AGENDA

- Low Probability Receptor Approach

- Pilot Project – Weyburn SK

- Pilot Project - First Nations

- Demonstration

WHAT IS LPR?

Remediation to protect absent receptors always leads to net negative environmental outcome

Landscape is stable in many parts of Alberta, probability of certain receptors is very low

LPR includes assessment of probability of receptor occurrence over the lifetime of contaminant impacts

Probability of Water Well Map
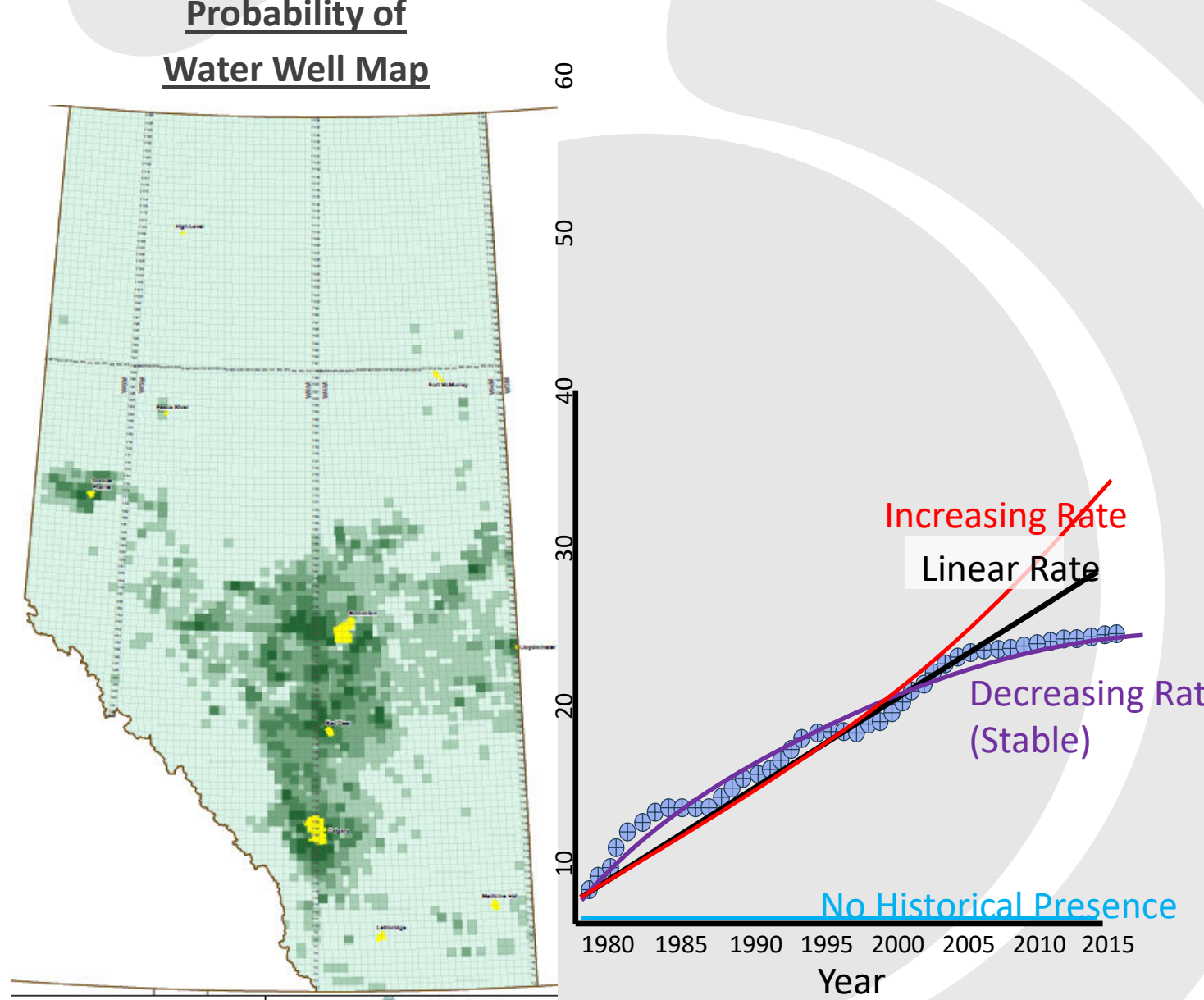
GOALS OF LPR

Accelerate redevelopment of select O&G assets and/or

Increase local level economic prospects

Environmental management decisions which can:

Maintain equivalent levels of protection while reducing impacts on the environment

Reduce risk of human health impacts

Reduce further environmental disturbance

Reduce costs and timelines to achieve remediation and reclamation

Fully maintain reasonable use of the land

LPR - NET BENEFIT ANALYSIS

- "More remediation" is not always better

- In the absence of an adverse effect to human or ecological receptors, remediation causes more disturbance but does not "protect" better.

- Net Benefit Analysis of LPR site-specific performance on 5 case studies:

  - Environment: **40% improved environmental protection** (impacts to soil water & air quality)

  - Social: **80% improved social reaction** (reduced impacts to human health, improved community satisfaction, stakeholder consideration) Economic: **50% reduced costs** (direct and indirect cost reductions)

SASKATCHEWAN RISK-BASED AOR PROCESS

- Saskatchewan framework has existing similarities with LPR
  - Tier 2 pathway elimination
  - PNG045 (sodium chloride-impacted sites)
- Consideration of net environmental benefit
- LPR validates process

October 13, 2022

KEY LEARNINGS

- Landowners/stakeholders understand and support
  - Agreements with landowners/land stewards required to manage low probability receptor occurrence
- Consistent framework of application
  - Standardization of analysis/interpretation
  - Landscape impact
  - Tracking/documentation

PILOT PROJECT – WEYBURN SK

Whitecap Resources Ltd./MER

WHITECAP CO$_2$ WEYBURN FIELD

- Canada's First Largescale CO$_2$ Sequestration/Enhanced Oil Recovery Project

- Approximately 40 sites selected within the area for potential closure

- Phase 2s were Available

- Minimal impacts reported

- SOPCs varied between PHCs Produced Water products and Combinations

UPSTREAM PILOT REVIEW

- Reviewed 40 Well Sites

  - Southern SK

  - Screening Sites to apply LPR

  - RenuWell Energy Solutions Inc. (RESI)

  - Opportunity for AOR

  - Integration of solar energy production

- Tier 1 Evaluations were available for sites

  - Limited Data

  - Potential candidate sites were screened through criteria

  - Criteria developed on the basis of site characteristics
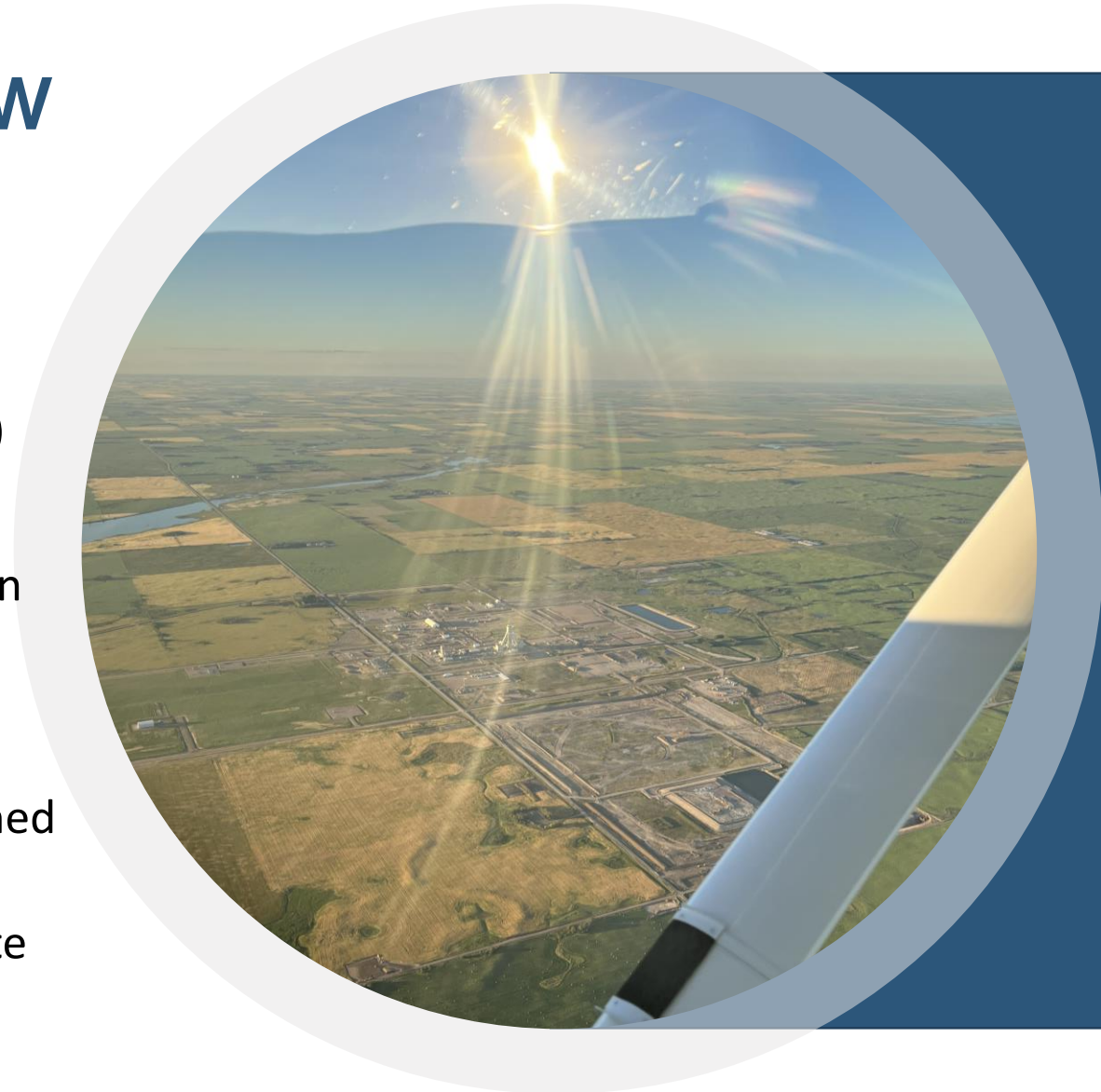
SELECTED CRITERIA

1 **Agricultural Land Capacity**
- Used Saskatchewan Soil Information System (SIS) classes
- Selected for low agricultural capability for solar use

2 **SOPC Evaluation**
- Ranked according to Tier 1 guidelines & background values
- Selected for sites where standard options may be insufficient to address SOPCs

3 **Receptor Evaluation**
- Appropriate SOPCs with no or limited receptors 500m from the site

SUMMARY OF CRITERIA & SELECTED SITES

Solar & LPR/AOR

- SOPC above Tier 1/background values; Limited by DUA pathways, livestock
- No surface water within 500m
- Low risk of water well/dugout construction
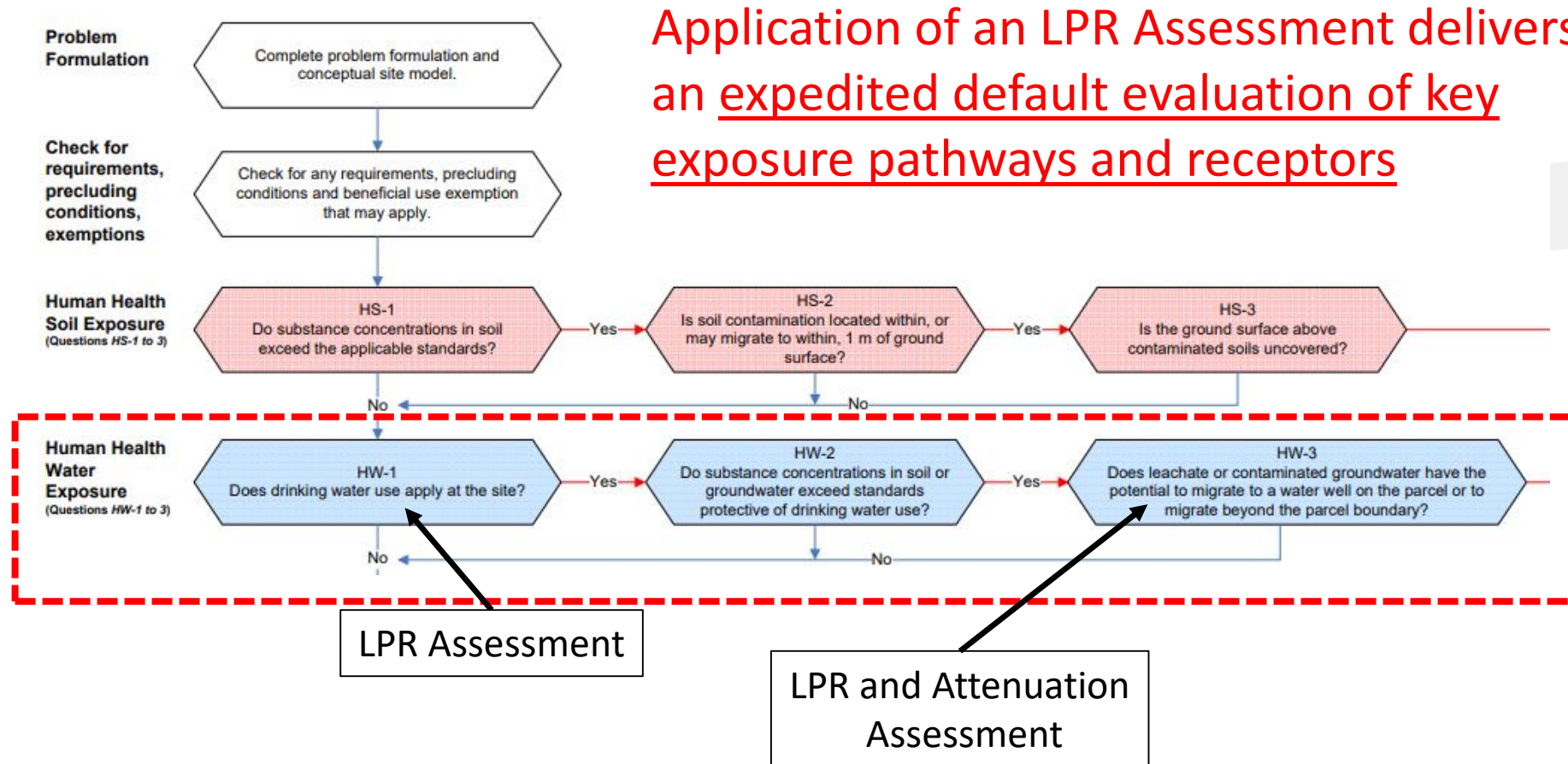- Agricultural productivity imitations

Solar Alone

- Severe limitations for Agricultural productivity
- SOPC marginally exceed background concentrations
- Some had proximity to significant receptors

LPR/AOR

- SOPC above Tier 1/background values; Limited by DUA pathways, livestock
- No surface water within 500m
- Low risk of water well/dugout construction

LPR ASSESSMENT METHODS – *SCREENING LEVEL RA*

Application of an LPR Assessment delivers an <u>expedited default evaluation of key exposure pathways and receptors</u>

LPR - BENEFITS

- "More remediation" is not always better

- Looking for prediction of adverse impact

- Community Investment Perspective

- Net Benefit Analysis of LPR site-specific performance on 5 case studies:

  - Environment: **40% improved environmental protection** (impacts to soil water & air quality)

  - Social: **80% improved social reaction** (reduced impacts to human health, improved community satisfaction, stakeholder consideration) Economic: **50% reduced costs** (direct and indirect cost reductions)

LANDOWNER/STAKEHOLDER ENGAGEMENT

- Whitecap – MER Understanding of risk based endpoints

- Workshop Opportunity to Educate

- Landowner Engagement

- Community Benefit Analysis

- Solar Energy – Contribution to Net Zero

CRITERIA 1 AGRICULTURAL CLASSIFICATION

Criteria 1	
Ranking	**Meaning**
1	Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.
2	Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices.
3	Soils in this class have severe limitations that restrict the range of crops or require special conservation practices, or both.
4	Soils in this class have very severe limitations that restrict their use to the production of native or tame species of perennial forage crops. Improvement practices are feasible.
5	Soils in this class are capable of producing native forage crops only. Improvement practices are not feasible.
6	Soils in this class have no capability for arable agriculture or permanent pasture.

CRITERIA 2 – SOPC / COPC RANKING

Criteria 2	
Ranking	**Meaning**
0	Maximum concentration of degradable/dilute COPCs is below background value (<186)
1	Low concentrations of degradable/dilute COPCs (marginal exceedance from background)
2	Moderate concentrations of degradable/dilute COPCs (exceedances can be addressed)
3	High concentrations of degradable/dilute COPCs (>7,000 mg/kg)
4	Contains COPCs that do not degrade or dilute

CRITERIA 3 – RECEPTOR EVALUATION

Criteria 3	
Ranking	**Meaning**
1	Site has 0 receptors
2	Site has 1 receptor
3	Site has 2 receptors
4	Site has 3 receptors

OUTPUT OF SELECTED LPR FUTURE PROBABILITY

LPR Township Range	Water Well Probability (%/acre/annum)				Dugout Probability (%/acre/annum)	Sum of Probability
	Depth 0m – 10 m	Depth 10m – 20m	Depth 20m – 30m	Depth >30m		
T06R13	9.91E-06	2.77E-05	8.34E-06	3.79E-05	3.27E-04	0.000410705
T06R12	2.09E-05	9.84E-06	1.97E-05	1.78E-05	1.00E-08	6.82335E-05
T06R12	2.09E-05	9.84E-06	1.97E-05	1.78E-05	1.00E-08	6.82335E-05
T04R1					1.00E-08	0.00000001
T06R13	9.91E-06	2.77E-05	8.34E-06	3.79E-05	1.00E-08	8.38574E-05
T05R32	1.41E-05	1.15E-05	2.48E-06	6.42E-06	1.00E-08	3.4535E-05
T06R14	5.97E-05	4.92E-05	1.36E-05	2.22E-05	1.00E-08	0.000144746
T06R12	2.09E-05	9.84E-06	1.97E-05	1.78E-05	1.00E-08	6.82335E-05

OVERALL OUTPUT – SITE CLASSIFICATION

Group	Meaning
A	Both Solar and LPR Applicable
B	Only Solar Applicable
C	Only LPR Applicable
D	Neither Solar nor LPR Applicable

EVALUATION

Group	No. of Sites	Percent of Pilot
A – Solar and LPR	7	18%
B – Only Solar	5	13%
C – Only LPR	8	21%
D – Additional Assessment/RA	19	49%

- 31% could be used for Solar Alternative Energy Source

- 39% Qualify for AOR through LPR

- <50% Would require additional ESA

NEXT STEPS

- Develop AOR submissions for the LPR Applicable Sites

- Identify sites optimized for solar only for application to SaskPower (Renu/Canada Solar)

- Run LPR for Solar developments – complete Community Benefit Analyses and Stakeholder Acceptance

- Remaining sites – use risk based planning to collect data for asset information management (AIM); consider identification of adverse effects for adaptive management planning

FIRST NATIONS CONSULTATION

CASE STUDY - FIRST NATIONS

- Site with deep salt impacts
- First Nations plan is to redevelop land for commercial use with supplied water
- Remediation based on unconditional land use including protection of domestic use of groundwater:
  - Not feasible in desired timeframe
  - Logistically difficult
- Reclamation to original land use (agricultural) and then commercial redevelopment is impractical
- Remediation based on future land use and receptors and direct redevelopment
- Net benefit – economic, social, environmental

DIGITAL INTEGRATION

LPR Application at Demonstration Site

KEY CONSIDERATIONS

1) **Standardization of Analysis/Interpretation**
   - Standardized assessment outputs
   - Standardized models
   - Use of CCME/AB/SK/BC, etc. default parameters

2) **Influence of Landscapes on Probability Projections**
   - Local and regional topographical variability and their influence
   - Proximity to roads and infrastructure

3) **Digital Tracking and Documentation**
   - LPR analysis outputs
   - Integration of LPR outputs with data aggregators and data process engines
   - Access to information in the future

STANDARDIZATION OF ANALYSIS/INTERPRETATION

Standardized application of compliance objectives

Standardized CSM assessment:
- Chemicals of concern
- Concentrations
- Delineation
- Limiting pathways

STANDARDIZATION – NATURAL ATTENUATION MODELS

Regulatory accepted models.
Default values and assumptions.

Standardized outputs for:
- How big will the projected footprint be on the landscape?
- How long will the chemicals be present in the soil/groundwater at concentrations > compliance objectives?
- What are the projected concentrations at known receptor locations?

LPR ANALYSIS - OUTPUTS

Conceptual Site Model

Province
Alberta ▼

Land Use
Agricultural ▼

Soil Texture (< 3 m bgs)
Fine ▼

Subsoil Texture (> 3 m bgs)
Coarse ▼

Depth to groundwater (m bgs)
2.5

Topographical slope at Site
< 6% ▼
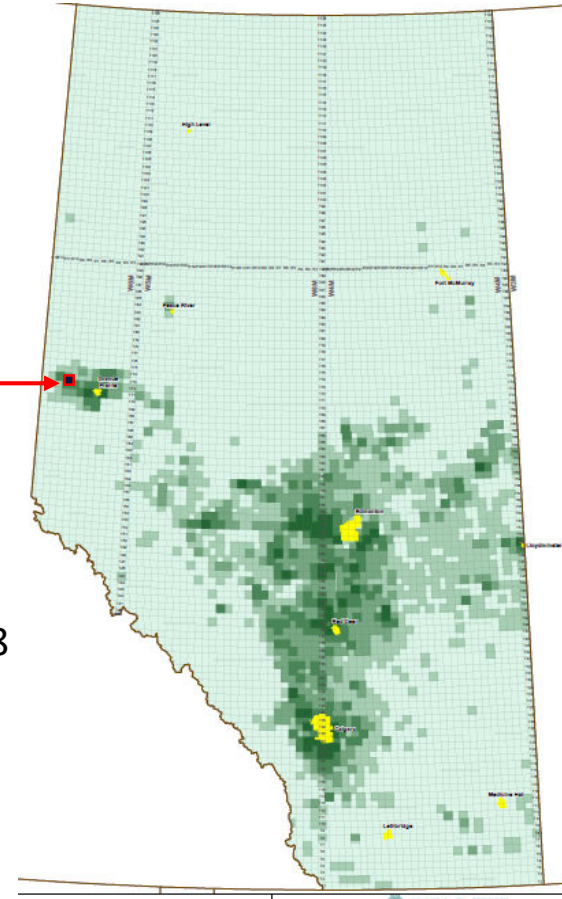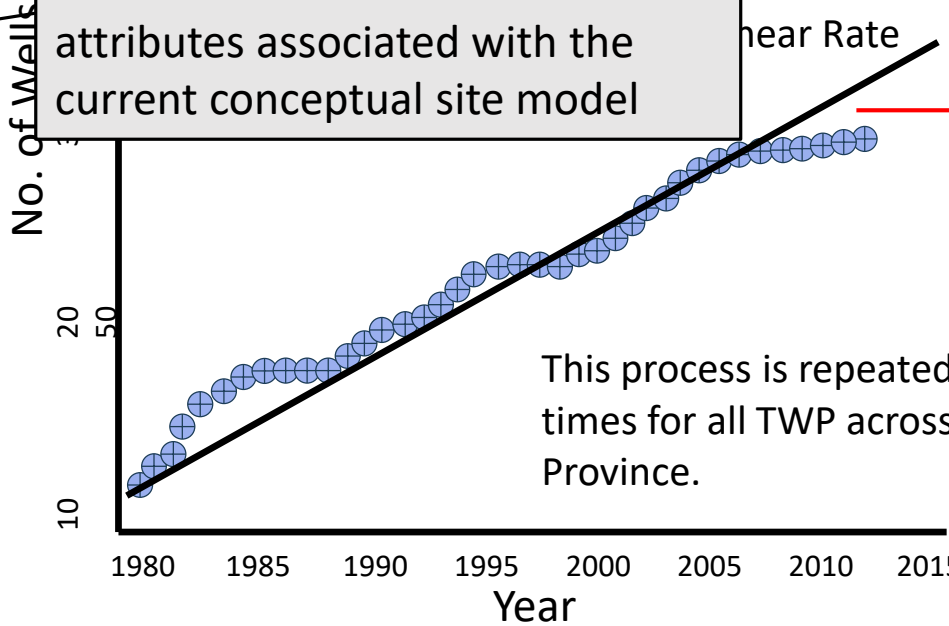
Distance of nearest road to Site
> 50 m ▼

Receptor Evaluation

Is there currently a domestic use water well within the footprint of the Site?
No ▼

Is there a dugout within the footprint of the Site?
No ▼

0.00400 %	0.00000 %	0.00300 %	0.03200 %	0.09300 %	0.29300 %
Dugout Time = 120 yrs	**Water Well (< 10 m bgs)** Time = 120 yrs	**Water Well (10 to < 20 m bgs)** Time = 120 yrs	**Water Well (20 to < 30 m bgs)** Time = 120 yrs	**Water Well (> 30 m bgs)** Time = 120 yrs	**Water Well (All depths)** Time = 120 yrs

Map

Regional linear probability projections are compiled to create a Province-wide water well probability mapping for wells installed to

Override the time and spatial characteristics as well as the attributes associated with the current conceptual site model
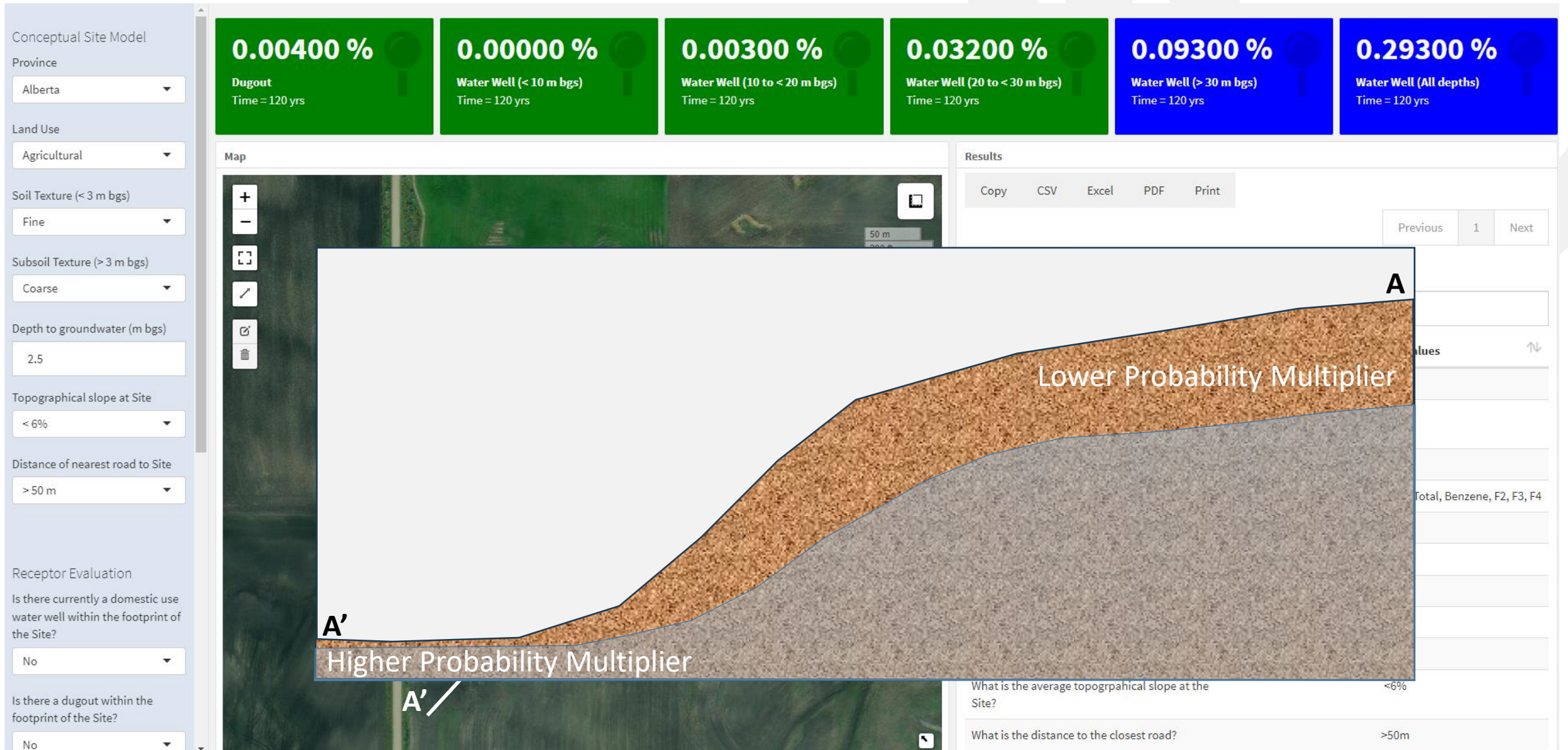
Linear Rate

This process is repeated 7,128 times for all TWP across the Province.

No. of Wells

Year
1980 1985 1990 1995 2000 2005 2010 2015

Next

Rate   F2, F3, F4

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INFLUENCE OF LANDSCAPES ON PROBABILITY PROJECTIONS

DIGITAL TRACKING AND INTEGRATION

LPR outputs are saved in a database and available to data aggregators and other data processing engines.
- Long-term tracking mechanism
- Access to Data

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- Whitecap Resources Inc.
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QUESTIONS AND ANSWERS

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