Introduction

In this review Canadian Discovery Ltd. (CDL) has analyzed oil industry activity, including recent discoveries and drilling activity in the Western Canada Sedimentary Basin (WCSB) and the Canadian portion of the Williston Basin, from 2004 to present (through Q2 2006). The purpose of this review was to assess current trends and highlight areas for possible future discoveries. This time period was chosen because there is sufficient public data available while still being recent enough to be relevant, the dataset is a reasonable size and there have been some notable recent discoveries. Statistical analysis maps and supporting material were generated using CDL's Exploration & Development Geotechnical Evaluator (EDGE) tool and other products, including Strategy 2005 (S2K5), Canadian Discovery Digest (CDD) and Current Exploration Overview (CEO) Maps.

Figure 1 depicts an overall increase in oil prices from 2004 to the present. The highest oil price of $78.40 per barrel was achieved on July 13, 2006. The price of a barrel of oil on November 22, 2006 was $58.70. The Heavy Oil Differentials graph (Figure 2) illustrates that although oil prices have been high over the past two years, the difference between light oil prices and the price of heavy oil, which accounts for much of the WCSB's production, is substantial. Figure 3 delineates the relationship between completion events and oil price over the past ten years. The increase in drilling activity from 2003 onward can be attributed to high commodity prices making formerly uneconomic plays feasible. Figure 4 highlights the fact that although increasing oil prices (from previous graphs) and a higher number of completions track very closely, this relationship has not translated into an equivalent increase in oil production. Also worth noting on this graph is the high number of ‘Other’ (yellow) wells in 2005. This reflects wells that are too new to be classified as anything other than standing. Finally, Figure 5 shows a 10% decline in original projected recoverable hydrocarbons per well over the past ten years. A possible interpretation is that pools are getting smaller, costs to recover are getting higher and there is increased pressure to capture production. Therefore, it is very important to use any tools available to focus exploration efforts and operate most efficiently and productively.

The Western Canada Oil Trends Map (Figure 6) provides a unique perspective on past performance and future opportunities in the review area. This interpreted map combines a statistical analysis of ultimate recoverable reserves with geological principles and is intended to provide a spatial view of where success has been achieved over the past ten years.

Statistical Analysis

From 2004 to present, approximately 60,000 wells were drilled. Of these wells, 21% were exploration wells (NFW, NPW, DPT, Outpost), 70% were development wells and 9% were categorized as ‘Other’. Fourteen percent (8,524 wells) of the total number of wells drilled were classified as oil producers, with only a small number (1,195) being exploration wells. Figure 7 maps the distribution of oil wells drilled in the WCSB and Williston Basin from 2004 to present,
excluding oil sands wells. The good news for the explorationist is that activity was dispersed throughout the four western provinces, indicating that opportunities are widespread. Figure 8 furthers the concept of broad-based opportunity because oil success has been found at a number of stratigraphic levels over the past three years, although Cretaceous and Mississippian zones predominate. Cretaceous oil sands dominate in northeastern Alberta, while Cretaceous Viking and Cardium sands are in the spotlight in southern and central Alberta. The Viking is key in Saskatchewan. Mississippian plays (Frobisher and Bakken) command the Williston Basin in southeastern Saskatchewan. Oil reservoirs in the Peace River Arch area were the most lightly drilled on a relative basis.

Figure 9 provides a historical perspective. The Sparky sand has had the most completions since 1998, although the number of successful oil wells drilled doubled from the 1998-2000 time period to the 2001-2003 time period, the number of successful oil wells drilled in the Williston Basin has been fairly consistent to the present. As well, the trend of drilling for Jurassic Sawtooth and Shaunavon formations in Saskatchewan has waned, and efforts have shifted to Triassic Charlie Lake oil development in northwestern Alberta. Finally, there has been a shift from chasing the Bakken in the Kindersley heavy oil area from 1998-2003 to looking for the Bakken in the Williston Basin proper in southeastern Saskatchewan and southwestern Manitoba. The current Bakken play can be categorized as a light oil resource play, suggesting that this approach can be successful in oil as well as gas exploration.

Where are the most successful wells? Figure 10 lists the top 20 exploration wells ranked by initial production (IP), defined as production for the first three months on-stream. IP numbers for these wells range from over 2,000 bopd to less than 300 bopd. Cumulative recovery also varies widely, from 25,000 to 272,000 barrels of oil, although the on-production date contributes to the differences in this category. By comparison, Galleon Energy’s press releases of their most recent discoveries at Puskwaswak in west-central Alberta quote IPs of around 2,500 bopd. However, at this stage, there is not enough production history to make a detailed assessment.

Figure 10 also reveals that the top exploration wells are operated by a variety of companies. Although a number of producing zones are represented, it is interesting to note that 13 out of the 20 wells are from the Devonian and Ordovician. Improved technology is key to achieving significant results when exploring in mature, high risk, high cost areas. Three-dimensional seismic allows for the exploration of smaller, subtler traps than conventional 2-D. These traps are often stratigraphic in nature or relatively small in structure. Improved horizontal drilling technology and experience allows operators to more effectively exploit complex reservoirs.

In contrast, 17 out of the top 20 IP development wells (Figure 11) are from the Cretaceous Clearwater Formation. The exceptions were two Mississippian Midale wells at Weyburn and a very productive Devonian Nisku well at Pembina. Unlike the top exploration wells, major companies are responsible for successful development drilling, and all but one of the top 20 wells are the result of technology driven (horizontal, CO₂, oil sands), capital intensive programs. Oil sands wells are under-represented in this list because very little production data has been released, and often these wells do not recover oil during the first three months of production.

In summary, where was oil activity from 2004 to present? Figure 12 clearly shows that most development oil wells were drilled into Cretaceous formations with 17 of the top 20 development wells being Cretaceous completions during this time period (Figure 11). Overall, the Sparky had the highest number of development oil wells completed, while the Viking and Cardium also provided consistent results (Figure 12).
Figure 12 also illustrates that Mississippian zones were second to the Cretaceous in terms of total number of oil reservoirs completed. Subcrop plays in the Williston Basin provide consistent successful results and the Bakken/Torquay is being developed as a resource play.

The Devonian dominates the top 20 exploration well list, with the Pembina Nisku gaining eight of the top 20 IP rankings. Finally, the lightly drilled Ordovician, with only 13 oil wells from 2004 to present, has two of the top 20 exploration wells (Figure 10).

The final statistical analysis identifies who the top operators were from 2004 to present. Not surprisingly, the top four in terms of number of wells drilled are Husky Oil, Canadian Natural Resources Limited (CNRL), EnCana Corporation and Devon Canada Corporation (Figure 13). However, when the criterion is changed from number of wells drilled to average IP greater than 200 bopd (Figure 14), EnCana and CNRL remain in the top four and are joined by Imperial Oil and BlackRock Ventures (now Shell Canada). The implication is that drilling large numbers of wells does not guarantee encountering the best producers. EnCana's oil properties include fields at Suffield Glauconitic, Viking-Kinsella Sparky, Pelican Lake, Foster Creek, Christina Lake and Weyburn. CNRL locations range from thermal in-situ wells at Primrose Clearwater and Wolf Lake McMurray to heavy oil properties around Lloydminster (Colony to Dina) and the Gilwood Formation on the Peace River Arch. Imperial's production is from the Clearwater Formation at Cold Lake. Husky produces heavy oil at Lloydminster and Provost. BlackRock, nineteenth in number of oil wells drilled, but fourth in number of wells with greater than 200 bopd, operates Cretaceous Bluesky heavy oil wells in the Peace River area.

**Selected Oil Plays**

The map in Figure 15 illustrates the location of some selected significant oil plays from 2004 to present. Note that conventional oil plays are distributed along the western Alberta border, whereas heavy oil, oil sands and unconventional oil are located along a parallel trend through eastern Alberta, Saskatchewan and Manitoba. The stratigraphic chart in Figure 16 reveals that these oil plays occupy many stratigraphic levels. The astute explorationist has many opportunities to explore for oil based on geographic location, depth of target and technology required.

The Oil Play Summary (Figure 17) lists some of the metrics of the selected plays on the map. The data was calculated with CDL's EDGE tool. The final three columns contain numbers that are to be used for relative purposes only; they are NOT absolute. The steam injection costs for Clearwater and Midale plays have not been included. Ultimate recoverable reserves were obtained through a partnership with XI Technologies that primarily utilizes a production decline approach in its calculations. Reserve Life Index (RLI) is used to facilitate further comparisons between wells. It is calculated by dividing ultimate recoverable reserves by the first year's production. It is not meant to be the length of time the well will actually be on-stream. Cost per boe is calculated by dividing drilling cost by ultimate recoverable reserves. The numbers in the Total Cost column represent drilling and completion costs only.

The Cretaceous Sparky Formation is the most completed formation and has the third lowest cost ($/boe) and lowest total cost. Not surprisingly, the total cost of a Cretaceous completion averages $509,000/well, while a Devonian completion averages $2,000,000/well. However, the next two graphs (Figures 18 and 19) demonstrate that possibility of high IPs and ultimate recoverables of the four Devonian plays at Pembina, Medicine River, Girouxville and Mega/Venus can make the initial investment worthwhile. The Cretaceous Clearwater at Cold Lake, Cummings/Dina at Winter/Senlac and Mississippian Bakken/Torquay can also show relatively high IPs and ultimate recoverables.
Summary

Canadian Discovery cannot predict the future, but statistical analysis and geologic interpretation of data from 2004 to present can delineate exploration hotspots and trends that can point to future concepts and direction. Recent trends in oil exploration and production can be summarized as follows:

1. Rig Release trends indicate that the quantity of wells drilled seems to have a positive correlation with the price of oil. Actual oil production has not increased in a proportional manner.

2. The location of wells drilled over the past three years has been relatively consistent.

3. The number of oil completions since 2003 has remained relatively flat despite the increase in total number of wells drilled.

4. Of the approximately 60,000 wells drilled over the past three years, only 14% were classified as oil producers, and only a small portion of those were true exploration wells. In other words, oil exploration wells are only a minor component of total wells drilled.

5. Operator graphs indicate that drilling large numbers of wells does not necessarily ensure success in locating the most prolific producers.

6. The top 20 exploration IP wells were dominated by Devonian formations, specifically eight Nisku wells.

7. There were also two Ordovician wells in the top 20 exploration IP wells. These Devonian and Ordovician successes indicate that for the most prolific, most impressive results explorationists may need to consider focusing on deeper, high risk, high cost targets.

8. The top 20 development wells were dominated by technology driven plays (horizontal, CO$_2$, oil sands) that are capital intensive. The only exception was a Pembina Nisku development well.

9. Cretaceous formations dominated in terms of numbers of completions. The Sparky Formation had the most wells completed and, along with the Viking and Cardium, the most consistent positive outcomes.

10. Activity surrounding Jurassic oil plays in southern Alberta and Saskatchewan declined.

11. There was an increase the level of activity in the Triassic Charlie Lake on the Peace River Arch.

12. The Mississippian formations had the second highest number of oil completions. Subcrop plays in the Frobisher, Bakken and Midale formations provided consistent results.

13. The Bakken in the Williston Basin has demonstrated that resource play philosophy, usually reserved for gas plays, can successfully be applied to an oil play.

14. The explorationist will need to gather information and utilize all of the tools available to be successful in today’s oil patch.
Why Oil from 2004 to Present?

[Image: Oil Prices, 2004-2006]

Not adjusted for inflation. Taken from: http://upload.wikimedia.org/wikipedia/en/2/28/Oil_Prices_Short_Term.png
Heavy Oil Differentials

Heavy Oil Differential
Edmonton Par vs. Bow River at Hardisty

Cdn$/Bbl

% of Light

95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
45%

Aug-03 Aug-04 Aug-05 Aug-06

Source: Imperial Oil.

http://www.petersco.com/peheavy.htm

Figure 2
E&D Trends
Rig Release Year versus Class

NYMEX Light Sweet Oil. Not adjusted for inflation. Taken from: http://upload.wikimedia.org/wikipedia/en/2/28/Oil_Prices_Short_Term.png

Figure 3
E&D Trends
Rig Release Year versus Status

Figure 4
Ultimate Recoverable Hydrocarbons per Well

Figure 5

9.7% Decline
Western Canada Oil Trends
1995 - 2004 (boe/Ha)

Figure 6

Oil Reserve Trends (boe/Ha)

1 - 2
3
4
5
6 - 10
11
12
13 - 16
17
18 - 21
22 - 25
26 - 30
31 - 32
33 - 35
36 - 50
51 - 80
81 - 123
124 - 132
133 - 154
155 - 223
224 - 256
257 - 352
353 - 394
395 - 481
462 - 524
625 - 712
713 - 1,078
1,079 - 1,432
1,433 - 2,608
2,809 - 20,001

STRATEGY 2005
Where was the Oil Activity? Location Rig Release Map

Figure 7
Producing Zone versus Oil Wells

Historical

2001 - 2003

1998-2000
## Top 20 IP Exploration Oil Wells
### 2004 - Present

<table>
<thead>
<tr>
<th>Well Location</th>
<th>Operator</th>
<th>Formation</th>
<th>Field</th>
<th>Status</th>
<th>IP Oil (bopd)</th>
<th>IP Gas (mcf/d)</th>
<th>Cum Oil (mbbls)</th>
<th>Cum Gas (mmcf)</th>
<th>Cum BOE (mboe)</th>
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<td>Nisku</td>
<td>Pembina</td>
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*Color Coding:*
- **Cretaceous**
- **Jurassic/Triassic**
- **Mississippian**
- **Devonian/Ordovician**

*Figure 10*
## Top 20 IP Development Oil Wells
### 2004 - Present

<table>
<thead>
<tr>
<th>Well Location</th>
<th>Operator</th>
<th>Formation</th>
<th>Field</th>
<th>Status</th>
<th>IP Oil (bopd)</th>
<th>IP Gas (mcf/d)</th>
<th>Cum Oil (mbls)</th>
<th>Cum Gas (mmcf)</th>
<th>Cum BOE (mboe)</th>
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<td>Pembina</td>
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<td>162,427</td>
<td>47</td>
<td>170</td>
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<tr>
<td>02/04-01-068-04W4/0</td>
<td>CNRL</td>
<td>Clearwater</td>
<td>Cold Lake</td>
<td>Dev</td>
<td>1,033</td>
<td>272</td>
<td>157,207</td>
<td>45</td>
<td>165</td>
</tr>
<tr>
<td>02/14-04-068-04W4/0</td>
<td>CNRL</td>
<td>Clearwater</td>
<td>Cold Lake</td>
<td>Dev</td>
<td>1,014</td>
<td>94</td>
<td>1,675</td>
<td>0</td>
<td>2</td>
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<tr>
<td>91/12-01-006-14W2/0</td>
<td>EnCan</td>
<td>Midale</td>
<td>Weyburn</td>
<td>Dev</td>
<td>986</td>
<td>996</td>
<td>94,835</td>
<td>101</td>
<td>112</td>
</tr>
</tbody>
</table>

- **Cretaceous**: Green
- **Jurassic/Triassic**: Orange
- **Mississippian**: Blue
- **Devonian/Ordovician**: Purple

Figure 11
Where was the Oil Activity?
2004 - Present

8,524 Oil Producers

Figure 12
Top Operators, 2004 - Present
Total Number of Oil Wells Drilled

Figure 13

- Husky Oil Operations Limited: 786 Total Wells, 171 Development Expenditures
- Canadian Natural Resources Limited: 765 Total Wells, 27 Development Expenditures
- EnCana Corporation: 447 Total Wells, 6 Development Expenditures
- Devon Canada Corporation: 400 Total Wells, 34 Development Expenditures
- Canetic Resources Inc.: 303 Total Wells, 14 Development Expenditures
- Tundra Oil And Gas Ltd.: 239 Total Wells, 54 Development Expenditures
- Penn West Petroleum Ltd.: 243 Total Wells, 26 Development Expenditures
- Imperial Oil Resources Limited: 262 Total Wells, 8 Development Expenditures
- ISH Energy Ltd.: 147 Total Wells, 42 Development Expenditures
- Baytex Energy Trust: 156 Total Wells, 8 Development Expenditures
- Harvest Energy Trust: 152 Total Wells, 8 Development Expenditures
- ARC Energy Trust: 126 Total Wells, 24 Development Expenditures
- Crescent Point Energy Trust: 137 Total Wells, 6 Development Expenditures
- Bonavista Energy Trust: 120 Total Wells, 17 Development Expenditures
- Talisman Energy Inc.: 111 Total Wells, 11 Development Expenditures
- Murphy Canada Exploration Company: 114 Total Wells, 5 Development Expenditures
- Mission Oil & Gas Inc.: 82 Total Wells, 34 Development Expenditures
- Compton Petroleum Corporation: 109 Total Wells, 7 Development Expenditures
- BlackRock Ventures Inc.: 113 Total Wells, 1 Development Expenditures
- NAL Oil & Gas Trust: 112 Total Wells, 1 Development Expenditures
Top Operators, 2004 - Present
Ave IP Oil >=200 bopd

Figure 14
Stratigraphic Chart

Figure 16

Canadian Discovery Ltd.

- Conventional Exploration
- Conventional Development
- Heavy Oil
- Oil Sands
- CO₂ Injection
- Resource

<table>
<thead>
<tr>
<th>BRITISH COLUMBIA</th>
<th>ALBERTA</th>
<th>SASKATCHEWAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tertiary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Cretaceous</td>
<td>Wilson Creek</td>
<td></td>
</tr>
<tr>
<td>Lower Cretaceous</td>
<td>Hay River</td>
<td>Cold Lake</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lashburn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Winter/Senlac</td>
</tr>
<tr>
<td>Jurassic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triassic</td>
<td></td>
<td>Cecil</td>
</tr>
<tr>
<td>Permian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mississippian</td>
<td>Pembina</td>
<td>Weyburn Viewfield</td>
</tr>
<tr>
<td>Devonian</td>
<td>Medicine River</td>
<td>Girouxville East</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mega/Venus</td>
</tr>
</tbody>
</table>

Figure 16
## Selected Oil Play Summary

<table>
<thead>
<tr>
<th>Formation</th>
<th>Field</th>
<th>T/R</th>
<th>Exp/Dev</th>
<th>Type</th>
<th>IP Oil (bopd)</th>
<th>Cum Oil (mbls)</th>
<th>Ult Rec Oil (mbls)</th>
<th>Rem Res Oil (mbls)</th>
<th>RLI* (yrs)</th>
<th>Cost* ($/boe)</th>
<th>Total* Cost (K$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belly River</td>
<td>Wilson Creek</td>
<td>42-4W5</td>
<td>Exp</td>
<td>Conventional</td>
<td>62</td>
<td>17</td>
<td>37</td>
<td>20</td>
<td>2.03</td>
<td>$22</td>
<td>$1,038</td>
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<tr>
<td>Bluesky</td>
<td>Hay River</td>
<td>94-1-9</td>
<td>Dev</td>
<td>Conventional</td>
<td>151</td>
<td>39</td>
<td>71</td>
<td>32</td>
<td>1.67</td>
<td>$29</td>
<td>$761</td>
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<tr>
<td>Clearwater</td>
<td>Cold Lake</td>
<td>66-4W4</td>
<td>Dev</td>
<td>Oil Sands</td>
<td>303</td>
<td>48</td>
<td>175</td>
<td>135</td>
<td>1.95</td>
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<td>N/A</td>
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<tr>
<td>Sparky</td>
<td>Lashburn</td>
<td>49-26W3</td>
<td>Dev</td>
<td>Heavy Oil</td>
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<td>13</td>
<td>54</td>
<td>47</td>
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<td>Cummings/Dina</td>
<td>Winter/Senlac</td>
<td>43-25W3</td>
<td>Dev</td>
<td>Heavy Oil</td>
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<td>Cecil</td>
<td>85-8W6</td>
<td>Dev</td>
<td>Conventional</td>
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<tr>
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<td>Weyburn</td>
<td>6-14W2</td>
<td>Dev</td>
<td>CO₂ Injection</td>
<td>43</td>
<td>5</td>
<td>26</td>
<td>22</td>
<td>2.28</td>
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<td>N/A</td>
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<tr>
<td>Bakken</td>
<td>Viewfield</td>
<td>8-9W2</td>
<td>Dev</td>
<td>Resource</td>
<td>144</td>
<td>26</td>
<td>150</td>
<td>123</td>
<td>3.16</td>
<td>$7.30</td>
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<tr>
<td>Nisku</td>
<td>Pembina</td>
<td>48-8W5</td>
<td>Exp</td>
<td>Conventional</td>
<td>876</td>
<td>107</td>
<td>532</td>
<td>524</td>
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<td>Leduc</td>
<td>Medicine River</td>
<td>38-4W5</td>
<td>Exp</td>
<td>Conventional</td>
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<td>215</td>
<td>158</td>
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<td>$11</td>
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<tr>
<td>Beaverhill Lk SS</td>
<td>Girouxville East</td>
<td>77-21W5</td>
<td>Exp</td>
<td>Conventional</td>
<td>237</td>
<td>45</td>
<td>129</td>
<td>94</td>
<td>1.29</td>
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<td>$1,557</td>
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<tr>
<td>Keg River</td>
<td>Mega/Venus</td>
<td>101-6W6</td>
<td>Exp</td>
<td>Conventional</td>
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<td>238</td>
<td>199</td>
<td>3.78</td>
<td>$5.70</td>
<td>$1,563</td>
</tr>
</tbody>
</table>

*Numbers are relative NOT absolute. Statistics determined from successful oil wells.
Selected Oil Play Summary

Initial Production (bopd)

Figure 18

- Wilson Creek
- Hay River
- Cold Lake
- Lashburn
- Winter/Senlac
- Cecil
- Weyburn
- Viewfield
- Pembina
- Medicine River
- Girouxville
- Mega/Venus

Legend:
- Conventional Exploration
- Conventional Development
- Heavy Oil
- Oil Sands
- CO2 Injection
- Resource
Selected Oil Play Summary
Ultimate Recoverable Oil (mbls)

Figure 19

- Wilson Creek
- Hay River
- Cold Lake
- Lashburn
- Winter/Senlac
- Cecil
- Weyburn
- Viewfield
- Pembina
- Medicine River
- Girouville
- Mega/Venus

Legend:
- Conventional Exploration
- Conventional Development
- Heavy Oil
- Oil Sands
- CO₂ Injection
- Resource