

# **The Use of Groundwater Vulnerability Mapping for Regional Risk Screening of Confined Feeding Operations in Alberta**



**Walter Ceroici and Jim McKinley**  
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# Presentation Outline

- Confined feeding operations (CFOs) and how they are regulated
- Overview of criteria used for the NRCB CFO risk-based compliance program
- Groundwater vulnerability mapping use
- Update on the CFO risk-based compliance program



# Confined Feeding Operation (CFO)

- Fenced or enclosed areas where livestock are confined for purpose of growing, finishing or breeding by means other than grazing
- Livestock includes cattle, horses, swine, poultry, etc.



# Confined Feeding Operation Distribution in Alberta





# Environmental Risk at CFOs

- Work commissioned by Alberta Agriculture on effects of manure storage on groundwater quality
- Environmental risk is generally low; however, however groundwater quality can be impacted by poor siting, and inappropriate manure handling and storage



# Regulation of CFOs

- *Agricultural Operation Practices Act* (AOPA) is the main legislation
- NRCB has been regulating CFOs in Alberta since January 1, 2002 (responsibility transferred from municipalities)
  - Issues permits for CFOs
  - Responds to non-compliance issues





# NRCB CFO Compliance

## Complaint-based

- The NRCB becomes aware of non-compliance issues from:
  - Public complaints (about 125 complaints per year)
    - By far, most complaints relate to odour
    - Vast majority of water complaints relate to surface water
  - Reporting requirements in AOPA permits
  - Referrals from other government agencies or municipalities



# **NRCB CFO Compliance**

## **Risk-based Compliance**

- Proactively identifies higher risk CFOs in high groundwater vulnerability areas
- Provides an education opportunity to inform operators on stewardship and AOPA requirements
- Appropriate use of scarce resources for numerous low risk operations
- Technique is used by other regulators for assessing compliance at large number, low risk operations/sites



# Risk-Based Compliance Program Criteria

**Does the operation have an liquid manure  
storage?**

- Used mainly by hog and dairy operations to manage liquid manure
- Lagoons are effective for removing manure solids
- Certain amount of natural sealing in lagoons
- Improper liquid manure storage has potential for impacting groundwater quality



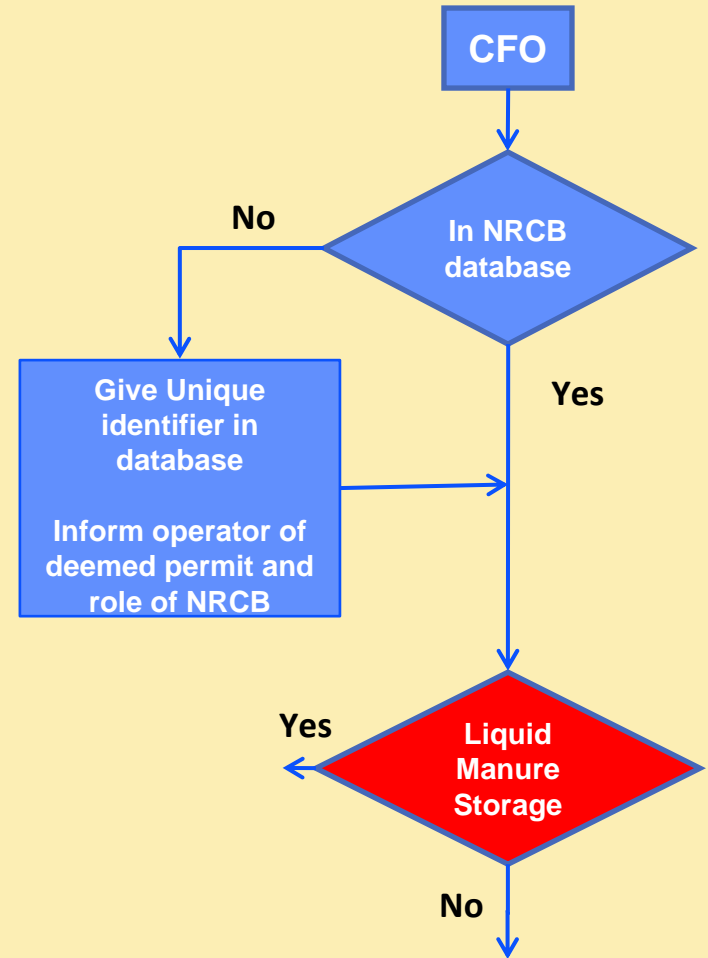








# NRCB Framework for Confined Feeding Operation (CFO) Compliance



environmental  
risk screening  
GW and SW

**Risk-based  
Compliance  
Inspections**

**Existing complaint  
based inspection program**



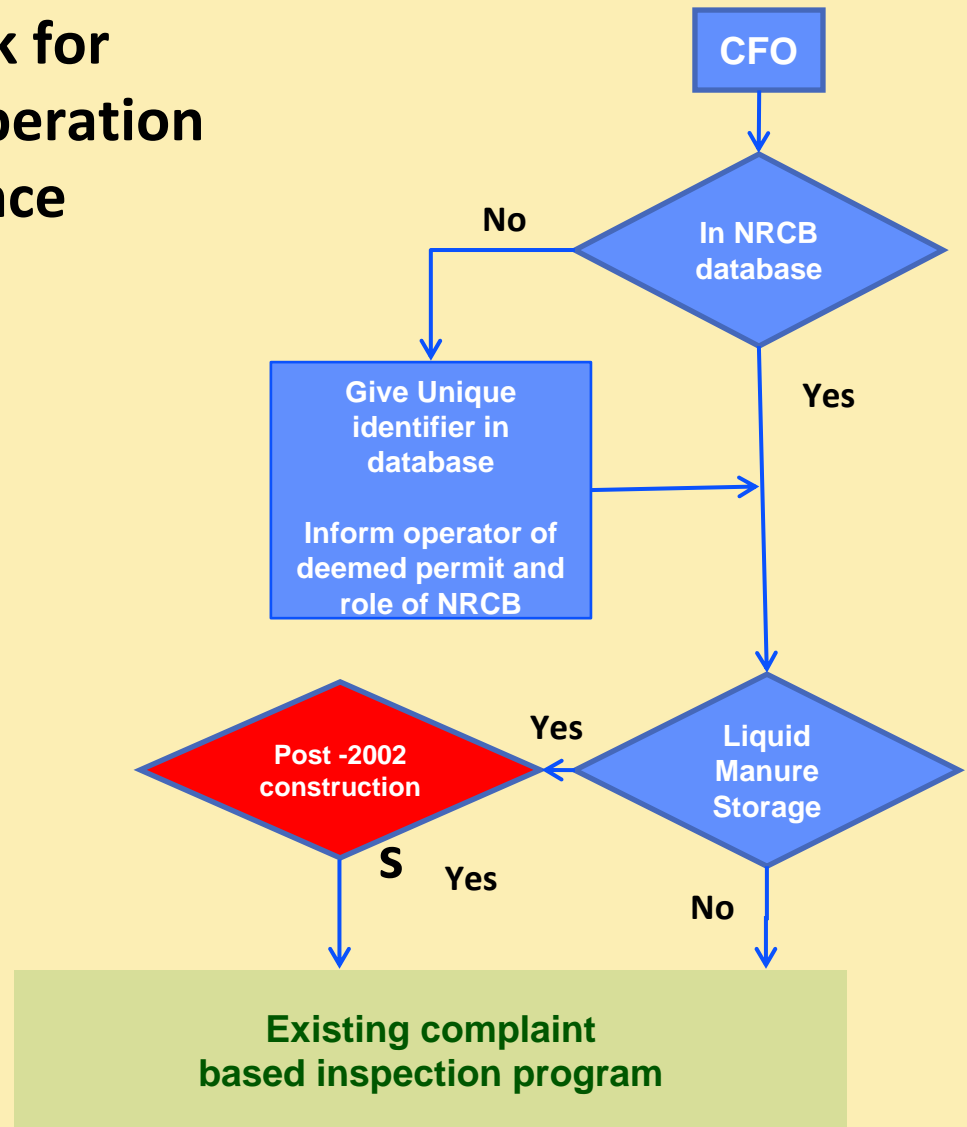
# **Risk-Based Compliance Program Criteria**

**Is the CFO older than 2002?**

- No specific provincial CFO legislation prior to 2002
  - AOPA came into force in 2002
- Older facilities not necessarily constructed according to AOPA requirements
- Significant advances in science knowledge and management practices since 2002



# NRCB Framework for Confined Feeding Operation (CFO) Compliance



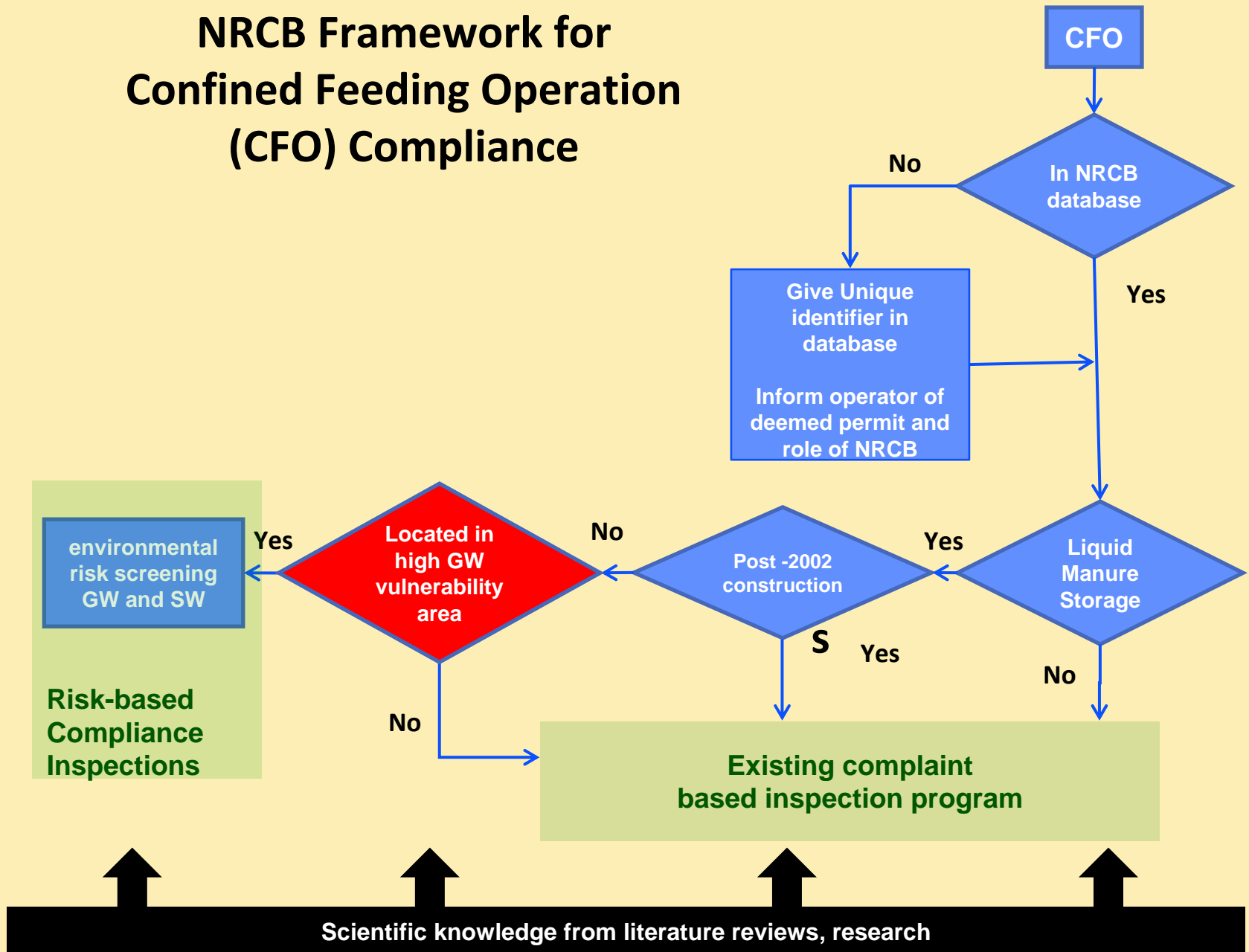
# Risk-Based Compliance Program Criteria

**Is the CFO located in a high groundwater  
vulnerability area?**

- Identifying high groundwater vulnerability areas is a challenge
- Conducted a search of available groundwater vulnerability information in Alberta
- Decided to use modification of an existing groundwater vulnerability map



# NRCB Framework for Confined Feeding Operation (CFO) Compliance



# Development of Groundwater Vulnerability (GV) Map

- Work on map began in 1998
  - Hog Environmental Management Strategy  
(Alberta Agriculture, Agri-Environmental Services Branch)
  - Land Use Committee of the Oldman River Basin Water Quality Initiative
- Target audience were rural municipalities because of day-to-day decisions on land use planning
- Draft report completed in 2001





# Groundwater Vulnerability (GV) Map Development Process

**Step 1** - A literature review of groundwater vulnerability mapping conducted in other jurisdictions

- Aquifer vulnerability index method was judged to be preferred
  - Relies on readily available well and test-hole data
  - Relative time for contaminant to reach the nearest to surface aquifer





# GV Map Development Process

**Step 2** - Reviewed Alberta Environment water well database and removed wells:

- With no lithology data
- That completely lack near-surface lithologic data
- With lithological descriptions that lack sufficient geological detail
  - Overall lithologic detail
  - Lack of shallow lithologic detail



# GV Map Development Process

**Step 3** - Convert lithologic data to general material type

**Step 4** – Assign representative hydraulic conductivity ( $k$ ) values to equivalent lithology

- $k$  values from literature, slug tests, estimations, etc
- Fracturing accounted for (decreases with depth)

# GV Map Development Process

**Step 5** – Calculate hydraulic resistance (c)

**Step 6** – Identify shallowest aquifer at each well location

- all coarse textured surficial layers >0.6 m and coarse bedrock layers >1.5 m
- Completion information

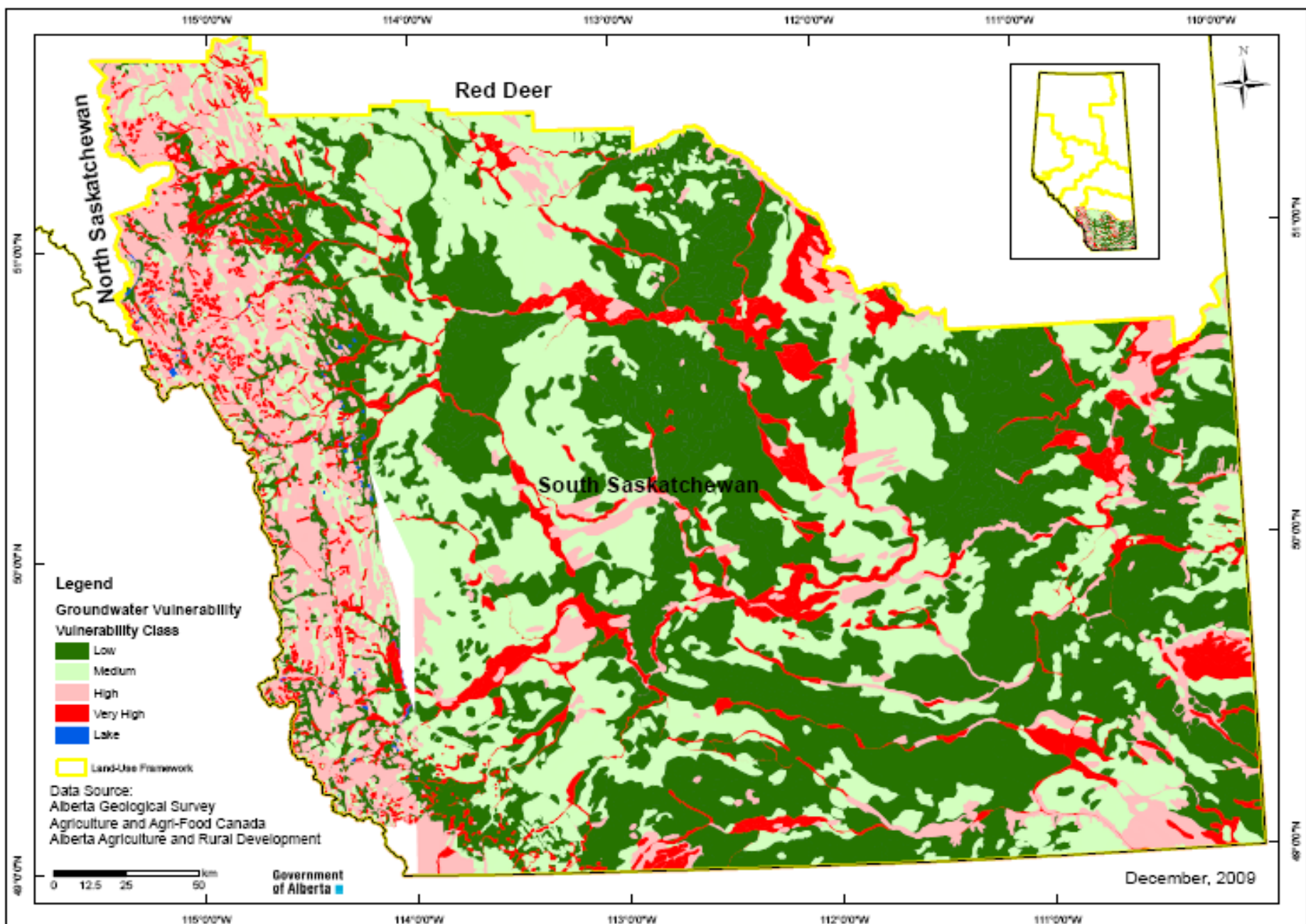
**Step 7** – Sum up c values to depth of shallowest aquifer - categorize



# GV Map Development Process

- Step 8** – Assign initial vulnerability ratings for each type of surficial geology (using the map legend and field experience)
- Step 9** – Determine vulnerability distribution using information from database analysis and surficial geology maps
- Step 10** – Professional review

# Groundwater Vulnerability: South Saskatchewan Region





# What GV Maps Do

- Provide a general sensitivity ranking based on potential impact of surface activities on shallow groundwater
- Provide a regional description of the potential relative risk to groundwater quality from land-based activities





# GV Map Limitations

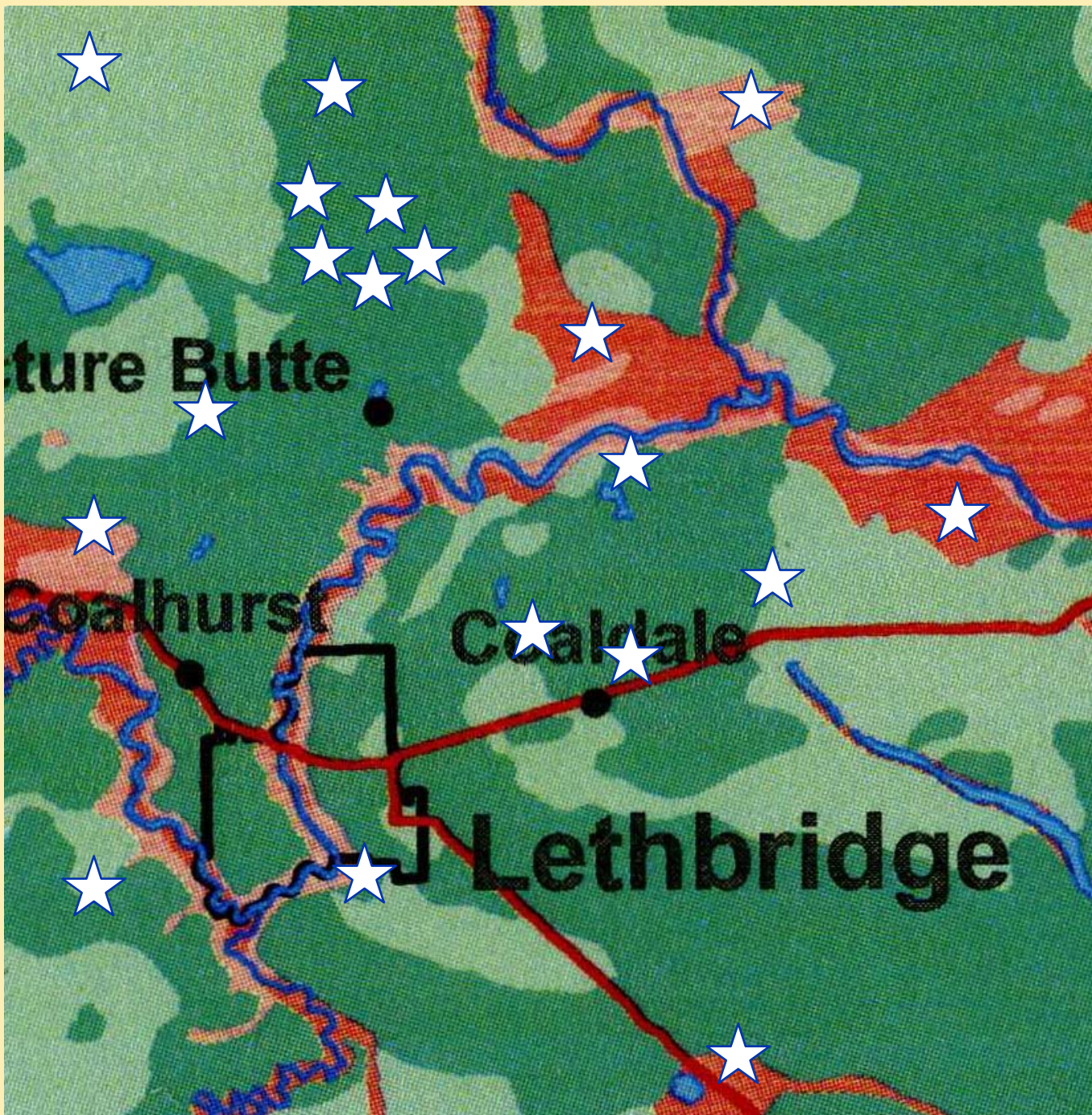
- Cannot be used as a sole source of information for siting
- Do not provide information on groundwater quality and quantity
- Do not provide information on location of aquifers



# GV Map Use in Risk Based Compliance

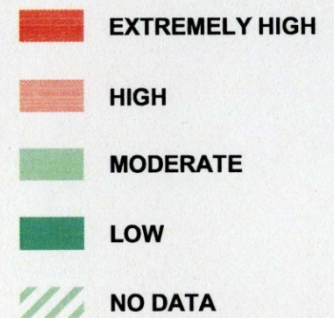
- ArcView GV map file acquired from Alberta Environment
- CFO database incorporated
- Allows for comparison of various aspects of CFOs to GV
  - Able to identify higher risk CFOs in high GV areas



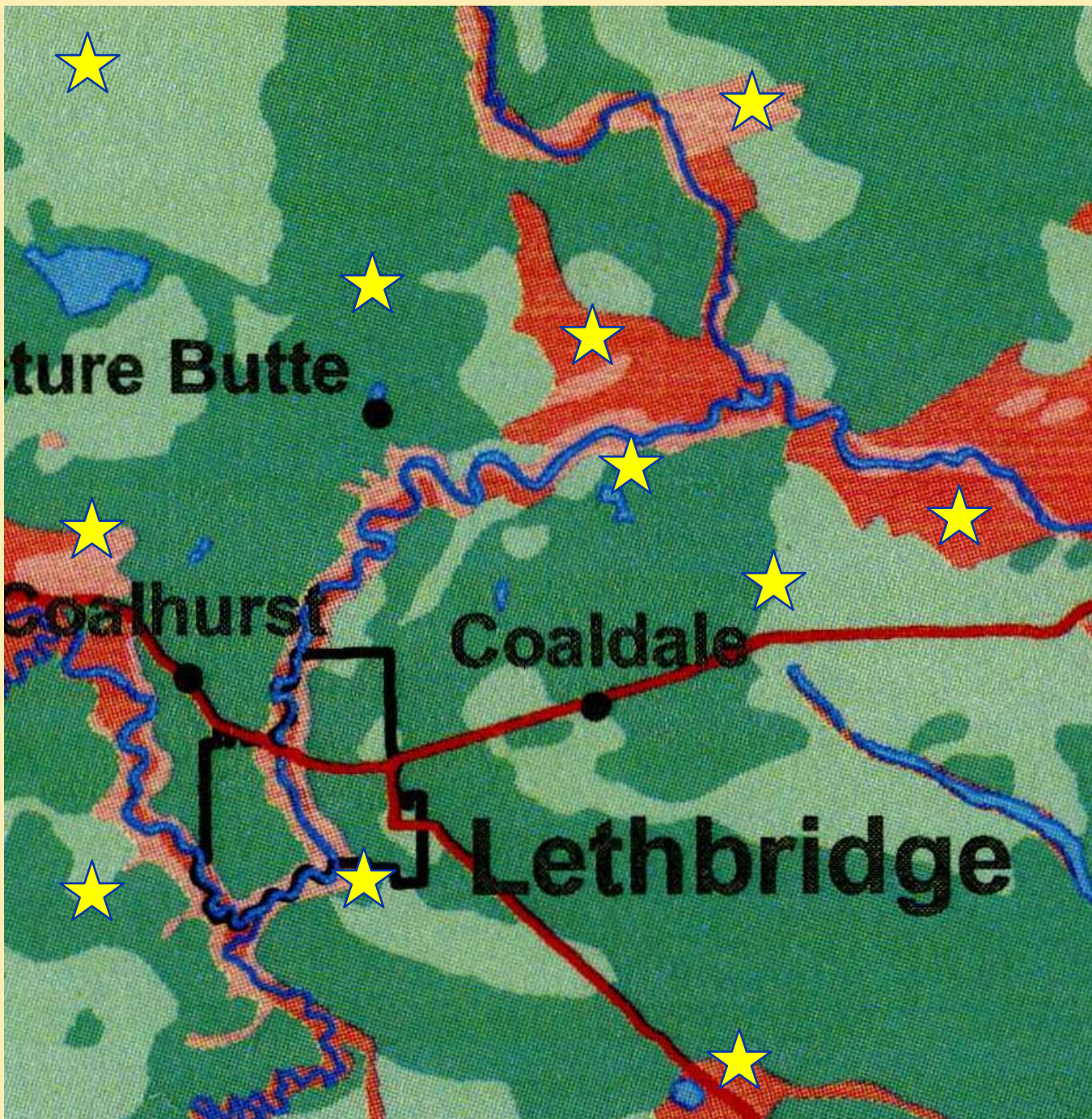


★ - CFO

GROUNDWATER VULNERABILITY







★ - RBC CFO

GROUNDWATER VULNERABILITY



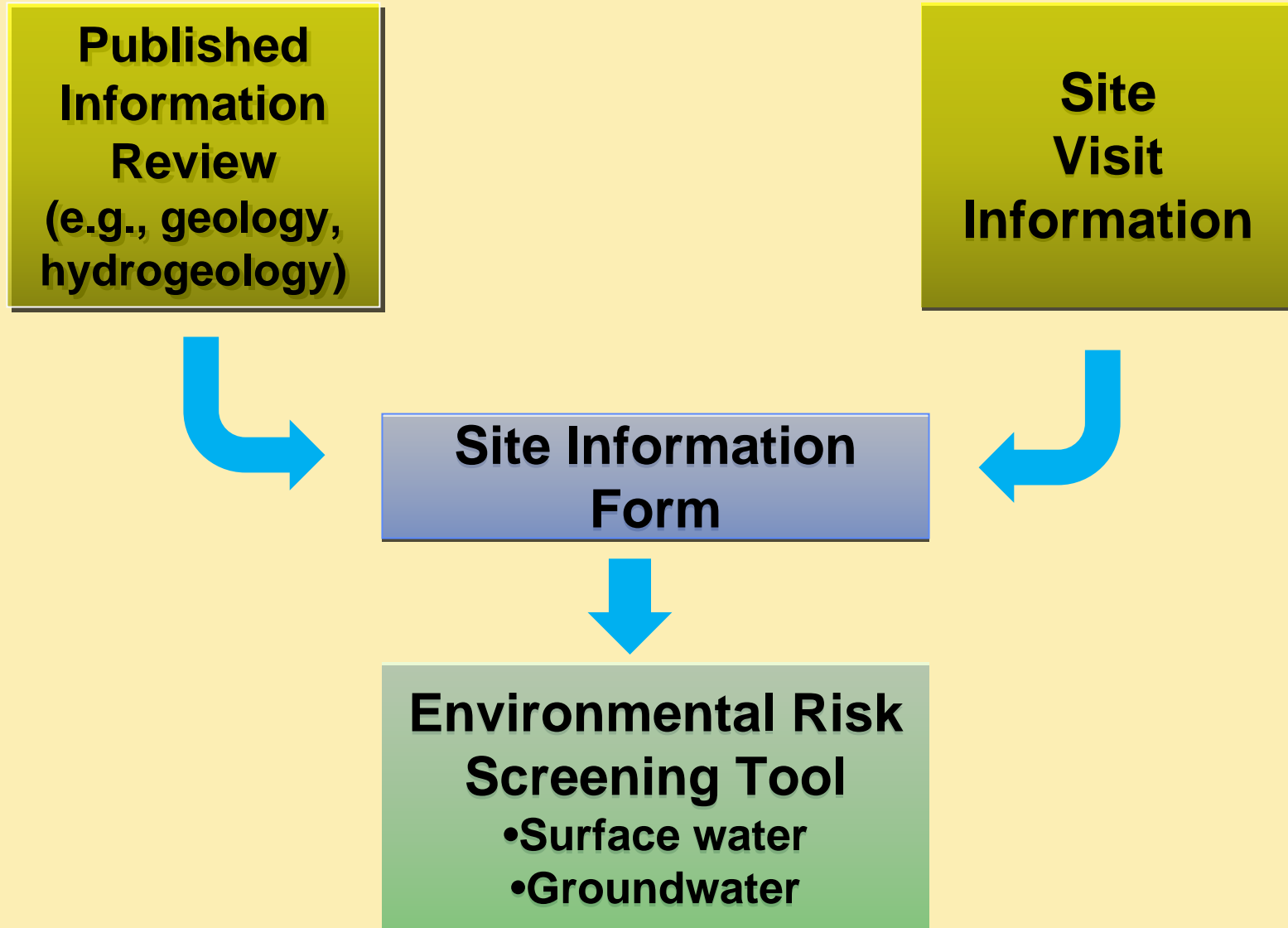




# Operations Selected for Risk-based Compliance Program

- Operations that meet the three criteria (i.e., liquid manure storage, pre-2002, located in a high groundwater vulnerability area) are candidates for environmental risk screening
- Environmental risk screening tool for CFOs developed in 2007
  - Developed in collaboration with industry, Alberta Agriculture, and Alberta Environment
  - Ensures risk to the environment is assessed in a consistent, transparent manner

# Environmental Risk Screening Tool (ERST)





# Update on Risk-based Compliance Program

- Initiated in the fall of 2009
- 20 CFOs selected in south Alberta
- Program introduced to operators of CFOs selected
- In the process of environmental risk screening



# Conclusions

- Protection of water quality a priority in Alberta
- GV map has proven to be a useful tool for the risk-based compliance program
  - Allows for focusing of resources on higher risk CFOs in high groundwater vulnerability areas
  - Need to appreciate limitations
- More robust groundwater mapping being conducted (e.g., Alberta Geological Survey)



# Acknowledgements

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# Questions?

