AV Significant Exploration Success in Northeastern British Columbia: A Story of People Resilience and Learning from Failure*

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Search and Discovery Article #110169 (2013)**
Posted August 12, 2013

*Adapted from oral presentation at Discovery Thinking Forum, AAPG Annual Convention and Exhibition, Pittsburgh, Pennsylvania, May 19-22, 2013.

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Exploration Examples

Ladyfern Gas Field
Conventional 600 BCF Gas Discovery in 2000
On platform in Upper Devonian Slave Point Formation (carbonate)

Horn River Gas Field
Unconventional (≈60 TCF) Gas Discovery in 2004
In Devonian-Carboniferous Besa River Formation

Liard Gas Field
Unconventional (≈ 100 TCF) Gas Discovery in 2009
In Devonian-Carboniferous Besa River Formation (but younger section than at Horn River)

Summary of Learnings/Validation

- Early is better.
- Resilience – significant failure can lead to more significant success.
- Move quickly.
- Understanding your competition – the herd mentality.
- Social license is critical! Listening, seeking creative solutions and acting early are essential.
- Solid exploration proposals combined with company commitment are optimal.

- It all comes down to excellent people… always!

Reference Cited

U.S. Energy Information Administration, 2011, North American shale plays (as of May 2011). Website accessed July 28, 2013. http://www.eia.gov/oil_gas/rpd/northamer_gas.pdf.

SIGNIFICANT EXPLORATION SUCCESS IN NORTHEASTERN BRITISH COLUMBIA: A STORY OF PEOPLE, RESILIENCE AND LEARNING FROM FAILURE

MAY 20, 2013

AAPG ANNUAL CONVENTION
PITTSBURGH, PA

ROB SPITZER
APACHE CANADA LTD.

AGENDA

- Background
- Exploration
- A recipe for sustained success
- Basic ingredients
  - People
  - Business
  - Technology
  - Company Support
- Significant discoveries
  - Ladyfern
  - Horn River
  - Liard
- Summary

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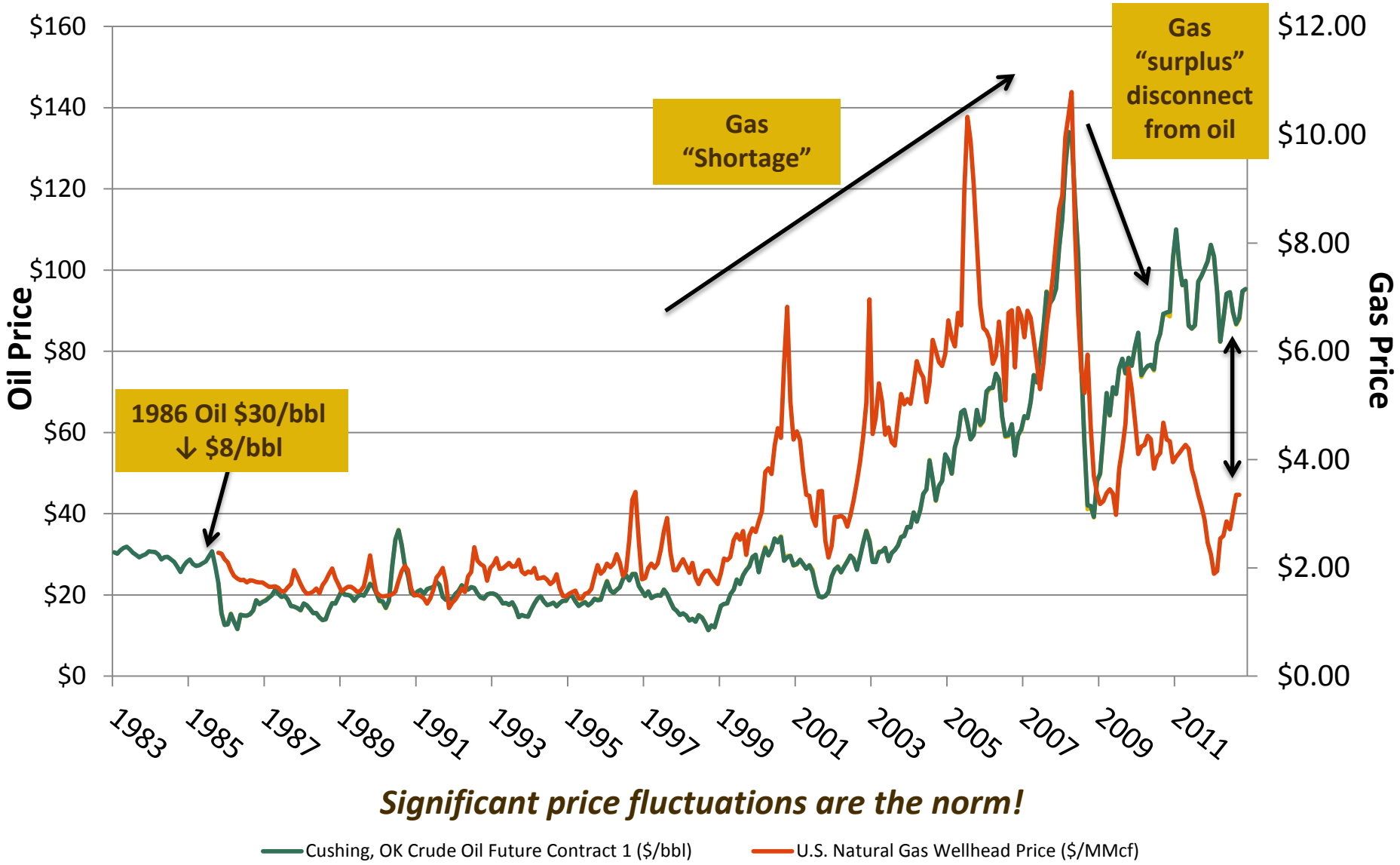
BACKGROUND

- 32 years of industry experience (18 Shell, 14 Apache)
- 50% Exploration, 50% Development
- Primarily in Canada (coast to coast to coast)
- Leading exploration groups for last 16 years
- Significant number of failures and some successes
- Initiated and chaired Horn River Producers Group (2007 – 2012)
- Currently EVP Apache Kitimat Upstream

OIL/GAS PRICES: PAST 30 YEARS



Significant price fluctuations are the norm!

HYDROCARBON EXPLORATION: WHAT IS IT? WHAT IS SUCCESS?

- In simple terms: finding new hydrocarbons

- What does success look like? A range of answers dependent on:
  1. Size of the find
  2. Profitability
  3. Impact on the company (companies) involved (stock price)

- Focus of this talk is: large finds, profitable and impactive to medium/large companies

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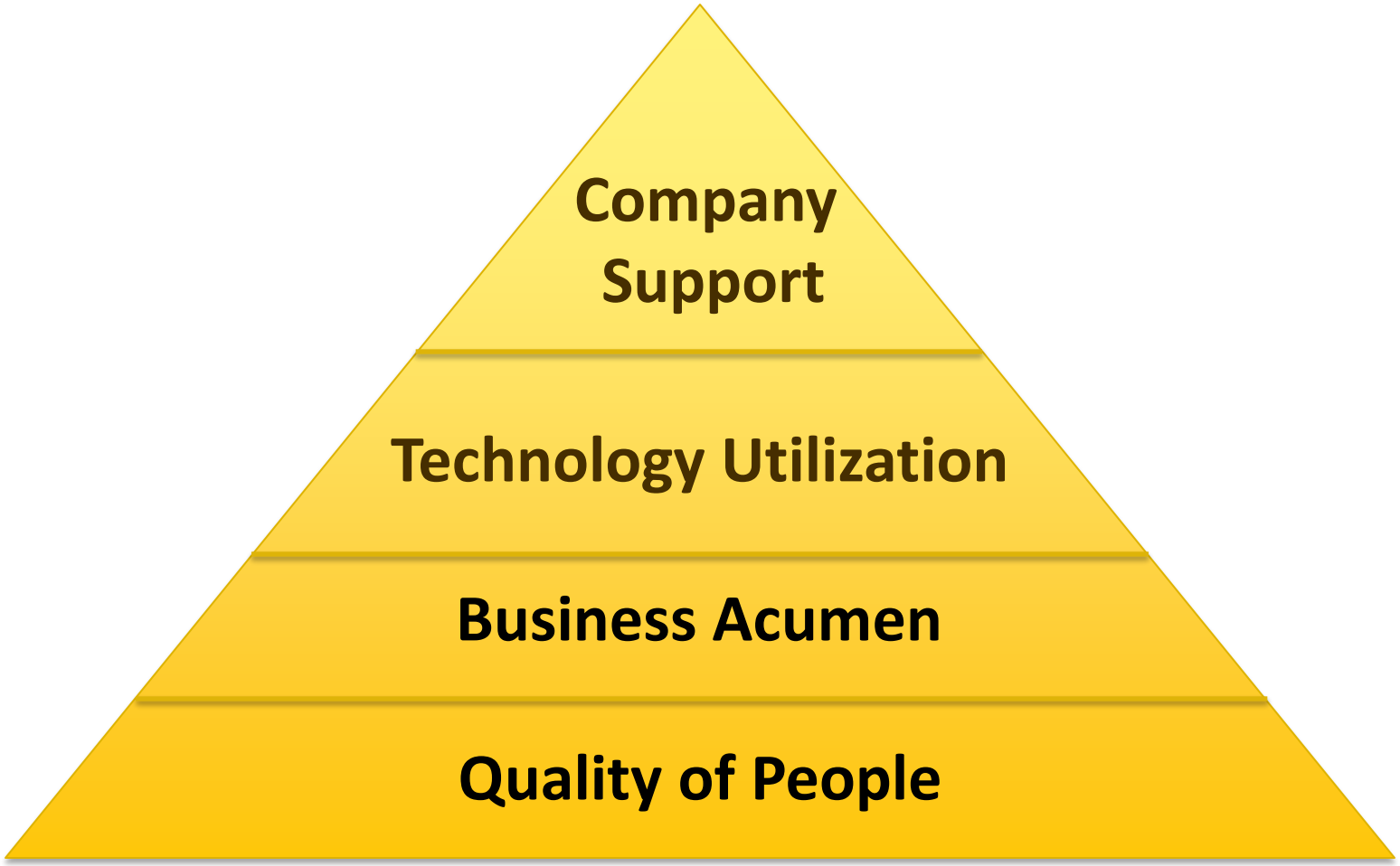
4 KEY OBSERVATIONS/LEARNINGS

- The only constant in exploration is change
- There are **many** ways to be a successful explorer
- **Quality of people** is the primary factor determining success
- Failure is a key component of success (if one learns from it!)

RECIPE FOR EXPLORATION SUCCESS: KEY INGREDIENTS



PEOPLE QUALITIES: WHAT TO LOOK FOR "TOP 10"

- **Resilience**
- **Passion**
- **Focused**
- **Ability to connect data**
- Curiosity/Creativity
- Objectivity
- Courage
- Not easily satisfied – hunger
- Able to pull the trigger
- Ability of individuals/team to excel with diversity of opinions - chemistry

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RESILIENCE

"More than education, more than experience, more than training, a person's level of resilience will determine who succeeds and who fails. That's true in the cancer ward, it's true in the Olympics, and it's true in the boardroom."

-Dean Becker,

President & CEO Adaptive Learning Systems

Harvard Business Review – May 2002

WHY RESILIENCE IS IMPORTANT

- Generally there are **more failures** than **success**
- Exploration for big, profitable accumulations is much less than a 50/50 proposition

Failures
Redfish
Ootla
(Horn River Deep)
Nordegg
Palliser
New Brunswick
Sask (Bakken)
Brule
Firewood
Thinahtea
Many more

Small Successes
Pickell
Ring Border
Milo
Simonette
Montney (oil)
Sask Ordovician
Many more

Major Successes
Ladyfern
Horn River
Liard

QUALITIES OF RESILIENCY

- Optimism **without distortion of reality**
- **Finding positives** and meaning from failure
- Improving what you have – **finding a way**

PASSIONATE ABOUT FINDING

- People generally do better in endeavors they like
- Tendencies often show up early in life ~ curiosity
- For example:
  - Young rock and mineral collectors/finders
- Passion enables a person/group to overcome many of the “darker days” in exploration

FOCUS

- Ability to **quickly** identify the **key factors** for **success** and direct energy towards resolving them
- This provides significant competitive advantage in speed and better evaluation of risk and therefore decision making
- This leads to better **early** decision making

"One is never far ahead of the pack."

CONNECTING THE DOTS

- People can have exactly the same data and end up with totally different recommendations in vastly differing timeframes

- Successful explorers have the ability to connect the data in a manner that is logical, **based on reality**, and is **compelling** to those holding the “purse strings”

TECHNICAL EXCELLENCE

- Extremely important attribute for competitive advantage
- It is the foundation for good decision making
- Learning by doing/experimenting leads to more valuable technical information
- Successful exploration requires that as much data is utilized and integrated in all pertinent disciplines – no silos

"The best geologist is the one that has seen the most rock"

(McMaster University Professor 1978)

TECHNOLOGY

- Developing and/or quickly reacting to new technology can be a game changer in exploration
- 3D and horizontal multi-stage fracing are excellent examples
- Good explorationists are always aware of new technology either by aiding a specific technology's development or quickly finding analogs to industry successes

BUSINESS

- Good business decisions can generally only be made from staff recommendations which are of the **highest quality – period!**

- Given the general lack of data in most new plays, as well as price uncertainty: chance of success can be further diminished by less than stellar technical, economic, strategic and execution work

- These need to be managed well to be successful!

BEST BUSINESS PRACTICES

- Ability to make a **timely decision**
- **First in** →lowest entry cost + highest capture + highest ROR (success case)
- **Spend capital proportionally to knowledge**
- Understand full cycle risks/reward
- Large portfolio = choice
- Be strategic and plan
- **Think big** with **realism**
- **Social license and stakeholders engagement with early communication is very important!**

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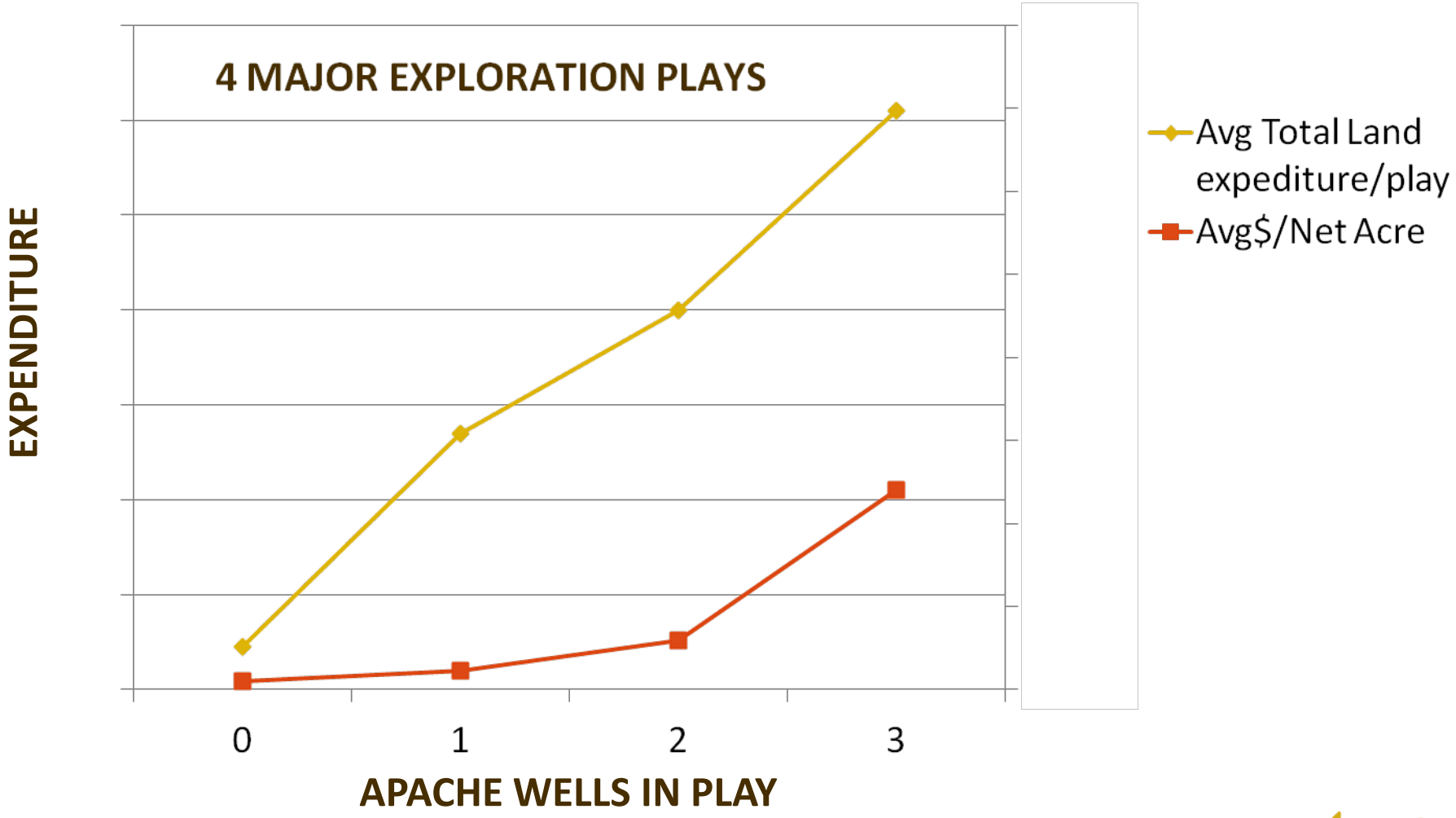
SPENDING WISELY: LAND EXPENDITURES VS. KNOWLEDGE



Important for maximizing ROR AND lowering cost of failure!

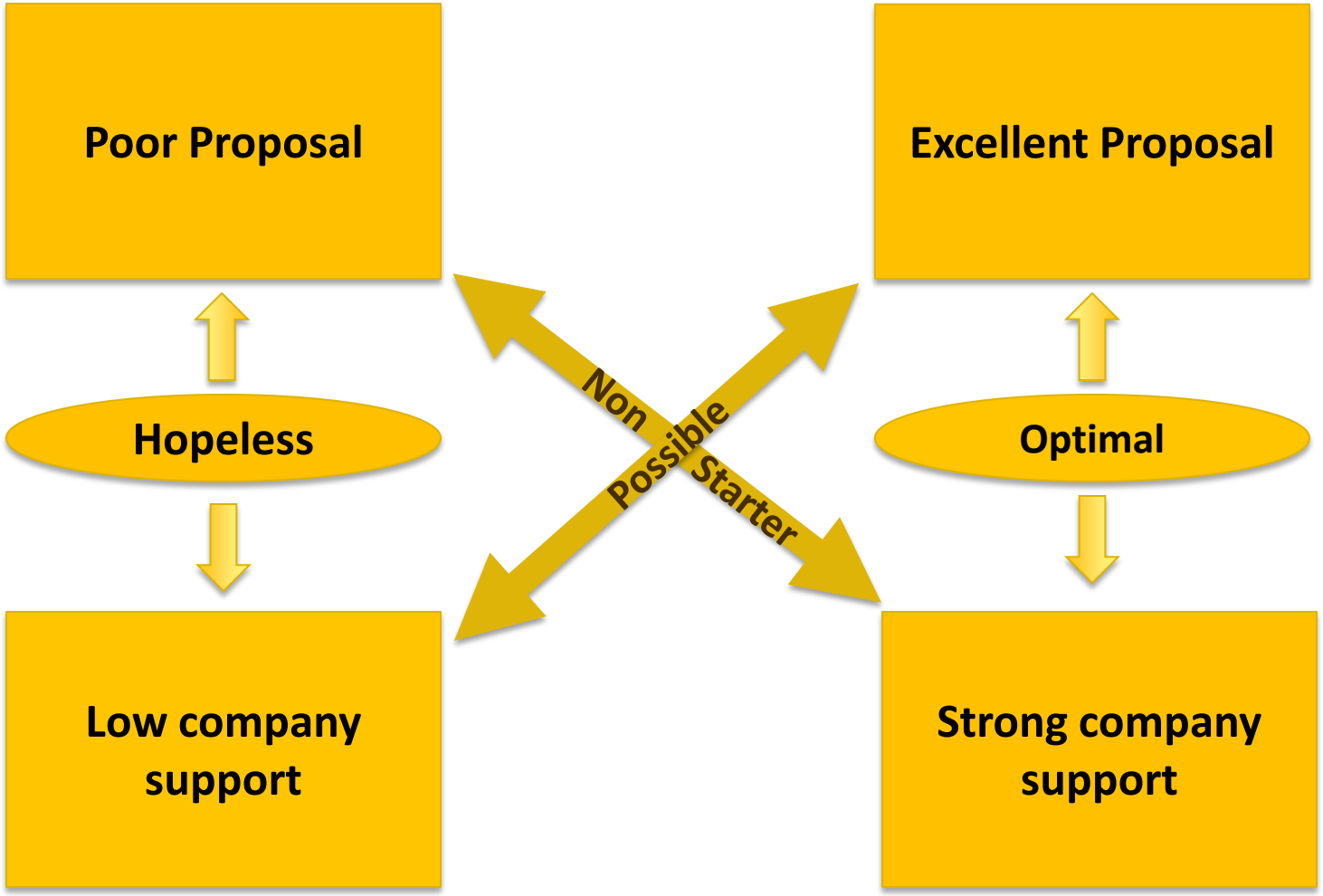
COMPANY SUPPORT FOR EXPLORATION

- Very important to have support, however, **not impossible** if it is weak

. . . Remember resilience, tenacity, quality of proposal etc. . .

- These qualities can change/influence the level of a company's commitment

COMPANY SUPPORT FOR EXPLORATION VERSUS QUALITY OF EXPLORATION PROPOSAL



EXPLORATION EXAMPLES

Ladyfern

- CONVENTIONAL 600 BCF GAS DISCOVERY IN 2000

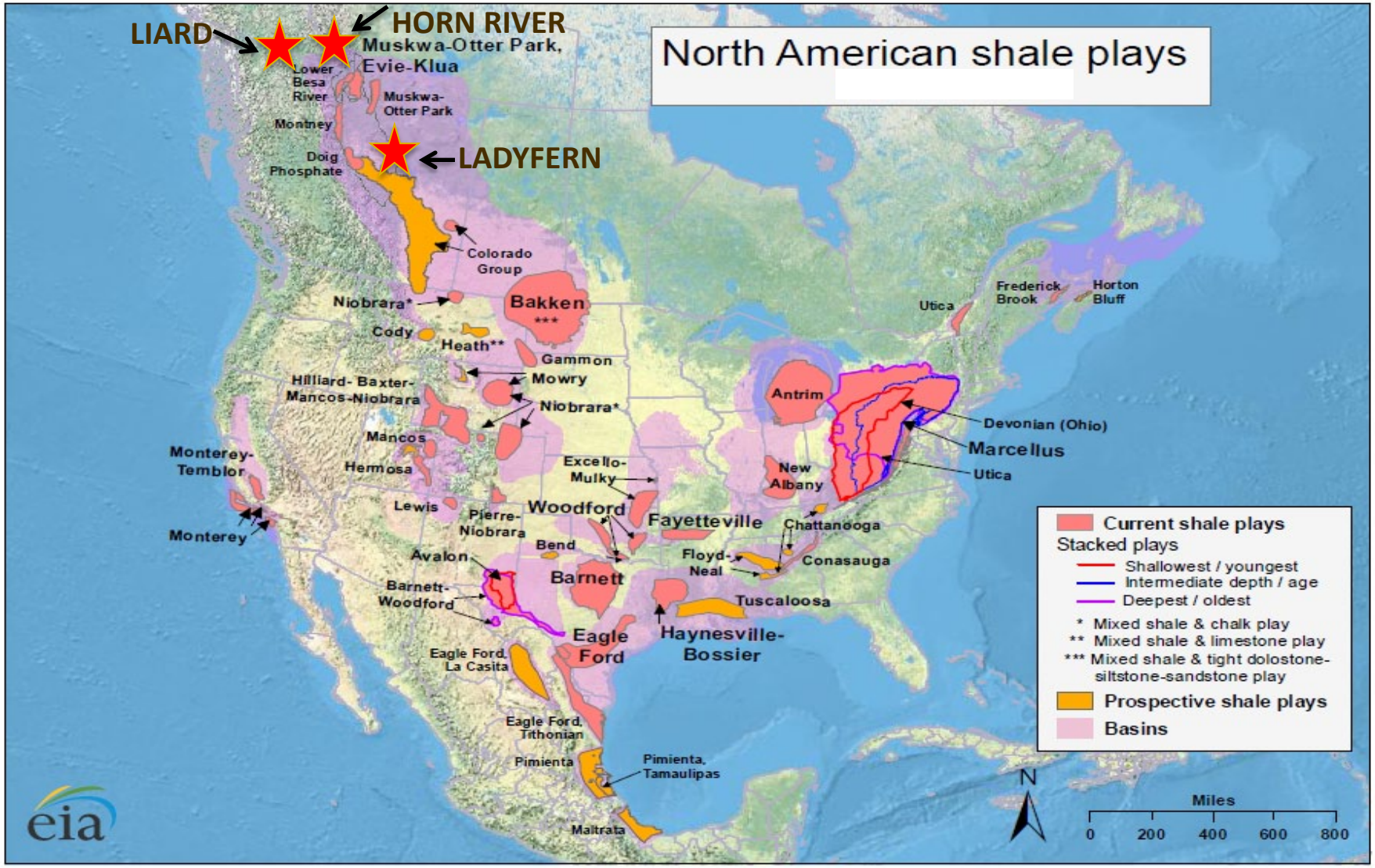
Horn River

- UNCONVENTIONAL (≈60 TCF) GAS DISCOVERY IN 2004

Liard

- UNCONVENTIONAL (≈ 100 TCF) GAS DISCOVERY IN 2009

LOCATION MAP: LADYFERN, HORN RIVER, LIARD



Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI.
Updated: May 9, 2011

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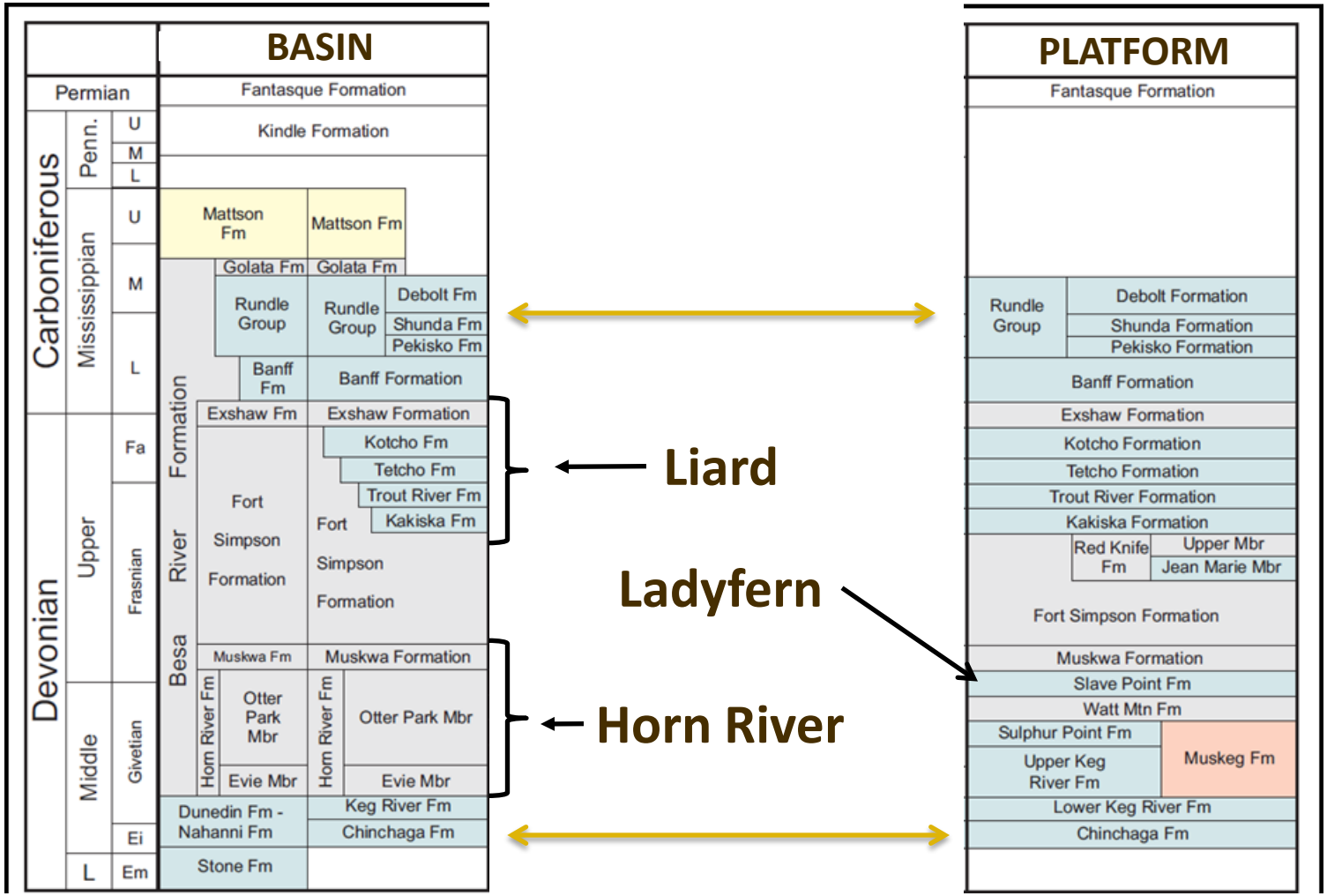
LADYFERN, HORN RIVER, LIARD STRAT COLUMN



LADYFERN DISCOVERY: ON THE GROUND

THE HEADLINES

UPSTREAM NEWS Page 9

Ladyfern is hot property

BC onshore play promises up to 1 Bcfd within

DANN ROGERS from Cal

Daily Oil Bulletin
March 30, 2000

Ladyfern Parcel Dominates Last B.C. Sale Of The Quarter

B.C. gas find triggers legal fight

Predator files counterclaim against three firms alleg ing of trade secrets

Murphy and Apache allege that

NICKLE'S ENERGY INFORMATION TECHNOLOGY

Petroleum Explo

Oilweek
CANADA'S OIL & GAS AUTHORITY

Volume 51, No. 37 Publication Mail Registration No. 09359 Calgary, AB Return Address: #800, 1333 8th Street S.W., Calgary, AB T2R 1M6

B.C. Gas Find

Firms Test Well At 31 Million A Day, Others To Follow

A Murphy Oil Corporation, Apache Canada Ltd. and Beau Canada Explo tested a natural gas well in the Ladyfern area in the northeastern British Columbia are

area is on the border, just west of

breakup via a 25-kilometre pipe and be connected into NOVA G owned by TransCanada PipeL Beau Canada, a 30% par up locations are being drilled on Murphy has a 33% intere It is currently drilling a well, jus

Pipeline dispute indicates worth of gas plays

ed to carry gas from a well pro- for a 6.5-section posting April 26, p drilled about 10 cial borders, into the second well has also ted and will be

field one of th

Ladyfern Play Shrouded in Secrecy

by JoAnne Sommers
May 4, 2001

BREAKING NEWS

Apache reports 31 MMcf/day gas discovery in Canada

Houston, Feb. 17, 1999 -- Apache Corporation (NYSE: APA) today announced a Canadian gas discovery which tested at the rate of 31 million cubic feet (MMcf) per day. The discovery is in the Province of British Columbia on acreage acquired from Shell Canada late last year.

"Proved reserves acquired in the Shell Canada transaction were mainly oil, but the major upside lies in gas exploration on nearly 300,000 net acres and in the staff of highly motivated technical people who joined Apache," said Apache President and Chief Operating Officer G. Steven Farris. "This is one of the prospects they had developed prior to the acquisition."

NORTHERN GREED

BC's Ladyfern was touted as one of the biggest gas finds in Canadian history. Instead it was a bust. What went wrong?

LADYFERN = 5% Canadian Gas Production
B.C. Oil & Gas Revenues Surpass Forestry

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THE STORY BEHIND THE HEADLINES

- 15 years of small finds/failures by the industry in the area
- Large gas finds unlikely in future
- Good work done at Shell previously to loosely identify the opportunity
- “Incremental 2D’s” shot over many years
- Then . . .

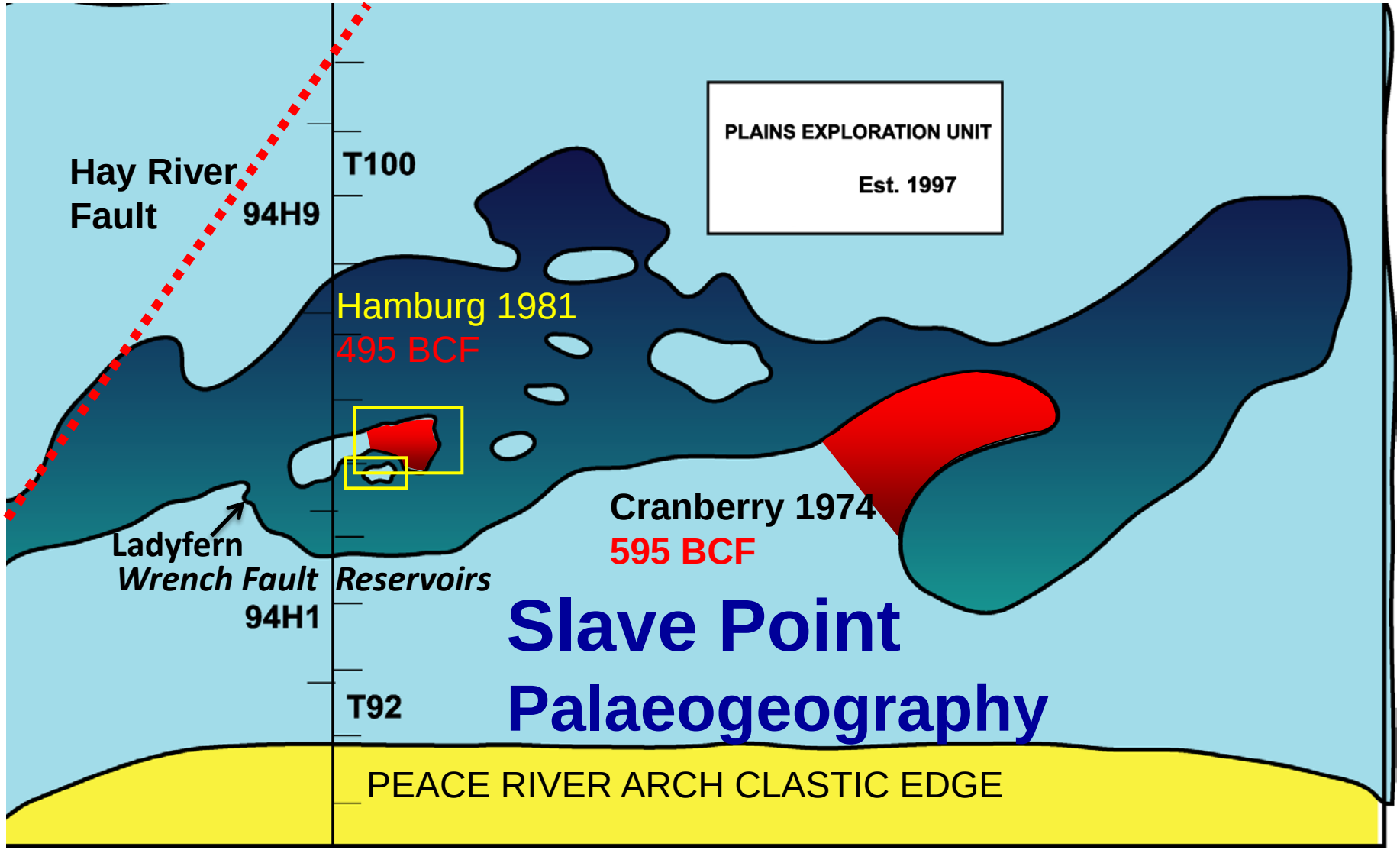
A CHANGE

- New Ventures group formed in 1997
  - Entrepreneurial, focused, good people . . .
- Only a $25M/year budget
- Committed to a 3D vs previous 2D's in order to better map trap/reservoir
- 3D confirmed both
- Acquired land
- Ready to drill!!

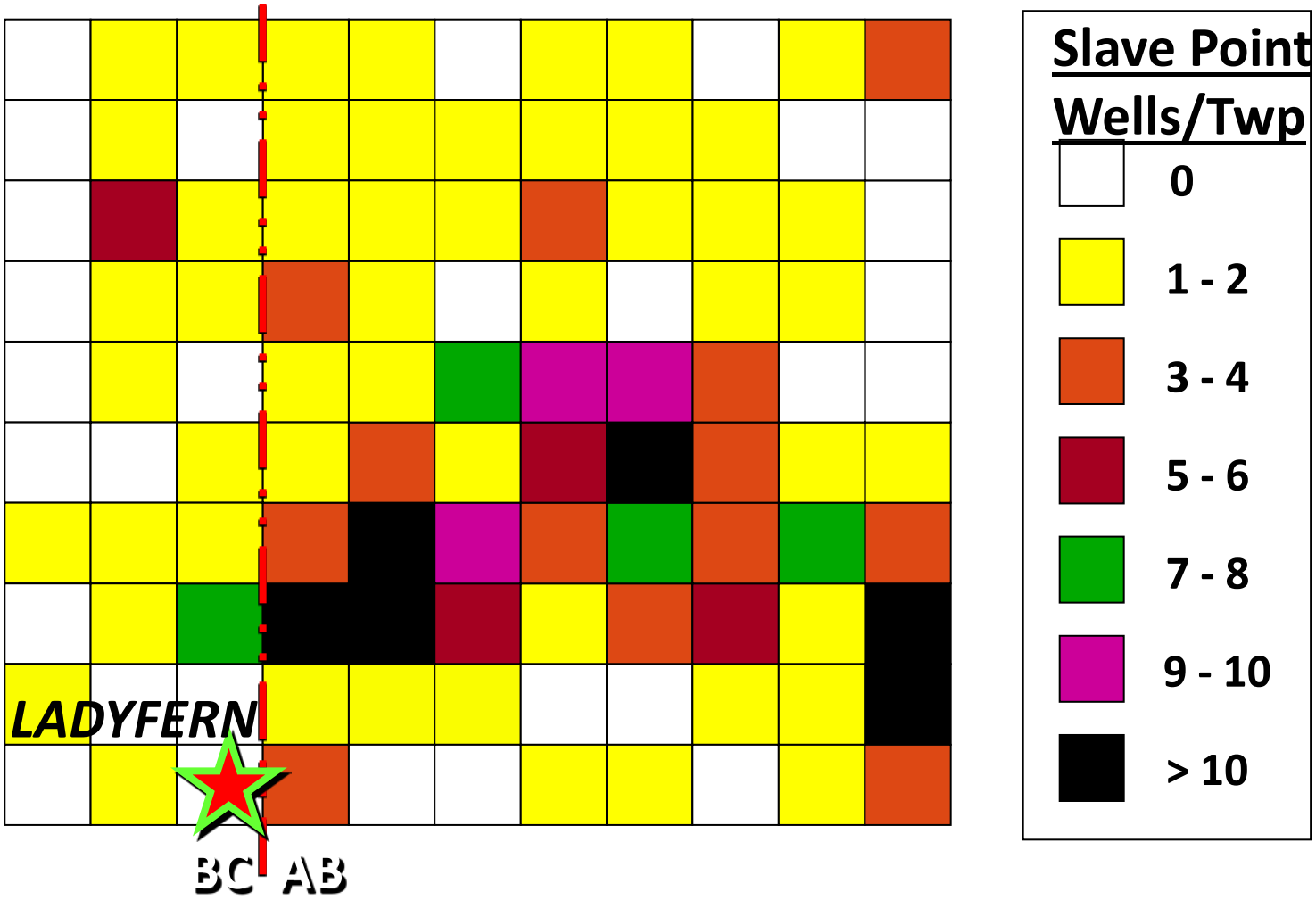
THE ROLLERCOASTER

- Stop!
- Exceeded our budget of $25M by $2M
- “Wanted the money back” in order to stay on budget
- Only asset was 3D – therefore farmed out a significant interest including $2M for 3D
- Now ready to drill! Well not quite . . .
- Shell sold plains assets to Apache in December 1999
- Apache drilled discovery well in January 2000
- 100 mmcf/d well deliverability!
- 600 Bcf produced . . .

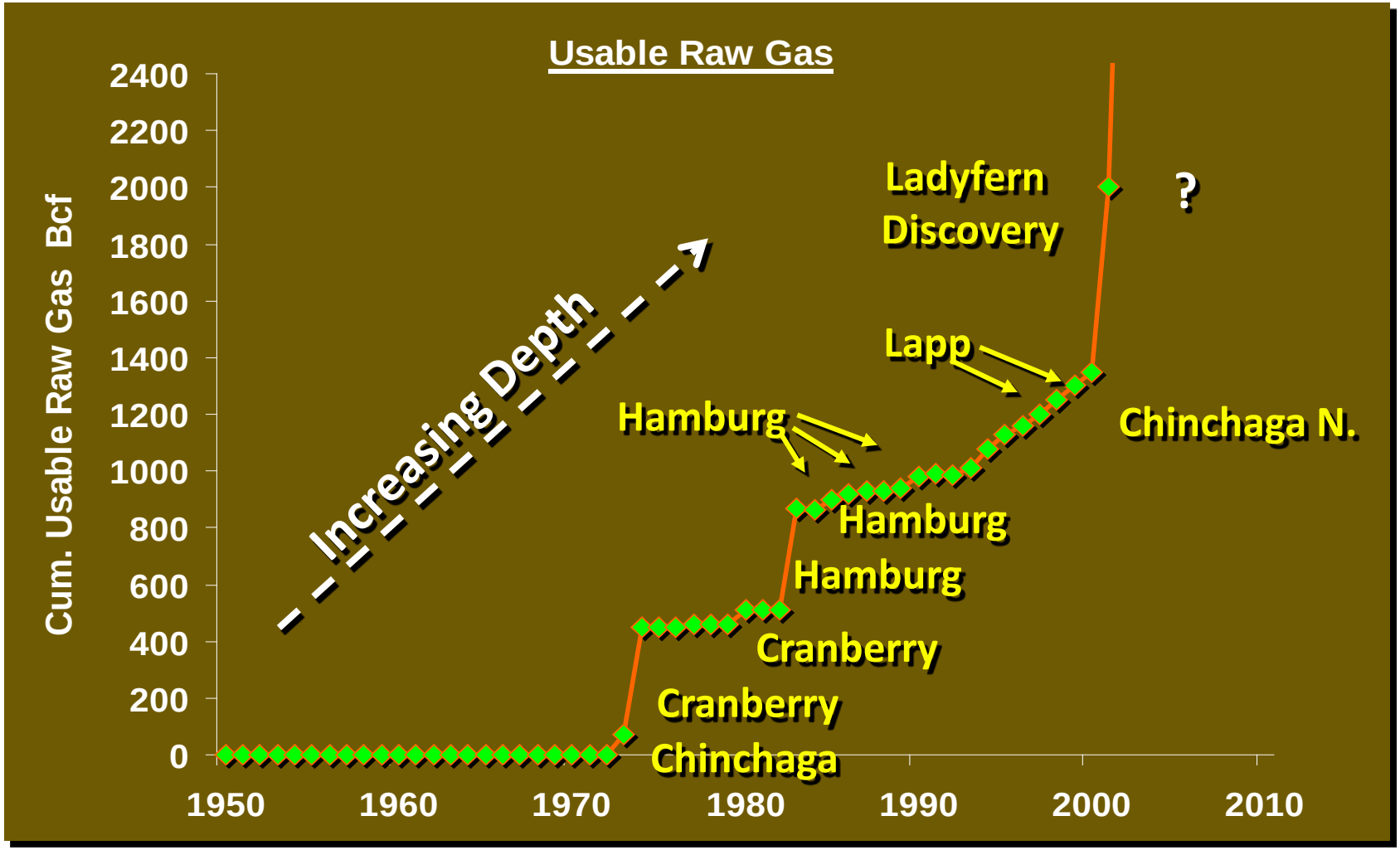
LADYFERN: PRE-DISCOVERY



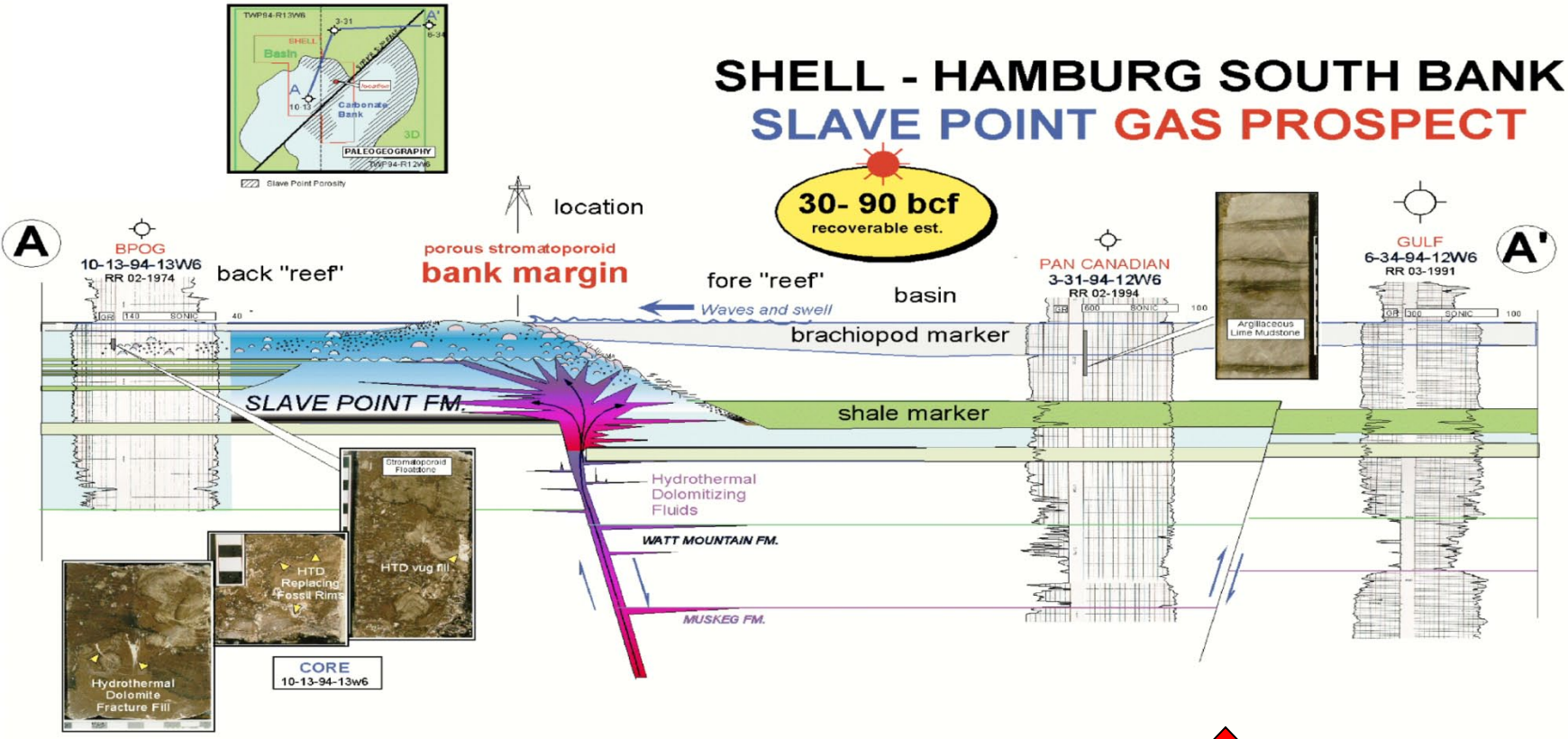
PRE-LADYFERN SITUATION (1999)



HAMBURG AREA – MIDDLE DEVONIAN

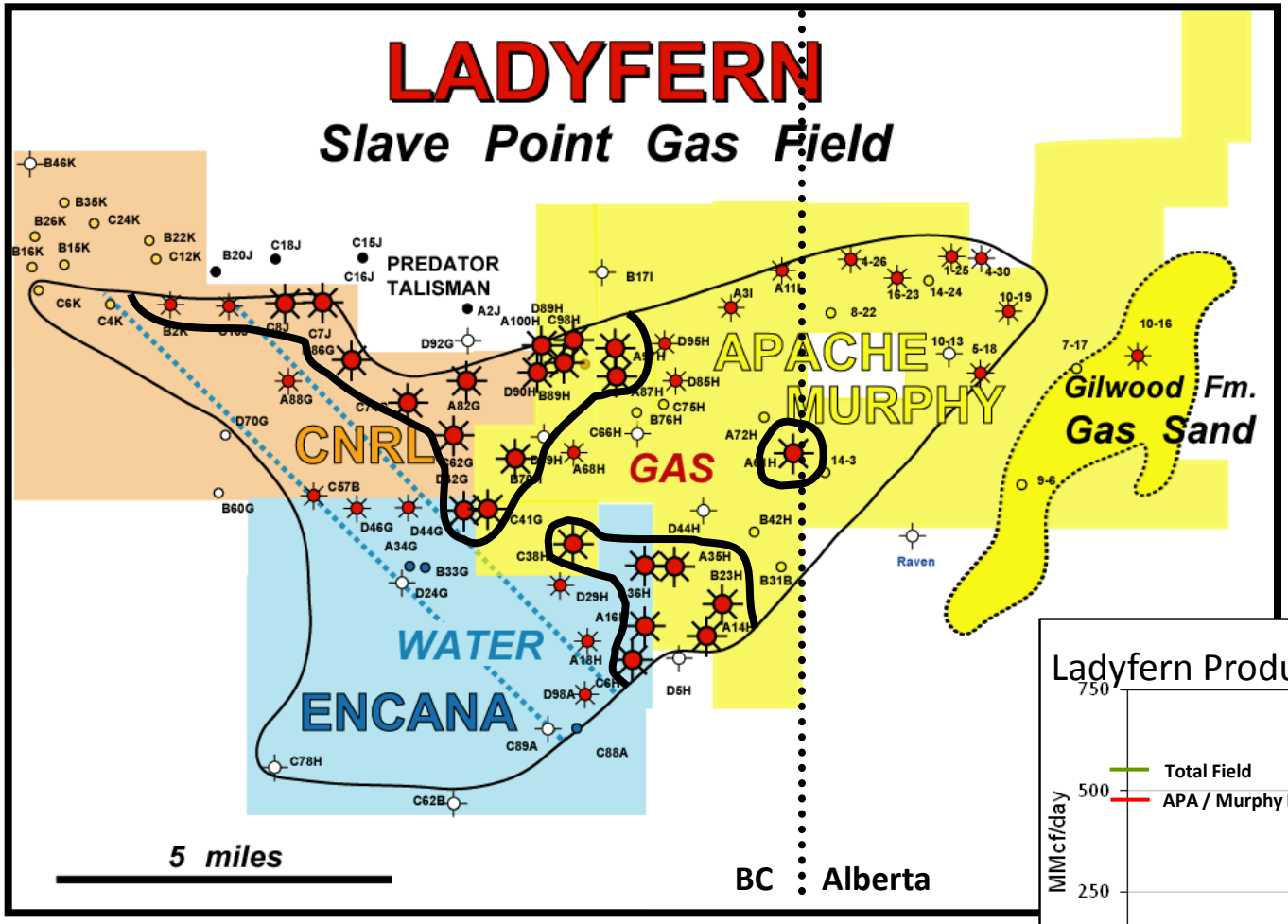


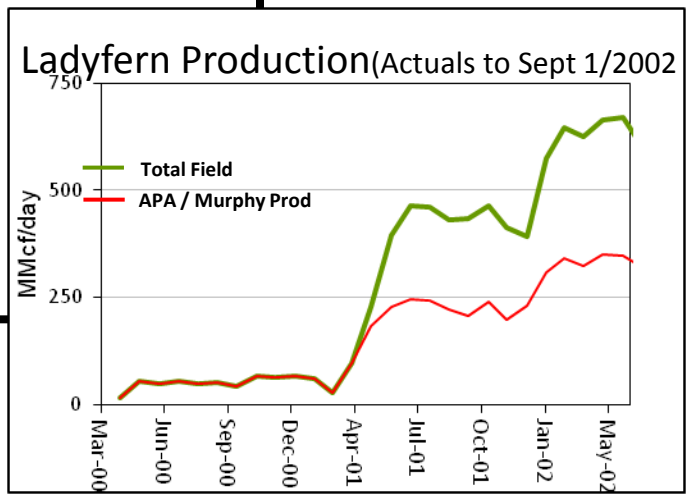
APRIL 1999 – WOULD YOU FARM IN ON THIS PROSPECT?



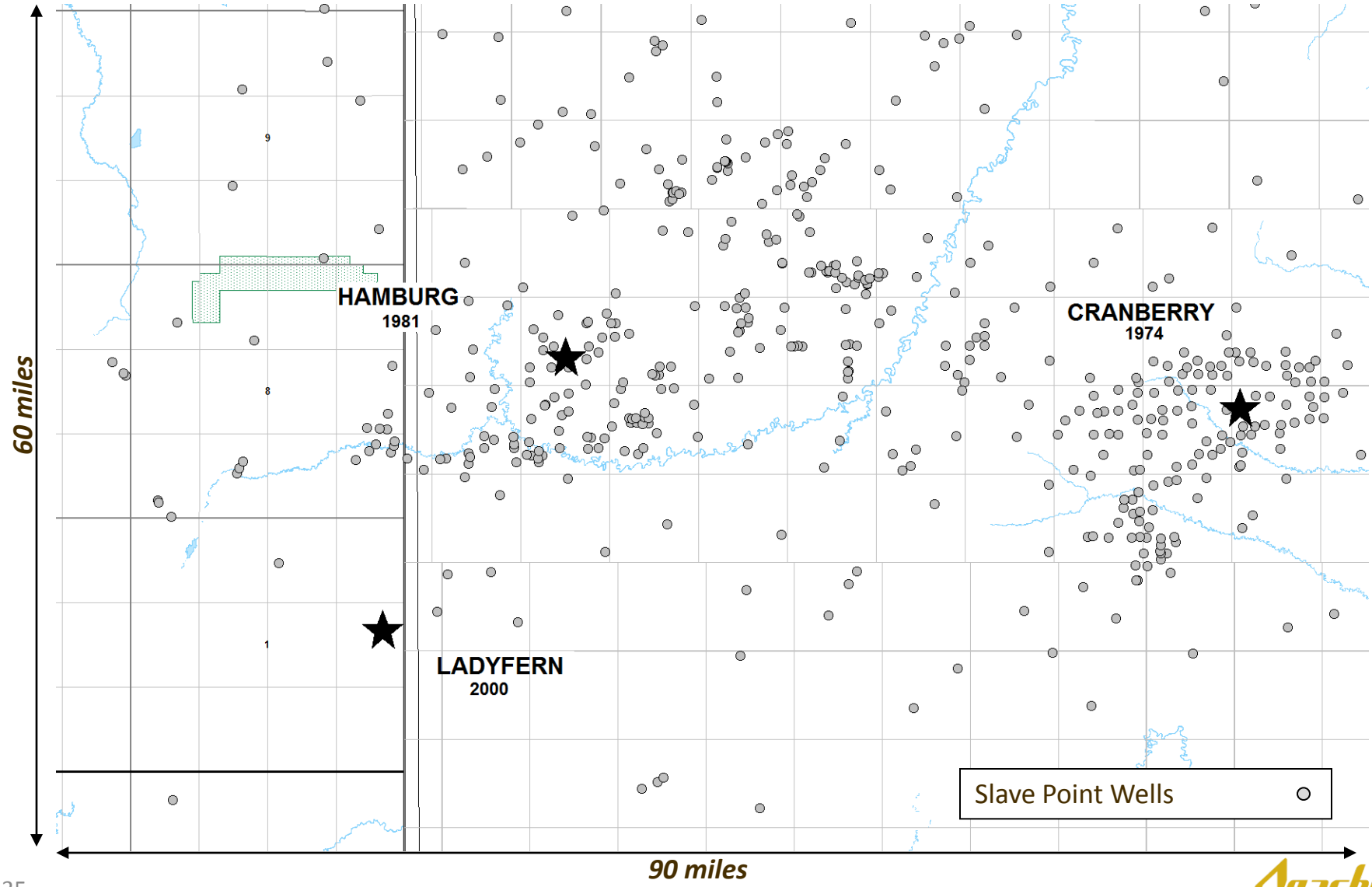
sonic

LADYFERN: 0 →500 MMSCF/D IN 18 MONTHS

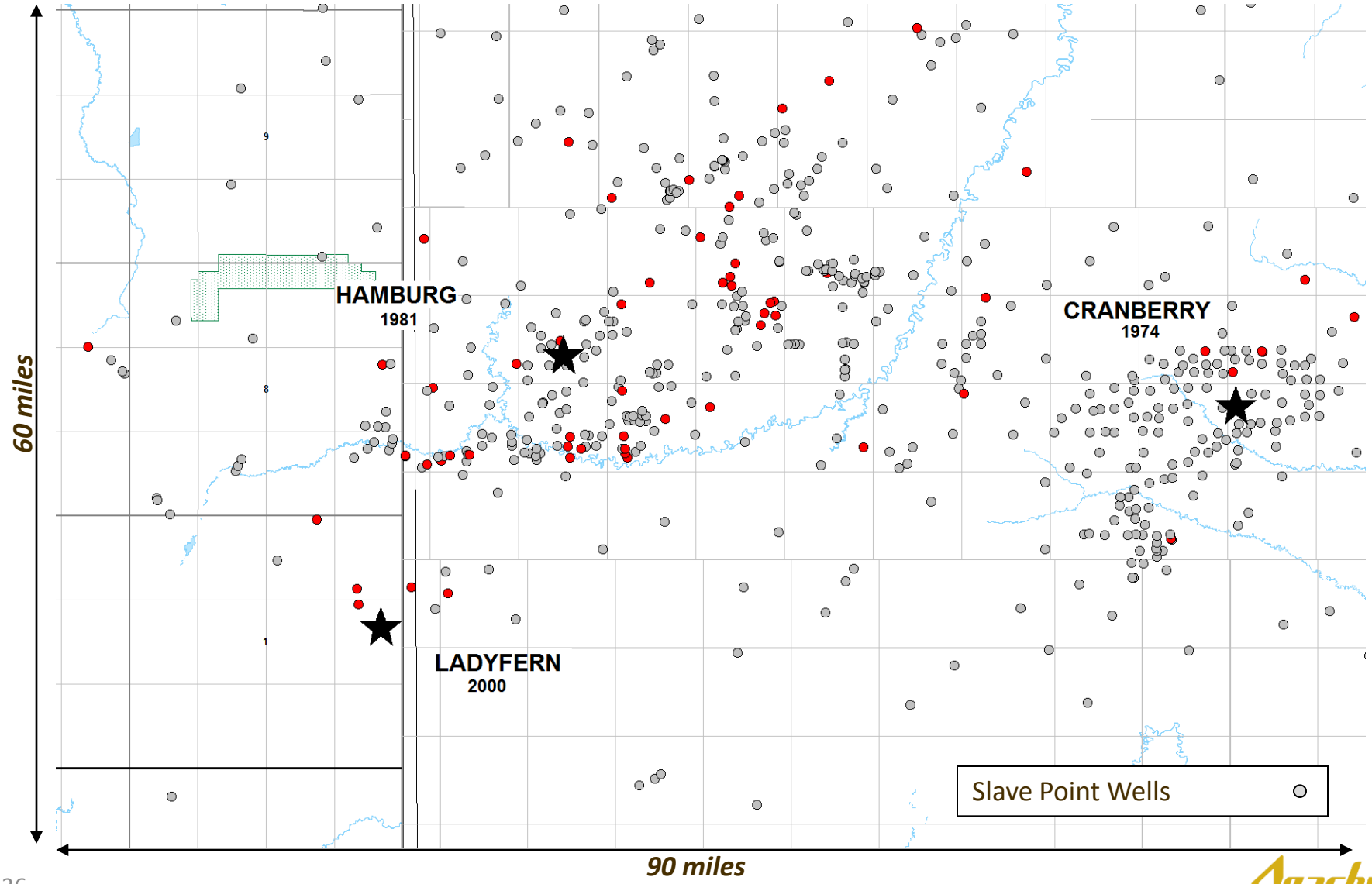




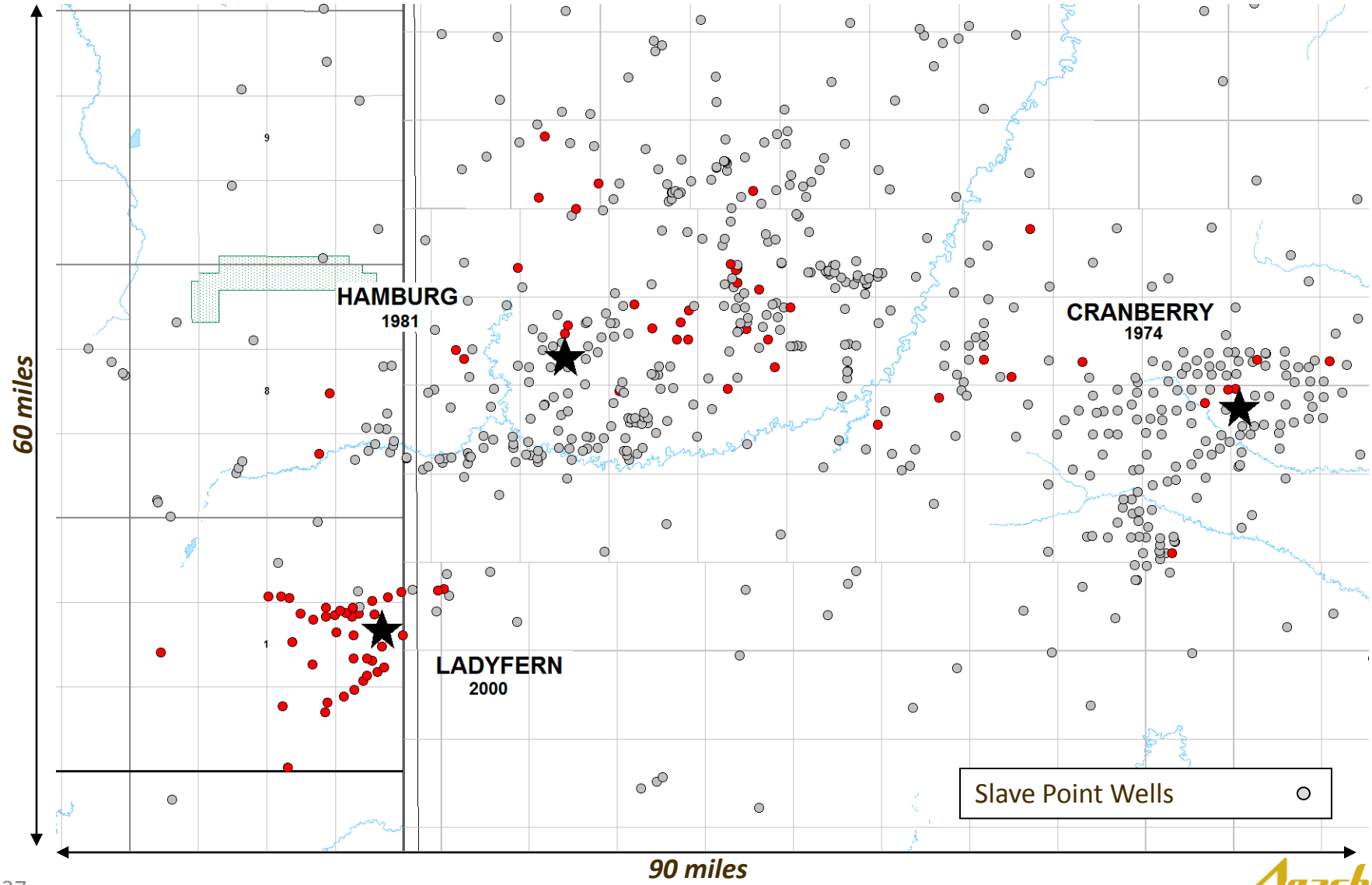
LADYFERN AREA: SLAVE POINT ACTIVITY – PRE-2000



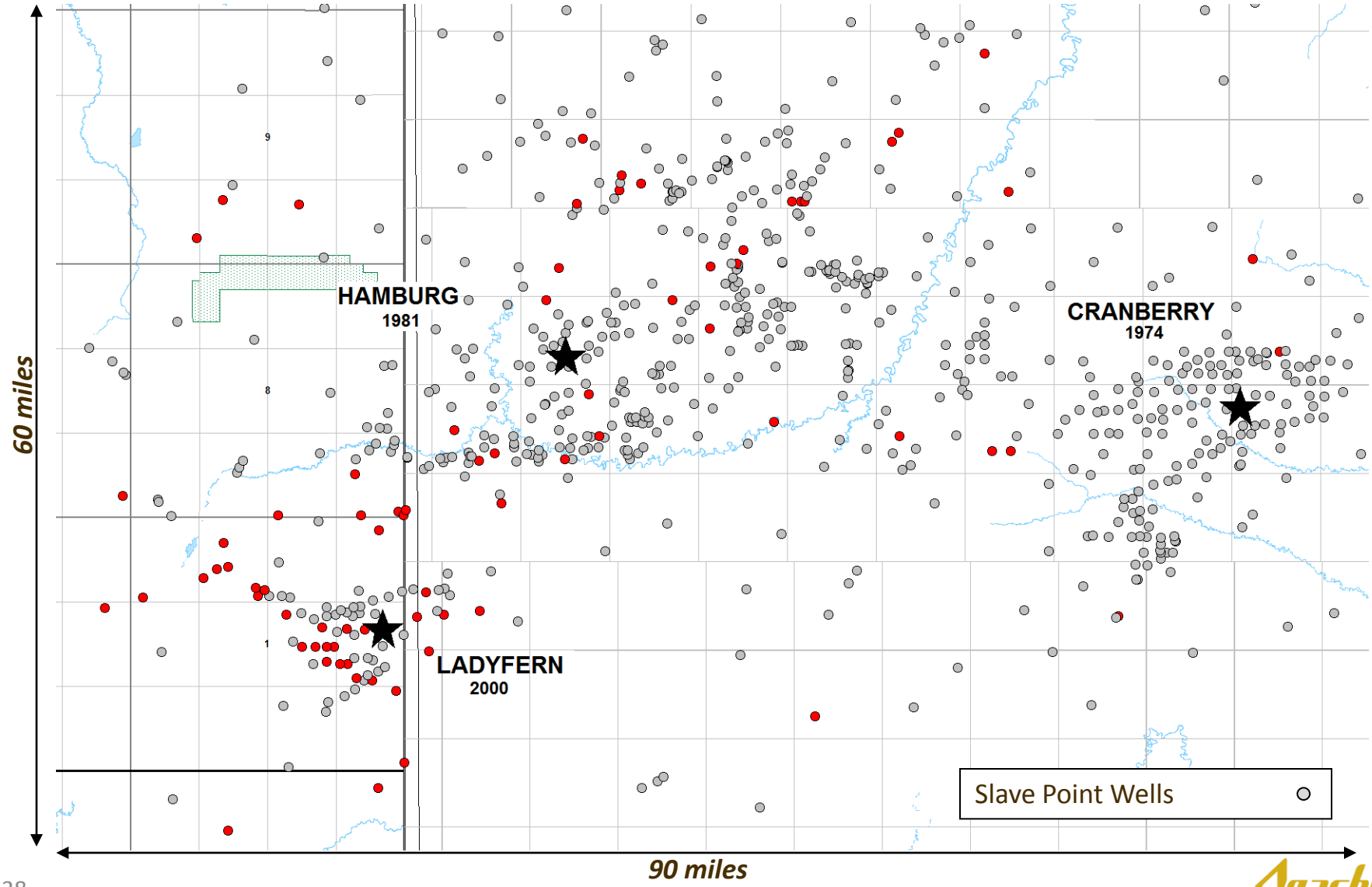
LADYFERN AREA: SLAVE POINT ACTIVITY – 2000



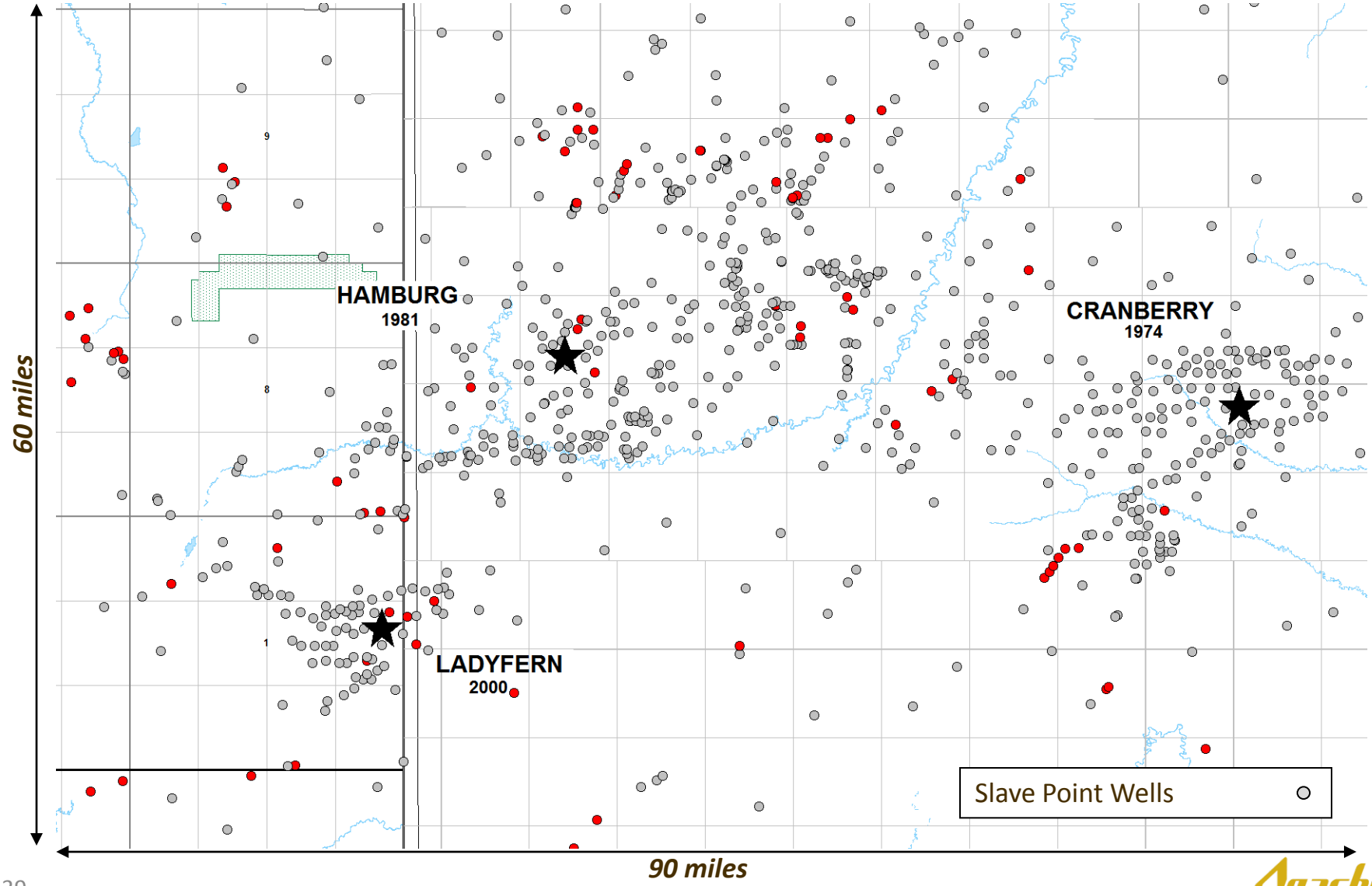
LADYFERN AREA: SLAVE POINT ACTIVITY – 2001



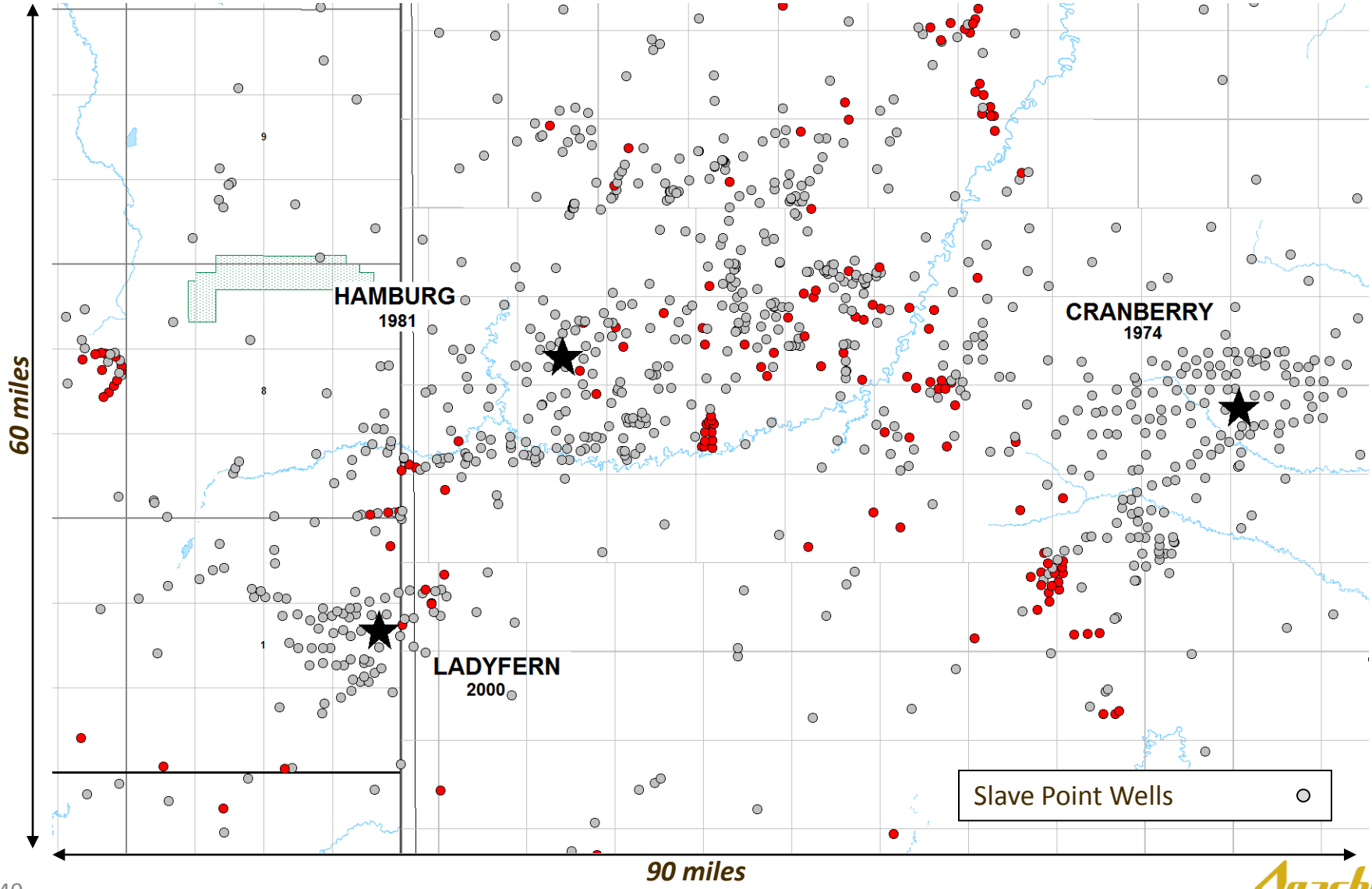
LADYFERN AREA: SLAVE POINT ACTIVITY – 2002



LADYFERN AREA: SLAVE POINT ACTIVITY – 2003



LADYFERN AREA: SLAVE POINT ACTIVITY – 2004-2012



LADYFERN LEARNINGS

- Good people with chemistry
- Focus on key success factors (seismically mapping reservoir and trap)!
- Acquire 3D data to resolve what will determine success
- Cheap entry (first in) → even cheaper after farm out!
- There are many setbacks out of your control – resiliency is key to success
- Big fields can/and will be found!
- It is never easy!

UNCONVENTIONAL SHALES IN CANADA (2005)

- Early days
- No significant producing area yet
- Major players, Apache, EOG, Trident, MGV possibly Shell, Talisman
- Many isolated shale producers (both gas and oil)
- Recent increase in activity
- Resource is there – rate / reserves are the issue!

. . . My take on shales in 2005 . . .

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THE HORN RIVER HISTORY

- Began exploration program for conventional gas opportunity in 2000

The Good

- Drilled three successful wells (depth ≈8500')

The Bad

- Three rigs working the next winter logs looked good; however tested poorly

The Ugly

- Continued to drill 15 wells with exceptionally poor results. (5 mmcf/d total) **many dry wells**

. . . "the dark days" . . .

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MAKING SOMETHING OUT OF NOTHING!

- Scoured the uphole for possibilities
- Tested a conventional reservoir – failed
- Looked at shale – analog to Barnett?
- Tested shale zone →100 mcf/d → encouraging (2004)
- Gradually have worked our way to 69 gross horizontal wells
  - Peak production (≈ 300 mmcf/d gross)
- 60 TCF + resource identified
- LNG project at Kitimat BC

. . . “better days ahead” . . .

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HORN RIVER: DIFFICULT TERRAIN AND REMOTE

PLANNING & EXECUTION CRITICAL TO SUCCESS

LIARD BASIN HISTORY

- Many competitors focused on Horn River and Montney plays
- Apache looked at other basins during this time
- Liard at top of list: thickness, richness, high OGIP close proximity to Horn
- Industry dogma was
  - Area is unexplored
  - Shale quality may be poor due to depth (11,500 – 15,000 ft)
  - Potentially high drilling costs

. . . Saw a window of opportunity to be first and bought land . . .

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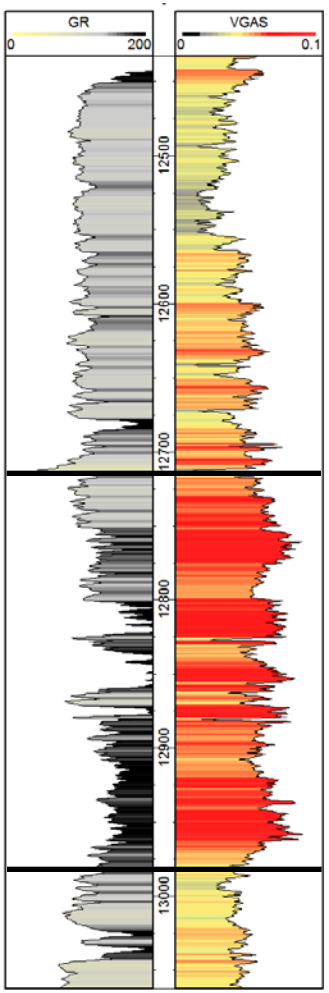
LIARD BASIN

BEST UNCONVENTIONAL GAS RESERVOIR IN NORTH AMERICA



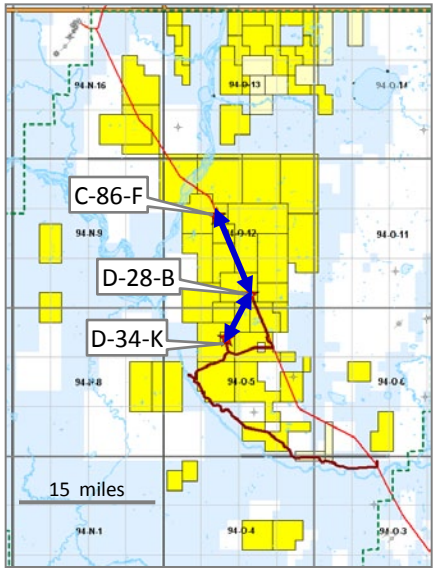
Reservoir	Units	Liard	NE-PA Marcellus	Haynesville
Depth	(ft)	9500 - 15000	7000 - 11000	10000 - 13000
Thickness	(ft)	400 - 1000	150 - 400	100 - 300
Porosity	(%)	3 - 8	6 - 12	4 - 7
Water Saturation	(%)	15 - 20	15 - 45	20 - 40
OGIP / Sec	(BCF)	170 - 500	30 - 200	50 - 100
Thermal Maturity	(VRo)	>1.5	>1.6	>1.7
Pressure	(Psi/ft)	0.85 - 0.92	0.5 - .65	~0.85
GOR		Dry Gas	Dry Gas	Dry Gas
Quartz+Carb	(Vol %)	>90	65 - 90	60 - 70
TOC	(Wt. %)	3 - 6	2 - 10	2 - 4

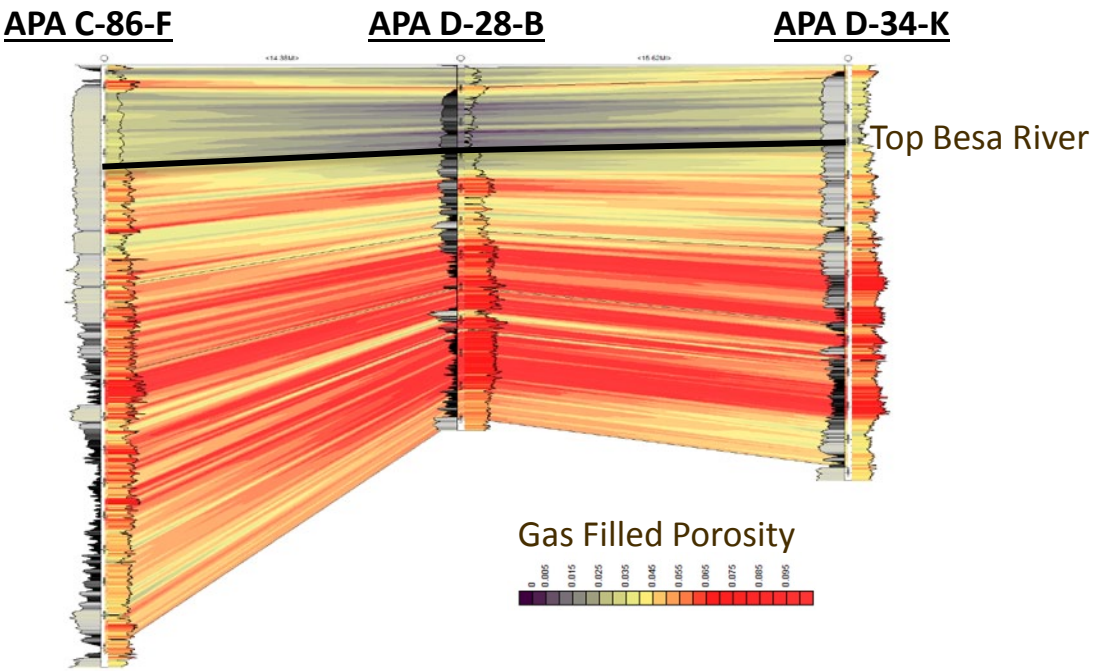
- Lower Besa River First Black Shale
- Best gas-shale reservoir evaluated in North America
- Excellent vertical and lateral reservoir continuity

Gas Filled Porosity

LIARD BASIN

CONTINUOUS GAS FILLED POROSITY





	APA C-86-F	APA D-28-B	APA D-34-K
Net pay thickness	1,024 feet	708 feet	425 feet
Porosity	6.4%	7.0%	7.6%
OGIP BCF/section	502	365	290
Well Type	Vertical	Vertical	Horizontal
Fracs	1	1	6
MMCF/D (30-day)	9.8	4.6	21.3
Total Vertical Depth	15,000 feet	13,200 feet	12,600 feet

BUILDING FOR THE FUTURE

LNG DEVELOPMENTS WITH A STRATEGIC PARTNER

Wheatstone LNG – NW Australia

- Construction underway
- 1st cargo projected ~YE20
- Monetizes ~11 TCF
- Initial capacity up to 1.25 BCF/D (APA 13%)

Kitimat LNG – NW Canada

- 1st mover for Canadian exports
- Initial capacity up to 1.5 BCF/D (APA 50%)
- Represents ~10% of Canada's current gas production

Apache LNG projects represent over 100,000 boe/d of additional oil-linked production - 12% of current global production

Presenter's notes: As I mentioned earlier, a key component to our strategy is balancing the short and long term and participating in large scale, long-term projects.

We are particularly excited about our promising LNG projects which we have established through two separate partnerships with Chevron, a key player in global LNG.

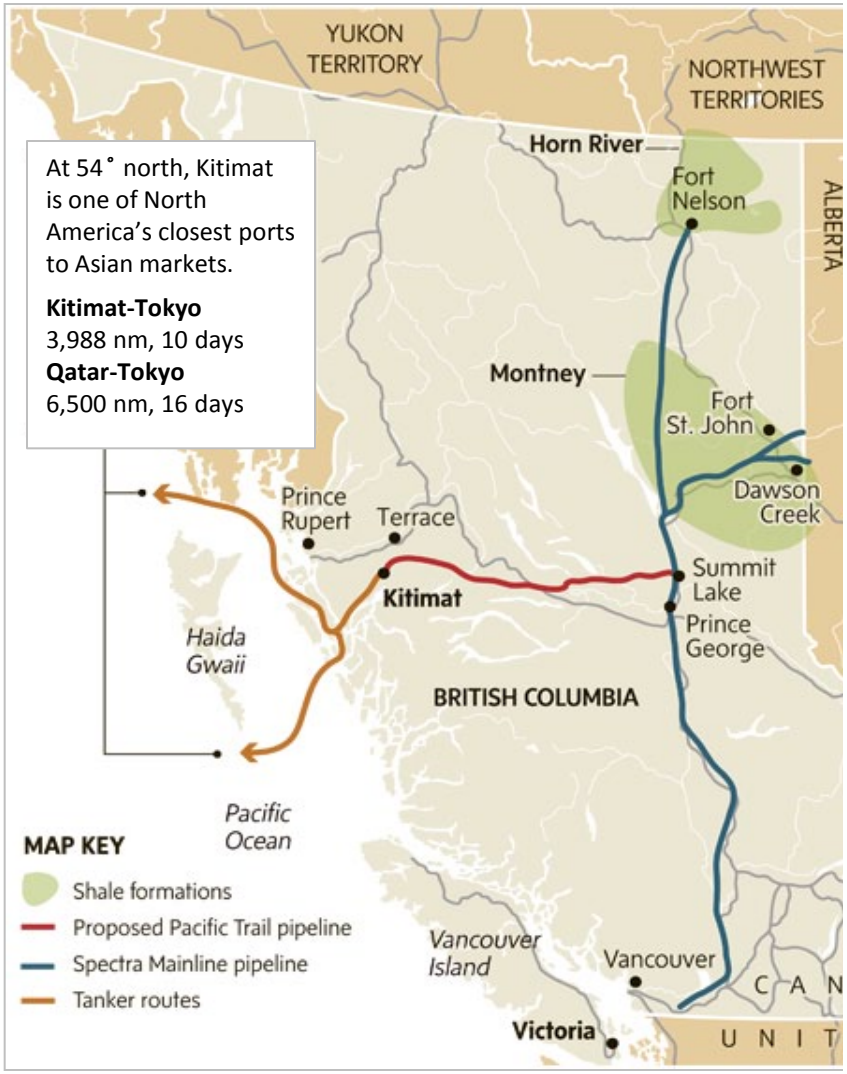
Our Wheatstone project in NW Australia is expected to come online by the end of 2016 and will monetize approximately 11 TCF gross of gas.

The Kitimat project in NW Canada will help Apache and Chevron monetize our significant shale gas resources in the Liard and Horn River basins which combined have nearly 50 TCF of gas.

Both projects are well positioned to deliver LNG to the growing Asian markets.

The potential size of each of these projects represents over 100,000 BOE/D of additional production for Apache – and at oil linked prices!

KITIMAT LNG



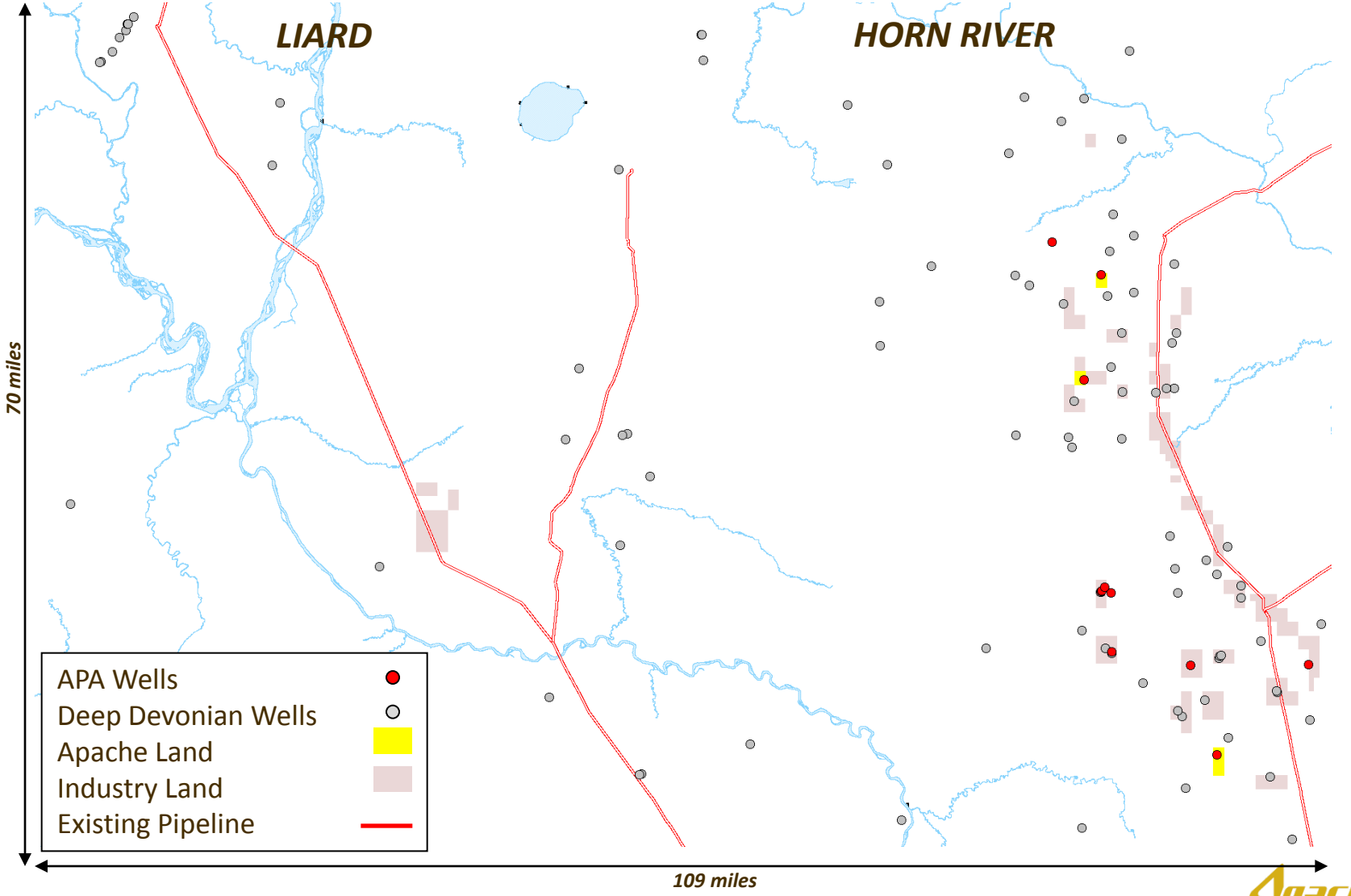
At 54˚ north, Kitimat is one of North America's closest ports to Asian markets.

Kitimat-Tokyo
3,988 nm, 10 days
Qatar-Tokyo
6,500 nm, 16 days

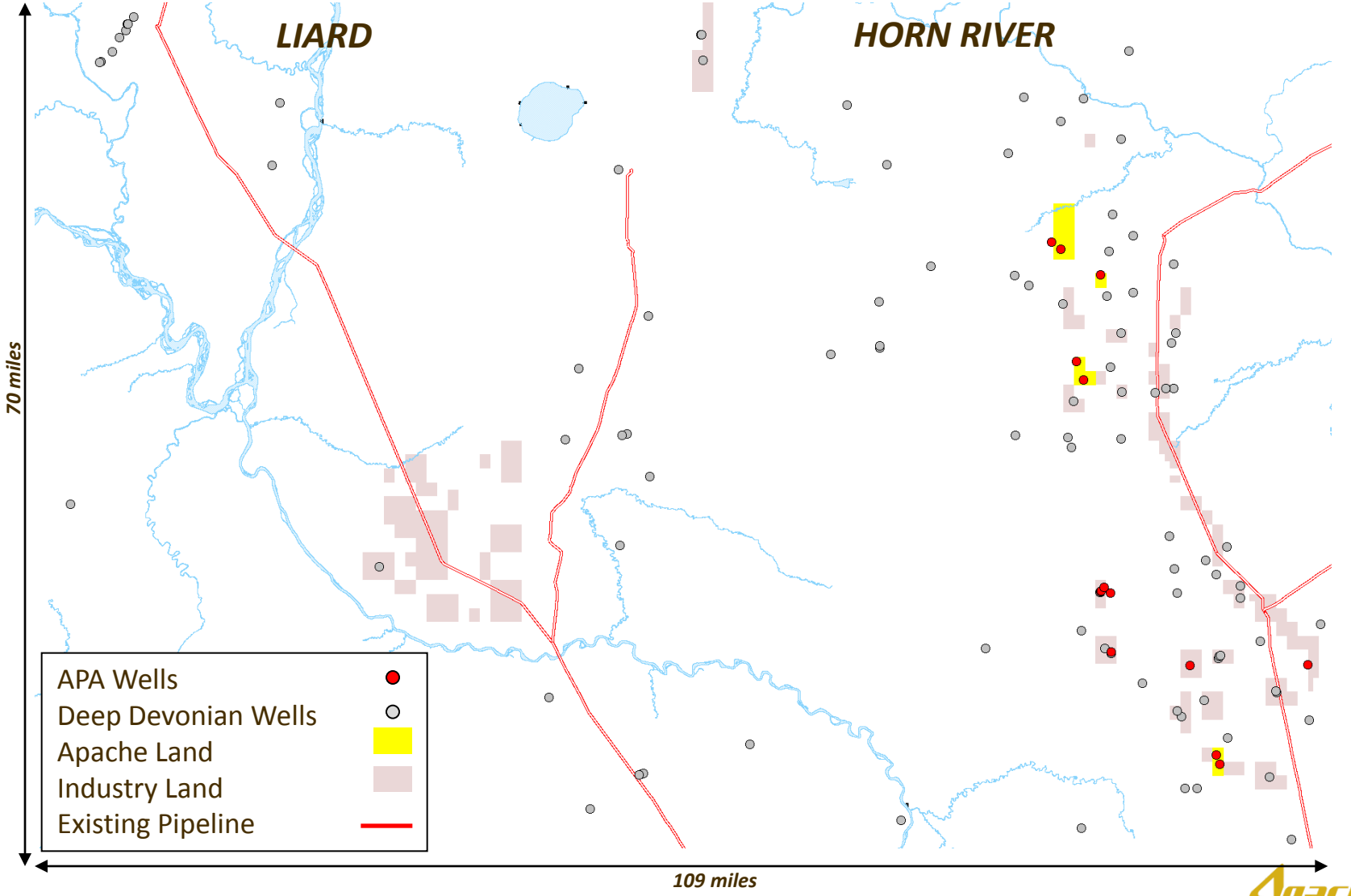
- Upstream operated by Apache
  - Prolific Western Canadian basins
  - Low-cost Liard/Horn River Basin gas
- Third Party Transportation – Joint
  - Infield or 3rd party gas processing
- Downstream operated by Chevron
  - KM LNG Trains 1&2 planned for 10+ MTPA gross
  - Pacific Trails Pipeline to Kitimat (480 km)
  - Pre-investing for future expansion

Apache WI	50%
Partners	CVX (50%)
First Delivery	Pending FID
Initial Gross Capacity	Up to 1.5 BCF/Day

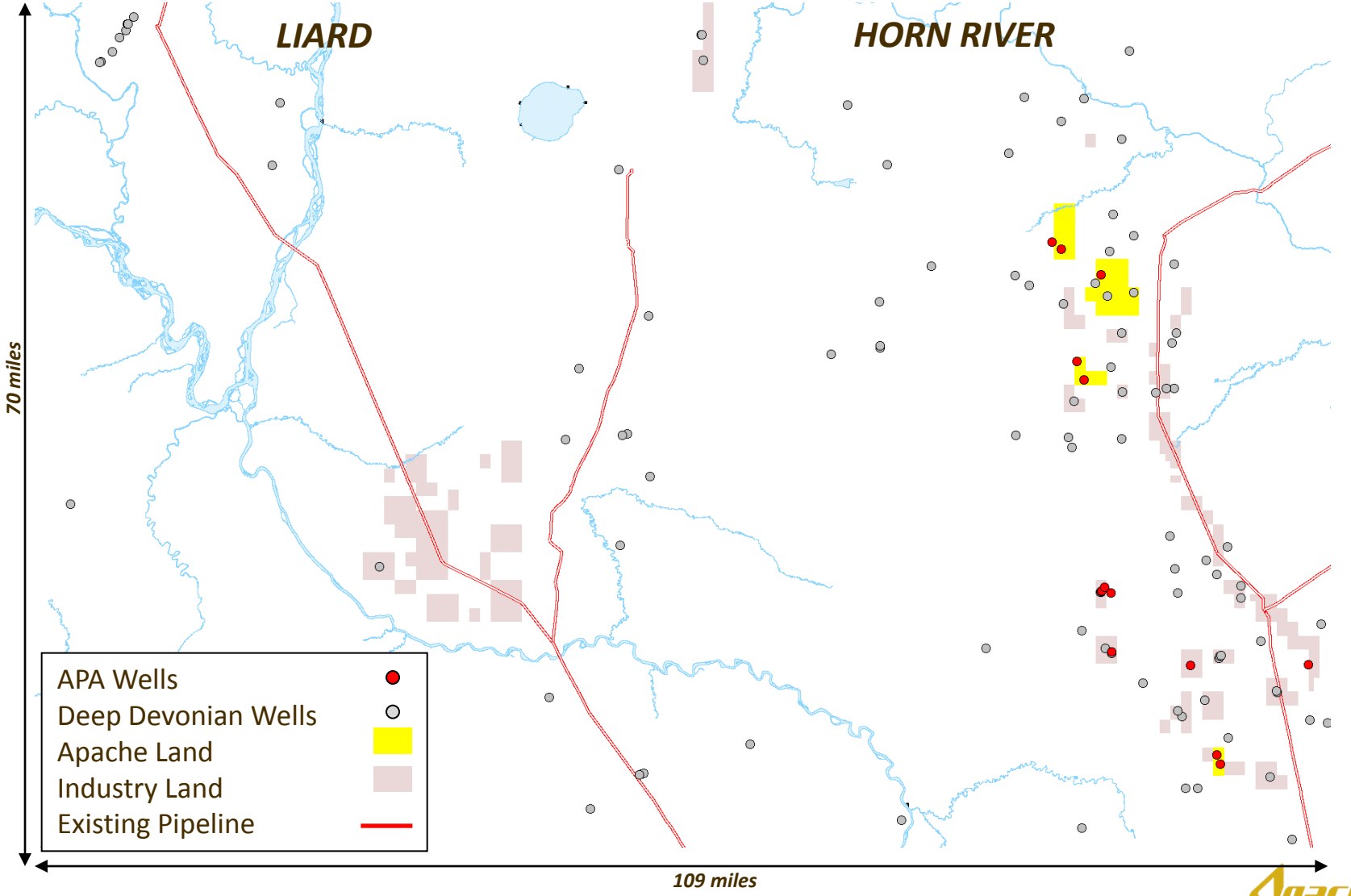
LIARD/HORN RIVER: ACTIVITY PRE-2001



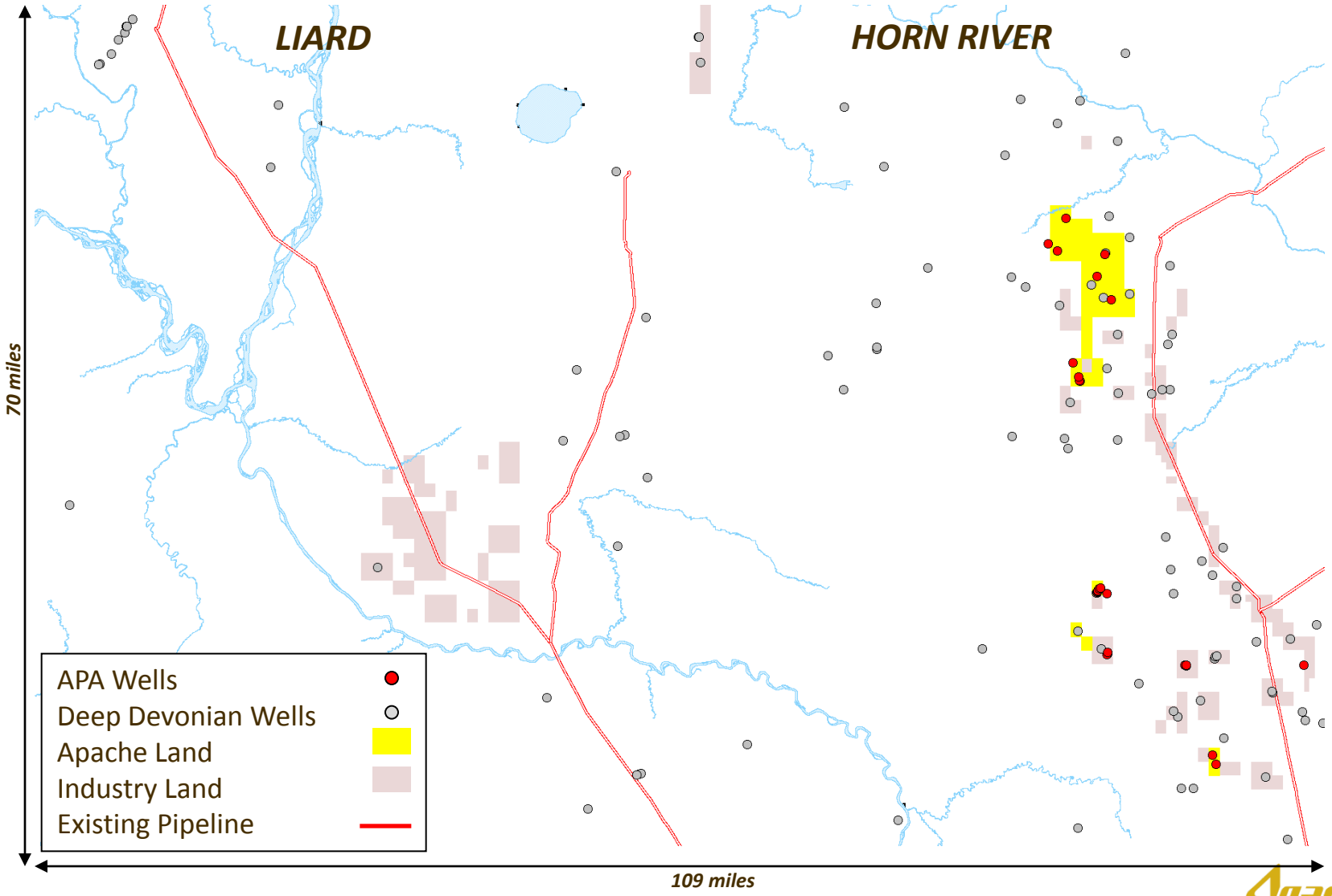
LIARD/HORN RIVER: ACTIVITY 2001



LIARD/HORN RIVER: ACTIVITY 2002



LIARD/HORN RIVER: ACTIVITY 2003



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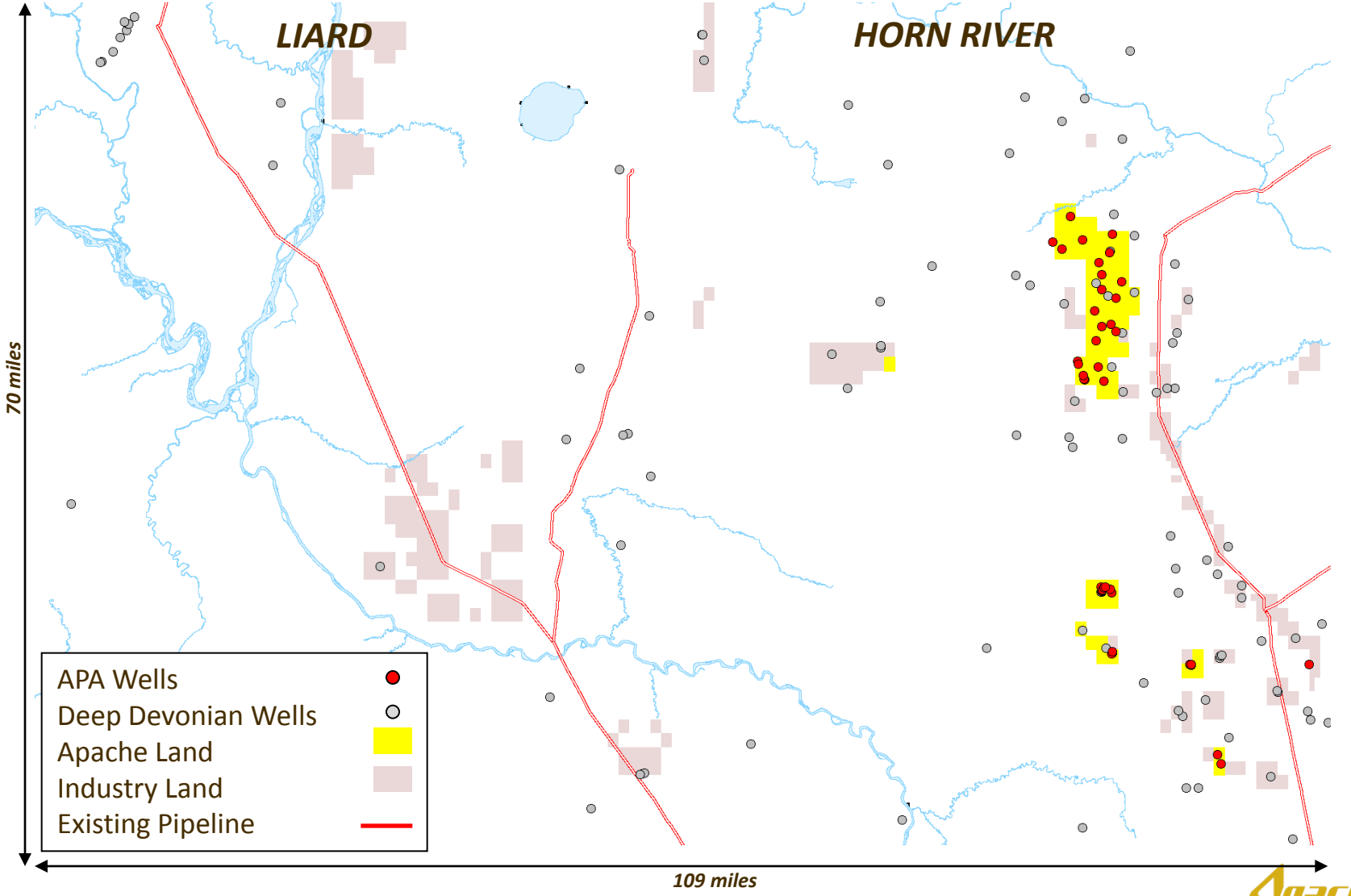

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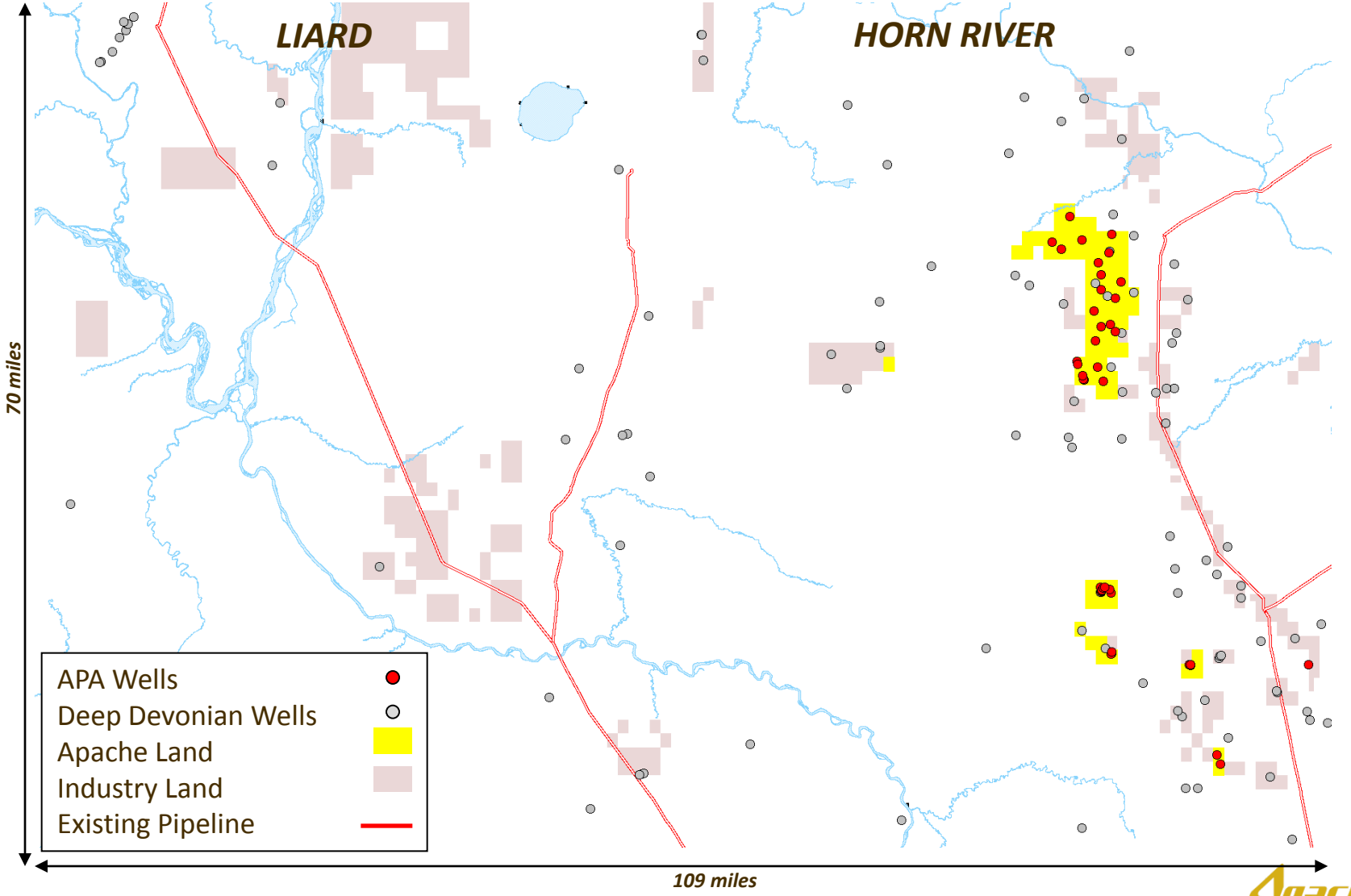

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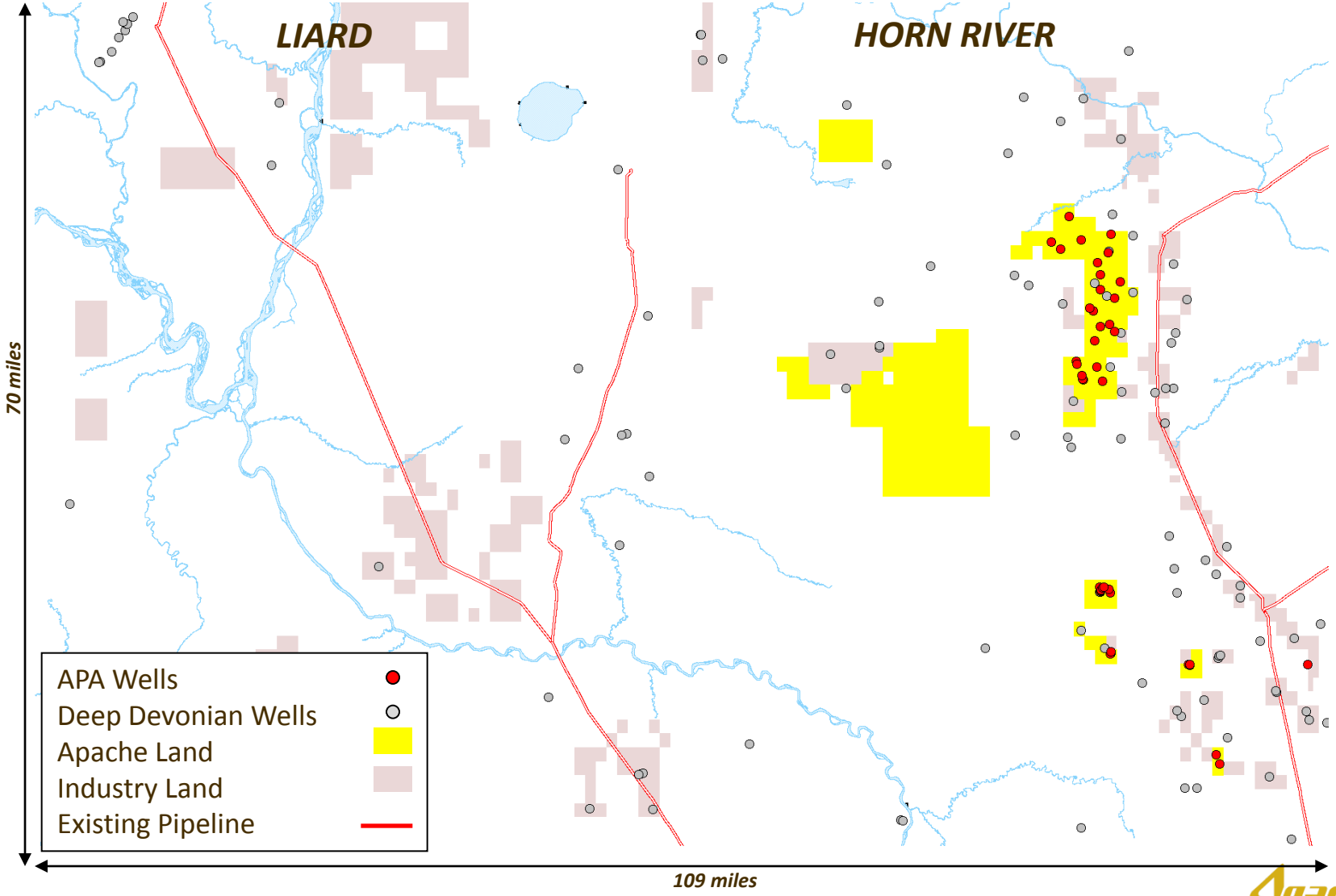

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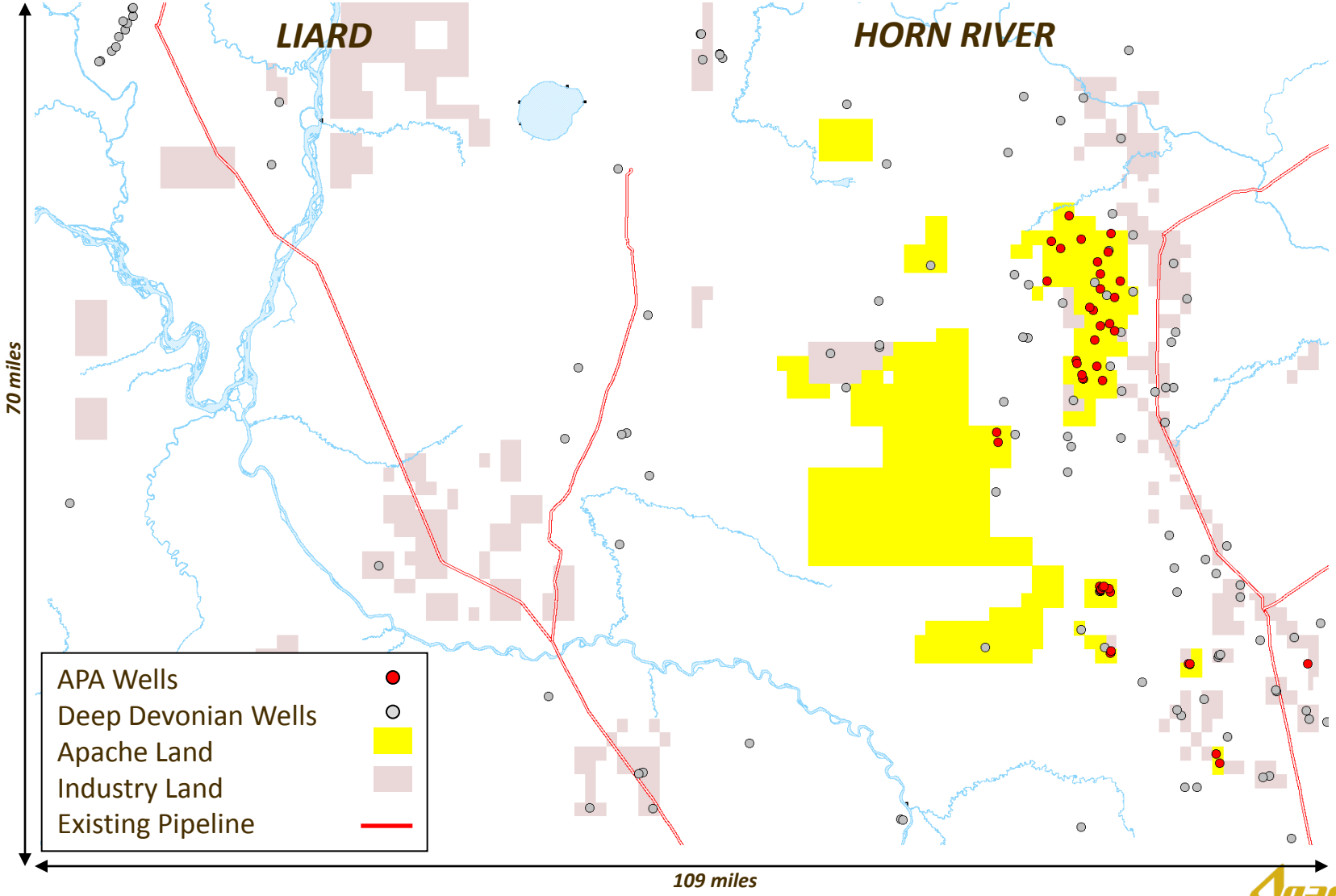

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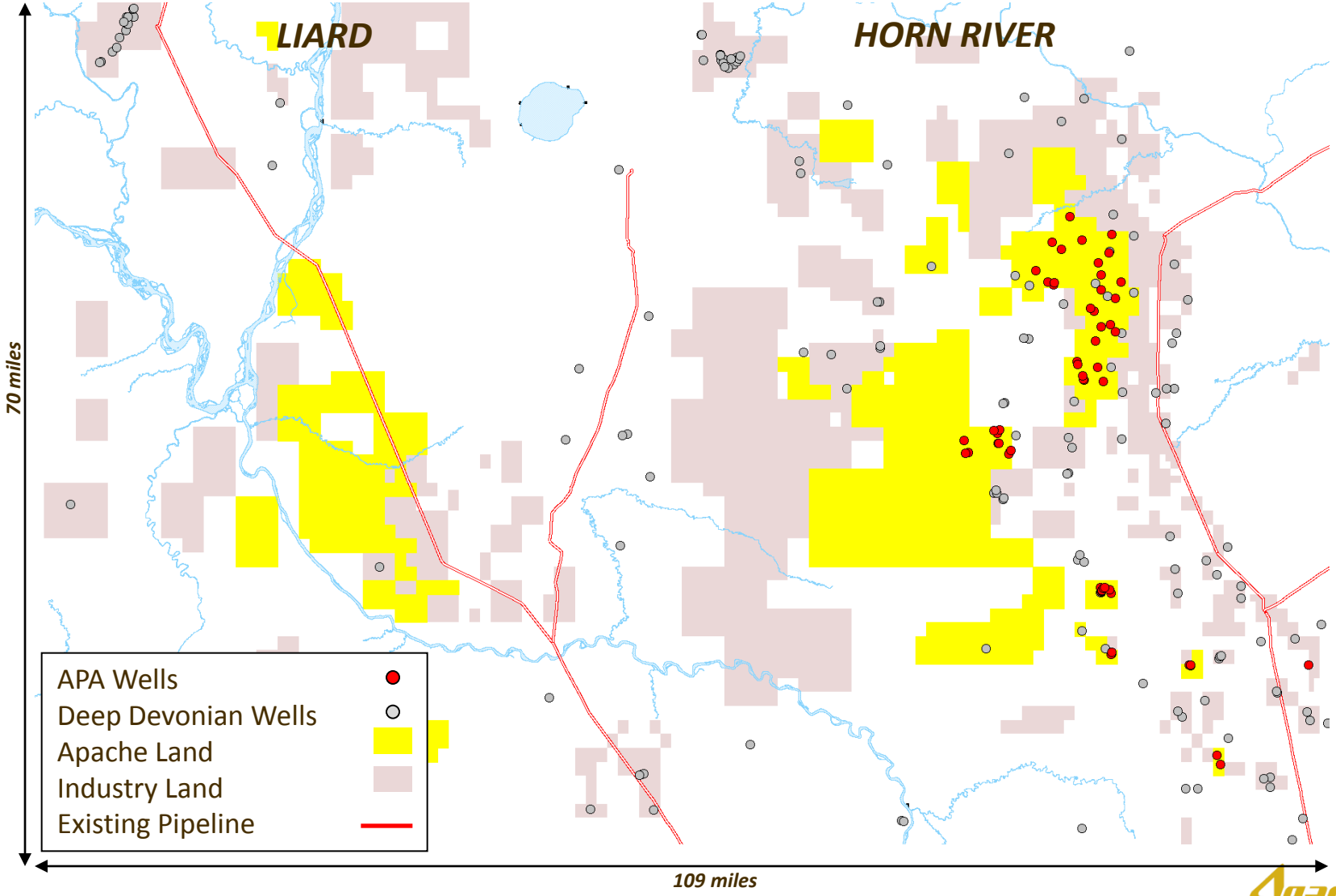

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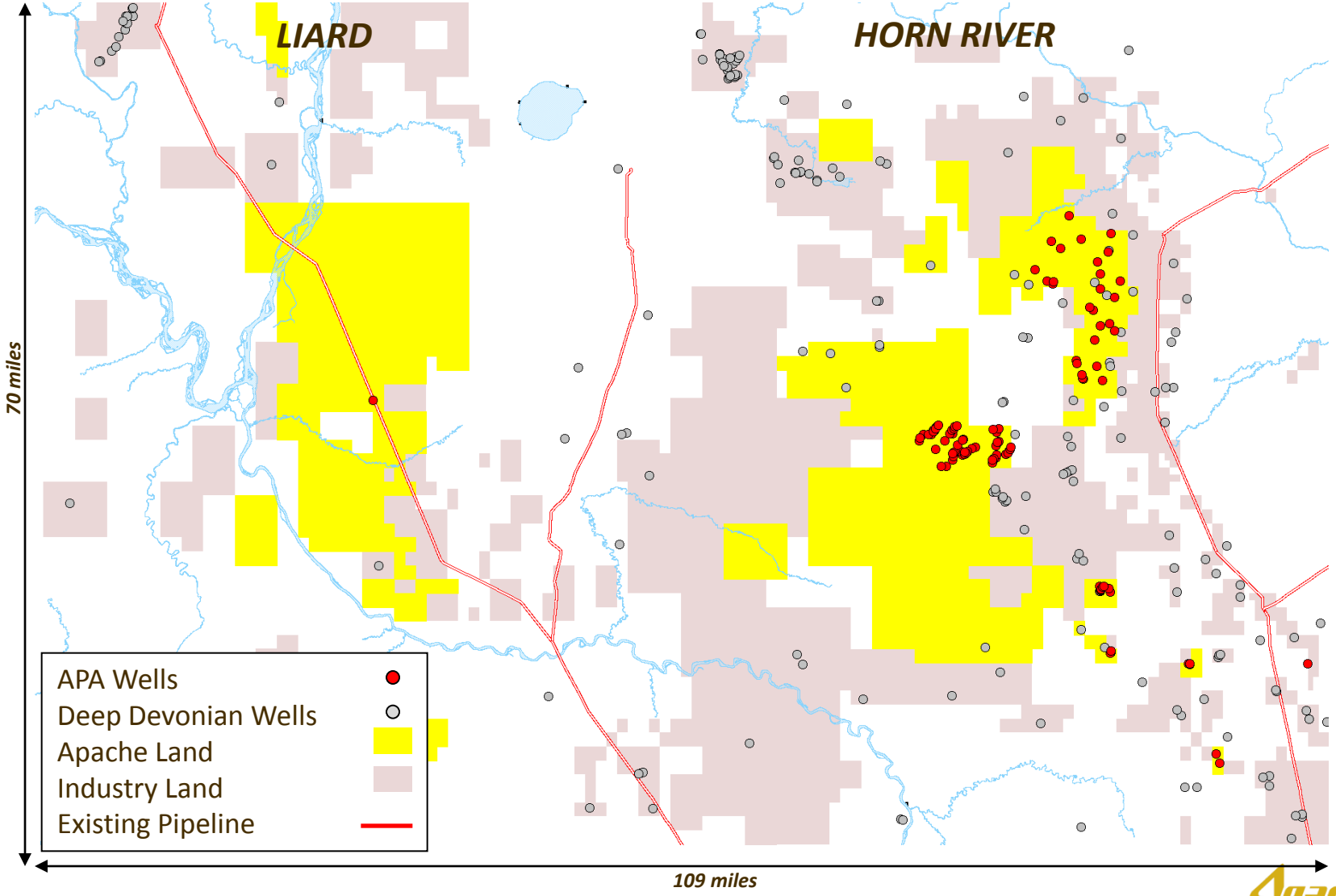

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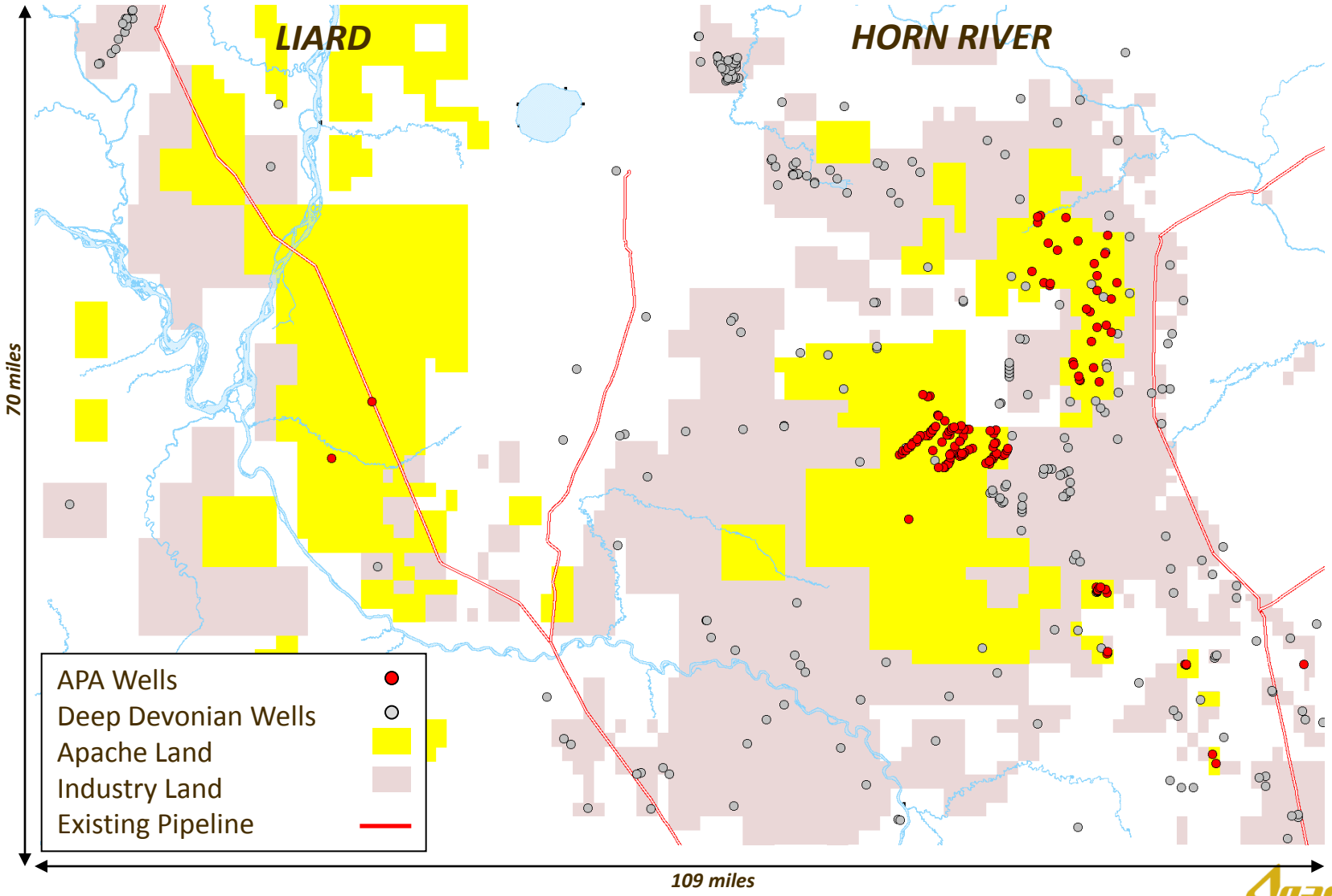
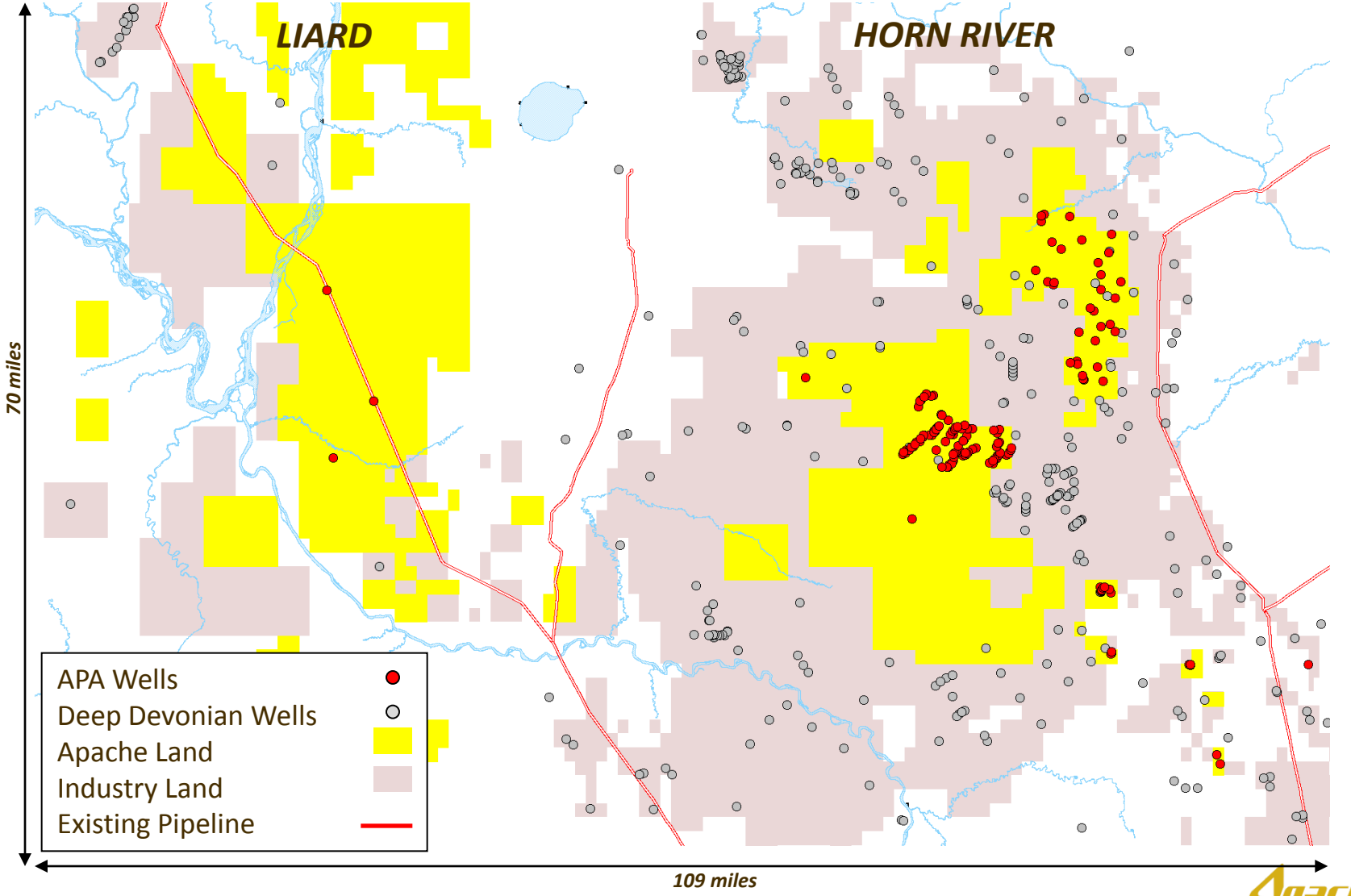


LIARD/HORN RIVER: ACTIVITY 2011



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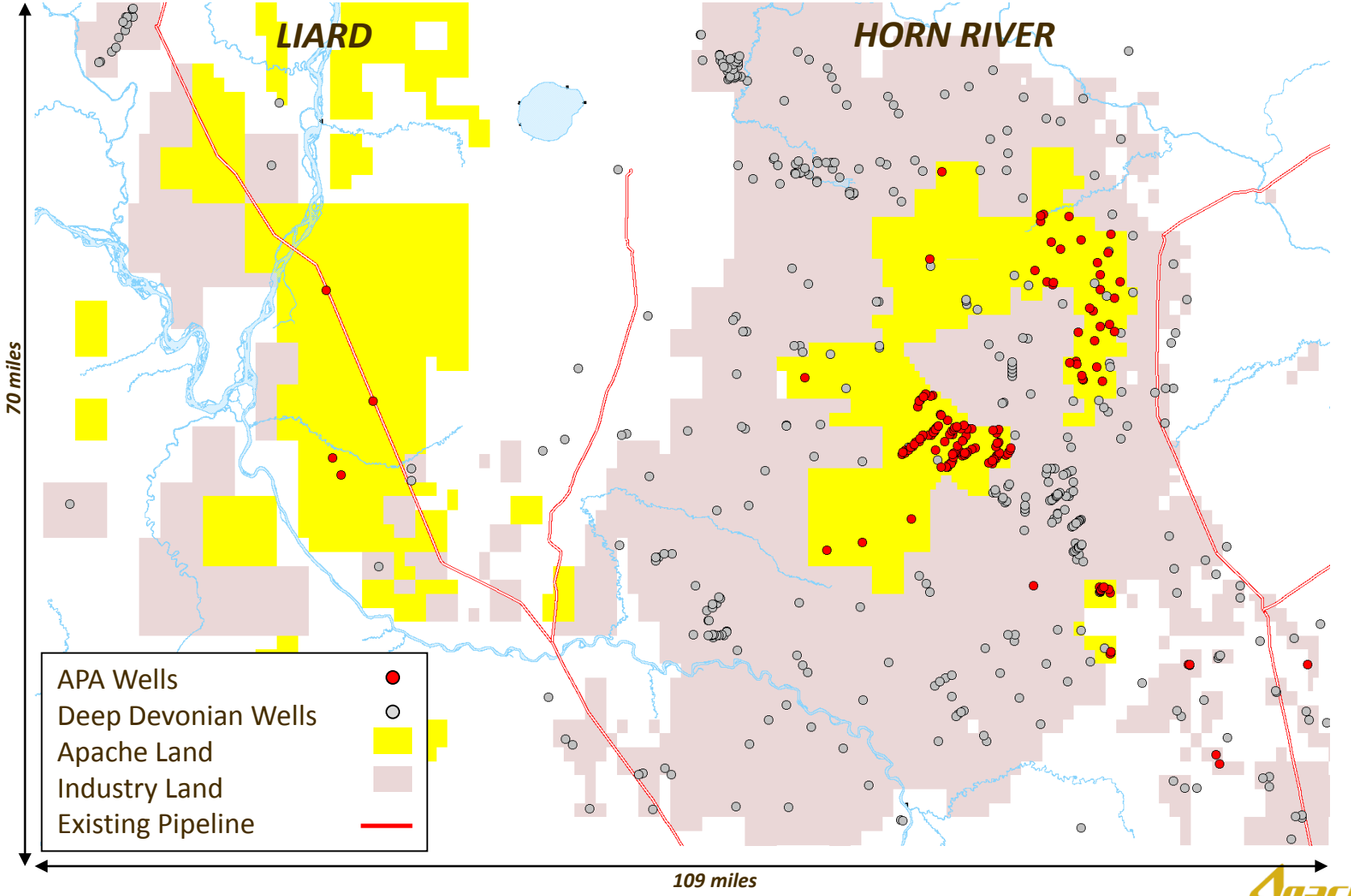


WORKING WITH STAKEHOLDERS AND FIRST NATIONS

- Significant oil and gas discoveries generally lead to development
- Development impacts people and environment
- It is vital to work with people early in the potential development
- At Horn River this was addressed by the formation of the Horn River Producers group in 2007

BASIC PREMISE

… The long term success of major oil & gas projects is best assured by:

1) The early definition of success

2) Listening and addressing concerns of stakeholders and First Nations

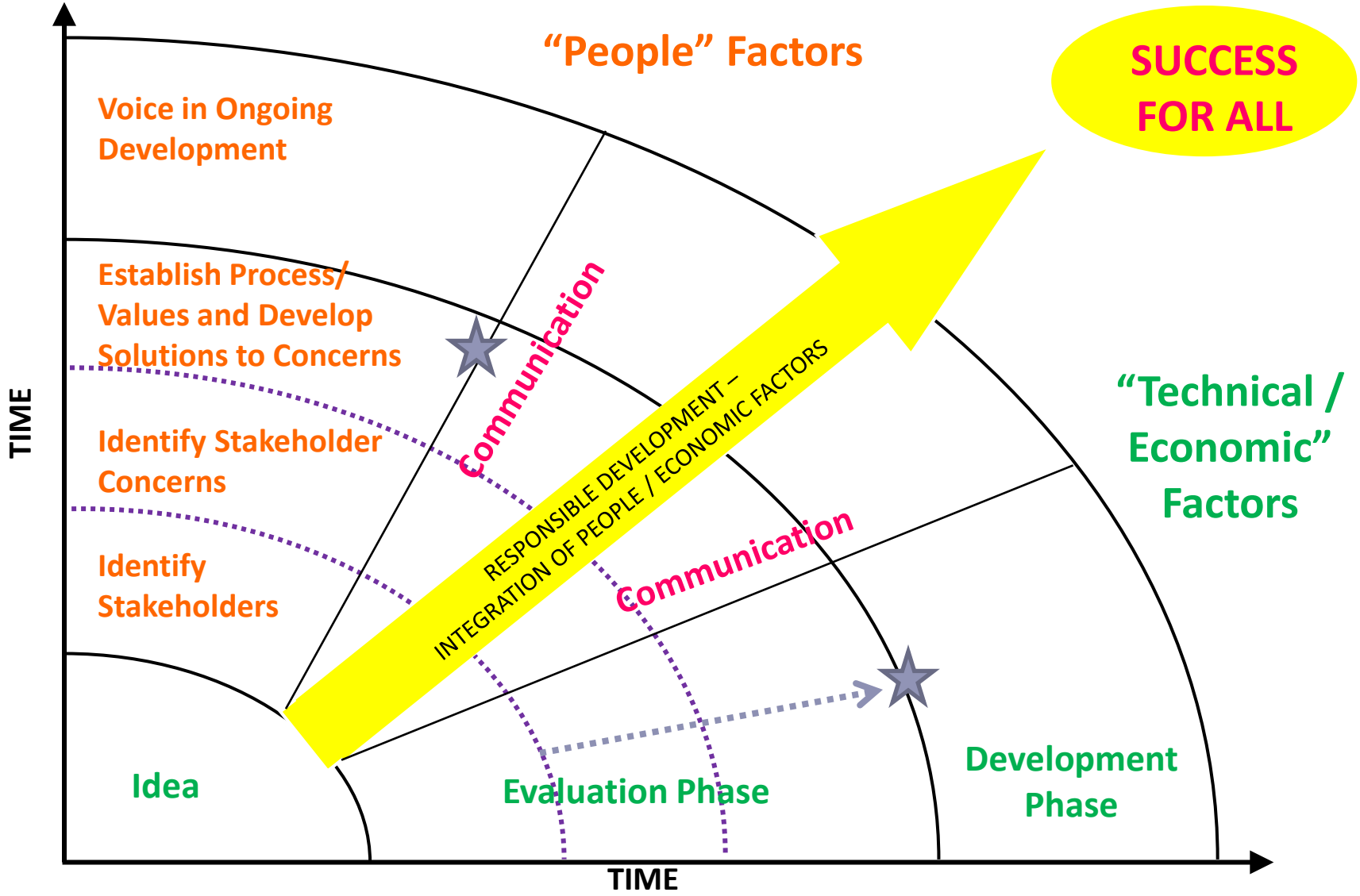
3) Communicating and developing relationships

4) Working with dedicated people

WHAT DOES SUCCESS LOOK LIKE?

Success of this project means that the main concerns from each major stakeholder group – the community of Fort Nelson, the government representing the people of British Columbia, the First Nations and industry – are understood and addressed while responsibly developing the asset . . .

THE MODEL: ROAD TO SUCCESS



ADDRESSING CONCERNS: LOCAL EMPLOYMENT

- The communities' **clearly articulated concerns** led to:

1) Focus on the issue
2) Set of HRBPG principles on local employment
3) Numerous job fairs in Fort Nelson
4) Development of a local employment office (Energy Services B.C.)
5) Funding of an Operator Training Program in Fort Nelson
6) Company offices in Fort Nelson
7) Result

. . . A significantly improved local employment picture . . .

Apache

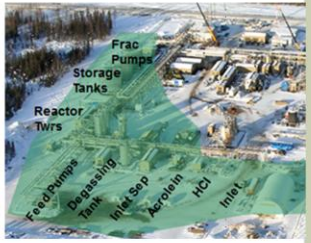
TECHNOLOGY, INNOVATION: ENVIRONMENTAL

Frac Water Plant

- Uses saline Debolt water
- Reduced fresh water by >95%
- Used >18 MMBBLS Debolt water to date
- OPEX ~$5/BBL less than fresh water

Fresh Water Source

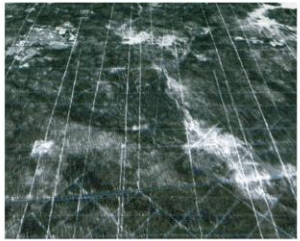
Debolt Water Plant



Slim Bin Seismic

- Random meander and narrow cut seismic lines
- Avoids long sight lines, minimizes new cut, accelerates re-growth

Zama 2D



Horn Slim-Bin

Apache

Presenter's notes: At Horn River, 2011 Completions (our latest) averaged 92% Debolt water with our last pad averaging 97.6% Debolt.

SUMMARY OF LEARNINGS/VALIDATION

- Early is better
- Resilience – significant failure can lead to more significant success
- Move quickly
- Understanding your competition – the herd mentality
- Social license is critical! Listening, seeking creative solutions and acting early are essential
- Solid exploration proposals combined with company commitment are optimal
- It all comes down to excellent people… always!

ACKNOWLEDGEMENTS/THANK YOU

- People who have worked with me through many of the failures and the success and are currently part of our team
  - **Ross Pitman** (Geologist) 16 years
  - **Kelvin Colquhoun** (Geophysicist) 18 years
  - **Joe Lamantia** (Land) 18 years
  - **Sharon Dixon** (G&G) 17 years
- Many others who have contributed over 32 years including the Apache EPT group for work on unconventional reservoirs!
- Shell Canada for their training and learning environment
- Apache for their unwavering commitment to exploration in Canada