

British Columbia - Well Spacing, Target Areas and Reservoir Projects



**Canadian Association of
Petroleum Landmen
(CAPL)
Calgary, Alberta**

May 28, 2015

Updated 2023

BC Energy Regulator
reservoir@bc-er.ca
www.bc-er.ca




Presentation Topics

1. Update on BC activity
2. Wells - confidential periods, surface positions & well types
3. Survey systems - DLS & NTS, road allowances
4. Spacing and target areas
5. Off-target production penalty
 - ❖ calculation formulas
 - ❖ directional survey
 - ❖ waiver options
6. Other-Than-Normal Spacing
7. Production Allowables
8. Reservoir Projects & Approvals
 - ❖ Good Engineering Practice (“downspacing”)
 - ❖ Other Reservoir Projects
 - ❖ Disposal, Source, and Storage Wells
9. Pooling & Unitization
10. Summary – life of a pool, data resources.

1.0 – Update on BC Activity

British Columbia – Oil & Gas Responsibilities

BC Energy Regulator (~ equivalent to AER)	 Ministry of Energy, Mines, and Low Carbon Innovation	Ministry of Finance
<ul style="list-style-type: none">• Wells• Production penalties• Pipelines• Production facilities• Reservoir projects• Waste disposal & environment• FN consultation• Landowner liaison• Public safety• Reserves inventory• Records	<ul style="list-style-type: none">• Subsurface titles• Royalty policy• Energy policy	<ul style="list-style-type: none">• Royalty administration• Production reporting

Statutes

Petroleum and Natural Gas Act

- ◆ Petroleum and Natural Gas General Regulation

Energy Resource Activities Act (ERAA)

- ◆ Drilling and Production Regulation
- ◆ Energy Resource Activities General Regulation

www.bc-er.ca > Legislation Links (Page Header)

Or

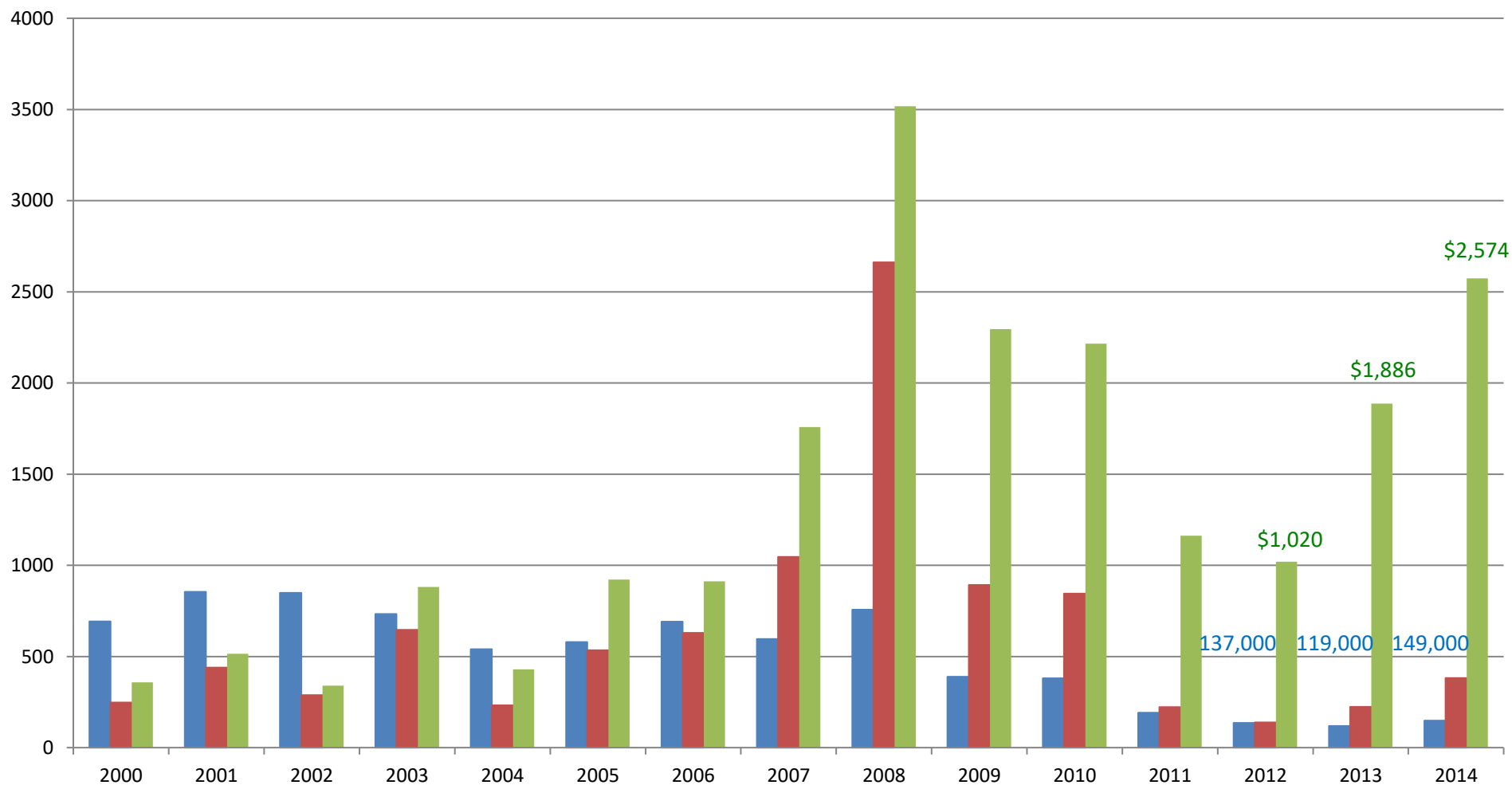
BC Statutes and Regulations www.bclaws.ca

BC Land Sales Activity

Large areas of oil and gas rights purchased that require development drilling.

BC Land Sales Activity

■ Hectares Disposed (kHa) ■ Total Tender Bonus (Mm\$) ■ Average Price (\$/ha)



LNG Activities

1. What is LNG?

Liquefied Natural Gas

2. Why do we care?

Alberta and BC gas will be produced, piped to the coast and cooled to -162° C. This shrinks the volume and makes it cost effective to ship to Asian markets where the price for gas is considerably higher than it is in North America

3. What's happened so far?

The Canada Energy Regulator has approved various applications to export LNG off of the BC Coast

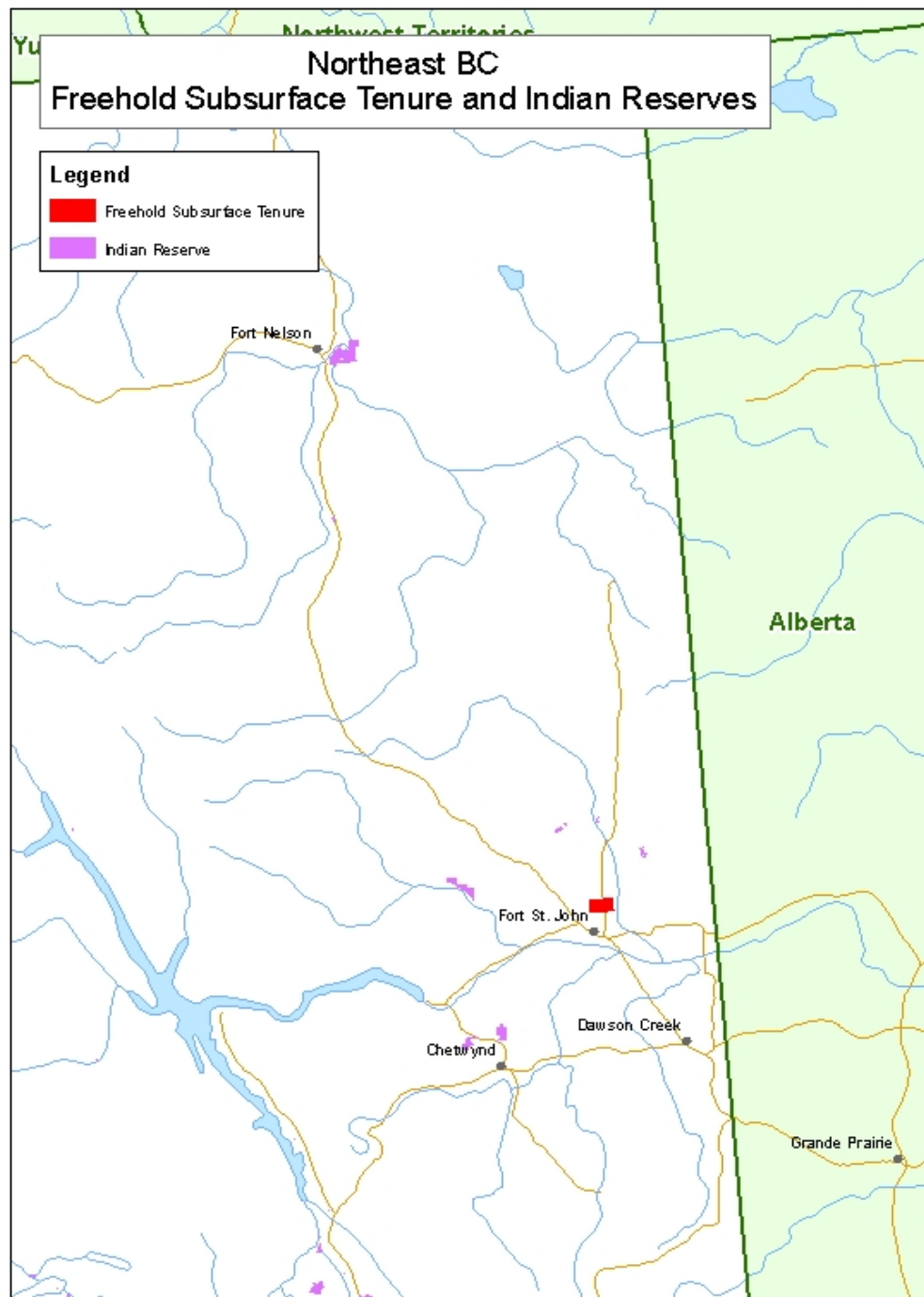
4. Implications?

Activity picks up 5 fold (at least). Land, roads, pipelines, facilities, plants, water source and disposal, drilling, completions...

LNG Video

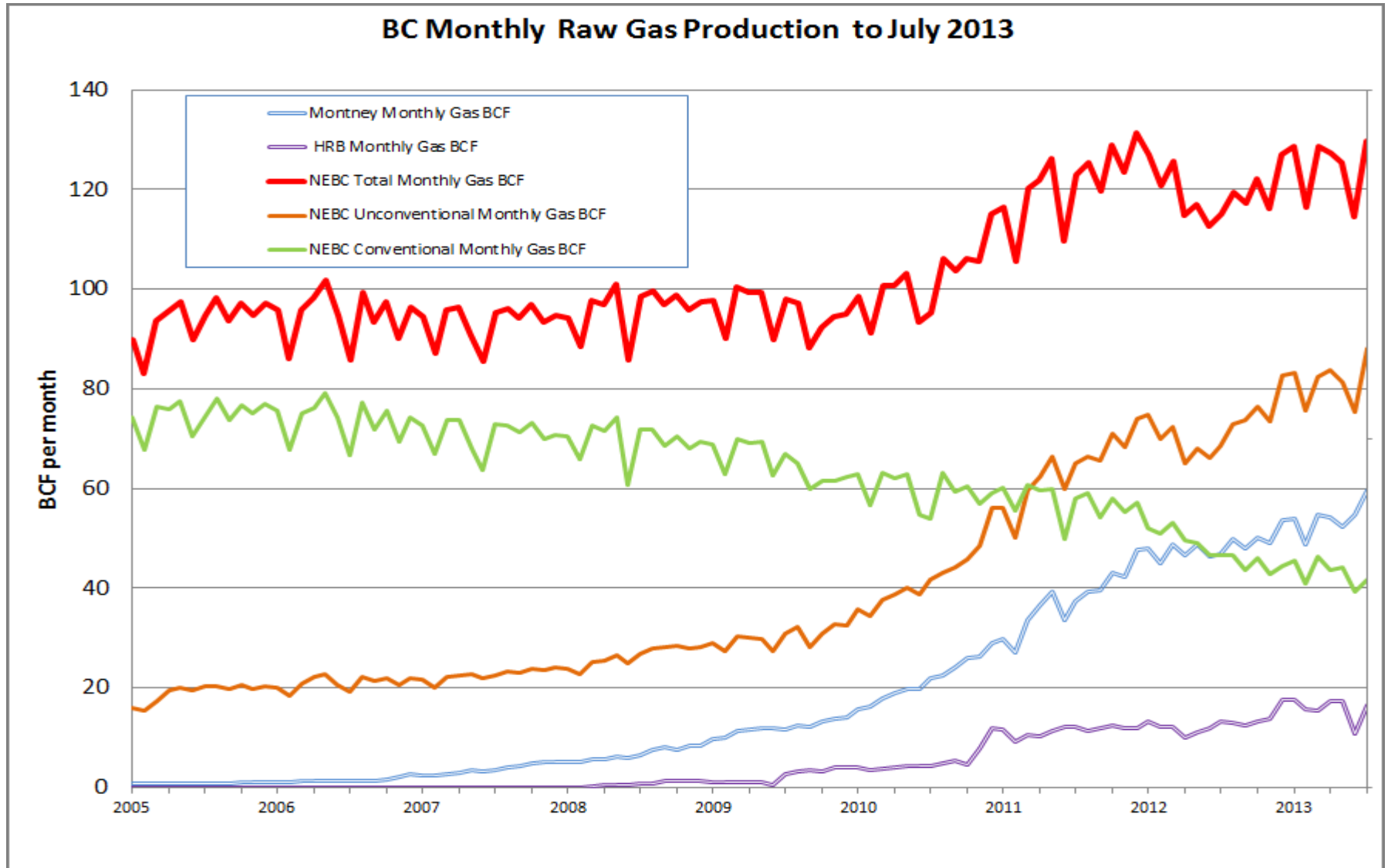


http://www.youtube.com/watch?feature=player_embedded&v=QgtSoEJD9HE



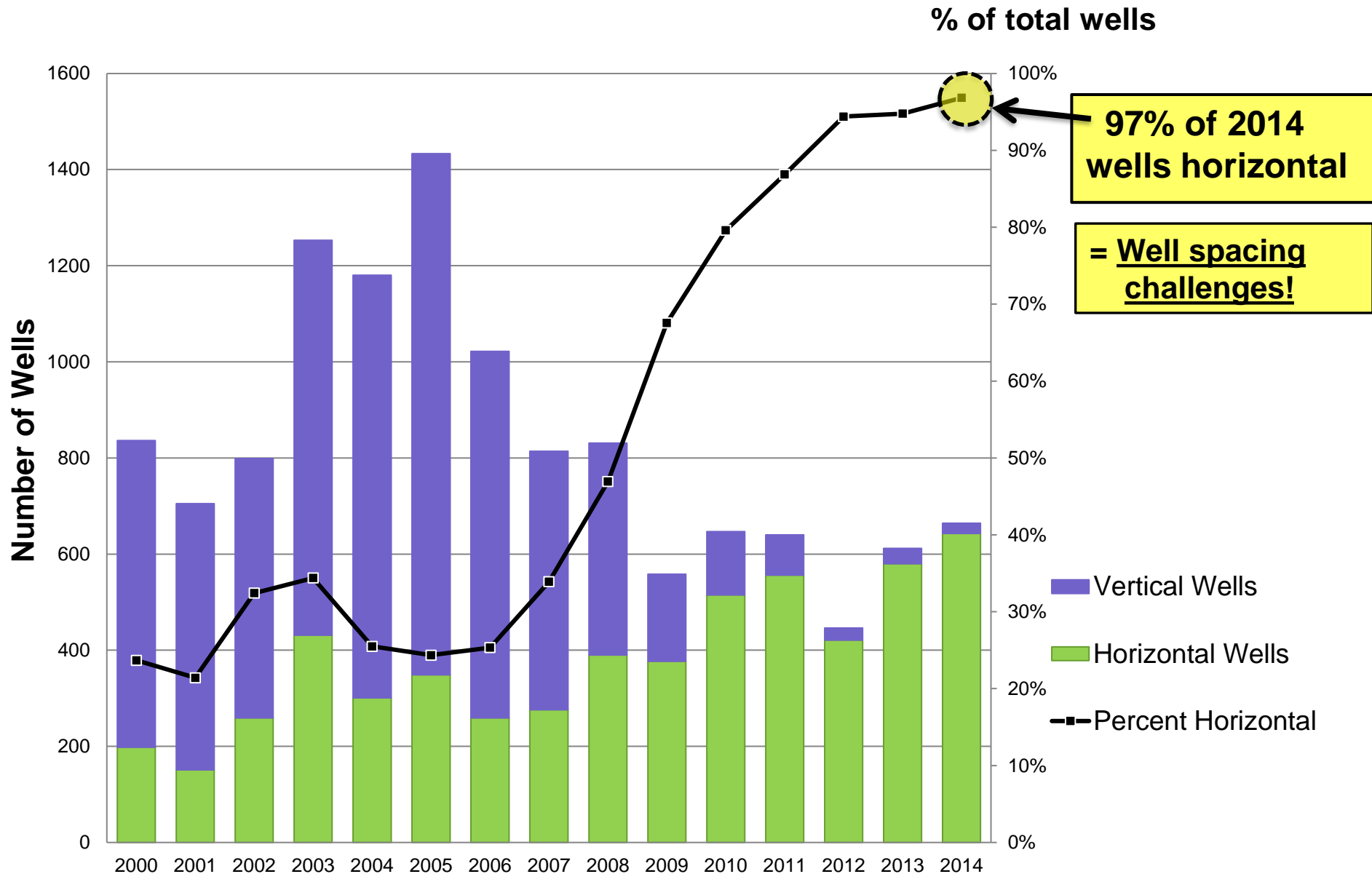
**Almost all Crown
oil and gas rights.**

BC - Trend to Unconventional Resources



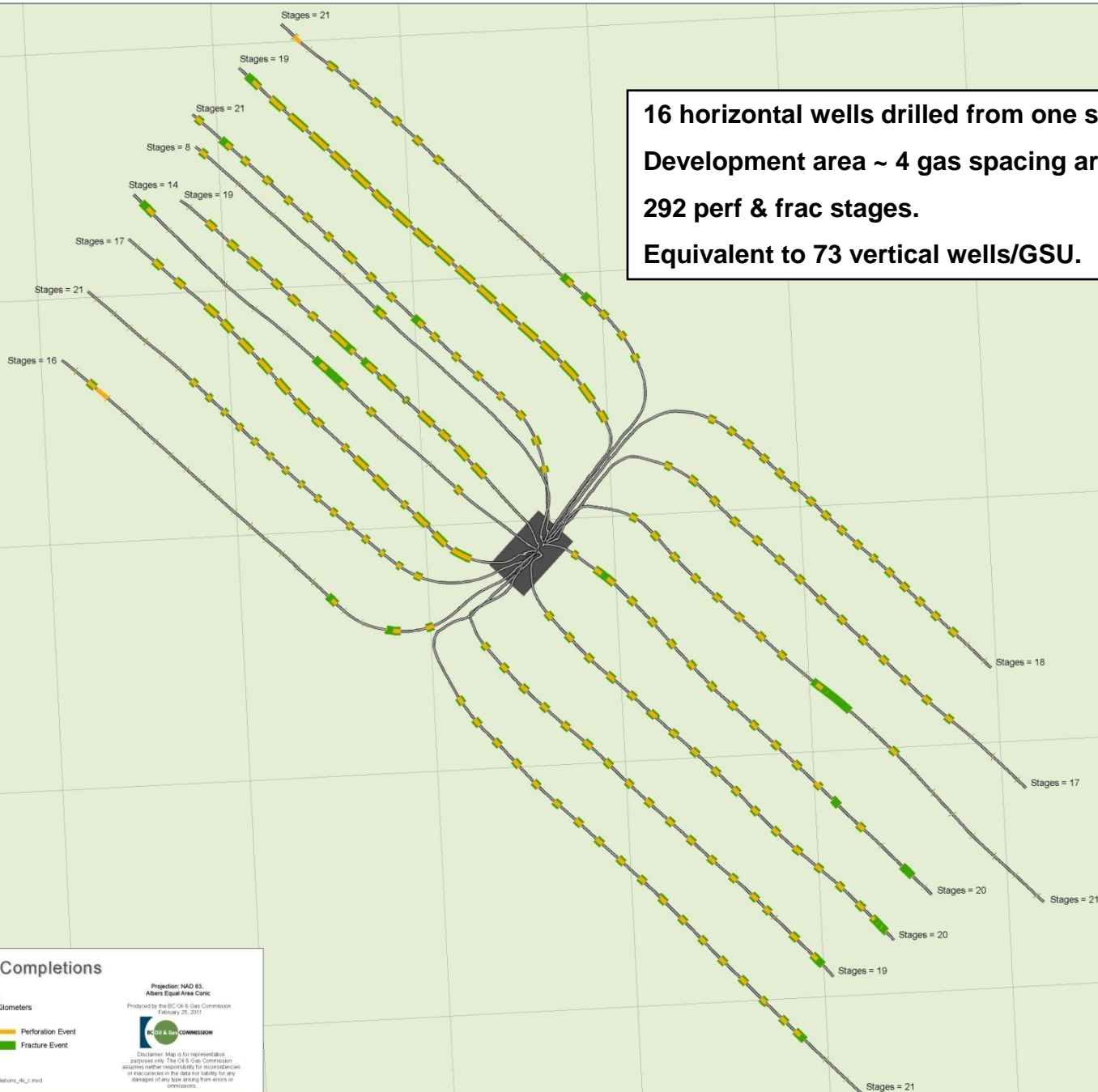
unconventional formations = Montney, Doig Phosphate, Horn River shales, Cadomin, Nikanassin

BC - Trend to Horizontal Wells





16 horizontal wells drilled from one surface pad.
Development area ~ 4 gas spacing areas.
292 perf & frac stages.
Equivalent to 73 vertical wells/GSU.



Directional Survey Completions

1:4,903
0 0.05 0.1 0.2 0.3 0.4
Kilometers

- Unconventional Play Trend
- Wellpad
- Directional Survey Line
- Perforation Event
- Fracture Event

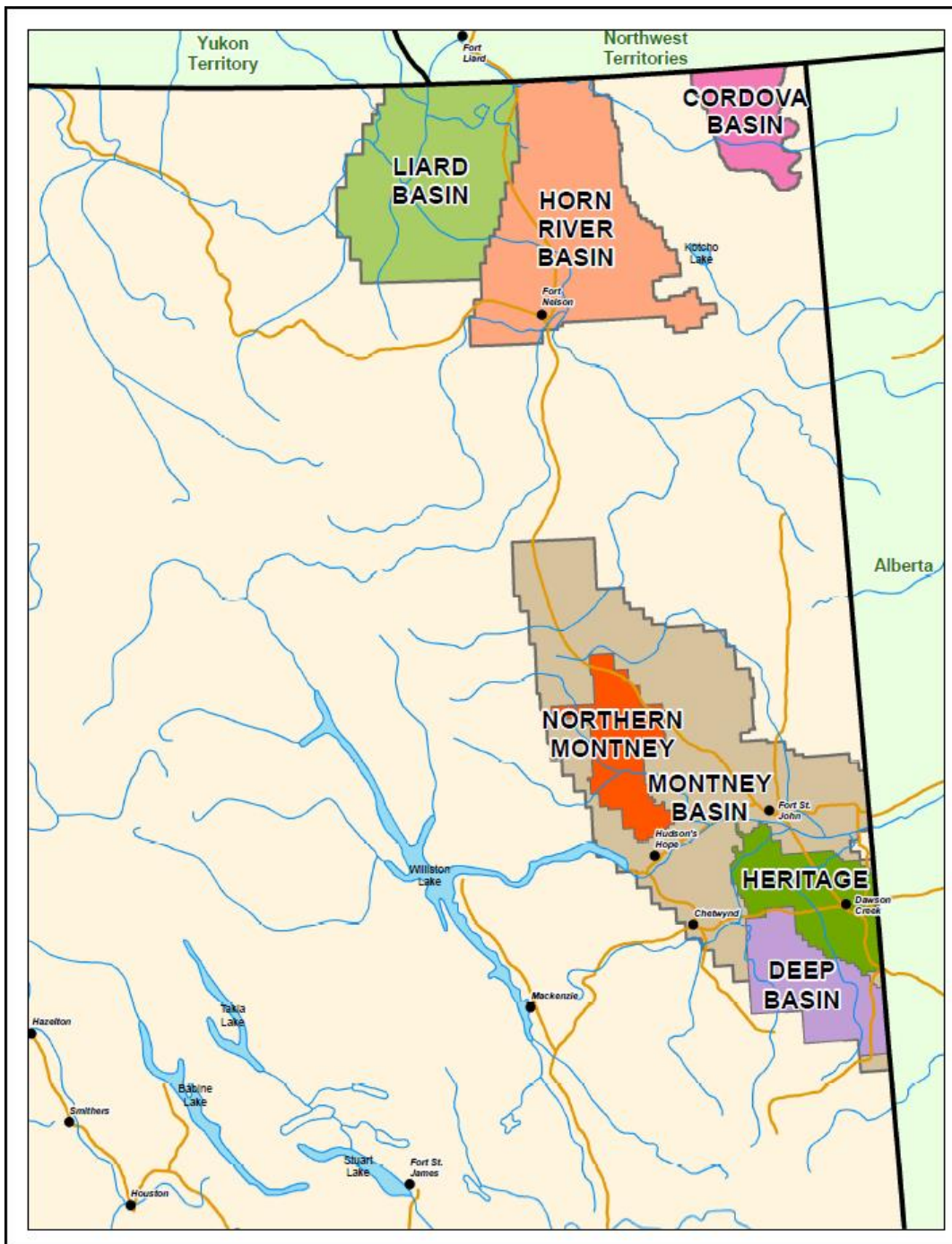
File: Projects\P127\MapOfR_StuRinRiser_Completions_4L_1.mxd

Projection: NAD 83,
Albers Equal Area Conic
Produced by the BC Oil & Gas Commission
February 25, 2011



Disclaimer: Map is for representation
purposes only. The Oil & Gas Commission
assumes neither responsibility for inaccuracies
of information in the data nor liability for any
damages of any type arising from errors or
omissions.

Major Unconventional Resource Basins in NE BC



2.0 – Wells in BC

Confidential Periods

Well Classification	Confidential Period (from rig release date)	Distance from designated oil or gas pool	Designated oil or gas pool
Development DV	2 months	In or contiguous	Same geologic formation
Exploratory Outpost EO	6 months	< 7 km & > 1 spacing unit	Any formation
Exploratory Wildcat EW	1 year	> 7 km	Any formation
Innovative Technology (experimental) EX	3 years (from date of approval)	No distance requirement	Does not apply
Special Data Well	18 months	No distance requirement	Does not apply

Notes: 1. Well classification determined at time well permit issued.

2. Operator may apply to re-classify to EW if new pool discovery well; submit request with relevant pressure data, logs, sample descriptions, seismic, etc.

3. Upon application, subsequent wells in a new pool may be held confidential until release date of the discovery well.

4. Innovative Technology Special Project, wells within boundary and objective zone.

5. Special Data Well = core and specialty logs, or microseismic data.

6. Well data that is public at all times = expected total depth and formation at total depth, surface and BH location, ground elevation & drilling status.

Exploratory/Research Wells (formerly Test Holes)

- section 24(5) of ERAA.
- do not require P&NG or Storage Reservoir rights (that is, no tenure required)
- approval by Minister of Energy, Mines, and Low Carbon Innovation— apply without title to the Regulator for a well permit.
- rare circumstances:
 - new basin, or
 - scientific purpose, or
 - exploration for underground storage, CCS.

Surface Position of a Well

A well must not be drilled within **40 metres** of

- ♦ the right of way or easement of any road allowance or public utility.

A well must not be drilled within **100 metres** of

- ♦ a body of water.
- ♦ a permanent building, installation or works.
- ♦ a place of public concourse.
- ♦ a reservation for national defense.

Primary Product Status – Oil or Gas Well?

- ◆ Well type has implications for well spacing, production allowables & royalties
- ◆ Not defined by Act or Regulation
- ◆ Regulator policy, several criteria used;
 - ✓ gas/oil ratio, $> 1781 \text{ m}^3/\text{m}^3 = \text{gas}$
 - ✓ liquid API gravity, $> 50 = \text{gas}$
 - ✓ C6+ molecular mass, $> 150 = \text{oil}$
 - ✓ liquid rate, $> \sim 10 \text{ m}^3/\text{d} = \text{oil}$
 - ✓ pool development, oil leg evident?

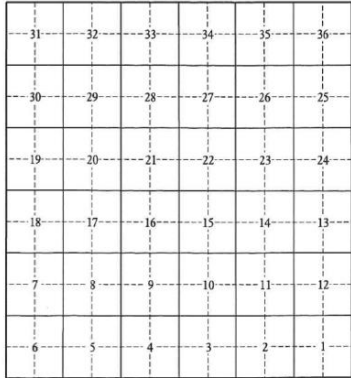
3.0 - BC Survey Systems



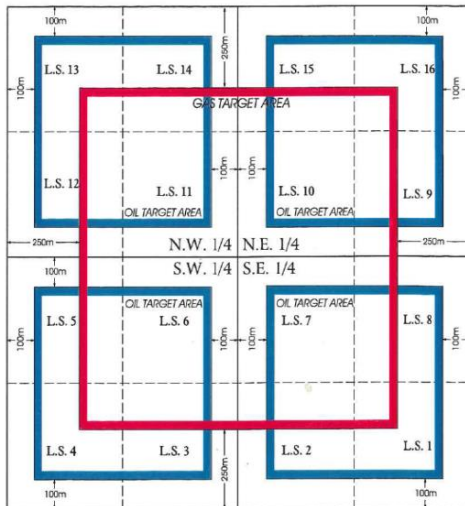
BRITISH COLUMBIA OIL AND GAS TARGET ZONE EXPLANATION

**TARGET AREAS
WITHIN PEACE
RIVER BLOCK**

TYPICAL TOWNSHIP
SCALE 1 : 125 000

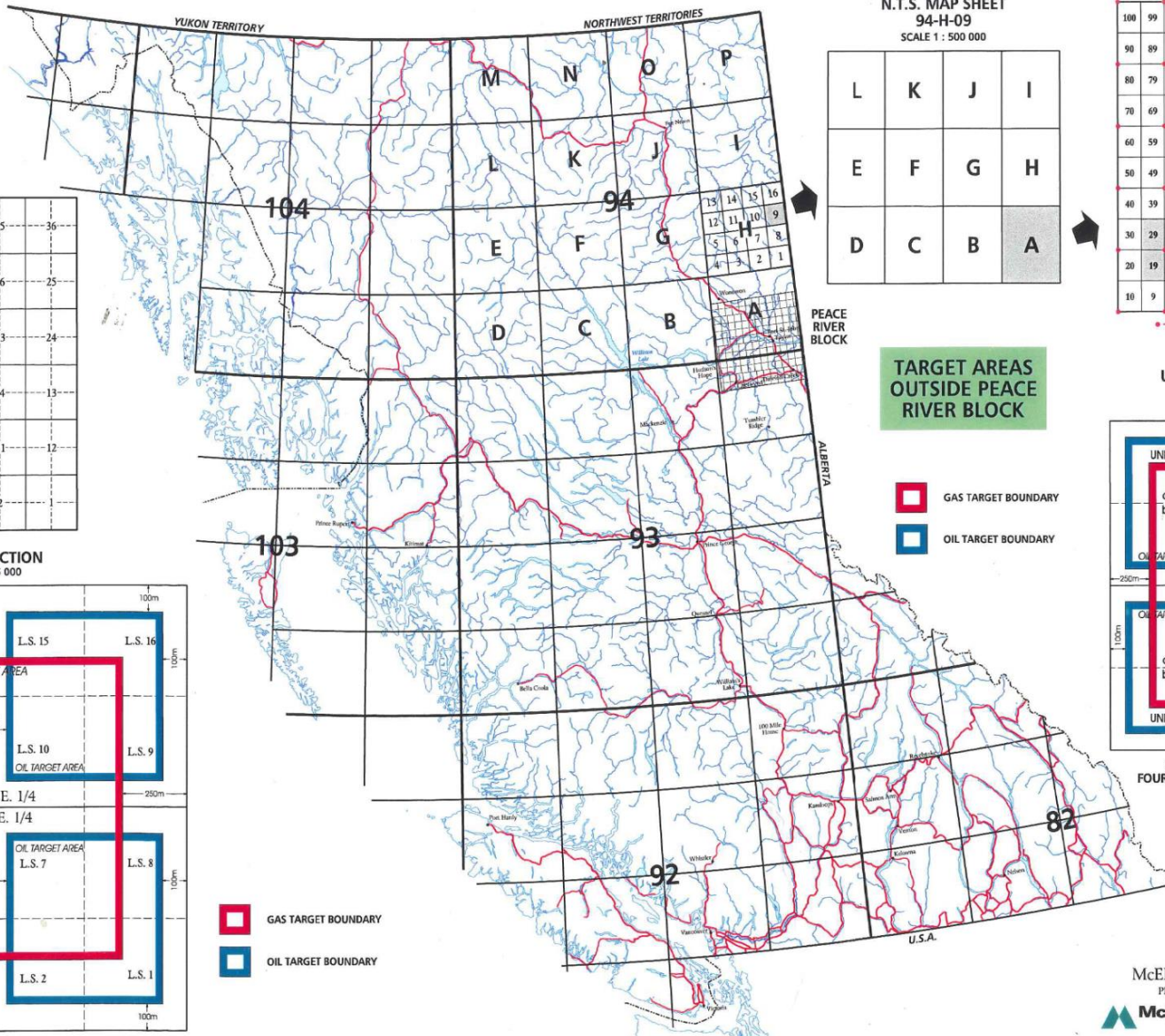


TYPICAL SECTION
SCALE 1 : 15 000

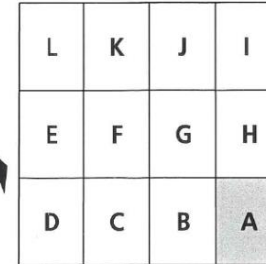


GAS TARGET BOUNDARY

OIL TARGET BOUNDARY



N.T.S. MAP SHEET
94-H-09
SCALE 1 : 500 000



PEACE
RIVER
BLOCK

**TARGET AREAS
OUTSIDE PEACE
RIVER BLOCK**

GAS TARGET BOUNDARY

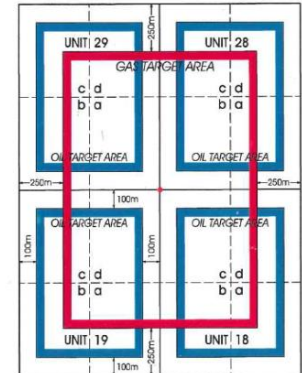
OIL TARGET BOUNDARY

BLOCK A
94-H-09
SCALE 1 : 125 000



• - Denotes Centre of Gas Target Area

UNITS 18, 19, 28, 29
BLOCK A 94-H-09
SCALE 1 : 25 000



EACH UNIT CONSISTS OF
FOUR QUARTER UNITS: a, b, c, & d.

McElhanney ASSOCIATES
PROFESSIONAL LAND SURVEYORS

McElhanney
18012/47TH AVE.
FORT ST. JOHN, B.C. V1J 5P3
PHONE: (250) 787-0056
FAX: (250) 787-4010

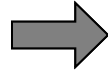
© COPYRIGHT McELHANNEY ASSOCIATES 2001.

NTS: a-20-B/94-H-09

MAP SHEET
94-H-09

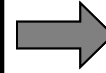
94
93
92

MAP



M	N	O	P
L	K	J	I
E	F	G	H
D	C	B	A

MAPSHEET



13	14	15	16
12	11	10	9
5	6	7	8
4	3	2	1

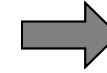
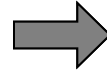
GRID

BLOCKS

L	K	J	I
E	F	G	H
D	C	B	A

UNITS

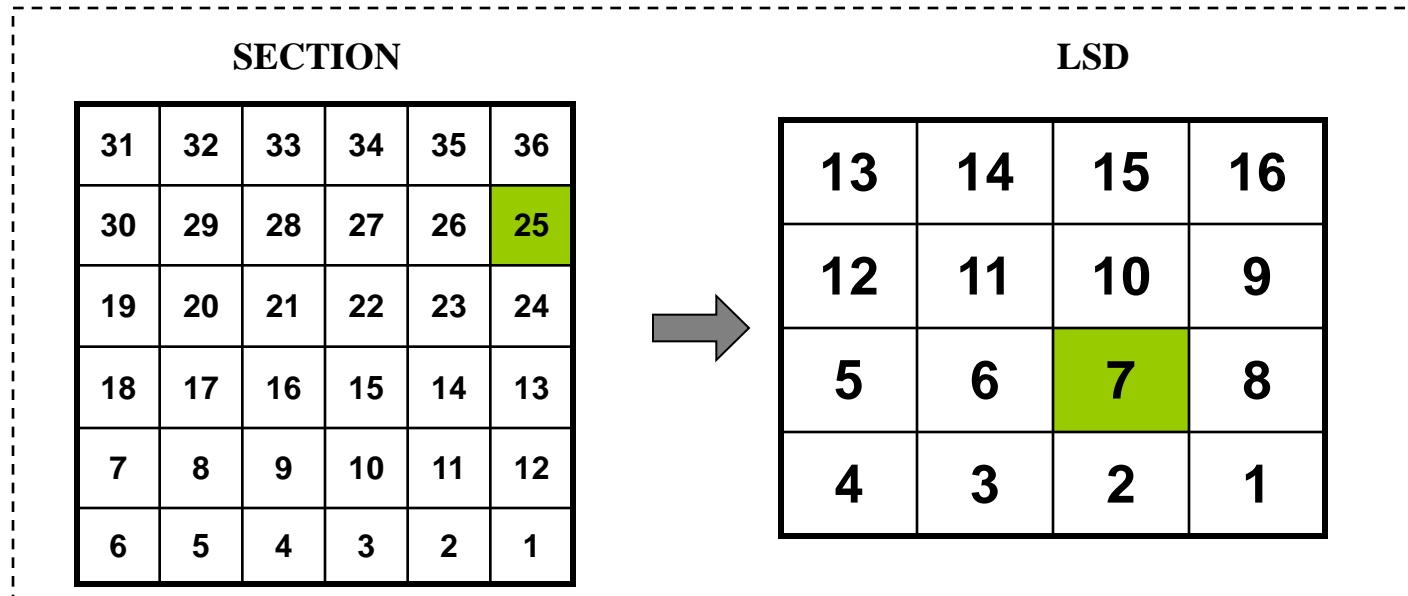
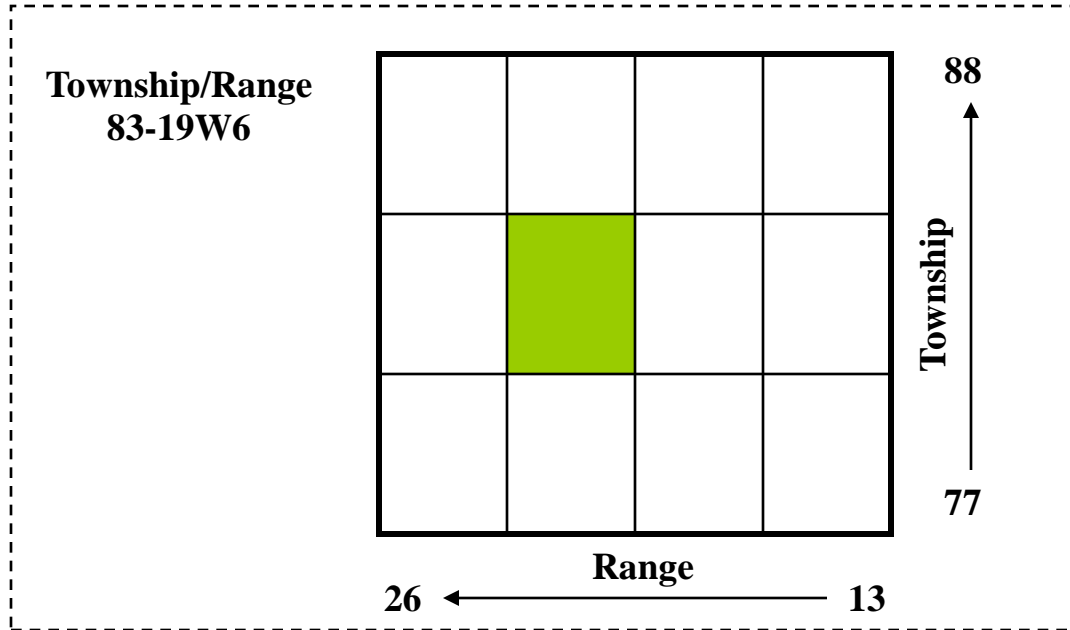
10	99	98	97	96	95	94	93	92	91
0									
90	89	88	87	86	85	84	83	82	81
80	79	78	77	76	75	74	73	72	71
70	69	68	67	66	65	64	63	62	61
60	59	58	57	56	55	54	53	52	51
50	49	48	47	46	45	44	43	42	41
40	39	38	37	36	35	34	33	32	31
30	29	28	27	26	25	24	23	22	21
20	19	18	17	16	15	14	13	12	11
10	9	8	7	6	5	4	3	2	1



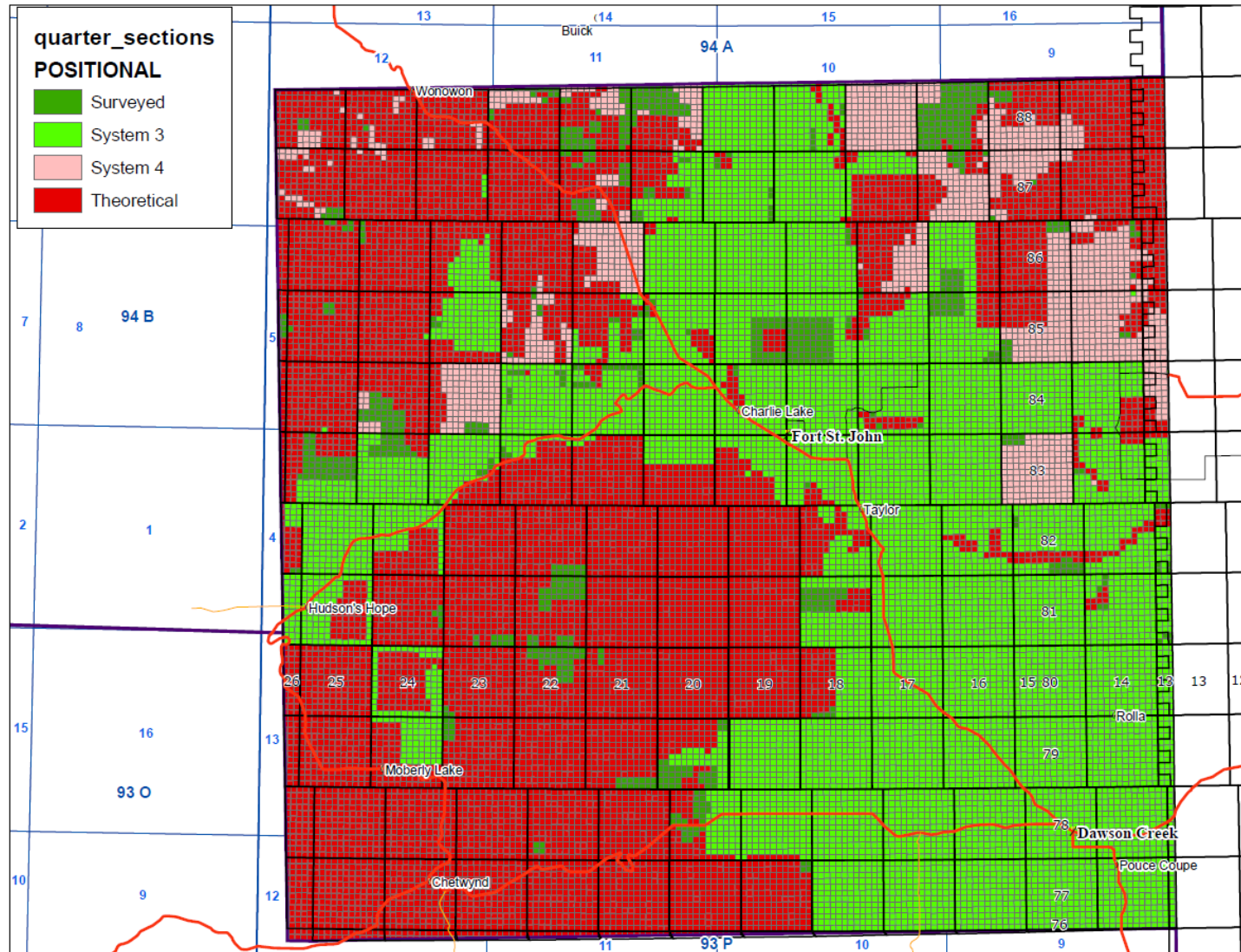
1/4 UNITS

c	d
b	a

DLS: 7-25-83-19W6



Peace River Block – Dominion Survey Systems



Surveyed = may or may not have road allowance.

System 3 = surveyed with road allowances.

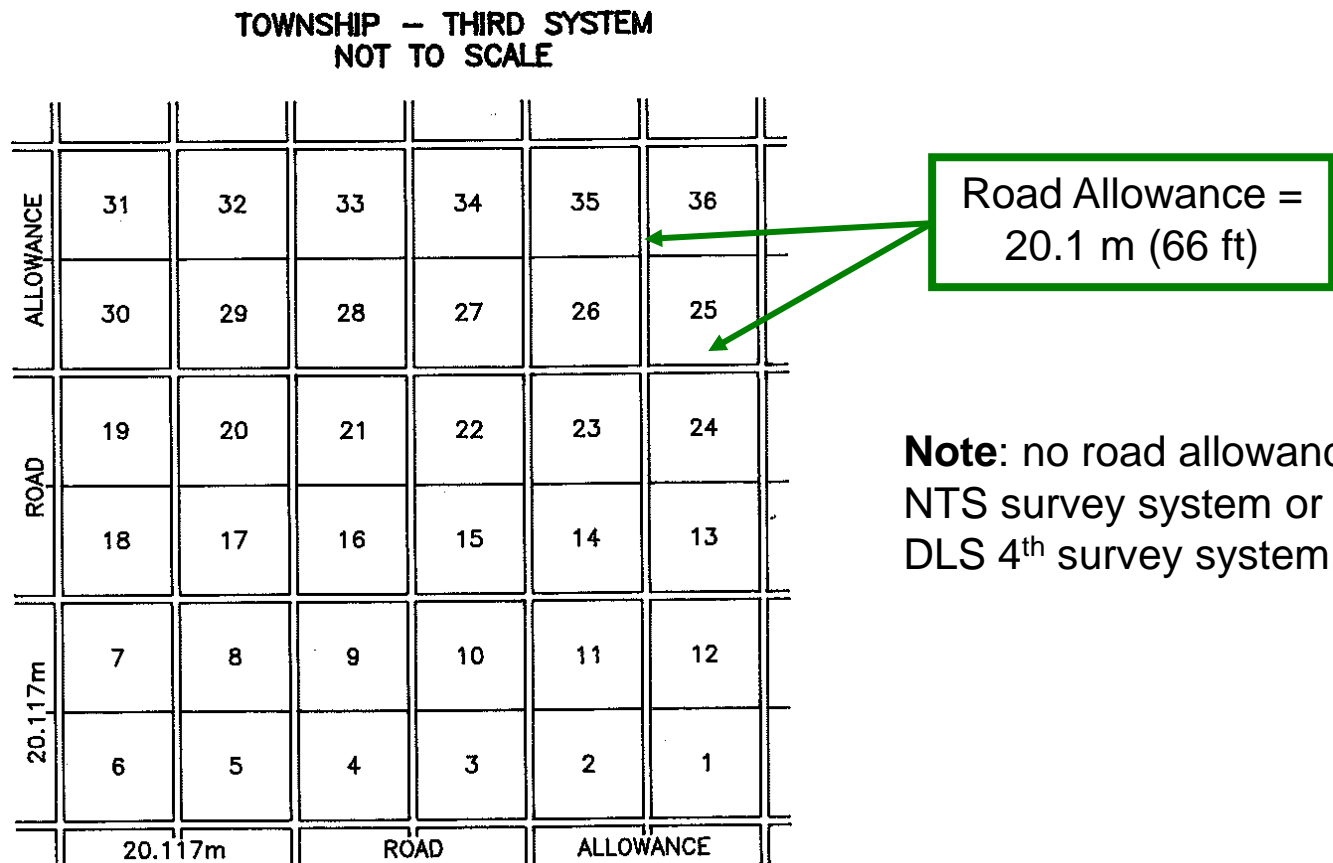
System 4 = survey with no road allowances.

Theoretical = not surveyed, no road allowances.

Rely on BC Land Surveyor!

Road Allowance – Dominion Survey System

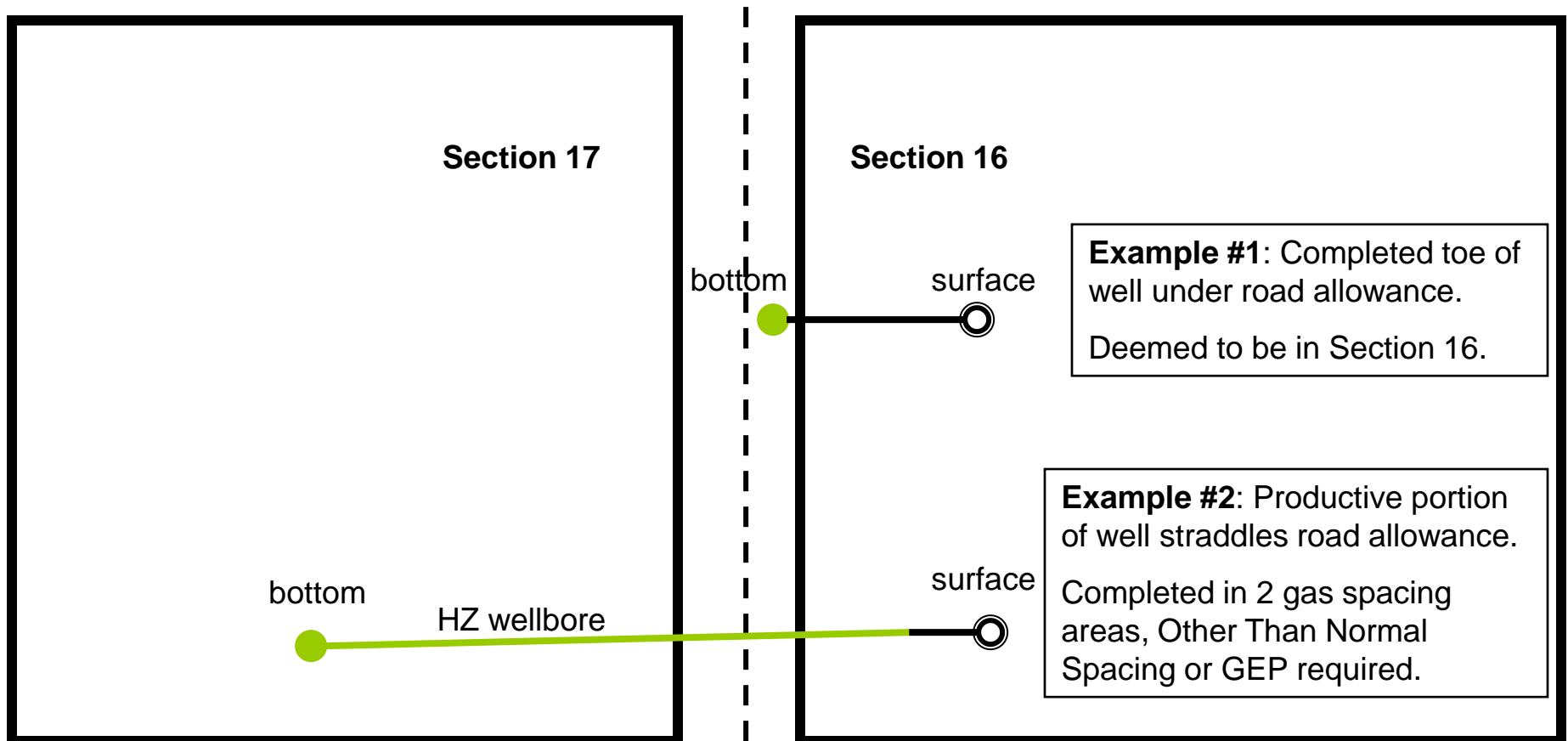
Within a **project area**, a well may be completed for production under a road allowance without prior approval or notification



Road Allowance

“Middle of the road” policy for assigning a well to a spacing area.

Road Allowance
20.1 m (66 ft)



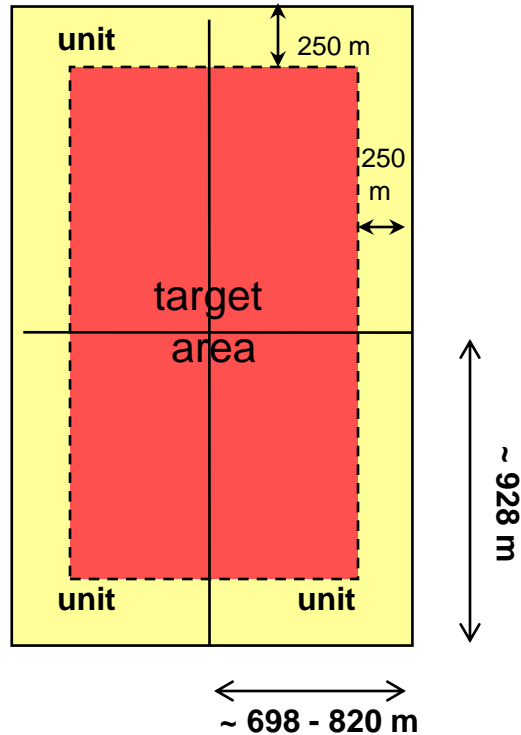
4.0 – SPACING AND TARGETS

Who Needs Well Spacing Rules?



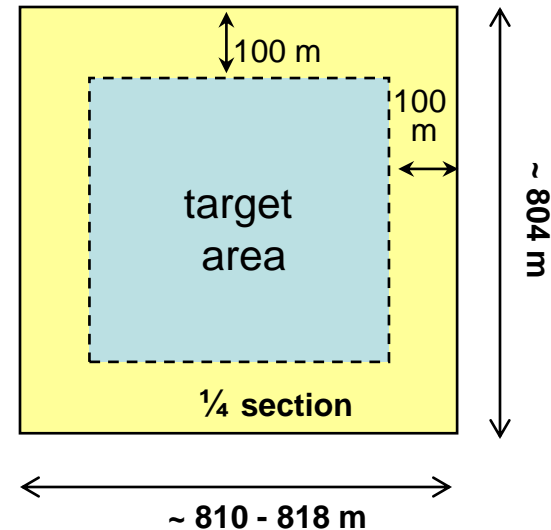
Normal Well Spacing and Target Areas

GAS WELL
SPACING AREA



One gas well per pool per
4 units (NTS) or,
1 section (DLS)

OIL WELL
SPACING AREA



One oil well per pool per
1 unit (NTS) or,
1/4 section (DLS)

Target Areas for Unconventional Zones

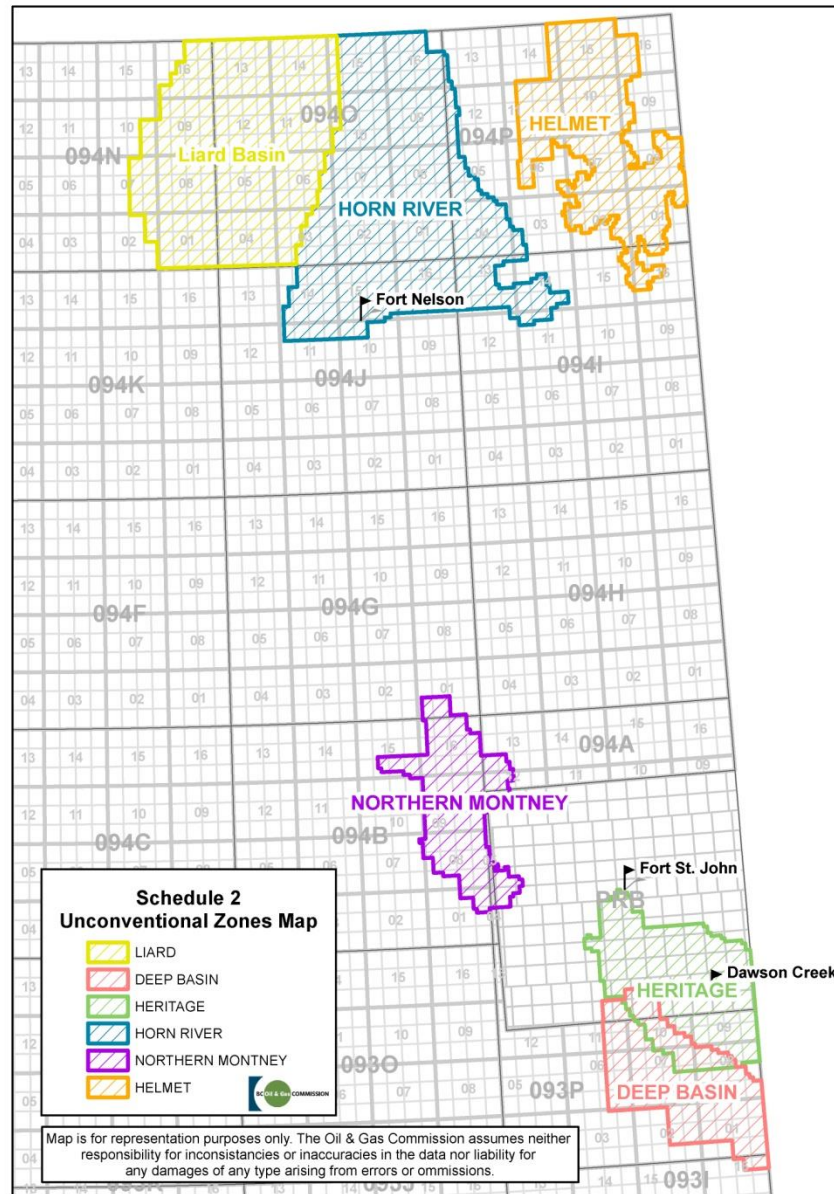
Recent changes to the Drilling & Production Regulation now define specific zones as “unconventional”.

These unconventional zones have defined target area setback distances as well as modified testing, logging, and sampling requirements. Also, normal well spacing stipulations do not apply.



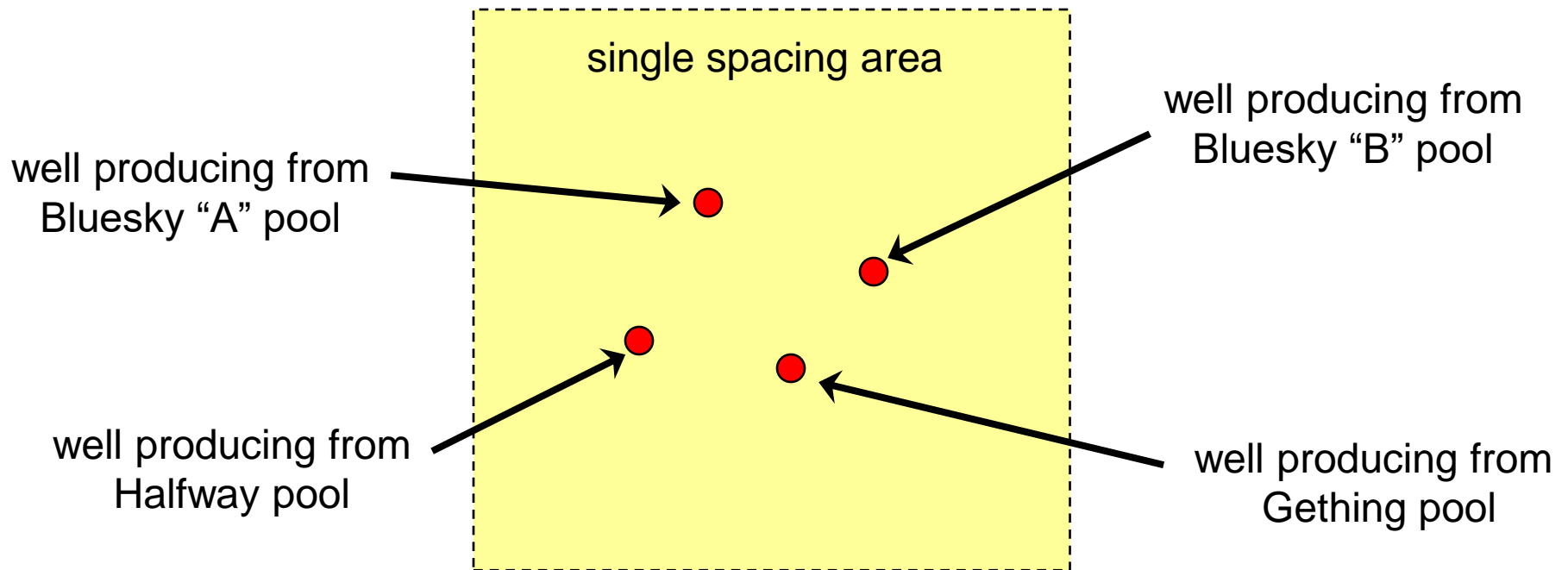
SCHEDULE 2		
Unconventional Zones		
Field	Zone Name	Distance (m)
Horn River	Muskwa-Otter Park	100
Horn River	Evie	100
Helmet	Muskwa-Otter Park	100
Helmet	Evie	100
Liard Basin	Besa River	100
Northern Montney	Montney	150
Northern Montney	Doig Phosphate-Montney	150
Heritage	Montney	150
Altares	Doig Phosphate-Montney	150
Town	Montney	150
Deep Basin	Cadomin	150
Deep Basin	Nikanassin	150

Schedule 2 Unconventional Zones



Well Spacing is Pool Specific


One well per pool in each spacing area



No "downspacing" in this example,
as each well producing from a different pool.

Increased Well Density

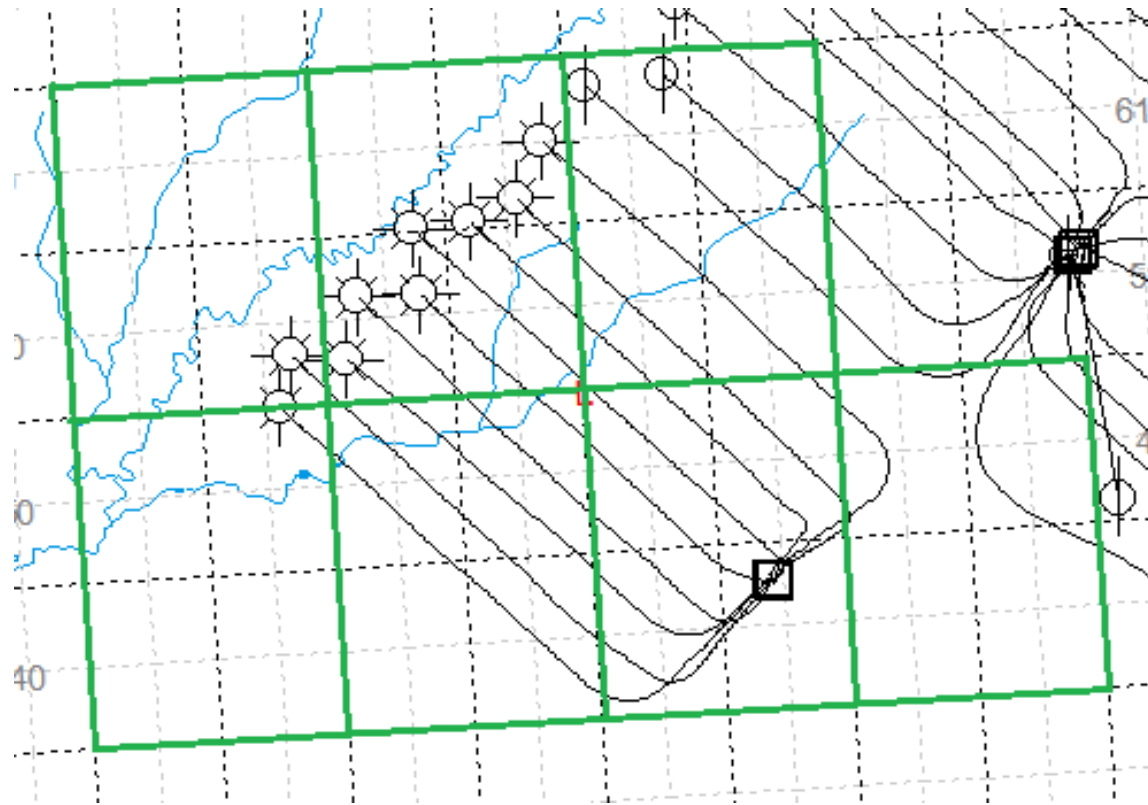
How can you have multiple wells in same spacing area completed in the same pool?

- ◆ apply for Special Project - Good Engineering Practice (GEP) approval to produce
- ◆ permitted if unconventional pool listed in Schedule 2 (no GEP application required) 

or

- ◆ amend well(s) to “observation status” (via form BC-11), only produce one well.

Example of increased density and the associated spacing areas



5.0 - Off-Target Production Penalties



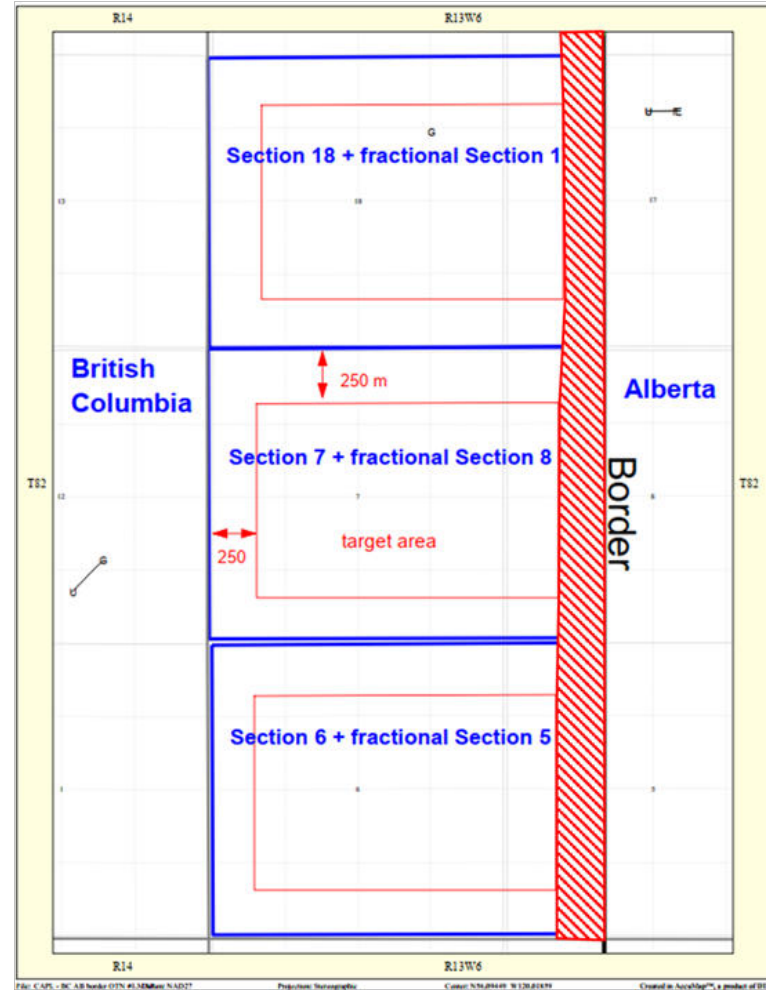
Off-Target Production Penalty

- ◆ For “conventional” wells, penalty factor (fraction < 1.00) applied to well daily gas or daily oil allowable.
- ◆ The Regulator may proactively apply penalty, request from competitor NOT required.
- ◆ Penalty applies even if no well on affected off-setting land.
- ◆ If off-target to Crown, penalty does apply!
- ◆ Penalized well may still be economic.

Target Areas at the Border

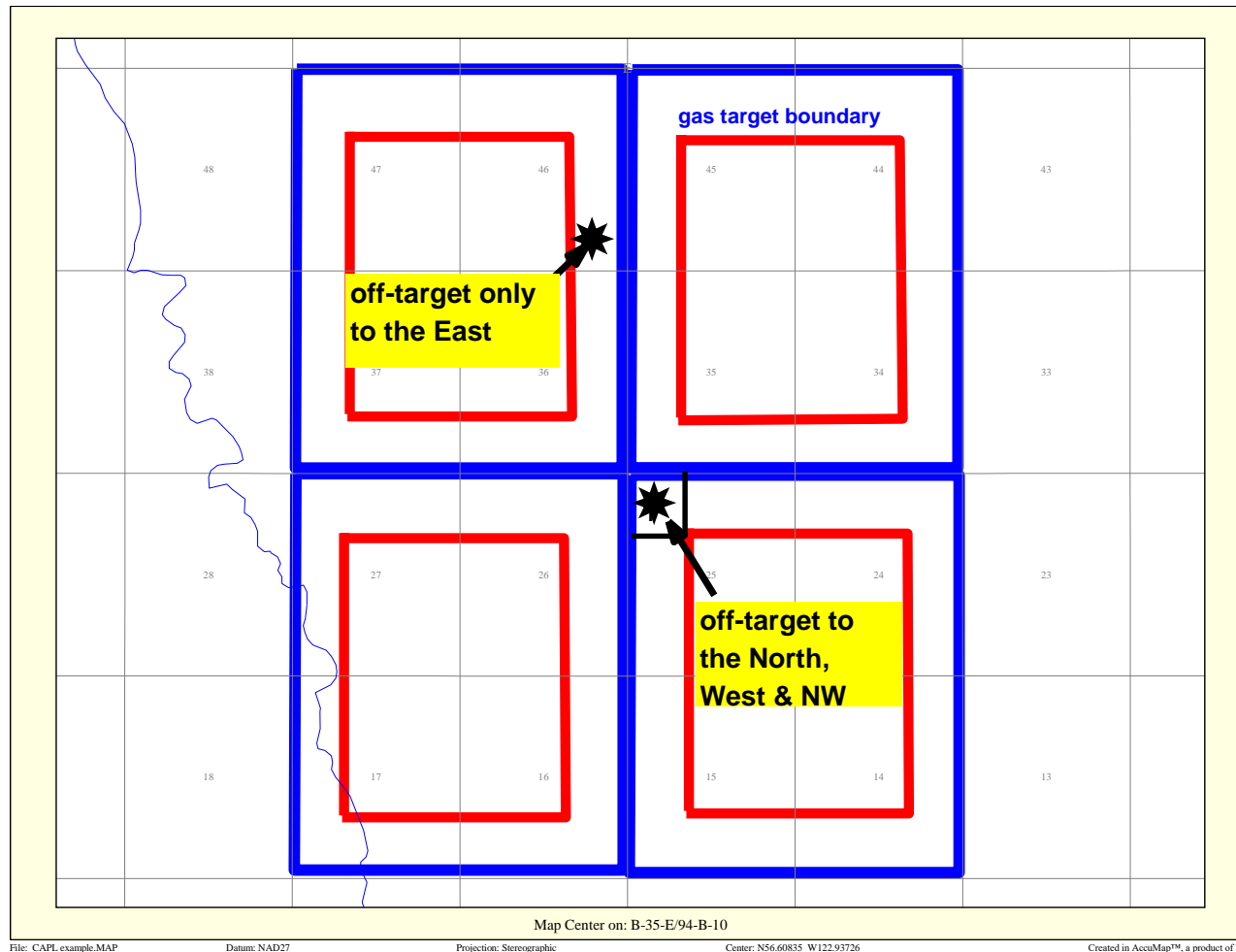
Wells may not be produced from the buffer area adjacent to the provincial border, regardless of the ownership of rights on the other side of the border.

The buffer area is 100m for oil wells, 250m for conventional gas wells, and a reduced 150m for unconventional gas (Schedule 2 or if allowed by GEP).



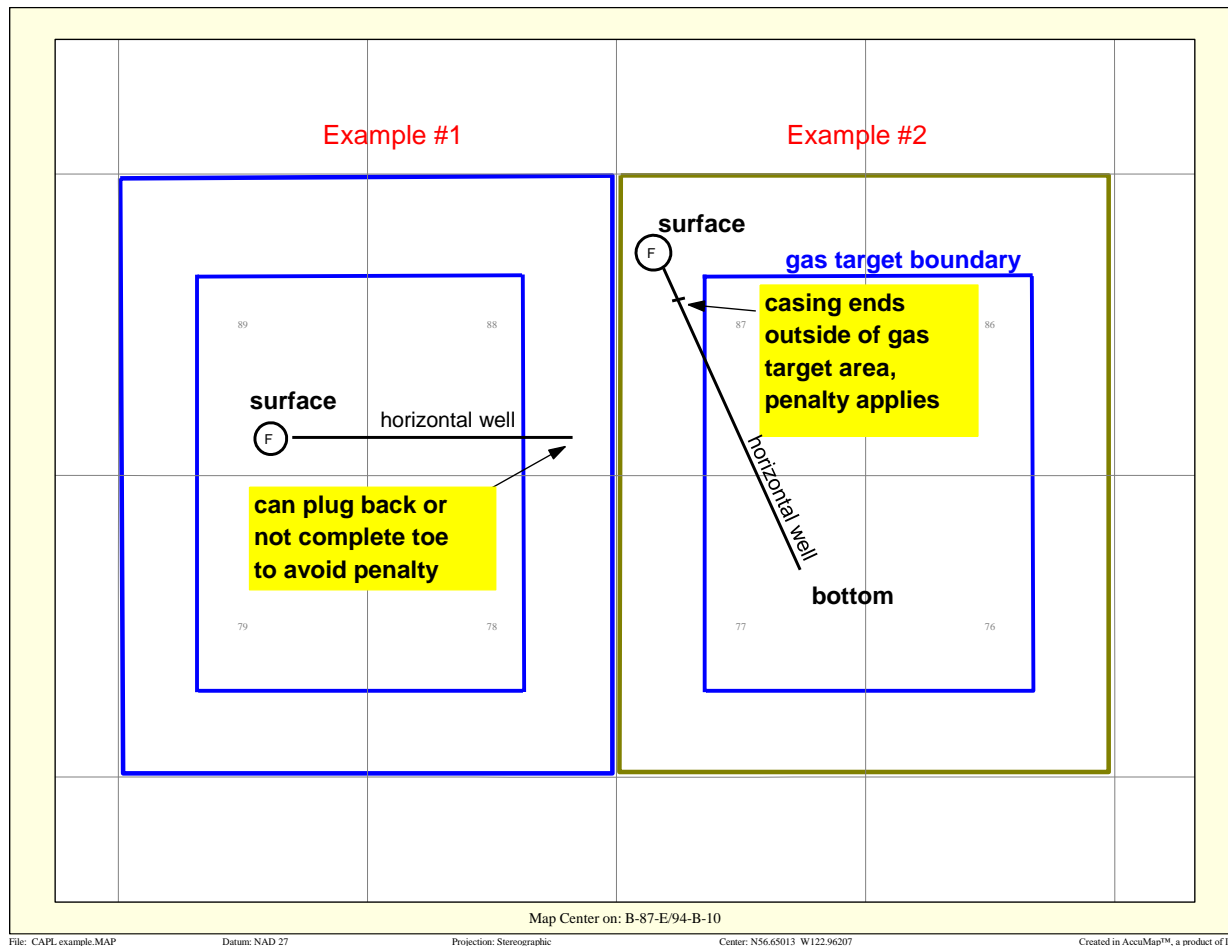
Off-Target Production Penalty (Example #1)

Well located off-target in the corner is considered to also affect spacing area in the diagonal direction.



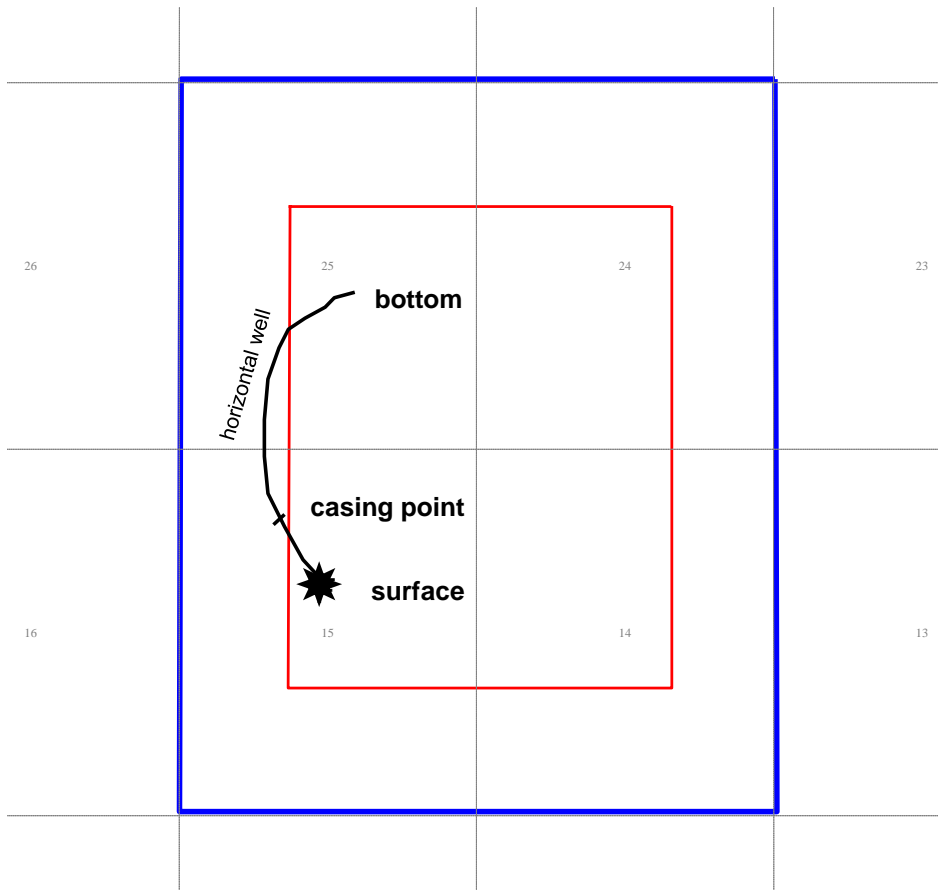
Off-Target Production Penalty (Example #2)

For directional/horizontal well, coordinates of “worst point of infringement” to calculate penalty.



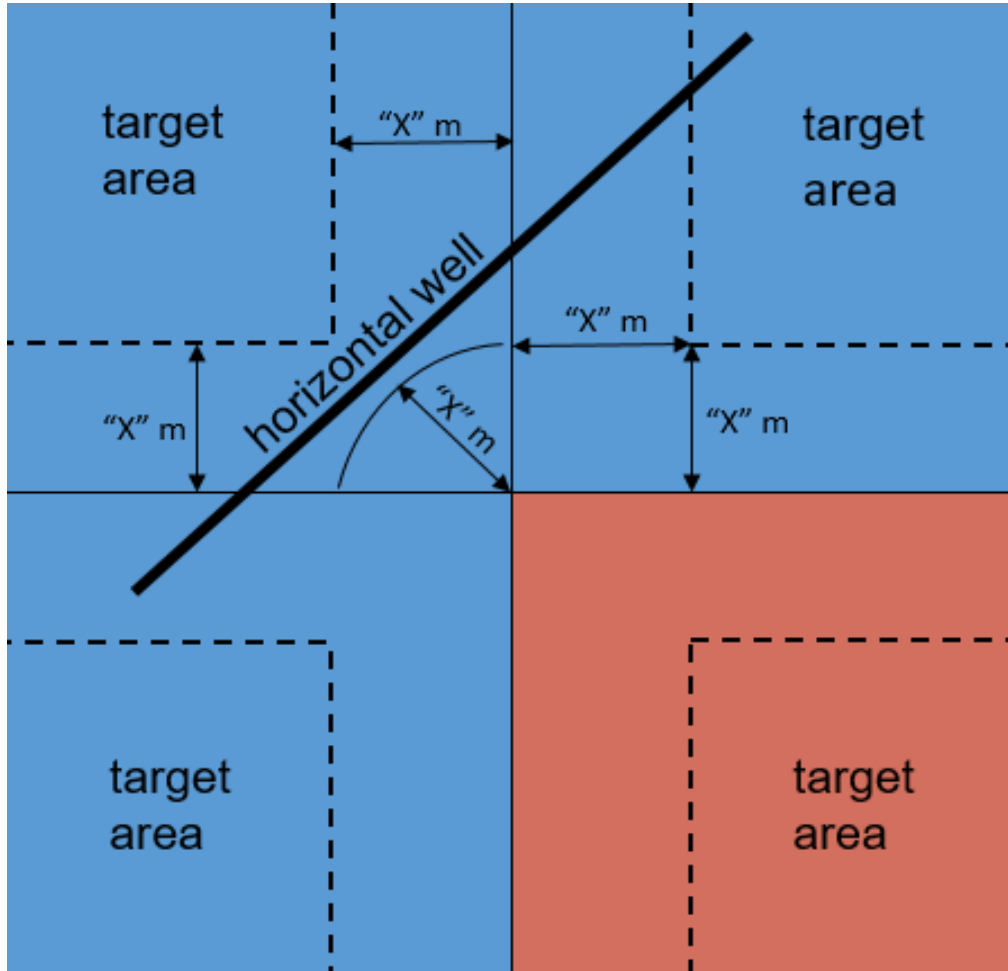
Off-Target Production Penalty (Example #3)

For directional/horizontal well, coordinates of “worst point of infringement” to calculate penalty.



Even though well begins and ends within target area, penalty would apply due to portion of open-hole completion that is off-target.

Tenure Surrounding a Corner



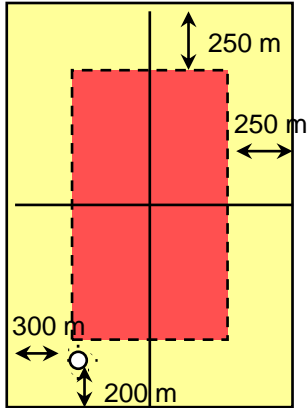
A special case.

Tenure ownership (blue) with a protruding corner of other ownership (red).

In this circumstance, an arc describes the buffer distance “not nearer than” that a well may be completed for production without being considered “off-target”.

The arc length = the buffer distance of the target area from a tenure boundary
("X" metres in this example)

Gas Well Off-Target Production Penalty



1 section (DLS)

4 units (NTS)

Target area is 250 m
inside spacing area.

$$\text{OTF} = \frac{8 (NS \text{ m}) (EW \text{ m})}{\text{Spacing Area m}^2}$$

- Notes:
1. NS & EW distances measured to nearest corner of the spacing area
 2. 1 ha = 100 m x 100 m = 10⁴m²

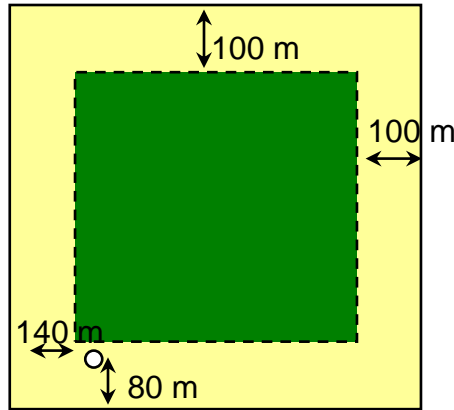
Example:

$$\text{OTF} = \frac{8 (200.0 \text{ m}) (300.0 \text{ m})}{270.0 \times 10^4 \text{ m}^2}$$

$$= 0.1778$$

Therefore production limited to 17.78% of DGA

Oil Well Off-Target Production Penalty



1/4 section (DLS)

1 unit (NTS)

Target area is 100 m
inside spacing area.

$$\text{OTF} = \frac{12 (\text{NS m}) (\text{EW m})}{\text{Spacing Area m}^2}$$

- Notes:
1. NS & EW distances measured to nearest corner of the spacing area
 2. 1 ha = 100 m x 100 m = 10^4m^2

Example:

$$\text{OTF} = \frac{12 (80.0 \text{ m}) (140.0 \text{ m})}{70.0 \times 10^4\text{m}^2} = 0.1920$$

Therefore production is limited to 19.20% of DOA

Off-Target Production Penalty

Wells in Unconventional Zones (as defined in Schedule 2):

Individual wells in these zones have limited drainage areas, so target areas have been enlarged to avoid stranding reserves:

- ♦ Montney formation = 150 m target buffer
- ♦ Horn River shale = 100 m target buffer

If drilled and completed outside of this enlarged target area, production NOT permitted from well without agreement of affected off-setting tenure owners.
(ie off-target penalty factor = zero!)



Directional Survey “2% Rule”

- ◆ Directional survey must be run if;
 - ✓ surface position of well is nearer to the boundary of its target area than 2% of well total depth, or
 - ✓ surface position of well is “off-target”, or
 - ✓ well is directionally drilled

Example: Gas well total depth = 2200 m
 $2200 \text{ m} \times 2\% = 44 \text{ m}$
 $44 \text{ m} + 250 \text{ m target area distance} = 294 \text{ m}$
 Therefore, if well surface location closer than 294 m to
 spacing border, a directional survey must be run.

Directional Survey “2% Rule” (cont’d)

- ◆ If directional survey not run, the Regulator assumes “worst case scenario” to calculate off-target penalty, based on deviation survey
- ◆ Deviation survey requirement, intervals of 150m
- ◆ Operator may request waiver of directional survey requirement if deviation survey proves well on-target and same location description as surface (example - both surface & TD within a-7-J)

Deviation survey = angle of well

Directional survey = angle and direction of well

Directional Survey “2% Rule” (cont’d)

Well Bottom-hole Displacement Calculation

(Based on surface co-ords & deviation survey, no directional survey)

Well Location: b-73-K/93-P-6

Gas Spacing: 72,73,82,83-K/93-P-6

	North (m)	East (m)		
Surface Co-ords:	262.2	498.6	From	SW cr 73-K/93-P-6

Measured Depth (mKB)	Deviation Angle (degrees)	Maximum Possible Displacement Co-ords			
		North/South (m)		East/West (m)	

28.0	0.25	262.3	262.1	498.7	498.5
83.0	0.50	262.8	261.6	499.2	498.0
139.0	0.25	263.0	261.4	499.4	497.8
194.0	0.50	263.5	260.9	499.9	497.3
280.0	0.75	264.7	259.7	501.1	496.1
339.0	0.50	265.2	259.2	501.6	495.6
485.0	0.75	267.1	257.3	503.5	493.7
619.0	0.25	267.7	256.7	504.1	493.1
743.0	1.25	270.4	254.0	506.8	490.4
868.0	1.00	272.5	251.9	508.9	488.3
955.0	0.25	272.9	251.5	509.3	487.9
1103.0	1.00	275.5	248.9	511.9	485.3
1251.0	1.00	278.1	246.3	514.5	482.7

	North (m)	East (m)		
Assumed TD Co-ords:	246.3	498.6	From	SW cr 73-K/93-P-6

Off-Target Penalty Factor = 0.3340

Off-Target Well Production Penalty Waiver

- A. Discovery Well
 - B. Common Ownership - same lease
 - C. Common Ownership - different lease
 - D. Different Ownership - different lease
- } absolute waiver
- } conditional waiver

Note: for C & D, operator may apply for waiver
on proposed well before drilling

Off-Target Well Production Penalty Waiver

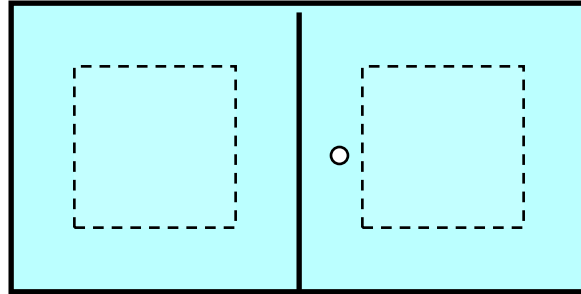
A. Discovery Well - “a new oil and gas pool has been designated as a result of data obtained from the well”.

- ♦ not first well to produce; older well with DST may qualify.
- ♦ operator apply to the Regulator’s Victoria office for recognition;
no specific application form.
- ♦ supply supporting data to build a “case”,
i.e. seismic, pressure, x-sections, etc.
- ♦ Must request “Discovery” status for waiver, even if well is already Exploratory Wildcat classification.

NOTE: 36-month royalty exemption for discovery oil well!

Off-Target Well Production Penalty Waiver

B. Common Ownership - Same Lease

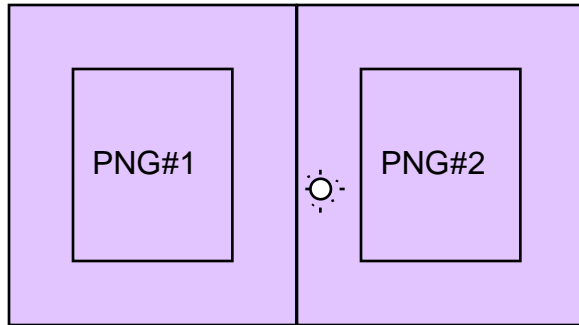


Two spacing areas
under one PNG lease

- ◆ Off-target waiver is automatic under section 6.5c (oil) and 7.4c (gas) of the *Drilling and Production Regulation*.
- ◆ No application required.

Off-Target Well Production Penalty Waiver

C. Common Ownership - Different Lease

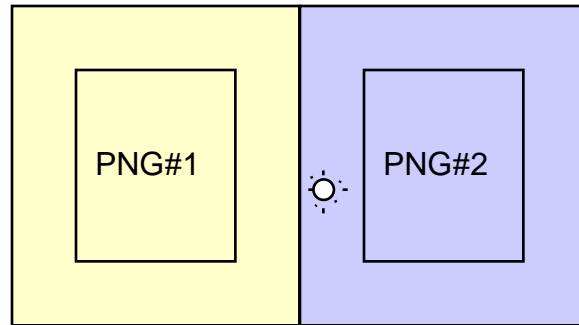


PNG#1 & #2 both registered under identical ownership

- ◆ Application required (no specific Regulator form).
- ◆ Include cover letter stating request and attached titles map with well location plotted.
- ◆ If title of affected lease (PNG #1 in example) expires or changes ownership, penalty may be imposed.
- ◆ Affected title must be a P&NG lease, not a Drilling Licence.

Off-Target Well Production Penalty Waiver

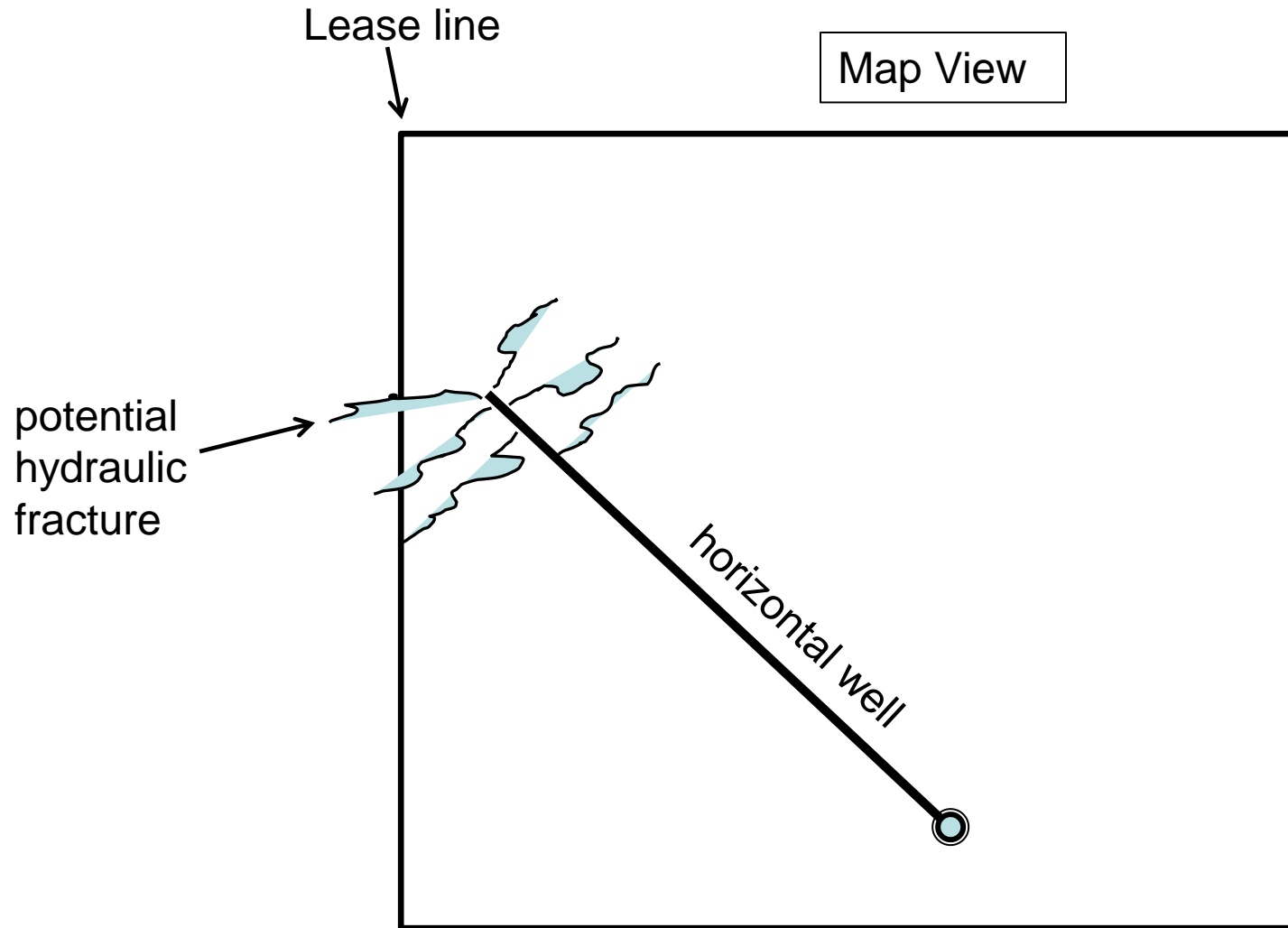
D. Different Ownership - Different Lease



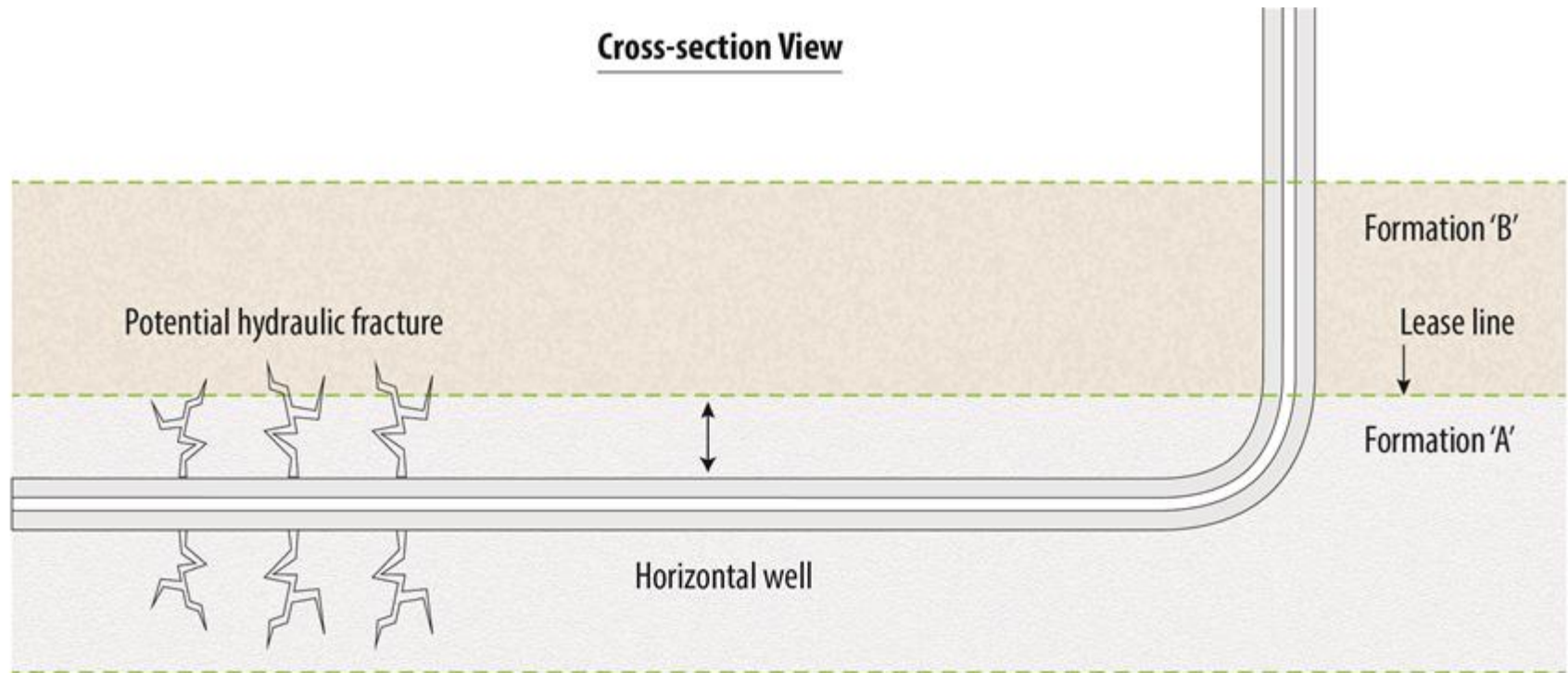
PNG#1 & #2 registered
different ownership

- ◆ Application required (no specific Regulator form).
- ◆ Include titles map with well location and letters of consent from registered owner(s) of affected off-setting lease (PNG #1 in example).
- ◆ Approval is “conditional” upon consent from ownership of PNG #1; if changes, OT penalty may be applied.
- ◆ PNG #1 must be P&NG lease, not a Drilling License.

Hydraulic fracture growth across Lease line **NOT** considered trespass!

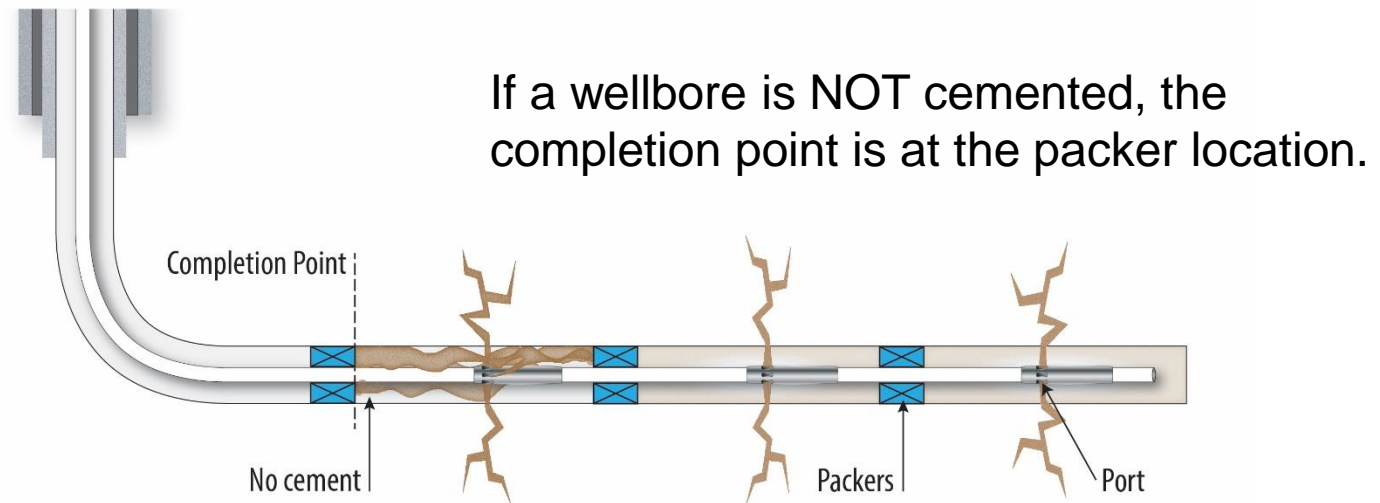
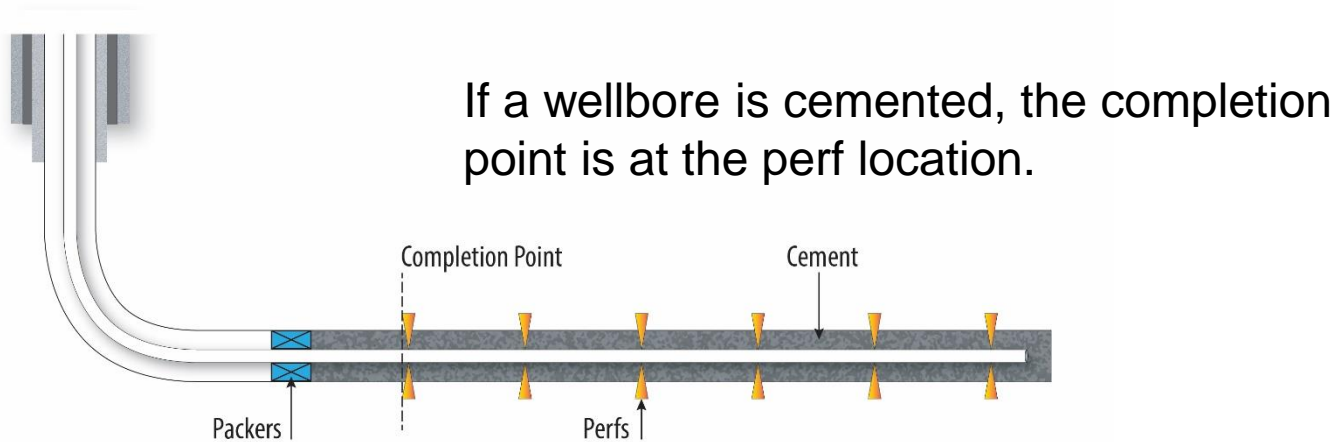


Hydraulic fracture growth across Lease line **NOT** considered trespass!

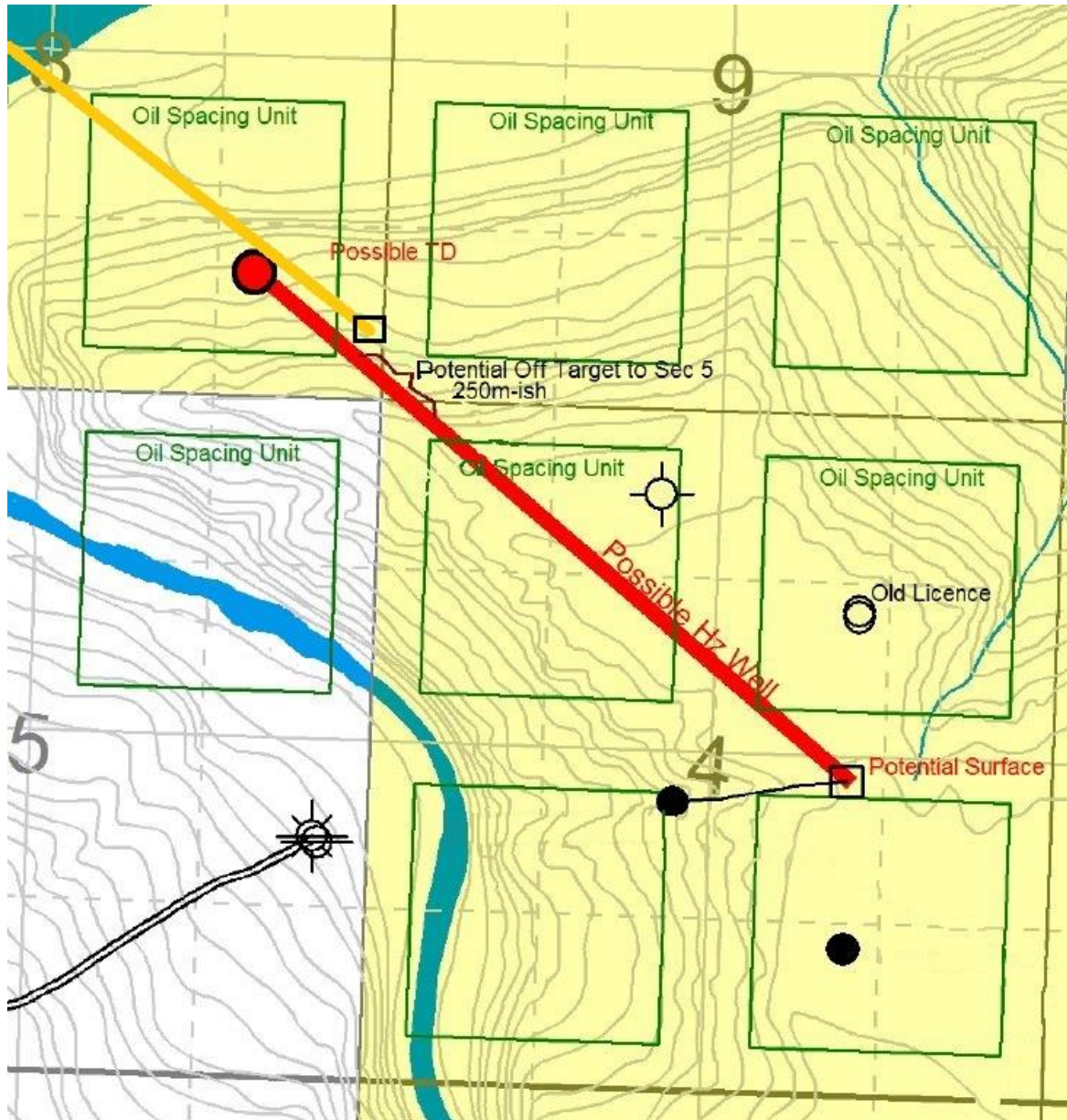


When is a completion off target at the heel?

That depends on the completion type!



Proposed Off-Target Well Story



1) Off Target Production Penalty

2) Off Target Production Penalty Waiver

3) No Completion in the Off Target Zone

Scenario #1 Off Target Production Penalty



$$\text{OTF} = \frac{12 (\text{NS m}) (\text{EW m})}{\text{Spacing Area m}^2}$$

$$\text{OTF} = \frac{12(10\text{m})(10\text{m})}{70.0 \cdot 10^4 \text{m}^2} = 0.0017$$

Therefore, production is limited to 0.17% of DOA

Scenario #2 Off Target Production Penalty Waiver



- Can apply before drilling
- Application includes:
 - Map with well locations
 - Letter of consent from the registered owner of the off setting lease (of same formation)
- Waiver conditional upon consent from ownership of the off-setting P&NG rights

Scenario #3 No Completion in the Off Target Zone



- Complete on either side of the off target zone

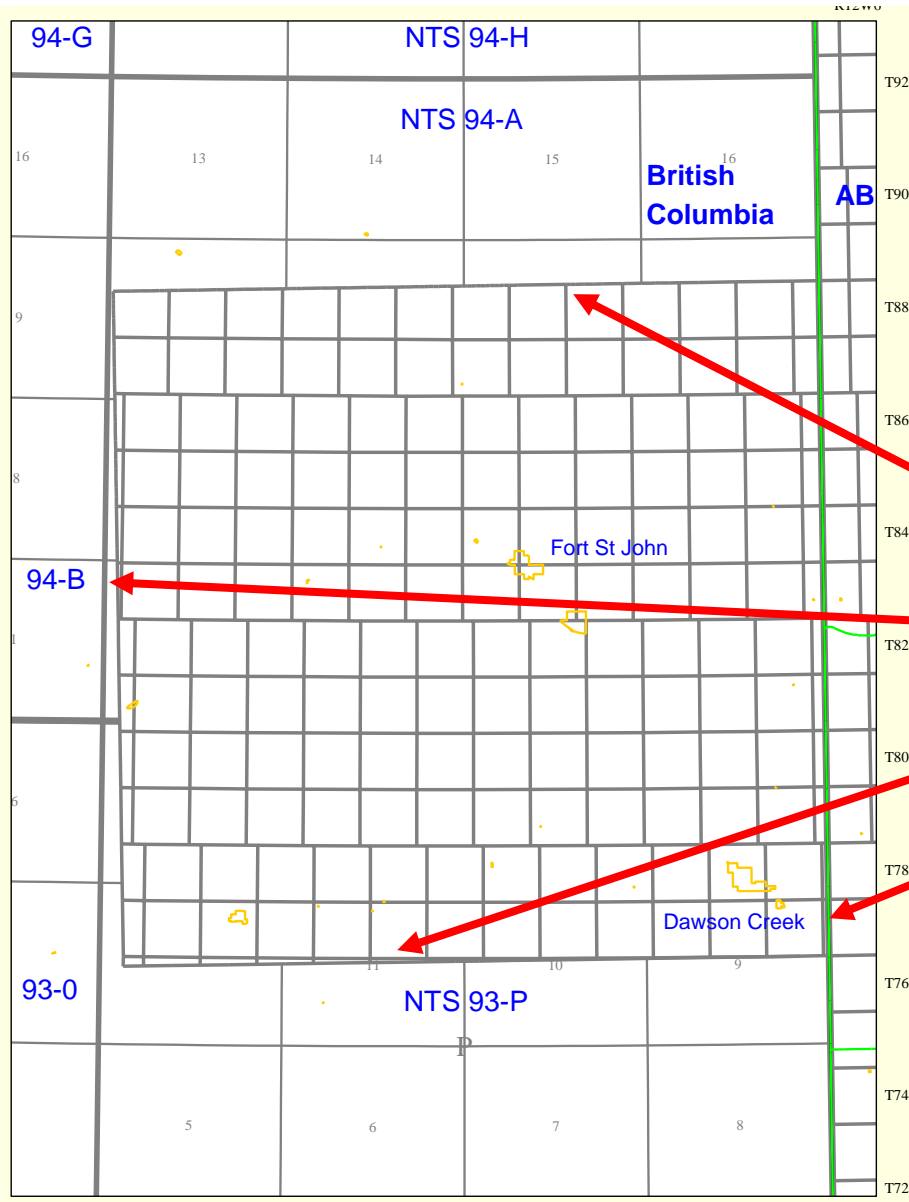


6.0 - Other Than Normal (OTN) Spacing

Section 65.1 of the Petroleum and Natural Gas Act

- ◆ Used for individual well “exceptional cases”, generally larger than normal spacing considerations (area down-spacing achieved under GEP approval).
 - ◆ DLS-NTS survey border - fractional units and sections combined (maps available – www.crownpub.bc.ca, items GM14 & GM15).
 - ◆ AB-BC border – gas spacing enlarged to 6 units.
 - ◆ Fractional spacing due to Park boundary? - apply to Min of Energy.
 - ◆ Horizontal well with open-hole section transecting 2 or more spacing areas (in non-GEP area)? - apply to the Regulator.
- ◆ Target area specified in OTN Approval.

Other Than Normal Spacing

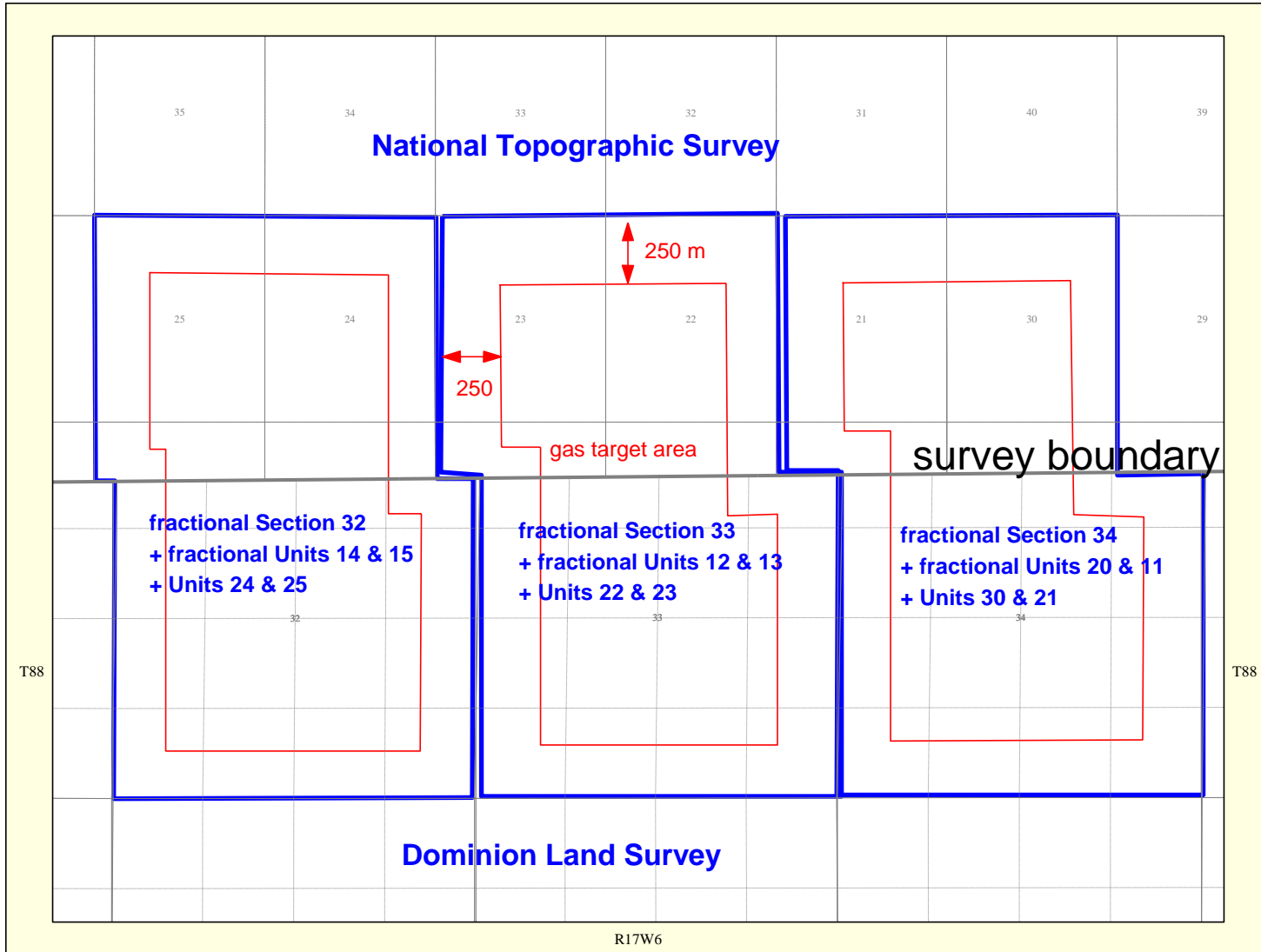


Referred to as the “Peace River Block”, a portion of BC is surveyed under the Dominion Land Survey.

Size ~ 75 miles EW X ~ 72 miles NS

Other Than Normal Spacing Areas at border of 2 survey systems and at BC-AB border

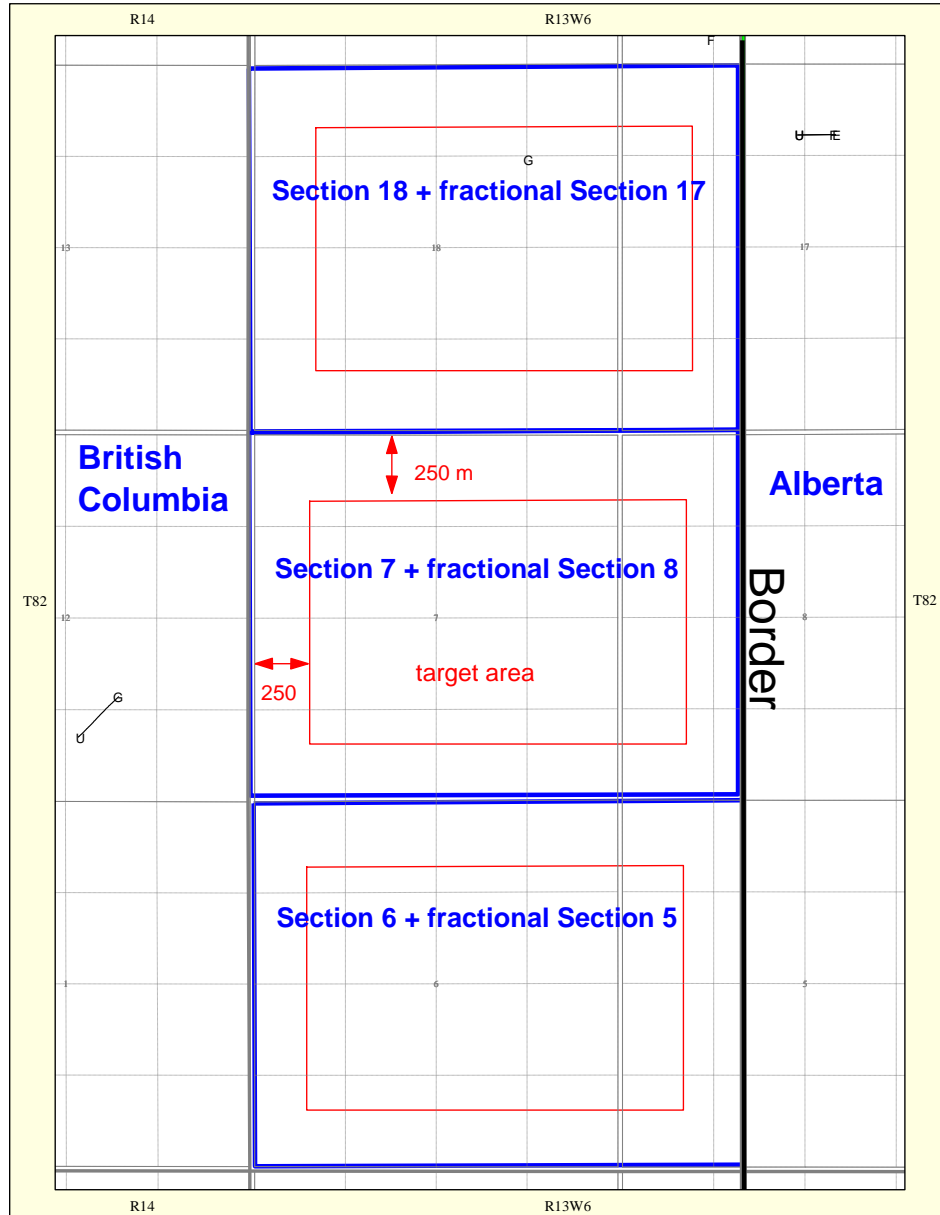
Other Than Normal Spacing - Survey



Fractional sections and units are joined in a pre-determined pattern.

Area up to 150% the size of a normal gas spacing area.

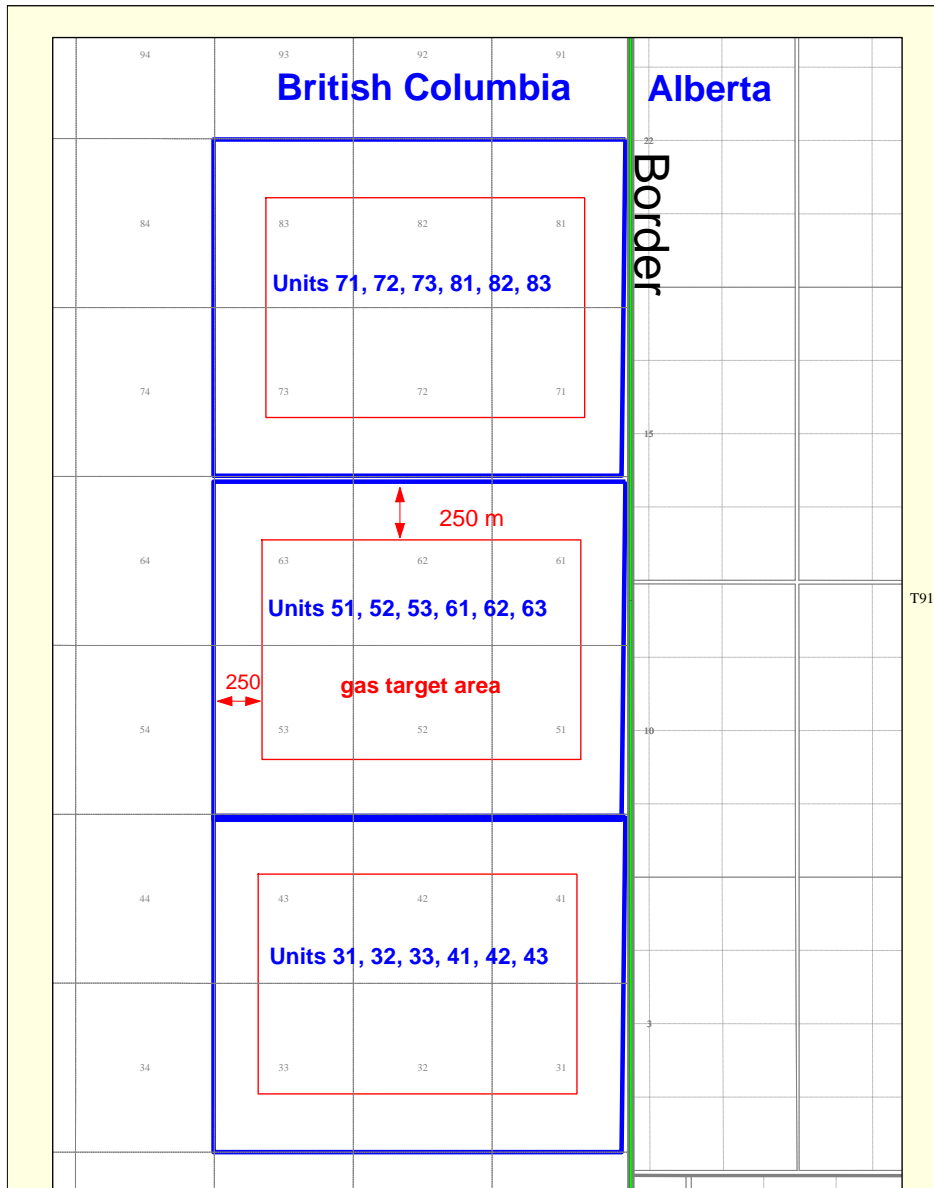
Other Than Normal Spacing - Border



Dominion Land Survey
along BC-AB border.

Fractional sections are included with full section to the west for Other Than Normal Gas Spacing areas.

Other Than Normal Spacing - Border



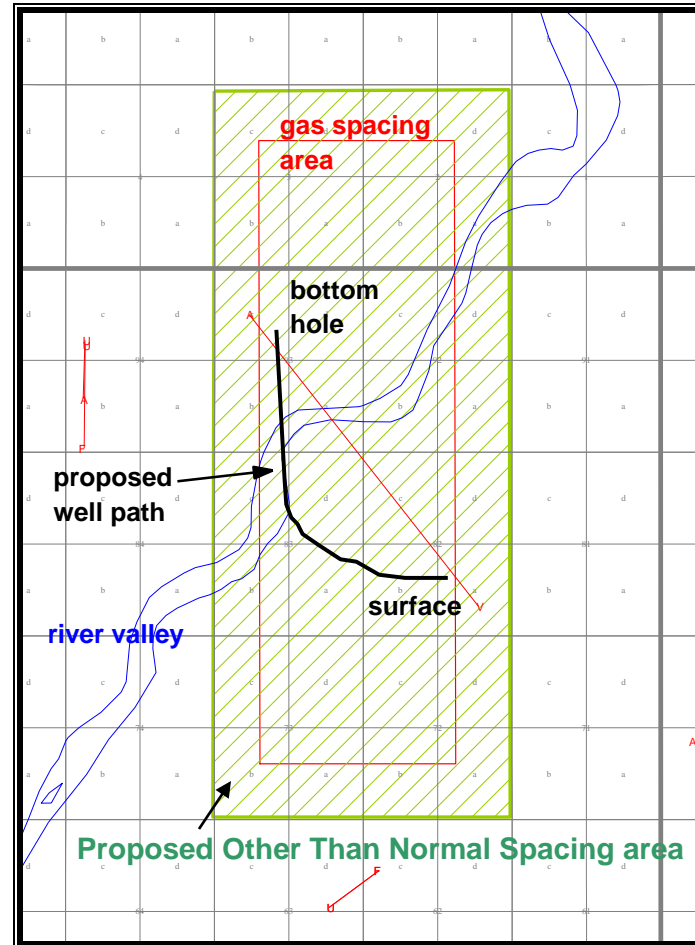
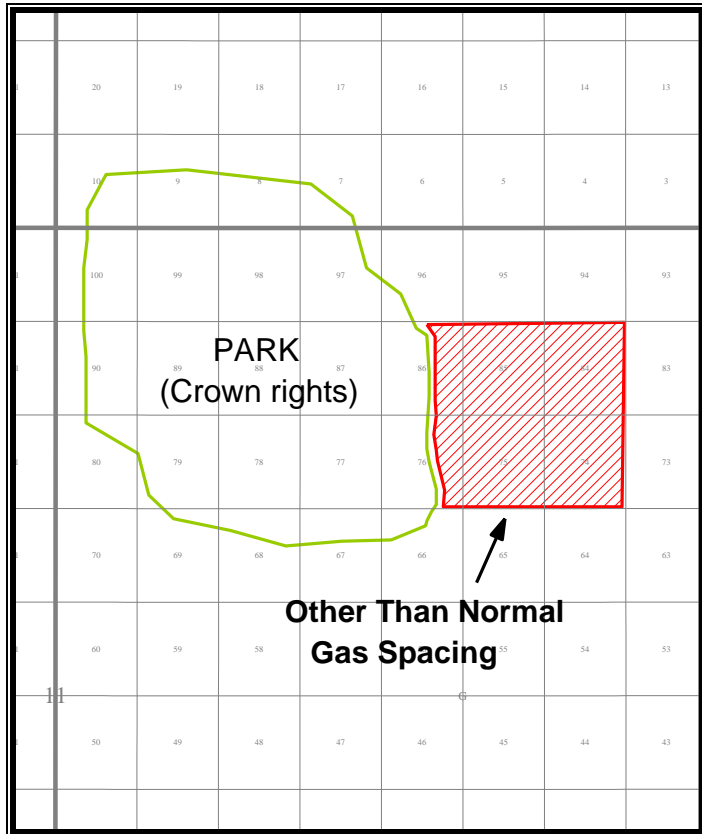
National Topographic Survey system (NTS) along BC-AB border.

Six Units constitute the Other Than Normal Gas Spacing areas.

Other Than Normal Spacing - Examples

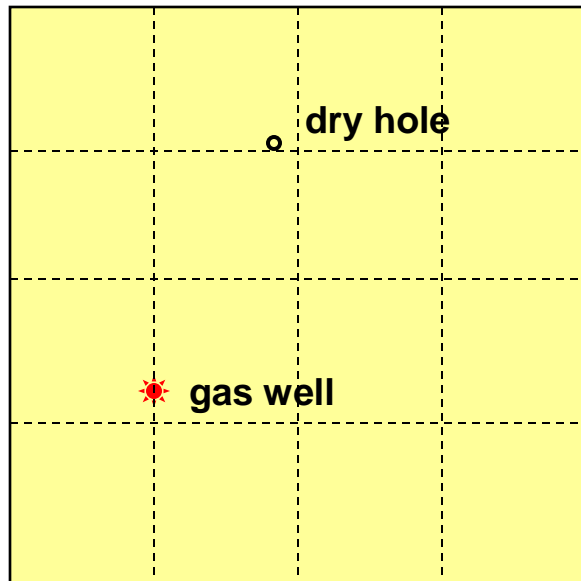
Fractional spacing due to Park boundary? - apply to MEM

Horizontal well with open-hole section transecting 2 or more spacing areas (in non-GEP area)? - apply to the Regulator



Other Than Normal Spacing

The Regulator will not approve a reduced spacing area based on a dry hole!



one section gas spacing

- ◆ The Regulator assumes pool extends over portions of each quarter section.
- ◆ In example, request for $\frac{1}{2}$ section gas Other Than Normal Spacing denied.

7.0 - Production Allowables



Daily Oil Allowables (DOA)

- Required for all individual oil wells outside of an approved project.
- Unadjusted DOA (UDOA) automatically assigned based on lowest completed depth (TVD):
 - $\text{depth to base of completion (m TVD)} \div 100 = \text{UDOA}$
i.e. $\text{UDOA} = 1694.7 \text{ mTVD} \div 100 = 16.9 \text{ m}^3/\text{d}$
- No application required, simply note on BC-11 “Notification of Commencement or Suspension of Operations” form for a new oil well.
- $\text{UDOA} \geq 10 \text{ m}^3/\text{day}$ (before any off-target penalty)
- $\text{DOA} = \text{UDOA} \times \text{GOR adjustment factor}$
- Initial test period provides opportunity for rate-sensitivity testing etc.
- Monthly reporting requirement.
- “Daily production limit” = 125% of allowable.
- No modifying factor for HZ wells.

Daily Oil Allowable (DOA)



REQUEST FOR PERMIT AMENDMENT: DAILY OIL ALLOWABLE (DOA) Form

Email Address: EnergyInfo@bc-er.ca

Phone: (250) 419-4400
Fax: (250) 419-4402

Form may be submitted to the BC Energy Regulator under the authority of Section 3(4) of the Oil and Gas Activities Act S.B.C. 2008, c. 38 electronically via email at EnergyInfo@bc-er.ca. Information collected on this form will be used for public record in accordance with Part 2 of the Oil and Gas Activities Act General Regulation.

Amendment No. _____

Well Name:			WIA No.:		
Field:			Pool:		
			PERMIT HOLDER'S CALCULATIONS		BCER USE ONLY
Factors		Units	Date Obtained from:	Values Used in This Calculation:	DOA Calculation:
Depth to top of pay		mfb			
Depth to bottom of pay		mfb			
Average net pay thickness	h	meters			
Average net porosity	φ	10%			
Average water saturation	C	25%			
Average shrinkage	S	0.75			
Recovery factor	R	20%			
Expected uniform rate life	L	10 years			
Assigned area	A	hectares			
Unadjusted Daily Oil Allowable = $(R) \left(\frac{h}{10} \right) \left(\frac{100 - C}{75} \right) \left(\frac{S}{0.75} \right) \left(\frac{R}{20} \right) \left(\frac{A}{31.00} \right) = \text{m}^3/\text{d}$					
Name:			Position:		
Signature:			Permit Holder:		
Date:	Phone:		Email:		
BCER USE ONLY					
UNADJUSTED DAILY OIL ALLOWABLE _____			OFF-TARGET PENALTY FACTOR _____ = _____ m ³ /d		
Field:			Pool:		
Amendment Date:					

Application form

- May apply to Regulator for volumetric reserve-based allowable if higher than depth-based allowable.
- Use Regulator form “Request for Permit Amendment – Daily Oil Allowable”
- Assume 10 year constant rate life recovery
- Form available from www.bc-er.ca under:
 - Industry Zone
 - Documentation
 - Reservoir Engineering
 - Production Allowables

Daily Gas Allowables (DGA)

- Not required for the majority of wells, only applies if:
 - ✓ off-target penalty
 - ✓ water drive pool (Slave Pt/Keg River)
 - ✓ gascap
 - ✓ retrograde condensate
- Based on initial pool pressure, not at time of application.
- Minimum value = $60 \times 10^3 \text{m}^3/\text{d}$ (~2 mmscf/d), before any off-target penalty.
- “Daily production limit” = 125% of allowable.

Daily Gas Allowable (DGA)

Application form

- Reserves-based calculation formula.
- Use Regulator form “Application for Daily Gas Allowable”
- With off-target factor, can estimate penalized allowable prior to drilling, well may still be economical.
- Form available from www.bc-er.ca



BCER
BRITISH COLUMBIA ENERGY REGULATOR

**DAILY OIL ALLOWABLE (DOA)
APPLICATION – Project**

Mailing Address: PO BOX 50311 STN PROXY
VICTORIA BC, V8T 9K2
Phone: (250) 419-4400
Fax: (250) 419-4402

Physical Location: 2550 Juleland Road
Victoria BC, V8T 9K2
Phone: (250) 419-4400
Fax: (250) 419-4402

Date Received

Form must be submitted under the authority of the s to the BC Energy Regulator, at the address noted above. Information collected on this form will be used for public record in accordance with Part 2 of the Oil and Gas Activities Act General Regulation

☐ Initial Application
 ☐ Revision No. _____

Unit, Project or Location Name:			WA No.:	
Field:			Pool:	
Factors	Units	Owner's Calculations		BCER USE ONLY Branch Calculations
		Values Obtained from	Values Used in This Calculation	
Average net pay thickness	h	100%		
Average net porosity	φ	10%		
Average water saturation	c	25%		
Average Shrinkage	S	0.75		
Recovery factor	R	20%		
Expected uniform rate life	L	10 Years		
Total area	A	hectares		
Unadjusted Daily Oil Allowable = $(\%) \left(\frac{\phi}{10} \right) \left(\frac{100 - c}{100} \right) \left(\frac{S}{0.75} \right) \left(\frac{R}{20} \right) \left(\frac{A}{2.55} \right) = \text{m}^3/\text{d}$				
Name:		Position:		
Signature:		Permit Holder:		
Date:	Phone:	Fax:	Email:	
FOR BCER USE ONLY				
Off-target penalty factor		Daily gas allowable		10 ³ m ³
<small>(minimum UDGA is in accordance with Section 54 of the Drilling and Production Regulation)</small>				
Date Effective				
Field		Pool		
Date				

OGC 038_DGA Rev.05/05
 Authorized BCER Employee
59070-CO/WA

8.0 - Reservoir Projects



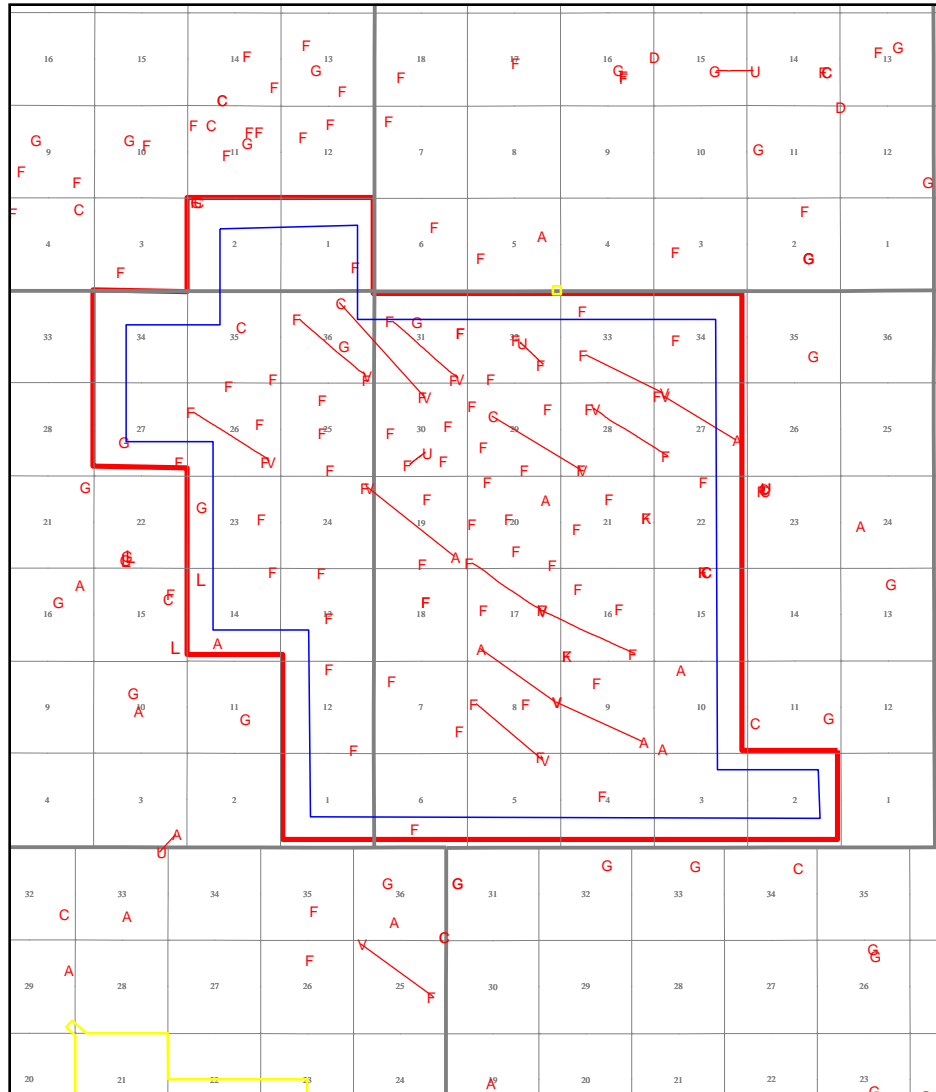
9 Types Of Projects

- | | | |
|--------------|---------------|----------------|
| 1. GEP | 4. Concurrent | 7. Storage |
| 2. Pressure | 5. Innovative | 8. Unitization |
| Maintenance | 6. Disposal | 9. Pooling |
| 3. Commingle | Wells | |

Special Project - Good Engineering Practice (GEP)

- ◆ Allow a pool (or portion) to be exploited without well spacing & target restrictions, i.e. “super” target area.
- ◆ Effective for “downspacing” or areas of horizontal drilling.
- ◆ No inter-well minimum distance specified,
Regulator expects economics and geology to dictate.
- ◆ Applies to oil *or* gas pools, approval is field/pool specific.
- ◆ Usually applied for area of common interest, but not a requirement.
- ◆ Single project allowable for the sum of all wells in project area:
 - for gas, usually waived
 - for oil, to encourage low GOR well production
- ◆ Individual allowable(s) may be applied to lease-line wells.
- ◆ For oil, often a first step before waterflood.

Special Project - Good Engineering Practice (GEP)



Example gas pool under GEP approval
(contiguous full spacing areas)

- off-target locations
- HZ wells crossing multiple spacing areas
- increased density

**Regulator requires evidence that
“downspacing” will result in increased
recovery, not just recovery acceleration.
(production decline vs. volumetric)**

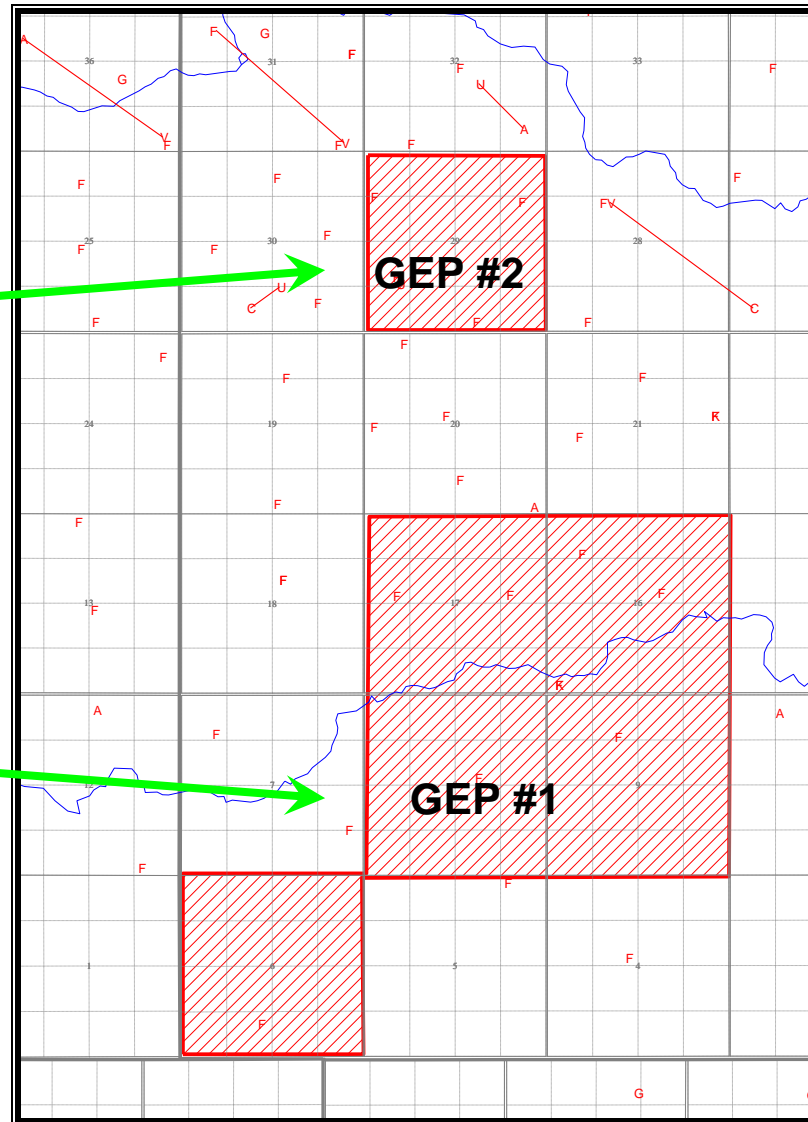
**However, in recognized unconventional
resources, detailed engineering not
required.**

Special Project - Good Engineering Practice (GEP)

non-contiguous
area receives
separate approval

contiguous lands
single approval

Both areas may be included
in a single application if for
the same pool.

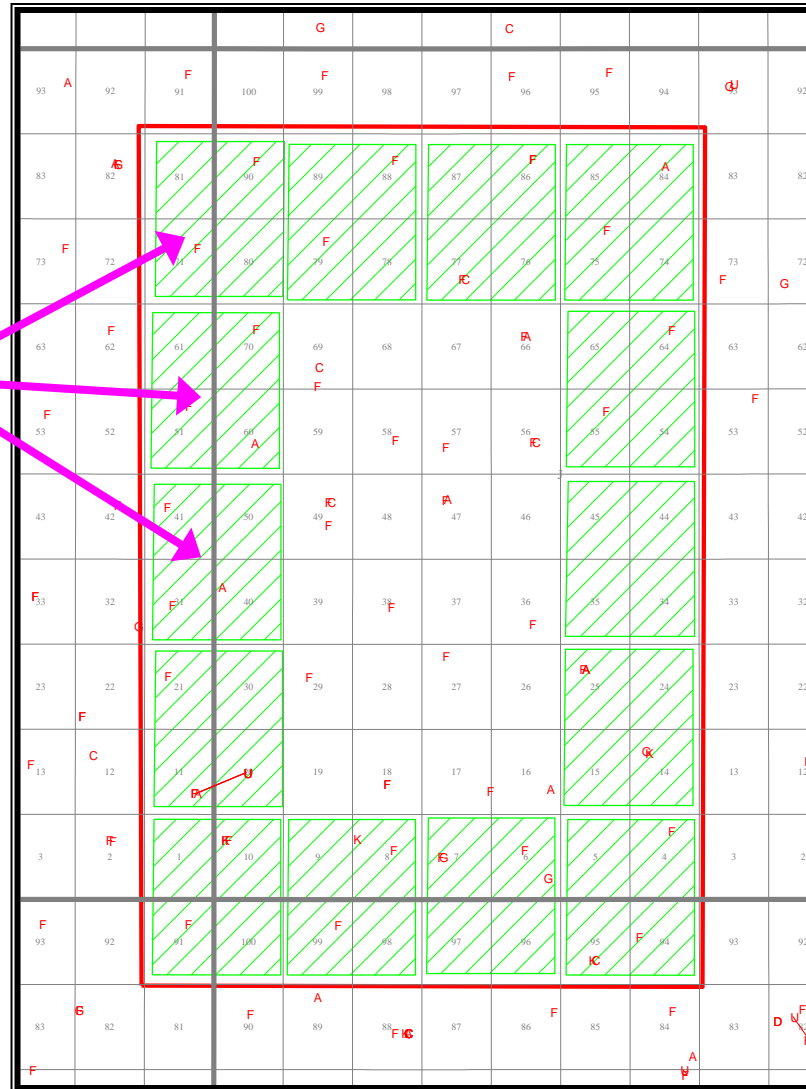


Special Project - Good Engineering Practice (GEP)

Individual allowable(s) may be applied to lease-line locations, based on objection(s) received.

GAS POOL GEP

Production from each of these gas spacing areas may be limited to a daily gas restriction
(example 60 e³m³/d)

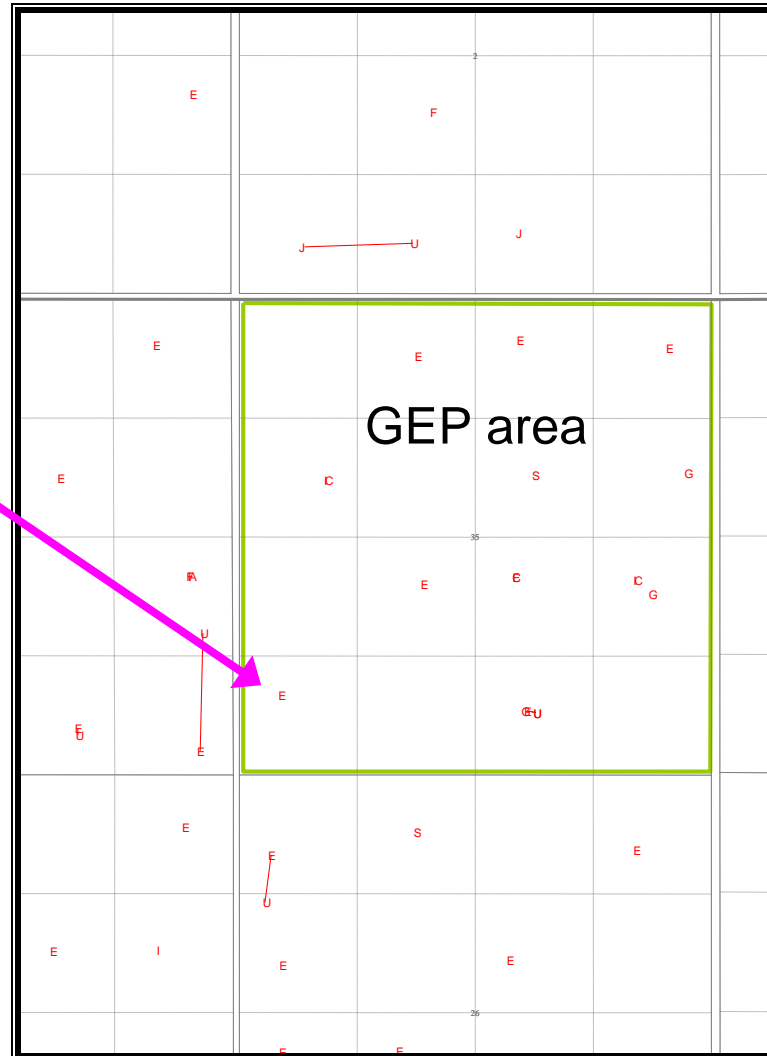


Special Project - Good Engineering Practice (GEP)

Individual allowable(s) may be applied to lease-line locations, based on objection(s) received.

OIL POOL GEP

Oil production may be limited by an individual DOA for this well



Special Project - Good Engineering Practice (GEP)

- ◆ Pooling agreement required to produce incomplete gas spacing areas.
- ◆ GEP areas range in size from one gas spacing to hundreds.
- ◆ GEP may be approved for land held under a Drilling Licence, provision that PNG Lease selection made prior to production.

Note: see February 2007 edition of
CAPL magazine “The Negotiator”
for detailed article on GEPs.

Special Project (Reservoir Project) Application

Guidelines for specific application types available at www.bc-er.ca



Reservoir Engineering Department
2950 Juliard Road
Victoria, B.C. V8T 5K2

Phone: (250) 419-4400
Fax: (250) 419-4403
24-hour: (250) 794-5200

GOOD ENGINEERING PRACTICE AREA APPLICATION GUIDELINE

The approval of a Good Engineering Practice (GEP) area, a Special Project under Section 75 of the Energy Resource Activities Act, recognizes the permit holder's intention to locate, complete and operate wells so as to optimize resource recovery while minimizing surface impacts. A GEP Order is normally accompanied by an Other Than Normal Spacing Order, issued under Section 65.1(2) of the Petroleum and Natural Gas Act, removing individual well spacing and target area restrictions. GEPs are area and formation specific. For oil, a single project production allowable, subject to Gas-Oil Ratio (GOR) adjustment, may be taken from any one or combination of wells. For gas, only wells subject to an off-target penalty are normally subject to a production allowable restriction under GEPs.

An application for a GEP Order should include, when applicable:

- A legal description of the area and the designation of the pool for which the application is made.

MAPS

- A map of the area referenced in the application, identifying the title holders within the area and within adjacent title holdings.
- A map of the status and completion intervals for all wells in the pool.

GEOLOGY

- A discussion of the geology of the pool, including relevant cross-sections, structural contour and isopach maps with details of top and base porosity, fluid-interface elevations, average porosity, water saturation and permeability.
- A discussion of reservoir rock and fluid properties including estimates of original hydrocarbon volumes in place per spacing area and for the project as a whole.

DEVELOPMENT

- A discussion of the proposed method of producing the area, including a prediction of rate-time performance, ultimate recovery of hydrocarbons and a comparison to recovery without a GEP Order.
- Development plans with timing and prospective drilling locations, including a discussion of limitations and risks that may inhibit the development of the acreage. (Indicate if confidentiality is required.)
- Prospective completion designs; that is, length of lateral, type of fracture treatment, size of each treatment, fracture spacing and well spacing. (Indicate if confidentiality is required.)

TABLES/GRAPHS Include Well Authorization (WA) numbers.

- A general discussion of the history and development of the area, including:
 - A table of completion details.
 - A table of production for each well with gas-liquid and water-oil ratios, and initial and last production dates.
 - Graphical presentation of the production histories for all wells in the area, including production rates and cumulative volumes with appropriate gas-liquid and water-oil ratios.
- A discussion of the pressure history of the pool, including a table and graphical history.

Special Projects – including GEP

- ◆ Notice of application posted on Regulator website; 3 week period for objections to be filed.
- ◆ Decision if objection is valid at discretion of Regulator, but applicant allowed to respond, no hearing process.
- ◆ Regulator requires Letters of Consent from all registered lease owners (example letter on website).
- ◆ Approval subject to specified conditions. Two parts:
 - approval of Special Project, section 75 of ERAA.
 - approval of Other Than Normal Spacing, section 65.1 of PNG Act.
- ◆ Approvals transfer to new operator.

Special Project – Consent Letters

Fictitious Oil Company Limited

200, 300 – 4th Ave SW
Calgary, AB T2P 2T2

October 24, 2006

BC Energy Regulator
Resource Conservation Branch
PO Box 9329
Stn Prov Gov't
Victoria BC V8 9N3

Attention Ron Stefik:

RE: Consent to Application for Good Engineering Practice

Please be advised the Fictitious Oil Company Limited, as a registered tenure owner of:

Petroleum and Natural Gas Lease(s) # 1234, 2345 and 3456,

hereby consents to inclusion of those lands within the application made by Serendipity Oil Company Limited, dated October 23, 2006, for Good Engineering Practice for the Lucky field Bluesky “A” pool.

Sincerely,

Signed

Gus Gusher
Exploitation Engineer

- ◆ Usually applied for area of common interest, but not a requirement.
- ◆ **Consent letter(s)** required from all registered lease owners, including brokers. (100% of lease ownership must provide consent. Even if the split is 90% A and 10% B. Projects are not “majority rules”.)

example letter on website

Special Project – GEP Approval

2 part approval
1)GEP Order
2)OTN Order

pool specific
area description

IN THE MATTER of an application from Storm Gas Resource Corp. to the Regulator dated January 20, 2011 for a Good Engineering Practice project.

ORDER 11-06-0011

1. Under Section 75(1)(a) of the *Energy Resource Activities Act*, the Horn River field – Muskwa-Otter Park and Evie formations is designated as a special project for the enhanced recovery of natural gas utilizing Good Engineering Practice within the following area;

NTS 94-O-08	Block I – unit 91
NTS 94-O-09	Block A – units 1, 11, 21
NTS 94-P-05	Block K – units 40, 50, 60, 70
	Block L – units 31, 41, 51, 54-57, 61, 64-67, 72-77, 82-87, 92-100
NTS 94-P-12	Block C – units 20, 30, 40, 50
	Block D – units 2-11, 14-21, 24-33, 41-43, 52, 53, 62 and 63.

waiver of well spacing & targets and specifies reduced setbacks

IN THE MATTER of an application from Storm Gas Resource Corp. to the Regulator dated January 20, 2011 for Other Than Normal Spacing.

ORDER 11-06-0011-OTN

1. Under Section 65.1(2) of the *Petroleum and Natural Gas Act*, Other Than Normal Spacing is approved within the regional Horn River field Muskwa-Otter Park and Evie formations within the following area;

NTS 94-O-08	Block I – unit 91
NTS 94-O-09	Block A – units 1, 11, 21
NTS 94-P-05	Block K – units 40, 50, 60, 70
	Block L – units 31, 41, 51, 54-57, 61, 64-67, 72-77, 82-87, 92-100
NTS 94-P-12	Block C – units 20, 30, 40, 50
	Block D – units 2-11, 14-21, 24-33, 41-43, 52, 53, 62 and 63.

1. Under section 65.1(3) of the *Petroleum and Natural Gas Act*, I specify the following:

- a) the target area for a gas well completed within the project area is not nearer than 100 m to the sides of the Other Than Normal Spacing area,
- b) a gas well completed outside the specified target area may be subject to an off-target production penalty,
- c) gas wells drilled within the specified project area are not subject to spacing requirements.

Good Engineering Practice (GEP)- Amendments

- ♦ GEP approval may be amended at any time (example - add additional area).
- ♦ Amendment application is required.
- ♦ Usually a simple process.
- ♦ Amendment applications may be advertised, similar to initial application, to allow review and comment from potentially affected tenure holders.

GEP's and Unconventional Zones



Section 7 of the Drilling & Production Regulation has been amended by adding the following:

(5) Subsections 1 (*normal well spacing*), 2 (*single well per spacing*), and 3 (*off-target penalty factor*) do not apply to the completed portion of a well producing from an unconventional zone listed in Schedule 2.

(6) A well permit holder may not produce from a well in an unconventional zone listed in Schedule 2 if a completed portion of the wellbore is located closer than the distance listed in Schedule 2 for that zone to land with respect to which the well permit holder

- (a) is not the owner of the petroleum and natural gas rights or the holder of the location, or
- (b) does not have an agreement with the owner or holder respecting the production.

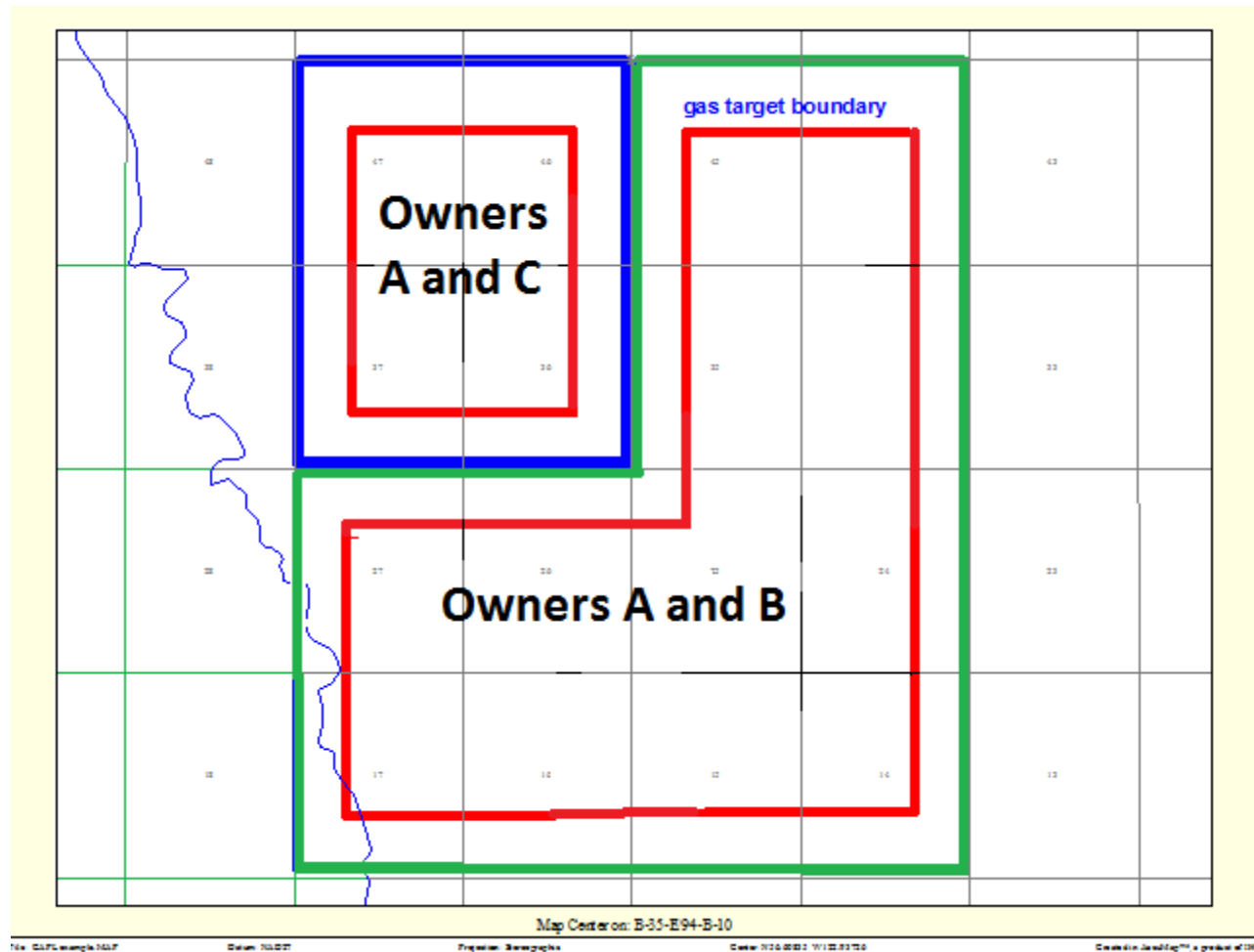
GEP's and Unconventional Zones



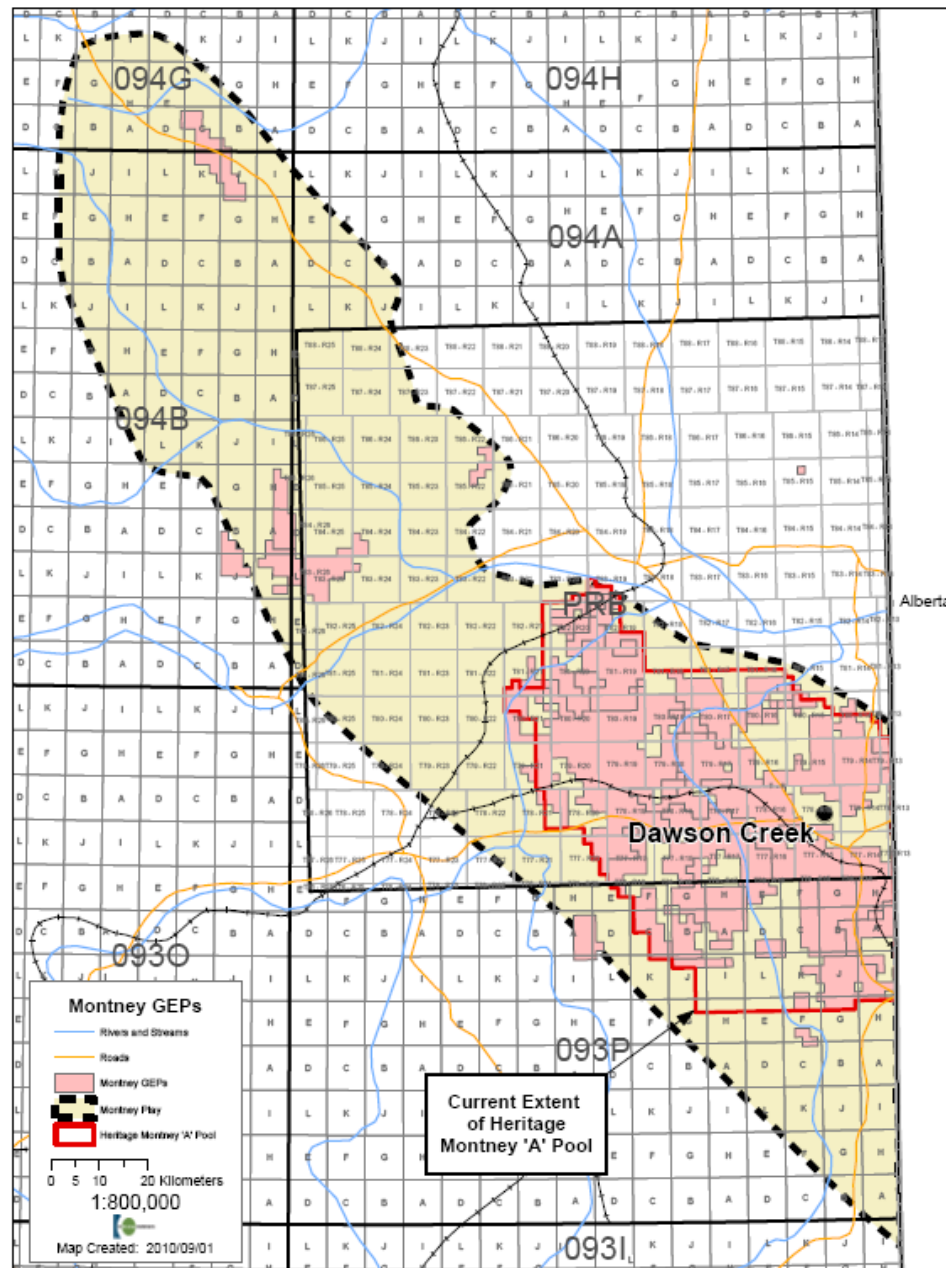
Since normal gas well spacing no longer applies to defined unconventional zones, Good Engineering Practice special project approval and the associated Other Than Normal Spacing order are no longer required for increased well density or horizontal wells crossing multiple spacing areas in these designated zones.

- ◆ **Areas of contiguous land blocks of ownership** may be developed to the boundary of the outer gas target areas with well density and orientation to recover resources while minimizing surface disturbances.
- ◆ A well completed outside the enlarged target area may not be produced, unless the permit holder has the rights, or consent of the rights holder, of the affected off-setting lands.
- ◆ Existing GEP and OTN orders within unconventional zones remain in effect, but any future changes to these projects do not require amendment applications to be submitted.

Example of GEP and Unconventional Spacing Target



Montney Play - GEP approval areas



Other Special Project Approvals

Reservoir project approvals other than GEP may contain conditions that **modify normal spacing/target requirements**.

Pressure Maintenance (waterflood/gas injection)

- ◆ Allow operator to inject water/natural gas into an oil pool to improve recovery.

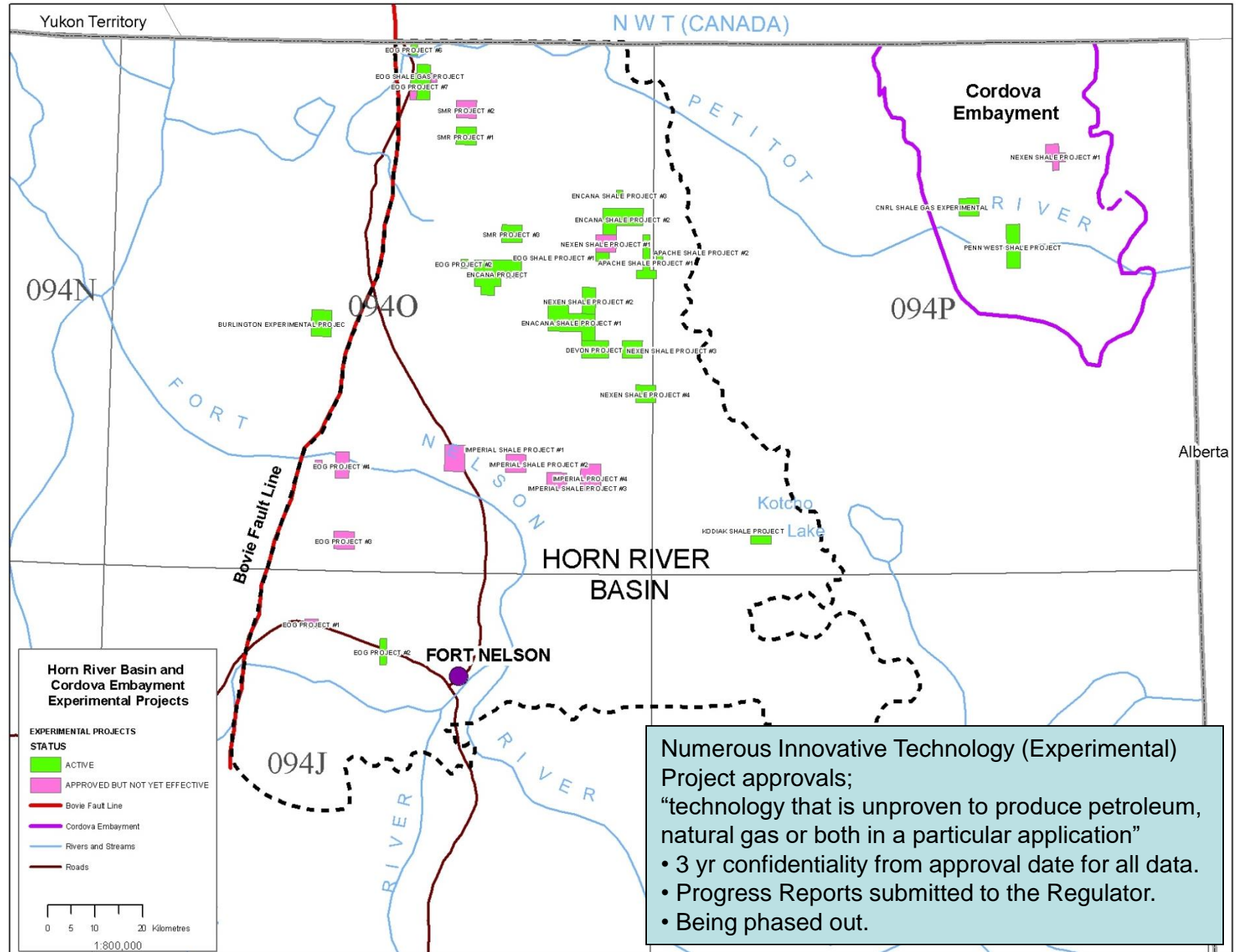
Concurrent Production

- ◆ Allow simultaneous oil and gas cap production, often applied for “gassy” oil production.

Innovative Technology Special Project (experimental)

- ◆ 3-year confidential period applies to data, starting from date of project approval.

Horn River Basin – Shale Gas



Numerous Innovative Technology (Experimental) Project approvals;
 “technology that is unproven to produce petroleum, natural gas or both in a particular application”

- 3 yr confidentiality from approval date for all data.
- Progress Reports submitted to the Regulator.
- Being phased out.

Approved Disposal Wells

Summary Document – Water Source, Injection and Disposal wells
(http://bc-er.ca/industry-zone/documentation/Reservoir_Engineering/Subsurface-Disposal)

Salt water and nonhazardous waste disposal

- ◆ Must control P&NG rights to ¼ section or 1 unit.

Acid gas (H₂S and CO₂) disposal

- ◆ Must control P&NG rights to full gas spacing area, 1 section or 4 units.

Note: inactive wells (no disposal reported for over 1 year) may be reviewed for lease continuation.

New standards for disposal well applications

<http://www.bcogc.ca/industry-zone/documentation/Subsurface-Disposal>

Water Source Wells

Source zones may be shallow Quaternary gravels or deep zones with non-potable saline water.

Water source wells traditionally for waterflood of oil pools.

Presently, provide water for “slick water” fracture stimulation of unconventional resources (Horn River shale or Montney tight).

- ◆ Do NOT require ownership of P&NG rights.
- ◆ HOWEVER, Water Sustainability Act may make changes for licensing of source wells.

Note : some source wells have produced sufficient associated gas to change status to gas well, require rights to full section.

Underground Gas Storage

- ◆ Application for Storage Licence required (*PNG Act, Part 14*).
- ◆ Licence is transferable.
- ◆ 4 gas storage pools presently in B.C.

<u>Field</u>	<u>Pool</u>	<u>Approval Date</u>
Aitken Creek	Gething "A"	July 24, 1984
Noel	Basal Bluesky "B"	March 11, 1997
Aitken Creek North	Bluesky "A"	August 27, 1999
Drake	A Marker/Base of Lime "A"	September 6, 2001

Note: large scale CO ₂ sequestration projects will be considered storage.
--

9.0 - Forced Pooling

- ♦ Tenure is usually composed of full gas spacing areas, no pooling required.
- ♦ Where tenure was issued based on oil spacing (1/4 section lease), pooling of the full section is required to produce natural gas as the primary product.
- ♦ Operator must control full spacing area to produce, but may licence a well, drill and test on portion of spacing they control.
- ♦ If tenure owners are unable to reach a pooling agreement, Ministry of Energy, Mines, and Low Carbon Innovation can enforce an agreement. Historically this has been rare in B.C.
- ♦ All pooling agreements must be registered with the Ministry, Titles Branch.

Forced Pooling

Petroleum and Natural Gas Act

Part 8 — Pooling of Locations

Section 68 Pooling of locations to operate spacing areas

(1) Two or more holders of locations in a spacing area may pool their locations for purposes of joint development of the spacing area or joint operation of a well in the spacing area, or both.

(2) If locations are not pooled by agreement, the minister, either on the minister's own initiative or on application by a holder, may invite submissions from interested parties for the purpose of determining whether or not the locations should be pooled.

(3) After reviewing the submissions, the minister may refuse to make an order, or the minister may

(a) order that the locations, or parts of the locations, as the minister may designate, be pooled,

(b) order, subject to the *Energy Resource Activities Act*, that a well be drilled and operated, or, if drilled, that it be operated,

(c) designate a person the minister considers appropriate for the purpose of carrying out an order, designation or requirement under this section,

(d) specify the proportions in which holders share petroleum and natural gas produced,

(e) specify the proportions in which holders share the costs of drilling, operating and abandoning the well, and

(f) specify the manner and time in which, and the conditions subject to which, petroleum and natural gas produced from the pooled locations must be sold.

(4) If locations are pooled, the drilling, operating and abandoning of the well, and the production of petroleum and natural gas from the well, are deemed to be carried out, in the proportions referred to in the pooling agreement or order, on the location of each holder.

(5) The minister may make a pooling agreement on behalf of the government on the terms the minister believes proper.

Unitization

Sections 114 & 115 of the Petroleum and Natural Gas Act

- ♦ Signed by Minister of Energy, Mines and Low Carbon Innovation.
- ♦ Allows continuation of lands, down to the base of the unitized zone, even if no well in spacing area.
- ♦ Final Unit Agreement must be registered with Ministry of Energy Mines and Low Carbon Innovation - Titles Branch, copy on file and updates submitted as required.
- ♦ Also submit Unit Operating Agreement.
- ♦ Not referenced in the Drilling and Production Regulation, separate GEP or waterflood approval required!
- ♦ Regulator advisory capacity, unit area conforms to mapped pool.
- ♦ Royalty “tract factors” no longer apply for newly created units, royalties are UWI specific.

Unitization – Petroleum and Natural Gas Act

Unit agreement

114 (1) The minister may, on behalf of the government, enter into a unitization agreement for the unitized operation of a field, pool or storage reservoir, or a part of any of them, and on its execution the unitization agreement is, subject to compliance with any applicable requirements under section 75 of the *Energy Resource Activities Act*, and other relevant provisions of this Act, binding on all parties to it, including the government.

(2) Section 117 does not apply to an agreement entered into under this section.

Unitization order

115 (1) On receiving an application for a unitization order from a working interest owner or group of working interest owners who have agreed in writing to a proposed plan of unit operations, the minister may invite submissions from interested persons to consider the advisability or necessity for an agreement.

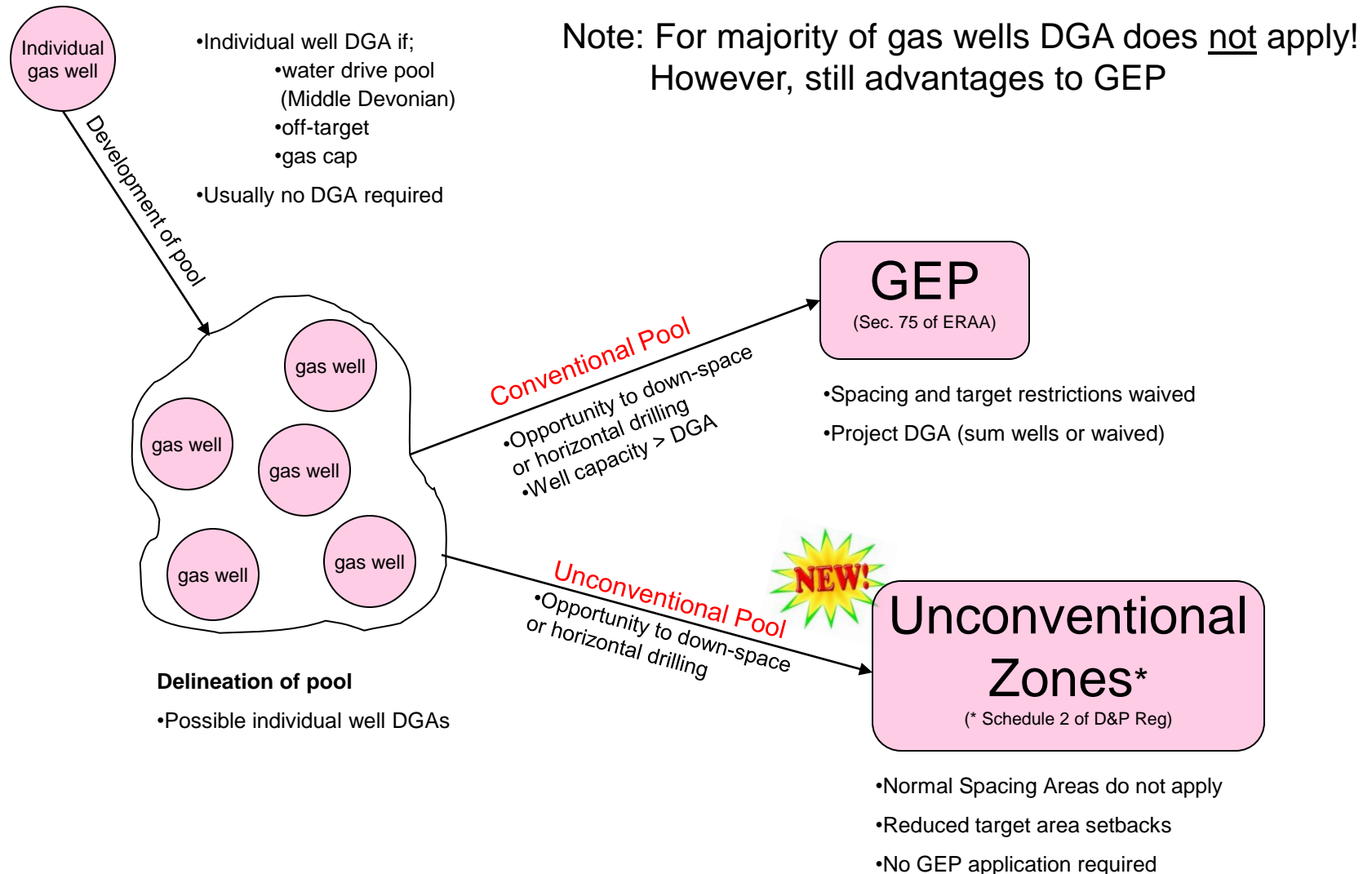
(2) After reviewing the submissions, the minister may reject the application or make a unitization order requiring that the plan of unitized operations proposed by the applicant be applicable to all of the proposed unit area, or any smaller area the minister determines, and on the making of the order it is binding on all owners of interests in the unit area.

10.0 - Presentation Summary

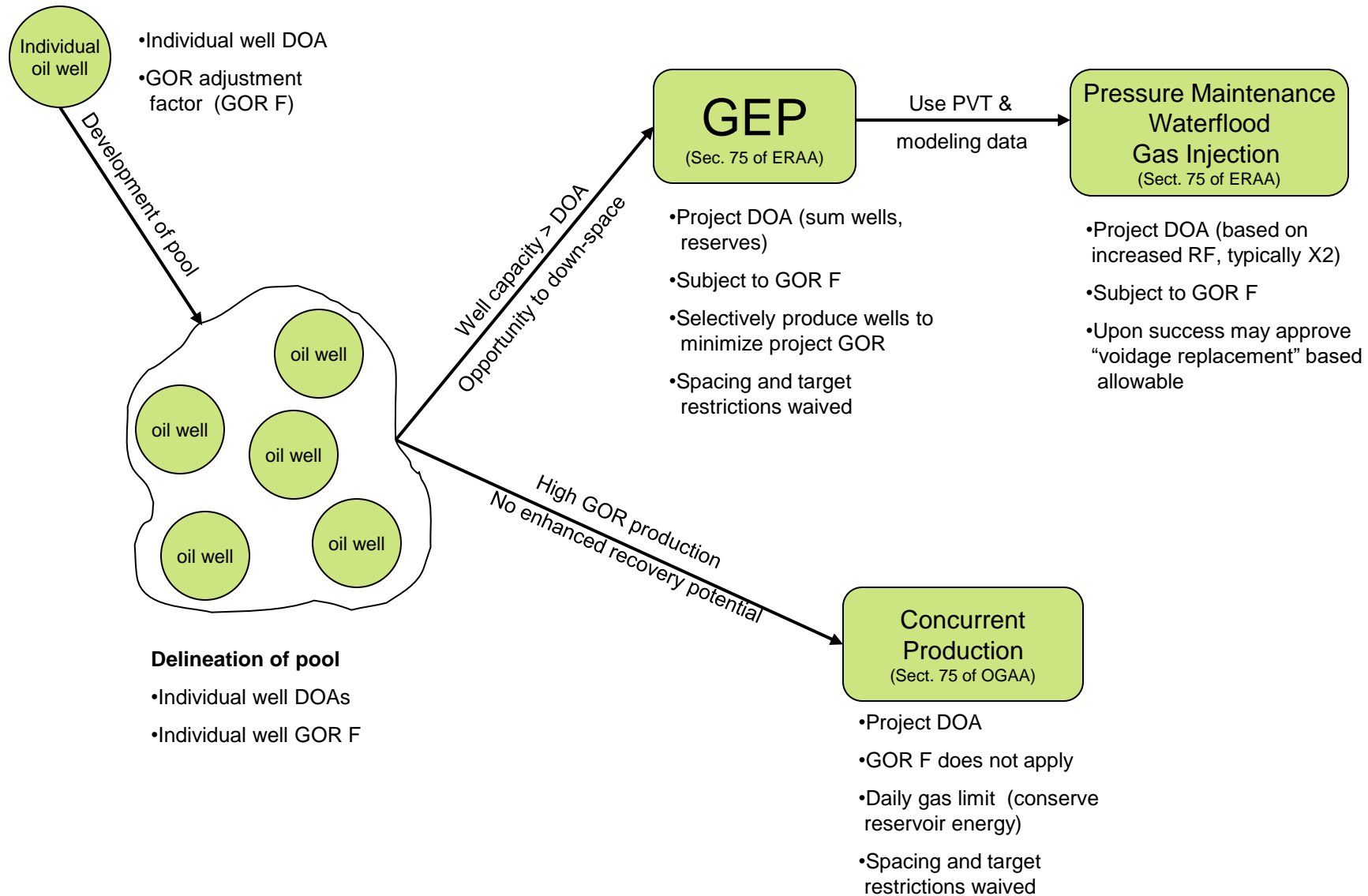


Peace River Valley, near Fort St. John

Life of a Gas Pool



Life of an Oil Pool



Project and Well Data Access

❖ Reservoir projects (including GEP) data files:

- Web Applications
 - Data downloads – will prompt to create password
 - ***'Drilling Data for all wells in B.C.'*** – csv file for Excel

❖ For past Project approvals:

- Industry Zone
 - Reservoir Application
 - Approvals

❖ For past Project applications:

- Regulator Well Data Request Form (<https://www.bc-er.ca/contact/well-data-request-form/>)

The Regulator has digital shape files for GIS systems, also digitizing pool net pay maps and pool designation areas.

Questions or Further Information

reservoir@bc-er.ca

Conclusion



The Regulator is approachable and flexible.
Review of applications are given high priority.

Questions?