

# Multiply Coalbed Methane Profits with Multi-Seam Laterals

Re-Entry Services

Unlocking the wealth of unconventional reserves  
with conventional re-entry technology.



## Multiply Coalbed Methane Profits with Multi-Seam Laterals

Coalbed methane (CBM) reservoirs are a huge and virtually untapped source for natural gas production. Coal holds nearly three to four times the volume of gas of conventional reservoirs. Worldwide reserves of CBM are estimated to be anywhere from 3,500 to 9,500 Tcf of gas with an estimated 750-900 Tcf in North America alone. The challenge is to find more efficient ways to tap these reserves, reduce capital expenditures and increase net present value (NPV).

### Weatherford Re-entry Systems Case History: Canadian CBM

**100% success retrieving installed whipstocks with an average of 1.1 installations and retrievals per day.**

Mainbore casing depth:  
3,938 to 4,593 ft (1,200 to 1,400 m)

Time to drill and case:  
6 days

Casing exit depth:  
3,445 to 4,265 ft (1,050 to 1,300 m)

Inclination:  
50° to 90°

Orientation:  
+/- 65° of high side

Lateral lengths:  
2,625 to 3,938 ft (800 to 1,200 m)

Average time to drill laterals:  
5.2 days

Lateral hole size:  
6-1/4 in.

Lateral liner:  
4 1/2-in. slotted

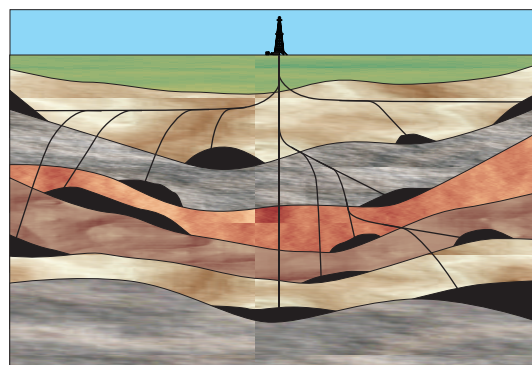
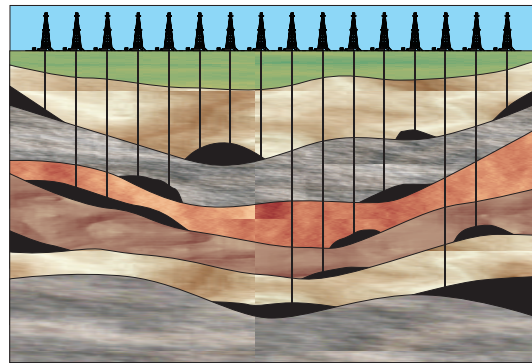
Weatherford well possession time:  
Reduced from 28.5 to less than 20 hours

**Field-proven CBM casing exit and multilateral technology provide far greater reservoir exposure and production than vertical wells.**

### Weatherford's economical, common-sense horizontal re-entry systems increase production

Traditional methods of extracting gas from coal seams are not very efficient and usually not very profitable. Drilling a conventional vertical CBM well to the top of a coal seam is relatively inexpensive, but it typically takes hundreds of wells and often several years to realize meaningful production or financial gains.

The best way to unlock the wealth of these unconventional reserves is with conventional re-entry technology. And Weatherford has been doing exactly that with its field-proven casing exit, horizontal drilling and multilateral systems.



This tri-lateral CBM system can deliver up to 20 times the production of vertical wells.



## Multilaterals provide faster dewatering of coal seams to get you on production sooner and at much higher rates.

With one coal seam lateral providing the reservoir exposure of at least eight vertical wells, the dewatering process is significantly faster. The sooner the wells give back the water, the sooner you'll be producing gas. And greater reservoir contact also means production rates up to 20 times higher, with no need for stimulation.

It all adds up to rapid acceleration of revenue to increase net present value (NPV).

### Multi-seam laterals provide a multitude of benefits.

- Simplify logistics and lower installed costs by minimizing the number of wells—just one to four wells per section—with reduced gathering systems requirements.
- Increase coalbed exposure per seam for faster dewatering and higher production.
- Minimize CAPEX by eliminating top-down drilling costs and reducing flow lines, number of wellheads and artificial-lift costs.
- Eliminate the need for costly fracture stimulation and the difficulty of keeping frac treatments in the zone.
- Reduce environmental effects by eliminating scores of vertical wells and related facilities—fewer surface locations, roads, pipelines, wellheads and traffic to and from the locations.
- Avoid problems of conventional CBM methods, including cavitation in open hole and getting the pump in the sump.
- Minimize damage to sensitive coal seams by using Weatherford's total underbalanced drilling capabilities.



Just one or two multilateral wells can drain the same square mile of coal seam as sixteen 40-acre or eight 80-acre vertical wells. Multi-seam laterals can provide as much as 20 times greater reservoir production than vertical wells and greatly increase the NPV of your assets.

#### Proven and Perfected CBM Re-Entry Systems and Services

Weatherford's CBM re-entry services are built on the solid foundation of more than 20 years of Weatherford experience and technology leadership in horizontal drilling and completion for conventional reservoirs. Proven in over 10,000 casing exits and multilateral installations, Weatherford is known for fast and accurate casing exits and the ability to "thread the needle" in directional drilling. These qualities made Weatherford a natural for entering the CBM world, where very narrow coal seams demand precise placement of laterals—and where speed and economy are vital.





## Multiply Coalbed Methane Profits with Multi-Seam Laterals



*QuickCut* technology combines a single-trip, full-gauge milling system with a single-angle concave that incorporates multiple anchor options.

### Weatherford re-entry technologies reduce installed time and costs.

#### All-around flexibility lets you handle a wide range of casing sizes with the top drive.

Weatherford's new-generation, single-trip *QuickCut*™ casing exit system mills better windows faster. On more than 1,150 jobs, the *QuickCut* system reduced average milling time by 40% while also reducing rathole drilling time in hard-to-drill formations. Along with reducing costs, *QuickCut* systems reduce risk exposure.

#### Total well possession time reduced.

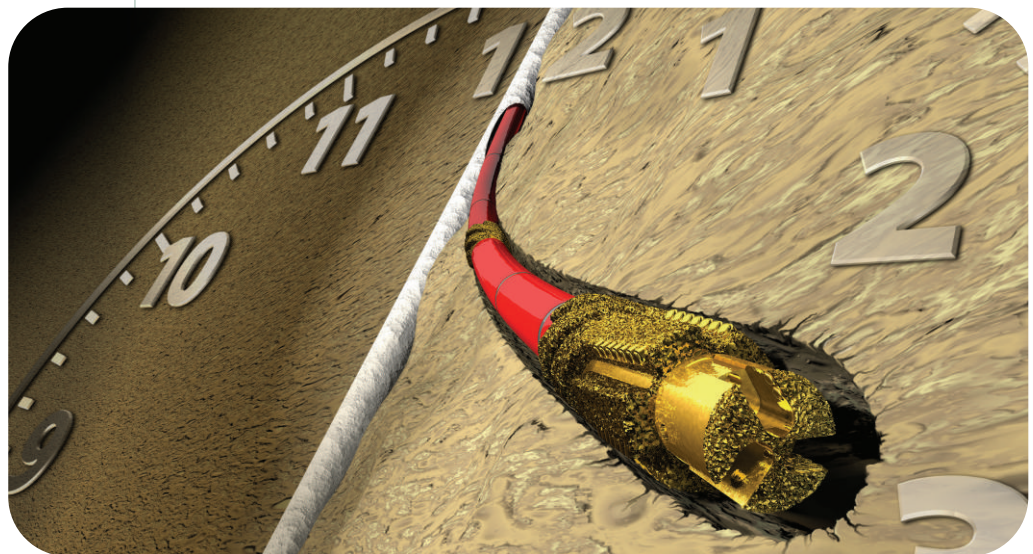
The *QuickCut* system also saves time with faster makeup on the rig floor, faster orientation, faster anchoring and faster breakdown. A good average for our well possession time for milling—from arrival to departure—is 27 hours.

#### Greater reliability and versatility.

Single-trip milling provides fast penetration while retaining full gauge. With a choice of mechanical, hydraulic or integral packer anchors, we can design the optimal exit for short-radius entry into narrow coal seams.

#### Over 94% success rate in whipstock retrieval.

One of the major concerns of CBM clients with respect to horizontal completions is that time spent on fishing expeditions can really hurt well economics. Take comfort in the knowledge that Weatherford has successfully retrieved over 94% of thousands of whipstocks—using primary retrieval means.



## High-quality, field-proven equipment is ready for action— around the clock, around the world.

From more than 150 service locations around the globe, Weatherford offers a wide range of casing exit systems, including whipstocks and multilateral systems—all designed with simplicity and practicality to drive down well costs while increasing productivity and accelerating cash flow.

Our complete line of drilling products and services greatly reduces your costs and time spent dealing with multiple suppliers.

- QuickCut™ casing exit systems provide one-trip efficiency and fast penetration while maintaining full gauge for smooth passage of bottomhole assemblies and other downhole equipment.
- CustomCut™ carbide inserts produce smaller, thinner and lighter cuttings, which are easily circulated to the surface for better hole cleaning efficiency and faster penetration rates.
- Various whipstock and isolation options are available—all fully retrievable, leaving full-bore access to the parent bore for lift and completion products.
- Mechanical, hydraulic or integral packer anchors offer a variety of anchoring options for any casing exit configuration.



Weatherford's vast global footprint and resources enable us to handle combined service jobs with greater efficiency.





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### Work Smarter with MillSmart<sup>SM</sup> Technology

Weatherford's *MillSmart* milling technology is an engineered approach to milling that encompasses a wide range of proven products, services and technical resources, developed and refined by the world's largest and most experienced provider of milling and fishing services. *MillSmart* technology is based on a tremendous amount of milling data—gathered by Weatherford's worldwide Performance Tracking System and used to create best practices for almost every imaginable application. Planning plays a major role in successful re-entry projects. Weatherford works with you to develop an optimal well design and drilling/completion program. Our wide-ranging capabilities are invaluable in the planning stages. Casing exit, directional drilling, drilling motor, tubulars, pressure control, underbalanced drilling, completion and artificial-lift technologies all work in harmony to provide a well-rounded, multi-discipline approach to CBM projects.

## Weatherford brings total capability and a team approach to all re-entry projects.

The Weatherford re-entry team works closely with your people to provide the most efficient re-entry services possible. Our team is made up of engineering and operational staff, on-site personnel and third-party vendors. We are one of the largest global providers of innovative mechanical solutions, technology and services for the drilling and production sectors of the oil and gas industry.

Service Capability	Weatherford	Competitor A	Competitor B	Competitor C
Full underbalanced drilling understanding	Y		Y	Y
Casing exit product line	Y		Y	Y
Chemical/foam product line	Y	Y	Y	Y
Directional drilling tools	Y	Y	Y	Y
Electromagnetic measurement-while-drilling tools	Y	Y	Y	Y
Equity project group	Y	Y	Y	Y
Drilling services product line	Y	Limited	Y	Limited
CBM well logging	Y	Y	Y	Y
CBM artificial lift	All Forms	Limited	Limited	Limited
Pipeline construction	Y		Y	
Pipeline process and services	Y		Y	
Compression	Y		Limited	
Remote field monitoring	Y	Y	Y	



### QuickPack™ casing exit system successes.

The *QuickPack* casing exit system reduces cost while maximizing reservoir contact for a major operator in Fort Assinaboine, Alberta, Canada.

#### Objective

- Provide production enabling technology that drives down well costs reducing client's CAPEX.

#### Results

- *QuickPack* systems were installed in 35 wells, providing 80 laterals as compared to 80 single wellbores.
- *QuickPack* system's modular, simple design reduces supply chain constraints while increasing manufacturing mobility.
- Well critical path time to install initial junction and remove hardware has improved from 28.5 to less than 20 hours per installation.

#### Value to Client

Weatherford continues to add value to the client's bottom line:

- Consistently providing high-performance milling without losing gauge requiring multiple mill runs.
- Premium zonal isolation integral packer that consistently actuates and retrieves by design.
- Safety-oriented personnel that establish team atmosphere, resulting in clear and decisive execution of their service.

*QuickPack* casing exit system provides the ultimate in versatility and retrievability for CBM project in central Alberta, Canada.

#### Objectives

- Maximize reservoir contact while minimizing surface footprint.
- Retrieve all whipstock assemblies, leaving full-bore access to the parent bore.
- Minimize costly rig installation time usually associated with multilateral projects.

#### Results

- Seven single-trip *QuickPack* casing exits, with laterals, were installed in three wells.
- All whipstocks were retrieved in a single trip, providing access for deployment of the large-OD submersible pump required during the dewatering cycle.
- Average well possession time per lateral, from whipstock installation to retrieval, was minimized to 20.3 hours.

#### Value to Client

Weatherford's *QuickPack* casing exit system delivered what was most important to the operator:

- Low-risk, simple multilateral construction that minimized costly junction hardware.
- Proven milling techniques that resulted in reduced installation costs.
- A fully retrievable system that returned the wellbore to its original ID.

Location:	Fort Assinaboine, Alberta, Canada
Formations:	Mannville Coals
Depth:	3,215 to 4,429 ft (980 to 1,350 m)
Well type:	CBM, deviated full-bore multilateral producer
Hole size:	6 1/4-in. laterals completed with 4 1/2-in. slotted liners anchored by annular casing packer
No. of wells:	27 wells, 64 laterals total



Location:	Central Alberta, Canada
Formations:	Mannville coals
Depth:	3,281 to 3,609 ft (1,000 to 1,100 m)
Well type:	Deviated CBM, multilateral producer
Hole size:	6 1/4-in. open hole below 7-in., 20-lb/ft casing
No. of wells:	3 wells, 7 laterals total



## Complete CBM service capability.

Weatherford's broad product and service base allows us to tailor solutions that can maximize returns from your reservoir.



### Drilling

**Direction drilling services**, such as measurement while drilling (MWD), logging while drilling (LWD) and rotary steerables that enhance drilling efficiencies and enable optimal well placement.

**Secure Drilling<sup>SM</sup> services** for underbalanced, managed pressure and air drilling applications that help safely increase asset profitability through the industry's largest portfolio

**Drilling-with-casing (DwC<sup>TM</sup>) systems** that increase drilling efficiency and reduce risk exposure by removing the need to trip pipe and bottomhole assembly components



### Evaluation

**Cased-hole wireline services** that help analyze and monitor well performance and determine appropriate intervention and remediation activities, as well as thru-casing evaluation.

**Geoscience services** that help maximize oil and gas assets for the life of the well.



### Completion

**Liner systems** that optimize casing programs and have been proven in world-record, extended-reach wells.

**Conventional sand screens**, including premium, pre-pack and wire-wrapped, for controlling sand in unconsolidated formations.

**Cased-hole completion systems** that enhance the safety and functionality of the production string, including permanent and retrievable packer systems, subsurface safety systems, flow controls, specialized downhole isolation valves and associated servicing equipment.



### Production

**Artificial-lift systems** for the life cycle of the well, including all forms of lift: progressing cavity pumping, gas, electric submersible pumping, reciprocating rod, hydraulic and plunger.

**Wellhead systems** that provide enabling technologies and superior services that maximize operations.



### Intervention

**Thru-tubing services** that use drilling motors, casing exits, fishing and milling technologies, and other well remediation techniques to enable production with existing wellbore infrastructure.

**Re-entry services**, such as casing exits and multilaterals, that enable production with reduced installation costs and exposure to risk.



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