Designing a Retrospective Hydraulic Fracturing Case Study
EPA Technical Workshop
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ecology and environment, inc.
Global Environmental Specialists

Ecology and Environment, inc.

- Multi Disciplinary Firm with over 1,000 employees in 43 domestic and 17 international offices
- Over 40 years of experience in conducting Superfund investigations for both Federal and State governments.
- Completed thousands of soil and groundwater assessments throughout the United States.

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Purpose of Retrospective Case Studies

Research potential impacts of hydraulic fracturing on drinking water resources, if any, and to identify the driving factors that may affect the severity and frequency of such impacts.

Develop Documented Approach

Decision Support System

- Documents a consistent and rigorous approach for evaluation of causal assessments
- Identifies decision points to determine whether additional work is recommended to identify the source of the impairment and complete the assessment
- Delineates and tracks a decision making process for the final assessment

Decision Support System

Figure 1 Decision Support System Flow Chart.pdf

Figure 2 Decision Support System Additional Studies Branch Chart.pdf

Tier 1 Activities

- Identification of Candidate Causes
- Existing Data Collection
- Evaluation of Data

- Tier 1 Challenges
  - Variations in acquiring state agency data
  - Availability of data
  - Determining optimal search radii
  - Significant number of historical and recent production wells

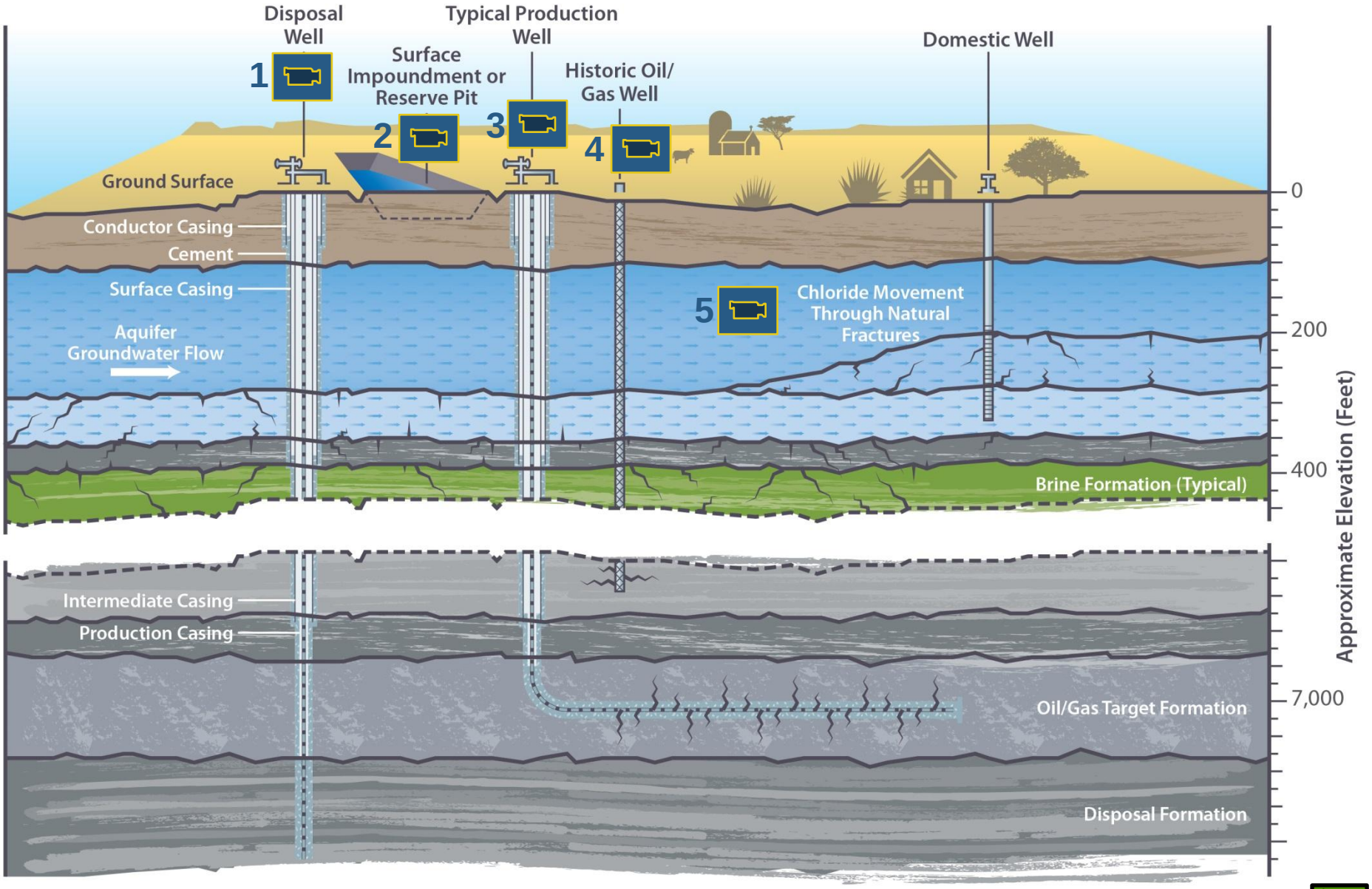
Tier 2 Activities

- Screening of Potential Causes
- Initial Groundwater Sampling
- Data Evaluation
- Initial Causal Analysis
  - Develop Initial Conceptual Site Model
  - Implement GW Model
  - Assess Nature and Extent
  - Assess Fate and Transport
- Identify Data Gaps
- Determine if Site Specific Studies are necessary

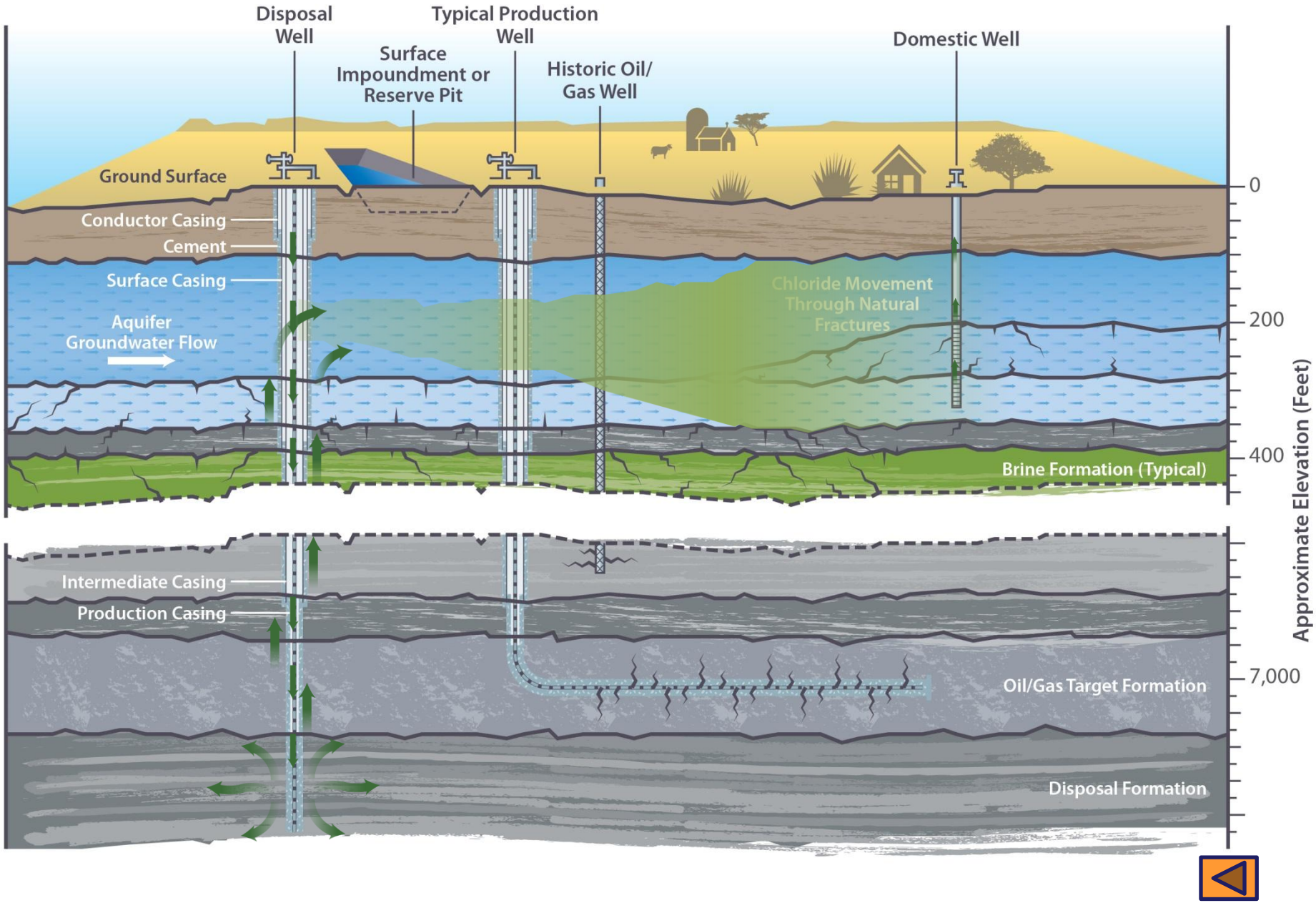
Tier 2 Challenges

- Site Selection
  - Based on homeowner complaints or state concerns - widespread
- Site access agreements with landowners
- Lack of background/historic water quality data
- Lack of domestic well construction records
- Lack of site specific geological/hydrogeological data

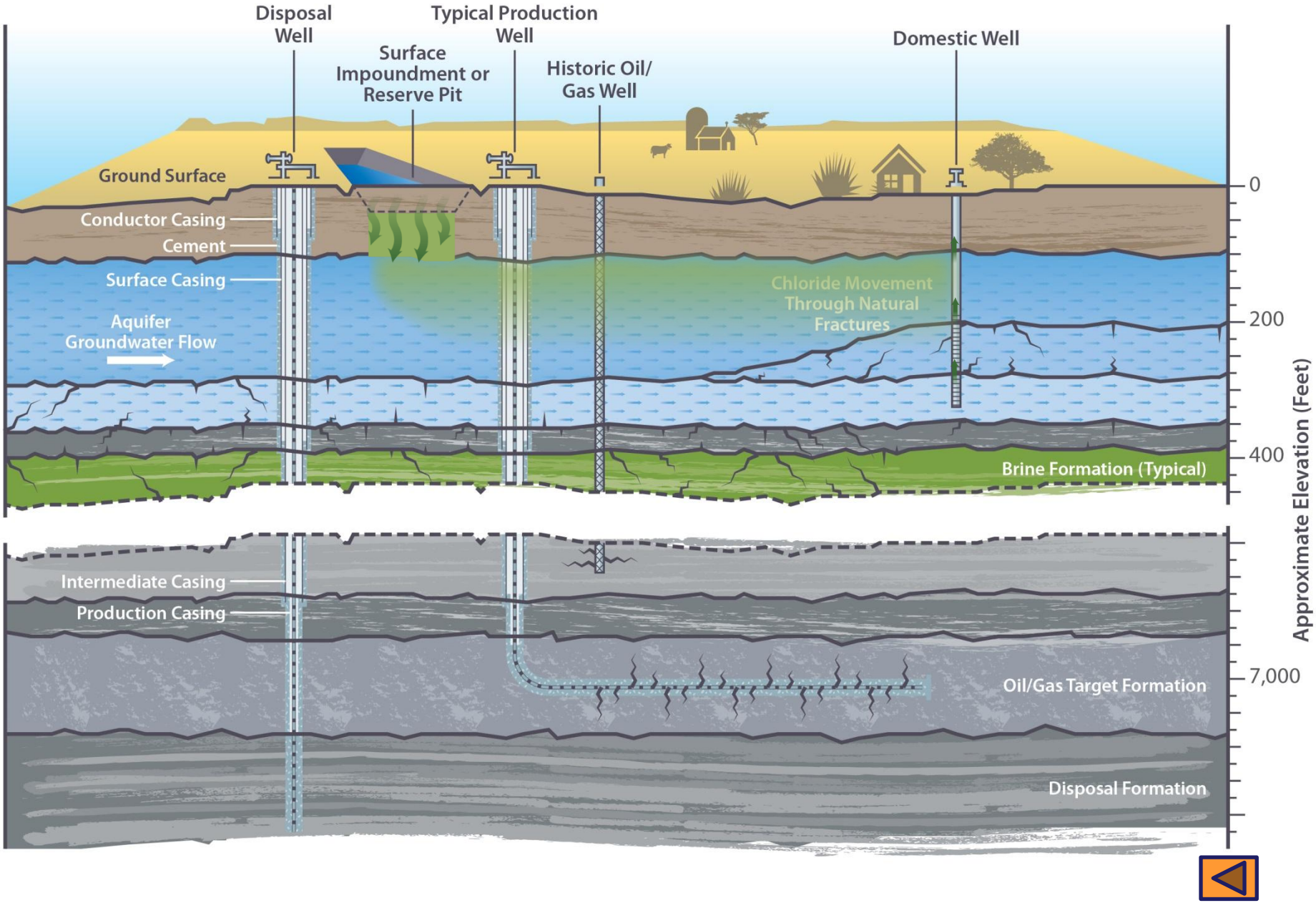
Chloride Migration Conceptual Site Model



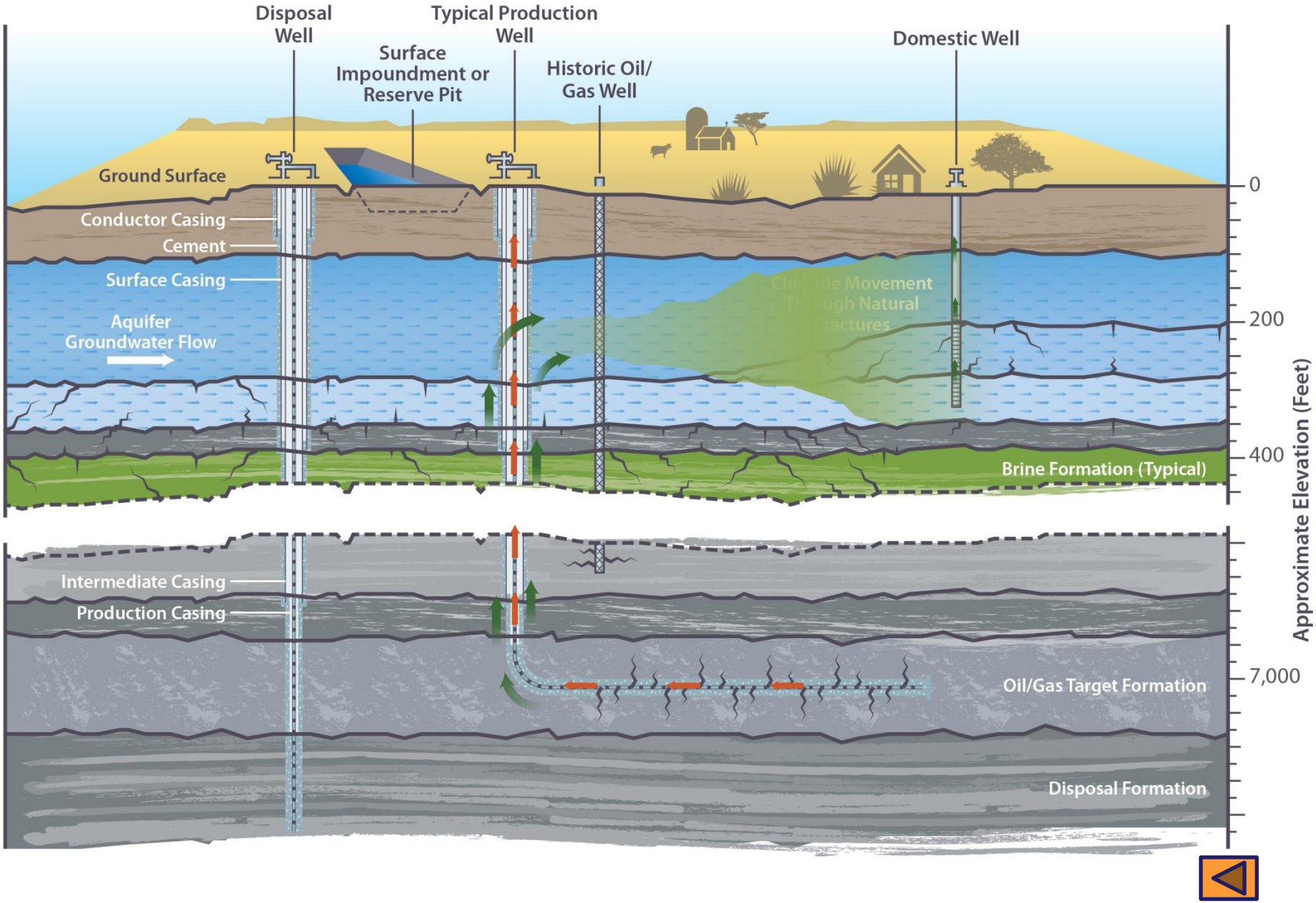
Brine Migration Along Well Bore from Injection Well



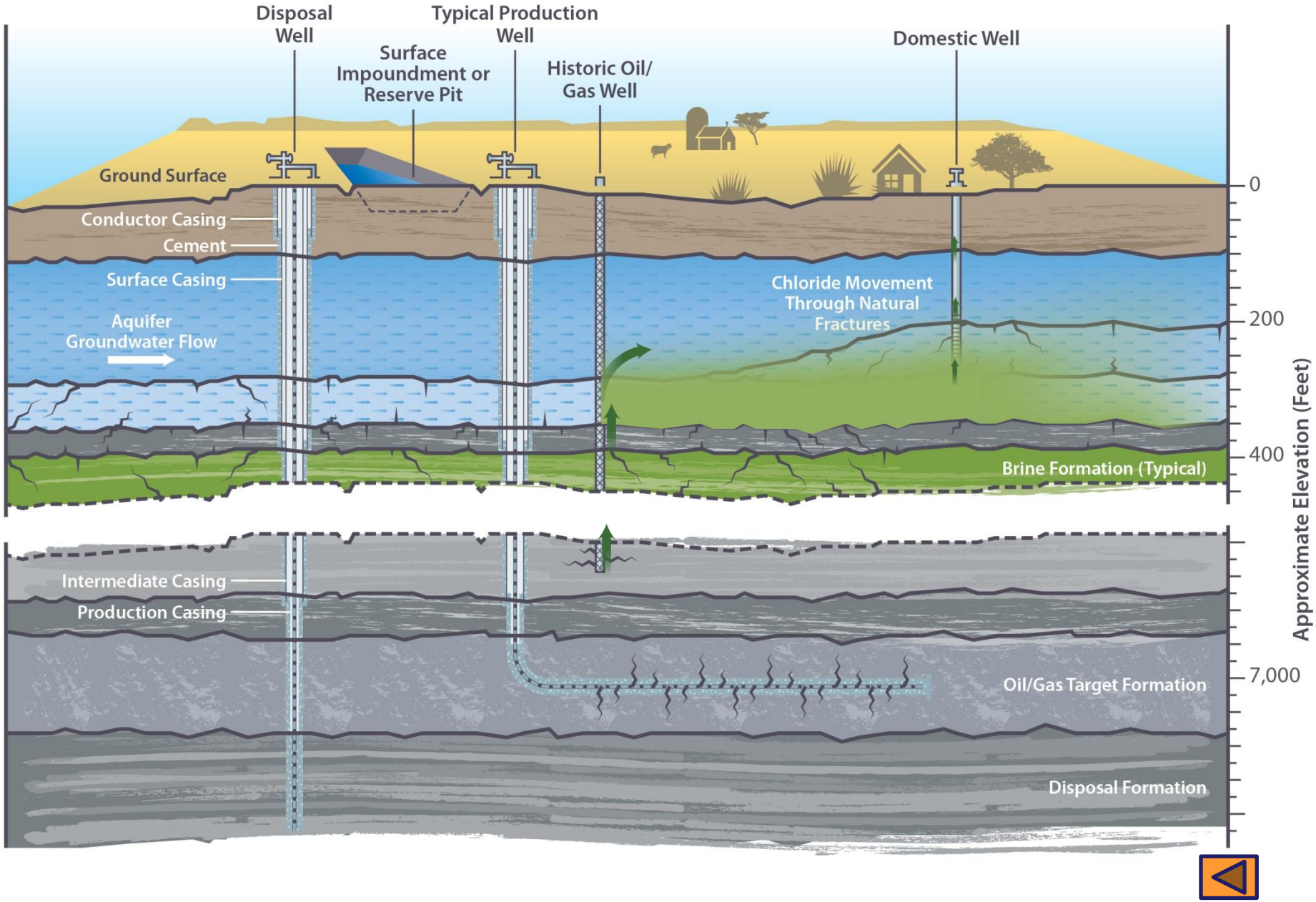
Pit/Impoundment Leak



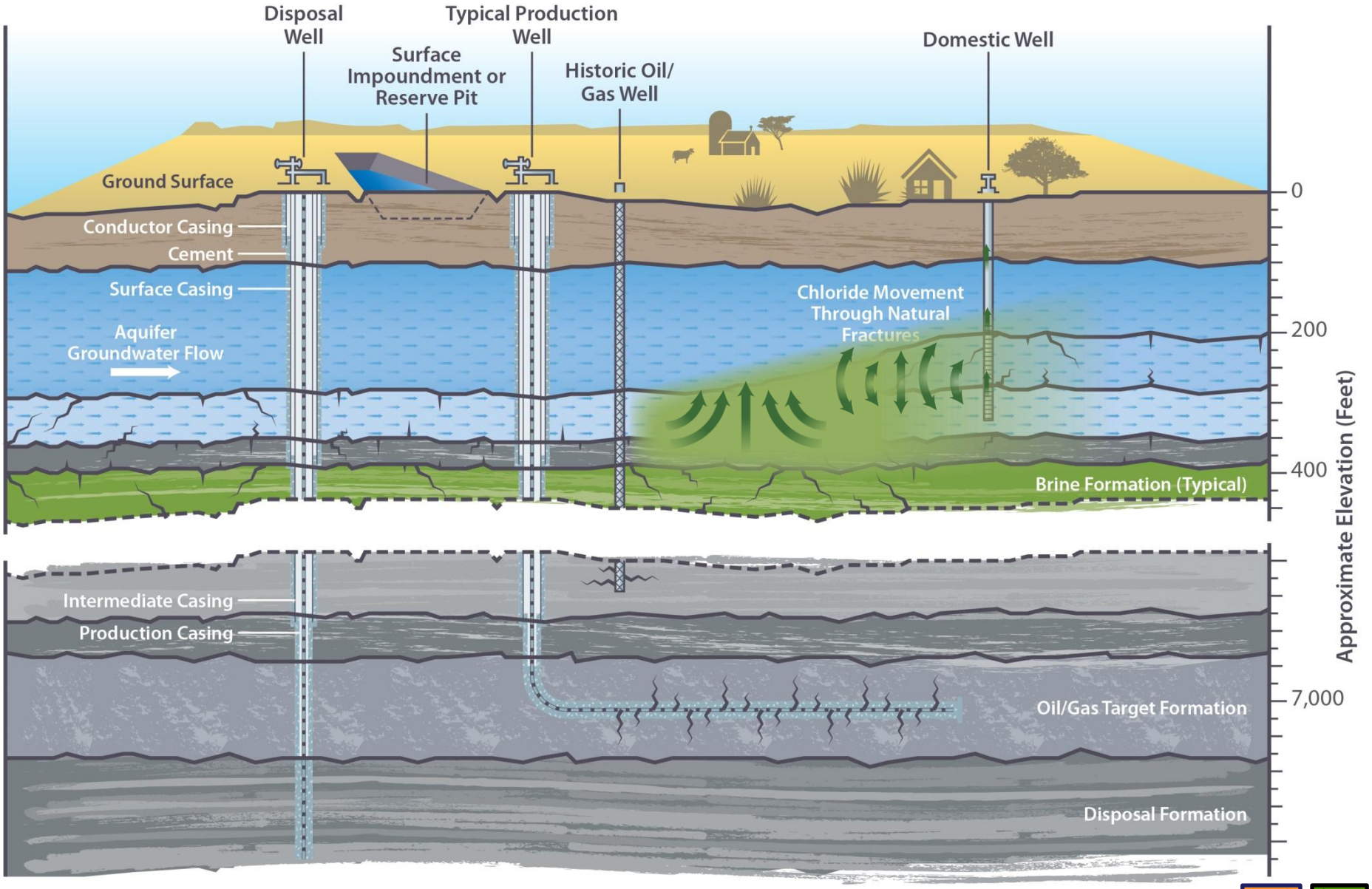
Brine Migration Along Well Bore from Production Well



Brine Migration Along Well Bore from Historic/Test Well



Brine Migration through Formation Fractures



Tier 3 Activities

- Re-evaluation of Data
  - Identify new data needs
  - Determine if data are sufficient
- Conduct Site-specific Investigations

- Tier 3 challenges
  - Site access agreements with landowners
  - Insurance
    - Higher than normal liability insurance may disqualify subcontractors

Tier 3 Challenges (cont.)

Designing a monitoring well network

- Determining horizontal gradient, vertical gradient, and GW velocity
- Determining optimal distance of MWs from production well
  - Too far:
    - Contaminant travel times may be too long to reach the MWs
  - Too Close:
    - MWs may be direct conduits for surface spills to underlying aquifers
    - MWs may be damaged by production well drilling processes
      - Struck by production well drill bit
      - Grout contamination from production well surface casing
      - Changes in WQ in the MWs from production well drilling methods (air rotary)

Tier 3 Challenges (cont.)

- Determining optimal MW design and installation techniques
  - Conventional drilling vs. angled drilling or horizontal drilling
- Peer Review and Public Perception
- Data Interpretation

Tier 4 Activities

- Determine Probable Candidate Causes
- QA Evaluation/Peer Review
- Conclusions

- Tier 4 Challenges
  - Final identification of probable candidate causes may not identify a single principle cause
  - Multiple principle and secondary causes may be responsible for the impairment
  - The magnitude of the studies necessary to determine the cause(s) may be technically impracticable, or beyond the scope of the study.

Questions?