



# TykeWest Limited

Applications for an Off-Target Penalty and Pool  
Delineation  
Erskine and Stettler North Fields

July 26, 2011

**ENERGY RESOURCES CONSERVATION BOARD**

Decision 2011 ABERCB 024: TykeWest Limited, Applications for an Off-Target Penalty and Pool Delineation, Erskine and Stettler North Fields

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**ENERGY RESOURCES CONSERVATION BOARD**

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**Calgary Alberta**

**TYKEWEST LIMITED**

**APPLICATIONS FOR AN OFF-TARGET PENALTY**

**AND POOL DELINEATION**

**ERSKINE AND STETTLER NORTH FIELDS**

**2011 ABERCB 024**

**Applications No. 1661488 and 1668182**

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**DECISION**

The Energy Resources Conservation Board (ERCB/Board) has considered the recommendation made by the examiners, adopts the recommendation, and directs that Applications No. 1661488 and 1668182 be denied and that pool orders be issued in accordance with the pool delineation recommended by the examiners.

Dated in Calgary, Alberta, on July 25, 2011.

**ENERGY RESOURCES CONSERVATION BOARD**

*<original signed by>*

Dan McFadyen  
Chairman



# **ENERGY RESOURCES CONSERVATION BOARD**

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Calgary Alberta

## **EXAMINER REPORT RESPECTING TYKEWEST LIMITED APPLICATIONS FOR AN OFF-TARGET PENALTY AND POOL DELINEATION ERSKINE AND STETTLER NORTH FIELDS**

**2011 ABERCB 024  
Applications No. 1661488 and 1668182**

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### **1 RECOMMENDATION**

Having considered all the evidence, the examiners recommend that Applications No. 1661488 and 1668182 be denied and that the thirteen Basal Belly River (BBR) gas wells involved in this hearing be assigned to pools as described in the examiners' conclusion (see Section 6).

### **2 INTRODUCTION**

#### **2.1 Applications**

##### **Application No. 1661488**

TykeWest Limited (TykeWest) applied, pursuant to Section 4.060 of the *Oil and Gas Conservation Regulations*, for an off-target penalty to be applied to BBR gas production from well 04-02-039-20W4M (4-2 well).

##### **Application No. 1668182**

TykeWest applied, pursuant to Section 33(2) of the *Oil and Gas Conservation Act*, for the ERCB to designate the following thirteen BBR gas wells to be in a common pool: 01-32-038-20W4M, 04-32-038-20W4M, 16-32-038-20W4M, 02/05-33-038-20W4M, 02/08-33-038-20W4M, 14-33-038-20W4M, 16-33-038-20W4M, 05-34-038-20W4M, 09-34-038-20W4M, 12-34-038-20W4M, 02/15-34-038-20W4M, 04-02-039-20W4M, and 02/06-02-039-20W4M.

#### **2.2 Intervention**

AvenEx Energy Corp. (AvenEx), formerly known as Avenir Operating Corp., as licensee of the 4-2 well, objected to the applications. It had a different pool interpretation than TykeWest, which it believed justified not applying an off-target penalty to the 4-2 well.

#### **2.3 Hearing**

The Board held a public hearing in Calgary, Alberta, which commenced on April 6, 2011, and was adjourned on April 7, 2011, before Board-appointed examiners G. W. Dilay, P.Eng (Presiding Member), C. A. Crowfoot, and D. B. Fairgrieve, P.Geol.

At the adjournment of the hearing, AvenEx was required to complete two undertakings. The undertakings were completed on April 7, 2011. On April 12, 2011, the Board requested that the parties submit certain additional information no later than April 27, 2011. The Board subsequently received the parties' responses to this request. On May 4, 2011, the Board informed

the parties by letter that it would reconvene the hearing to allow the parties an opportunity to provide oral evidence and argument on the additional submissions. The public hearing reconvened on May 12, 2011, and was closed that day. Those who appeared at the hearing are listed in [Appendix 1](#).

### 3 BACKGROUND

With respect to the thirteen wells involved in this hearing, three are currently designated as being in the Erskine Basal Belly River D Pool (D Pool), two are designated as being in the Stettler North Basal Belly River B Pool (B Pool), and eight are in undefined BBR pools (see Figure 1). In October 2008, AvenEx's wells, located in Section 32-38-20W4M (Section 32), came on production. Later, in November and December of 2009 and over the period from December 2009 to August 2010, its wells located in Section 2-39-20W4M (Section 2) and Section 34-38-20W4M (Section 34), respectively, also came on production. Over the period from May to November of 2010, TykeWest's wells, located in Section 33-38-20W4M (Section 33), came on production.

The wells discussed in this report are listed in Table 1.

Table 1. Wells in the area of application

Unique well identifier	Current ERCB pool designation	Date on production	Licensee
00/01-32-038-20W4/0 (the 1-32 well)	Erskine Basal Belly River D Pool (D Pool)	October 2, 2008	AvenEx
00/04-32-038-20W4/0 (the 4-32 well)	Erskine Basal Belly River D Pool (D Pool)	October 2, 2008	AvenEx
00/04-32-038-20W4/2 <sup>1</sup> (the 4-32 well)	Erskine Basal Belly River D Pool (D Pool)	June 1, 2010	AvenEx
00/16-32-038-20W4/0 (the 16-32 well)	Erskine Basal Belly River D Pool (D Pool)	October 2, 2008	AvenEx
02/05-33-038-20W4/3 (the 02/5-33 well)	Undefined	November 15, 2010	TykeWest
00/08-33-038-20W4/0 (the 8-33 well)	Undefined	Not applicable	Baytex Energy Ltd.
02/08-33-038-20W4/0 (the 02/8-33 well)	Undefined	June 8, 2010	TykeWest
00/14-33-038-20W4/0 (the 14-33 well)	Undefined	May 20, 2010	TykeWest
00/16-33-038-20W4/0 (the 16-33 well)	Stettler North Basal Belly River B Pool (B Pool)	May 25, 2010	TykeWest
00/05-34-038-20W4/0 (the 5-34 well)	Undefined	May 1, 2010	AvenEx
00/09-34-038-20W4/0 (the 9-34 well)	Undefined	August 11, 2010	AvenEx
00/12-34-038-20W4/0 (the 12-34 well)	Undefined	April 21, 2010	AvenEx
02/15-34-038-20W4/0 (the 02/15-34 well)	Undefined	December 3, 2009	AvenEx
00/02-36-038-20W4/0 (the 2-36 well)	Undefined	Not applicable	Bears paw Petroleum Ltd.
00/04-02-039-20W4/0 (the 4-2 well)	Stettler North Basal Belly River B Pool (B Pool)	December 3, 2009	AvenEx
02/06-02-039-20W4/3 (the 02/6-2 well)	Undefined	November 30, 2009	AvenEx
02/04-03-039-20W4/0 (the 02/4-3 well)	Undefined	Not applicable	Baytex Energy Ltd.
02/08-11-039-20W4/0 (the 02/8-11 well)	Stettler North Basal Belly River A Pool (A Pool)	November 4, 1998	Apache Canada Ltd.

<sup>1</sup> Gas production from the BBR zone was commingled with gas production from other zones.

ERCB *Interim Directive ID 94-2: Revisions to Oil and Gas Well Spacing Administration*, describes the Board's "first well" policy and administration. *ID 94-2* states that, upon a request to have an off-target penalty applied, the Board will review pool delineation using all available relevant information such as geological and pressure data. Where the well in question is deemed to be the "first well" in the pool, the off-target penalty will not be applied. Where pools containing a well with "first well" status are coalesced, only one well will retain its "first well" status.

The implication of applying *ID 94-2* to the situation being considered at this hearing is that with the current pool designations, the 4-2 well would be considered the "first well" in the B Pool and would not be subject to an off-target penalty. However, if the pool delineation was changed so that the 4-2 well was interpreted to be in the same pool as the wells in Sections 32 and 33, the 4-2 well would not be the "first well" in the pool and would be subject to an off-target penalty.

## **4 ISSUES**

The examiners consider the issues respecting the applications to be

- the pool designation of the thirteen BBR wells, and
- whether the 4-2 well should be subject to an off-target penalty.

In reaching the determinations contained in this report, the examiners have considered all relevant materials constituting the record of this hearing, including the evidence and argument provided by each party. Accordingly, references in this report to specific parts of the record are intended to assist the reader in understanding the examiners' reasoning on a particular matter and should not be taken as an indication that the examiners did not consider all relevant portions of the record with respect to that matter.

## **5 CONSIDERATION OF THE APPLICATIONS**

### **5.1 Views of TykeWest**

Based on its geological interpretation and analysis of the pressure data, TykeWest contended that all thirteen wells involved in this hearing were in the same pool and, as a result, requested that an off-target penalty be applied to the 4-2 well.

#### **5.1.1 Geological Interpretation**

TykeWest submitted that the reservoir was deposited within a shallow marine environment as a barrier bar sandstone with two to three episodes of stacked marine sand accumulation. The stacked morphology of the sand was indicated by the gamma ray curve showing two to three cleaning upward cycles of sand, deposited directly overlying each other.

TykeWest interpreted the reservoir to be a continuous and homogeneous sandstone, periodically interrupted with discontinuous, postdepositional, noninvasive, tight streaks resulting from calcitic groundwater activity. The sandstone was composed of clean, fine to medium grained sand of varying thickness, often with high porosities and permeabilities. TykeWest noted that the

stratigraphic elevation of the tight streaks varied from well to well and, therefore, did not correlate or form permeability barriers.

TykeWest recognized some degree of heterogeneity within the reservoir. It noted that the quality of the reservoir deteriorated outwards from the centre of the pool towards the south and the east edges and that the sand pinched out to the east. It further noted changes evident in Section 3-39-20W4M where a thinning of the reservoir limited prospects for economic production.

TykeWest mapped a stratigraphic thinning of the sand in various locations throughout the reservoir. It constructed a structure map on the top of the BBR that showed structural highs caused by thick sand deposition that were separated by structural lows caused by thinner sand deposition. TykeWest noted that where the thin areas occurred, there was more likely to be higher clay content and poorer reservoir quality. However, it believed that these areas were not constricted and did not result in discontinuity in the reservoir.

TykeWest further noted that there was a thinning of the sandstone in the 16-33 well when compared with the nearby 4-2 well and acknowledged that the sand bar might pinch out completely. However, it stressed that the upper bar was present again at the top of the sequence in the 00/8-33 well, indicating possibly another depositional event. TykeWest believed that the last deposition and best quality sand occurred in the area of the 4-2 well where there had been the last remnants of the marine environment and regression of water elsewhere. As a result, there was a higher concentration of gas and better quality reservoir in the 4-2 well.

TykeWest believed that communication of marine bar reservoirs depended on the continuity of the sands and the presence or absence of tight streaks and tidal channels. It stated that tidal channel activity would be supported by seismic data, a change in the gamma ray character of the well logs, and dramatic variations in reservoir pressure. However, it did not see evidence on either log or pressure data that would indicate the presence of a tidal channel and further noted that there was no seismic evidence submitted at the hearing. TykeWest stated that if a subtle permeability barrier was present in the reservoir, gas could still migrate through it. TykeWest believed that the presence of subtle permeability barriers could explain some of the pressure anomalies seen across the pool. As a result, TykeWest mapped the thirteen wells involved in the hearing in a common pool, as illustrated in Figure 1.

### **5.1.2 Pressure Data Analysis**

TykeWest estimated the initial pool pressure to be 2948 kilopascals (kPa). This pressure was the average of an initial pressure of 2925 kPa for the 16-32 well and the drillstem test (DST) pressure of 2970.6 kPa for the 02/8-11 well. TykeWest noted what it believed to be an anomaly in the pressure test of the 16-32 well, possibly a leak, and argued that this could mean that the initial pressure was somewhat higher than 2925 kPa. TykeWest commented that an analysis of the pressure data might show a higher pressure, but did not provide such an analysis. TykeWest acknowledged that the DST pressure for the 02/8-11 well was taken over both an upper Belly River zone and a lower BBR zone. Based on its estimate of the initial reservoir pressure, TykeWest concluded that all other BBR wells involved in the hearing had some degree of depletion but that the 5-34 well might be an exception. TykeWest contended that initial pressures 20-25 or 25-30 kPa lower than its estimated initial pool pressure of 2948 kPa should be considered depleted pressures.

TykeWest argued that early gas production from Section 32 relative to the start of gas production from Sections 33 and 34 had created a pressure gradient across the pool and that this pressure gradient indicated reservoir continuity across these sections. TykeWest stated that the initial pressure for the 16-33 well showed 10.5 per cent depletion relative to TykeWest's interpreted initial pool pressure and that the initial pressure for the 12-34 well showed 8.3 per cent depletion relative to the initial pool pressure. TykeWest interpreted this pressure depletion to indicate that a barrier did not exist between the 16-33 and 12-34 wells and the wells to the west since the 4-2 well had only been on production about one month prior to the pressure test on the 16-33 well and about three months prior to the pressure test on the 12-34 well; there was not enough production from the 4-2 well to cause the amount of depletion seen at the 16-33 and 12-34 wells.

TykeWest stated that the production of AvenEx's wells in Sections 32, 34-38-20W4M, and 2-39-20W4M at much lower suction pressures than TykeWest's wells in Section 33-38-20W4M, created multiple pressure gradients in the pool. As a result, TykeWest believed that steady state pressures would never exist and that it was not appropriate to use a plot of the pressures to interpret pooling, as AvenEx had done.

TykeWest acknowledged that the 5-34 well could be in a separate pool because its initial pressure was only 7 kPa below TykeWest's interpreted initial pressure for the pool and because of the 239 kPa pressure difference between the initial pressures for the 5-34 and 12-34 wells, both of which were taken on the same date.

### **5.1.3 Off-Target Penalty for the 4-2 Well**

TykeWest confirmed that the buffer distance for Section 2 was 300 metres from the south and west boundaries of the section and that based on its bottomhole location, the 4-2 well was in the 0.25 penalty factor zone. With respect to the gas production rate to which the off-target penalty should be applied, TykeWest also confirmed that it should be based on the  $Q_{\max}$  formula defined in Section 10.300(1) of the *Oil and Gas Conservation Regulations* with the values of the variables in the formula determined from the well test on the 4-2 well.

TykeWest raised the issue of clustering with regard to AvenEx's 5-34, 12-34, and 4-2 wells and the equity impact on TykeWest. It stated that AvenEx had drilled a cluster of wells with nominal interwell distance, directly offsetting the Section 33 wells, and that this had adversely affected recovery of the gas reserves. TykeWest believed that a cluster of wells could damage the reservoir by affecting the flowing properties of the pore space. It was concerned that a portion of the reservoir could be inaccessible once the flowing properties of the pore space were altered. However, it did not provide any specific evidence to support this.

## **5.2 Views of AvenEx**

Based on its geological interpretation and analysis of the pressure data, AvenEx contended that the 4-2 well was not in the same pool as the wells in Section 32 and, as a result, believed that it should not be subject to an off-target penalty.

### **5.2.1 Geological Interpretation**

AvenEx interpreted that the BBR had been deposited as a series of onlapping shoreline related sand trends that were separated by marine flooding surfaces. Typically, the BBR shoreline sand

deposits trended in a north-south direction; however, in the application area, AvenEx interpreted the BBR shoreline to have trended in an east-west direction. This was a result of the sands being deposited on the underlying Lea Park Formation, which had altered topography as a result of drape on the deeper Leduc reef located immediately to the south. AvenEx submitted that the shoreface sequences were stacked one above the other and that the wave processes came from the northwest.

AvenEx divided the BBR into upper and lower units. The lower unit was composed of marine siltstones and shales that coarsened upward to a shoreface that may, locally, be of reservoir quality. AvenEx believed that a relative rise in sea level occurred at the top of the lowermost unit and had resulted in the formation of the upper unit of onlapping cleaner shoreface sediments. The upper unit was the primary producing reservoir in the area and was the second coarsening upward sequence on the gamma ray log. Subsequent to deposition of both the upper and lower units, AvenEx submitted that a fluvial channel system developed that eroded the existing shoreface deposit. As the relative sea level rose, the lower portion of the channel system was filled with shale and the upper portion was filled with sand.

AvenEx contended that typically, the BBR in the area of application consisted of multiple smaller pools. This was indicated by the relatively poor deliverability of the wells in the south half of Section 33 and by reservoir pressure discontinuities found between several BBR wells. AvenEx submitted that the generally prograding but occasionally onlapping depositional model of the BBR and the overprint of associated fluvial influences resulted in multiple hydrocarbon trapping possibilities and the separation of reservoir units. AvenEx submitted that the BBR fluvial sands acted as unique reservoirs separate from the multiple stacked shoreface deposits.

AvenEx did not agree with TykeWest's view that there was preferential drainage from the structurally lower wells in the BBR. AvenEx believed that wells with more porous and permeable rock and good reservoir connectivity between them would exhibit preferential drainage. AvenEx argued that its 4-2 well would have shown the most significant pressure depletion from production at the 16-32 well if it had been in the same reservoir, since these are the wells that encountered the best quality BBR reservoir rock. AvenEx submitted that the lack of preferential drainage from the 4-2 well supported its belief that the 4-2 and 16-32 wells were not in the same pool.

As illustrated in Figure 1, AvenEx submitted mapping that showed there were two separate gas pools in the area of application, with the 4-2 well in a different pool than the wells in Section 32. Although the 5-34 and 12-34 wells were mapped in the same pool, AvenEx acknowledged that the pressure data did not support this. The pressure of the 12-34 well was 239 kPa lower than the pressure of the 5-34 well, even though the pressures had been taken on the same date and the wells were in close proximity to each other. In spite of its map showing only two separate gas pools in the area of application, AvenEx stated that it believed there were at least three separate gas pools. AvenEx indicated that its pooling had focused on the 4-2 well and the wells in Section 32.

Based on its review of the logs for the 5-34, 2-36, and 02/4-3 wells, AvenEx interpreted an upward fining gamma ray log response as indicative of fluvial deposition, in contrast to the typical upward coarsening shoreface signature. AvenEx further believed that the upper shoreface sand originally deposited in these wells had been eroded away by a fluvial channel system.

AvenEx submitted a depositional environment map that showed the presence of a fluvial channel system, as illustrated in Figure 1, that dissected the stacked shoreface sands. AvenEx contended that this system explained the localized pressure discontinuities seen in the BBR since the channeling effectively separated the BBR into several smaller reservoirs.

### 5.2.2 Pressure Data Analysis

AvenEx provided the following table summarizing the available pressure data.

Table 2. AvenEx summary of pressure data

Well	Pressure (kPa)	Date of pressure test
16-32	2918	August 15, 2008
	2650	April 17, 2009
02/5-33	2297	May 13, 2010
02/8-33	2247	January 17, 2010
14-33	2437	January 17, 2010
16-33	2640	January 16, 2010
5-34	2941	March 31, 2010
9-34	2840	July 8, 2010
12-34	2702	March 31, 2010
02/15-34	2919	November 22, 2009
4-2	2874	November 22, 2009
02/6-2	2878	November 25, 2009

AvenEx also indicated that a pressure test conducted on the 1-32 well in January 2011 showed a pressure of 1985 kPa.

Based on plots of the pressure data versus time and cumulative gas production, AvenEx submitted that wells 1-32, 16-32, 02/5-33, 02/8-33, and 14-33 followed a common trend and could be grouped in a common pool along with the 4-32 well, but that the other wells, including the 4-2 well, appeared to be in one or more separate pools.

AvenEx agreed with TykeWest that the initial pressure test for the 16-32 well measured 2926 kPa and that this should be the initial pressure of the well instead of 2918 kPa. AvenEx further noted that the pressure build-up derivative analysis of the 16-32 well test indicated a similar initial pressure of 2927 kPa. AvenEx believed that the anomaly in the pressure data noted by TykeWest was probably due to a surface event such as the pressuring up of the testing equipment, not a leak.

AvenEx did not believe that the pressure of the stray Belly River sand in the 02/8-11 well was representative of an initial pressure for the BBR. AvenEx noted that the stray Belly River sand in the 02/8-11 well had higher permeability than the BBR, which it believed would result in the stray sand dominating the pressure measurement.

AvenEx contended that the initial pressure measured at the 4-2 well was not a depleted pressure. AvenEx believed that a well would need to have an initial pressure a couple hundred kPa below

the initial pool pressure to conclude that there was pressure depletion at the well. AvenEx argued that there could be some difference in the initial pressures of different pools in the same geological setting and that pressure variations could be caused by what was done to a well when it was completed. AvenEx commented that there could have been pressure depletion at the 02/8-33, 14-33, and 16-33 wells, but there was uncertainty because the pressures measured at these wells were not stabilized. AvenEx believed that the 12-34 well likely showed pressure depletion.

### **5.2.3 Off-Target Penalty for the 4-2 Well**

AvenEx submitted that its 4-2 well was drilled subsequent to the wells in Section 32 and was a follow-up to its 02/6-2 well. The 02/6-2 well did not show the same gas potential on logs compared to the 16-32 well. When AvenEx drilled the 4-2 well, it believed that the gas reserves in Section 32 did not extend beyond that section and, therefore, believed that the 4-2 well targeted a separate BBR pool. AvenEx drilled the 4-2 well off-target to move away from the 02/6-2 well and because it expected the well would be in a separate deposit from the wells in Section 32.

AvenEx agreed with the details provided in Section 5.1.3 of this report regarding the off-target penalty factor and gas production rate to which an off-target penalty should be applied.

With respect to the issue of clustering raised by TykeWest, AvenEx stated that its view was opposite to that of TykeWest's, in that it believed production was maximized by increased well density.

## **5.3 Findings of the Examiners**

With respect to the evidentiary test that the examiners must use and whether the evidence provided meets the appropriate test, the examiners have referred to ERCB *Decision 2009-050: Nexstep Resources Ltd., Pool Delineation Application: Redesignation of the Lower Mannville C Pool to Rock Creek*, which states that the burden of proof is on the balance of probabilities. This requires that the examiners weigh all the evidence they heard and their determination must be based on the balance of the evidence. Specifically, there has to be a preponderance of evidence to show that the conclusion the applicant seeks to establish is substantially the most probable of the possible views of the facts presented to the examiners. However, conclusive evidence is not necessary in order to make a determination on the applications.

### **5.3.1 Geological Interpretation**

The examiners note that TykeWest and AvenEx both agreed that the majority of the BBR was deposited within a shallow marine environment as a series of onlapping stacked marine bar sands and that there was more than one episode of marine bar deposition in response to changes in sea level. The examiners agree with both parties that a gamma ray log signature that coarsens upwards is a common indication of marine bar sands. The examiners believe that the reservoir could be considered to be relatively continuous within a single marine bar sand.

Contrary to their common views regarding the shallow marine environment, TykeWest and AvenEx had different interpretations on the presence of channels in the application area. While TykeWest did not see any evidence of the presence of a tidal channel, AvenEx interpreted the

presence of a fluvial channel that eroded the shoreface deposit. The examiners agree with AvenEx that the log data for the 5-34, 2-36, and 02/4-2 wells exhibit an upward fining gamma ray signature in the upper sands of the BBR and conclude that this indicates that one or more channels are present.

With respect to the 16-33 well, which is between the 4-2 and 16-32 wells, the examiners find that the well logs indicate that the reservoir sand in the 16-33 well is four metres thinner than in the 4-2 well and is overlain by an upward fining shale/siltstone deposit. The examiners also find that the gamma ray log for the deposits in the 16-33 well that are directly correlatable with the upper marine bar sand of the 4-2 well shows the presence of a channel. The examiners conclude that the upper marine bar sand in the 16-33 well has been at least partially eroded by channel activity and subsequently filled by shale.

The examiners believe that the interpreted presence of one or more channels in the 16-33, 5-34, 2-36, and 02/4-3 wells has the potential to interrupt the continuity of the BBR marine bar sand within the area of application and could result in multiple gas pools.

### 5.3.2 Pressure Data Analysis

With respect to the initial pressure of the 16-32 well, the examiners accept that 2927 kPa is a reasonable estimate. As pointed out by AvenEx, this pressure was obtained from the analysis of the 16-32 well test. Although TykeWest commented that an analysis of the pressure data for the 16-32 well might indicate a higher pressure, TykeWest did not provide such an analysis. The examiners are not convinced that it is appropriate to use the DST pressure for the 02/8-11 well because the pressure was taken over an interval that included an upper Belly River zone and a BBR zone. The logs for the 02/8-11 well indicate that the upper Belly River zone has much better reservoir quality than the BBR zone, so the upper zone likely dominated the pressure measurement.

The examiners note that the following three wells in the application area had initial pressures greater than 2900 kPa: 16-32 (2927 kPa), 5-34 (2941 kPa), and 15-34 (2919 kPa). On the other hand, the 4-2 well had an initial pressure of 2874 kPa, which could be interpreted to be an indication of pressure depletion caused by the production of gas from the wells in Section 32. However, the examiners agree with AvenEx that drilling, completion, and cleanup operations can affect the measured initial pressures and that the initial pressures of different pools within a common geological setting can vary. The examiners, therefore, are not convinced that a difference of 53 kPa in the initial pressures of the 16-32 and 4-2 wells is sufficient to conclude that the initial pressure of the 4-2 well is a depleted pressure. While the examiners are unable to specify how large the difference in pressure would need to be in this case, the examiners do not believe that 50 kPa is enough. The examiners agree with AvenEx that if the 16-32 and 4-2 wells were in the same pool, the 4-2 well would have been expected to show a significant depletion in pressure from gas production at the 16-32 well since these wells encountered the best quality BBR reservoir.

The examiners note the significant difference in pressures between the 16-33 and 4-2 wells, where the pressure of the 16-33 well was 234 kPa lower and was taken only about two months later than the pressure at the 4-2 well. This pressure difference could be interpreted to indicate that the two wells are not in the same reservoir and would be consistent with the examiners' view that the upper marine bar deposit in the 16-33 well has been at least partially eroded by a

channel. The examiners note that the pressure depletion in the 16-33 well is consistent with the pressure depletion of the other wells in Section 33. However, the apparent difference in pressures between the 16-33 and 4-2 wells needs to be tempered because the pressure of the 16-33 well was not completely built-up. Also, because of problems encountered with the pressure test, the pressure was measured at surface rather than downhole. This introduces uncertainty in the estimated bottomhole pressure because it is not known if there was a liquid level in the well. The presence of a liquid level would result in the estimated bottomhole pressure being too low. Liquid levels were observed in the pressure tests done on the 02/8-33 and 14-33 wells, so the presence of a liquid level in the 16-33 well is a possibility.

## **6 CONCLUSION**

Based on the examiners' interpretation that the geological data shows the presence of channels and that the initial pressure of the 4-2 well could be an undepleted pressure, the examiners do not believe that there is sufficient evidence to show that the 4-2 well is in the same pool as the wells in Section 32. The examiners interpret the 4-2 well to be in a separate pool along with the 12-34 and 02/6-2 wells. Although there was a relatively small amount of gas production from the 4-2 and 02/6-2 wells when the pressure test was conducted on the 12-34 well, the examiners believe that this production could account for the depleted pressure measured at the 12-34 well because of the relatively small size of the gas pool. Based on this pooling, the examiners recommend that the 4-2 well should not be subject to an off-target penalty.

With respect to pooling of the other wells in the area of application, the examiners believe that the geological and pressure data support putting the 1-32, 4-32, 16-32, 02/5-33, 02/8-33, 14-33, and 16-33 wells in a common pool. The examiners note that TykeWest and AvenEx seem to agree that the 5-34 well is in a separate pool and the examiners concur. Finally, the examiners interpret the 9-34 and 02/15-34 wells to be in a common pool that is separate from the pool containing the 12-34, 4-2, and 02/6-2 wells, considering the different initial pressures of the 4-2 and 02/15-34 wells and the pressure of the 9-34 well being higher than the earlier pressure measured at the 12-34 well.

Regarding the issue of clustering raised by TykeWest, the examiners note that TykeWest did not provide any specific evidence to support its view. The examiners believe that, in general, additional wells in a heterogenous gas reservoir would likely access more of the reservoir and result in greater gas recovery. Therefore, the examiners are not convinced that TykeWest's concern is valid.

Dated in Calgary, Alberta, on July 26, 2011.

## **ENERGY RESOURCES CONSERVATION BOARD**

*<original signed by>*

G. W. Dilay, P.Eng.  
Presiding Member

*<original signed by>*

C. A. Crowfoot  
Examiner

*<original signed by>*

D. B. Fairgrieve, P.Geol.  
Examiner

## APPENDIX 1 HEARING PARTICIPANTS

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### Principals and Representatives (Abbreviations used in report)

### Witnesses

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TykeWest Limited (TykeWest)

T. Tycholis, P.Eng.

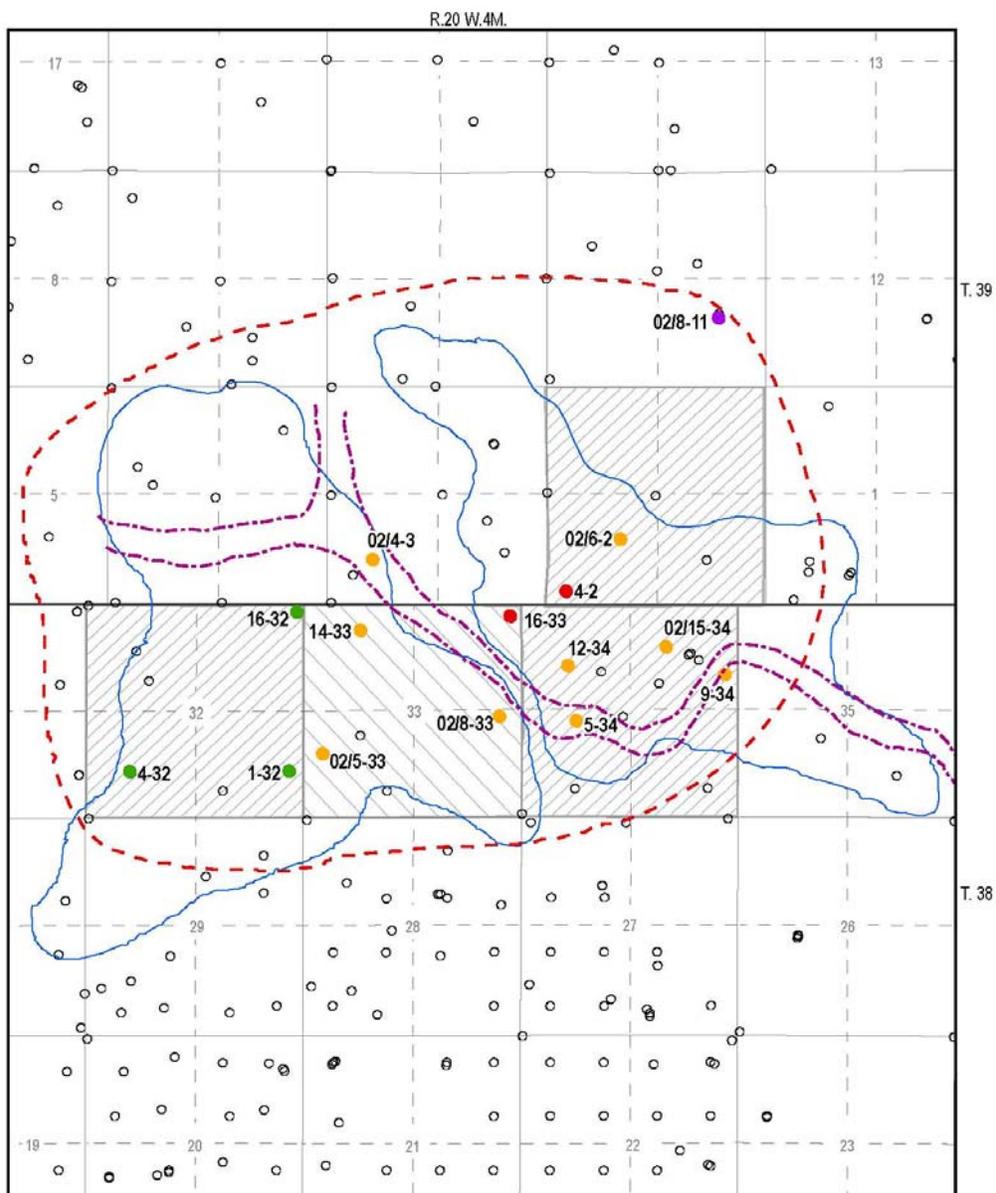
AvenEx Energy Corp. (AvenEx)

B. Likuski  
C. Thompson  
B. Skorenki  
T. Watters

### Energy Resources Conservation Board staff

B. Kapel Holden, Board Counsel  
K. Cameron, Board Counsel  
L. Stubbs, C.E.T.  
A. Lung, C.E.T.  
K. Fisher  
A. Darwiche  
K. Bieber, P.Geol.  
A. Nagy, P.Geol.

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Legend

- Existing well
- Erskine Basal Belly River D Pool well
- Stettler North Basal Belly River B Pool well
- Stettler North Basal Belly River A Pool well
- Undefined Basal Belly River well
- AvenEx pool zero-edges
- AvenEx fluvial channel
- AvenEx land holdings
- TykeWest pool zero-edge
- TykeWest land holding

Figure 1. Map of area of application