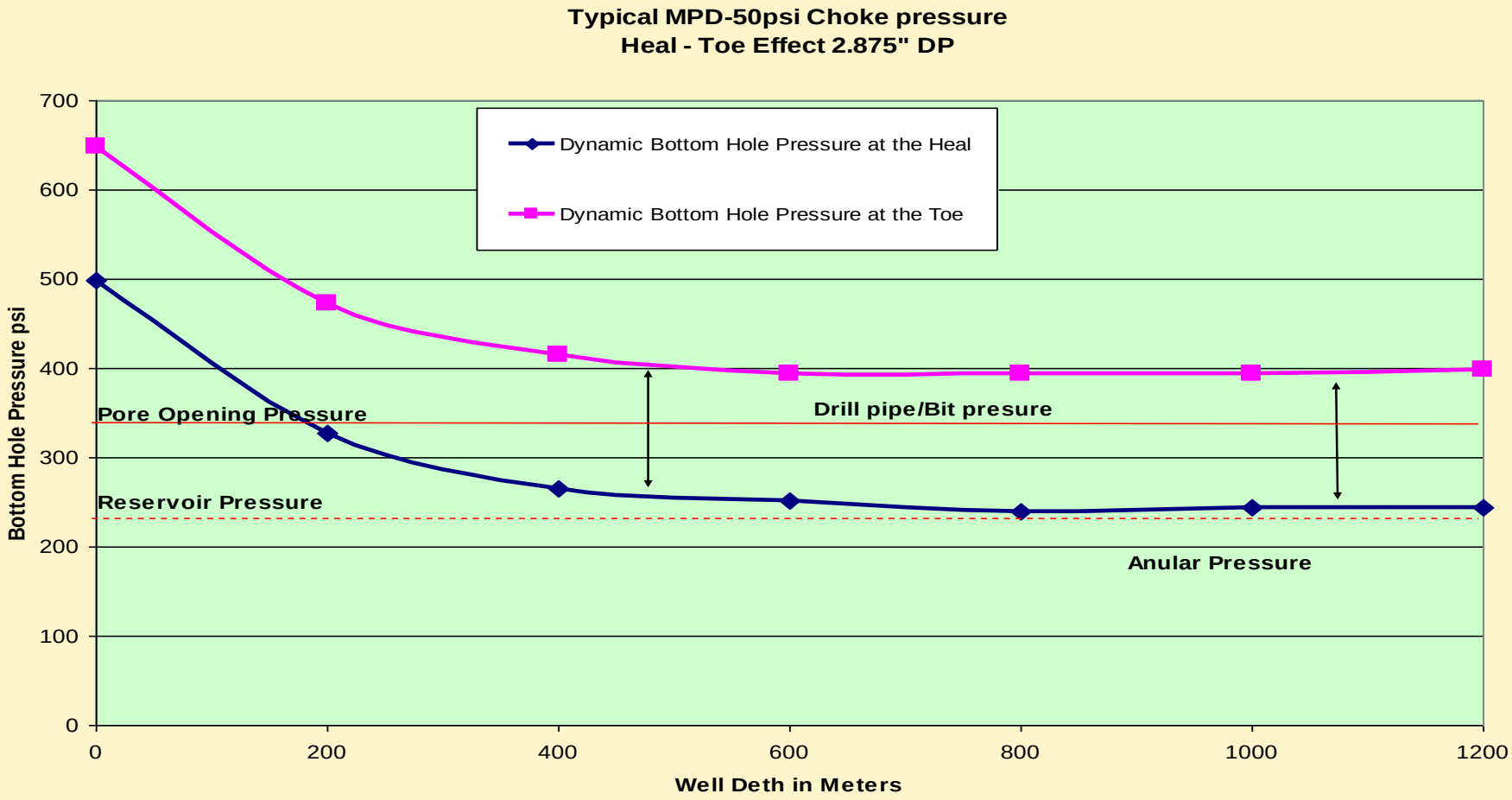
# Heel Toe-MPD



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# Managed Pressure Drilling

- MPD is a field proven technology
- MPD can increases productivity
- MPD can be used in a variety of CBM reservoirs
- MPD is more effective than OBD in Water/Gas depleted areas
- MPD requires thorough understanding of reservoir geology, proper well engineering, planning and implementation in the field to ensure success
- MPD enables economic production from reservoirs previously deemed non-commercial

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