November 4-6, 2025

5-D Approach for Sustainable & Resilient Groundwater Remediation

2025 RemPlex Global Summit, Richland, WA

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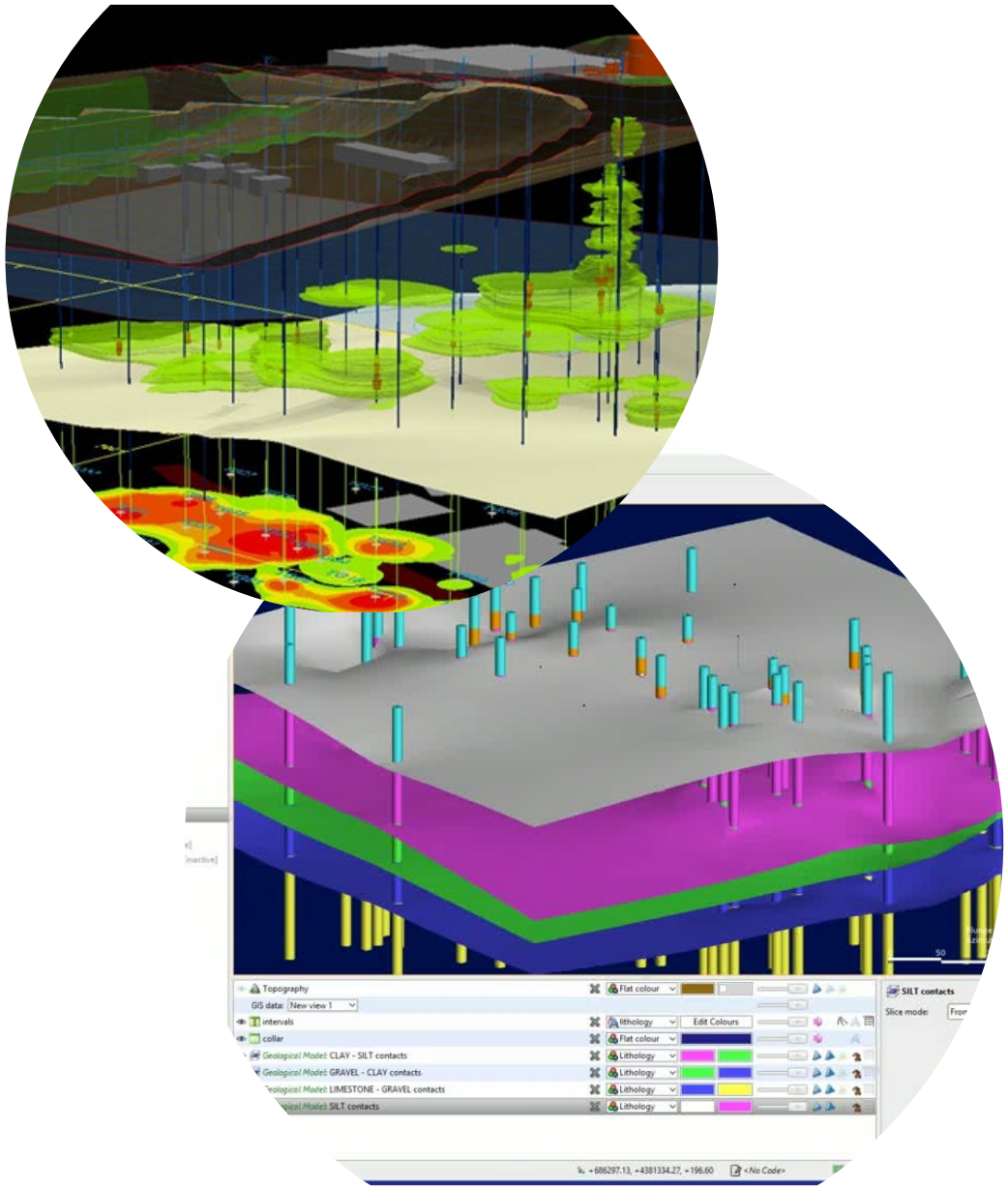
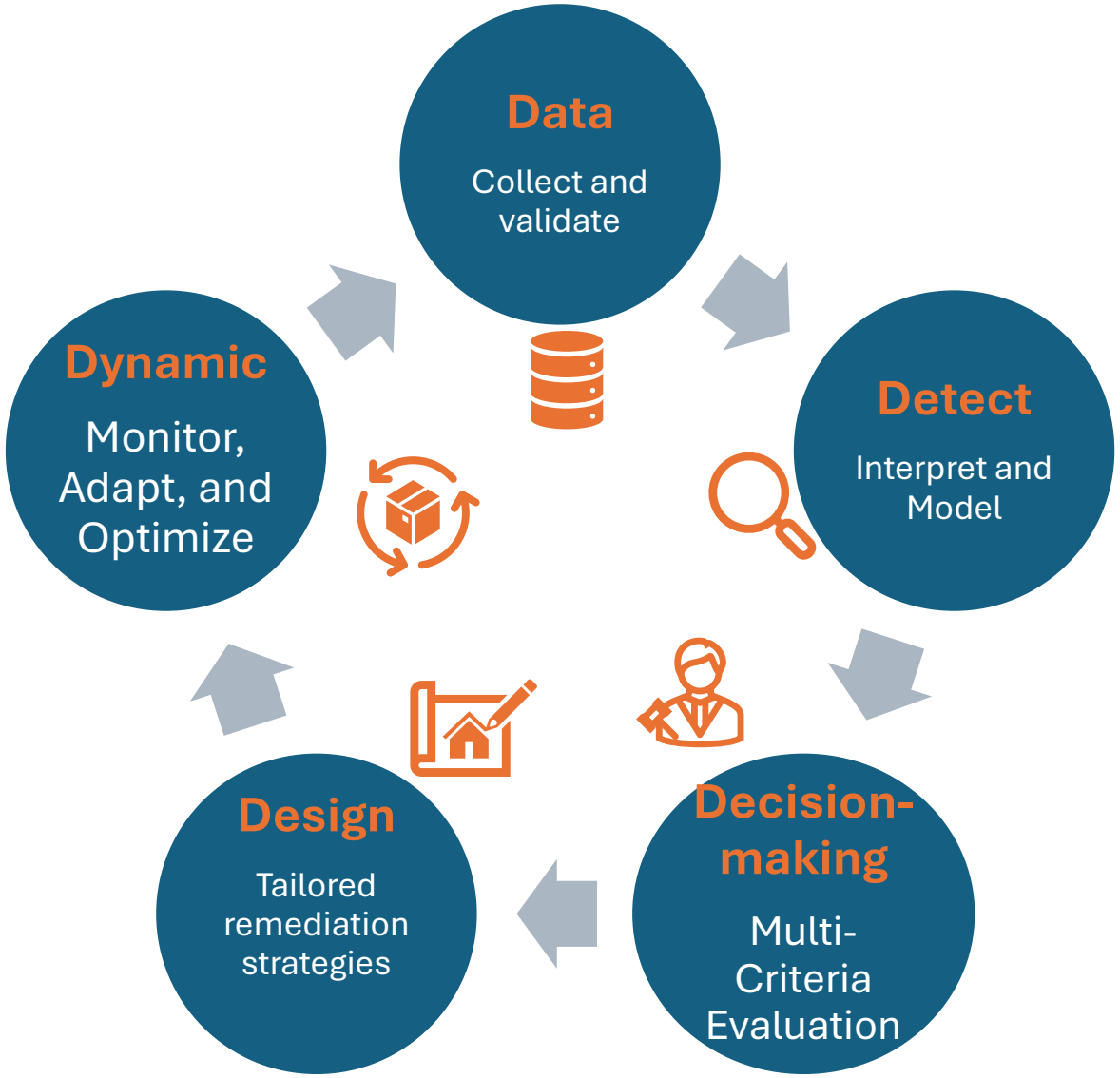
Challenges in Existing Practices



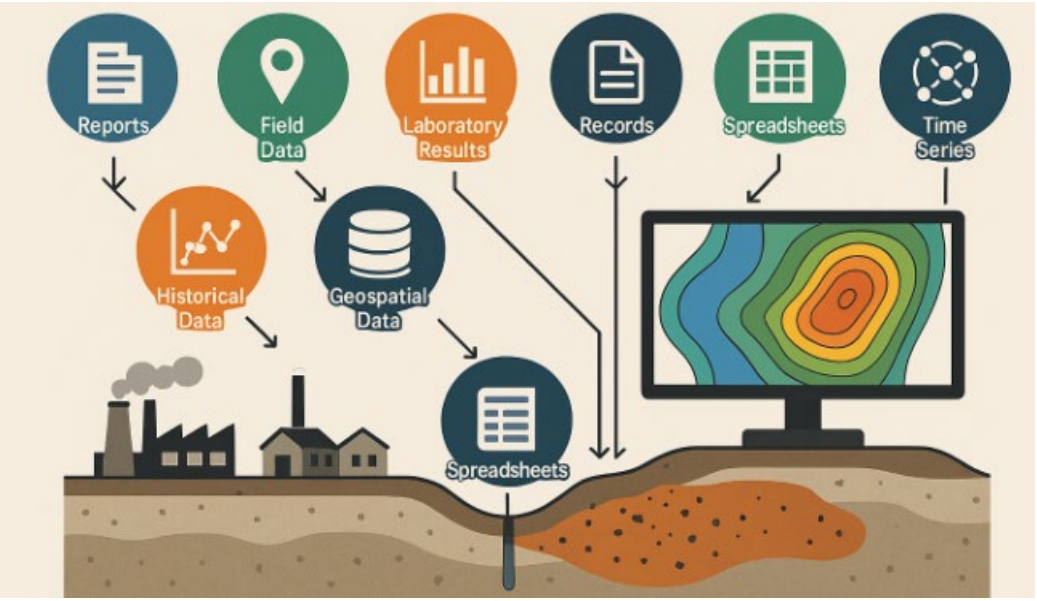
- Increasing contaminant complexity
  - Static Designs in a Dynamic World
  - Fragmented Data Use
  - One-Size-Fits-All Approaches
- Limited Adaptability to Climate & Regulatory Change
- Budget Constraints & Efficiency Pressure

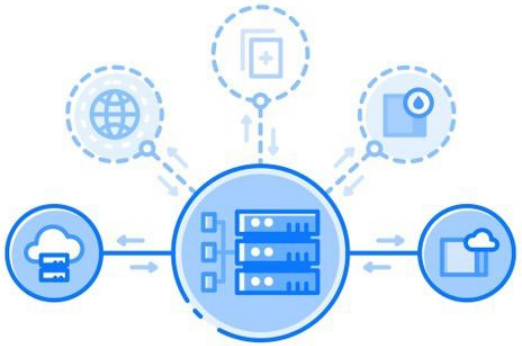
Thinking in 5D: A Comprehensive Framework



Repeatable
Scalable
Adaptable
Long-term Effectiveness
Environmental
Stewardship

Data: Foundation of Effective Remediation

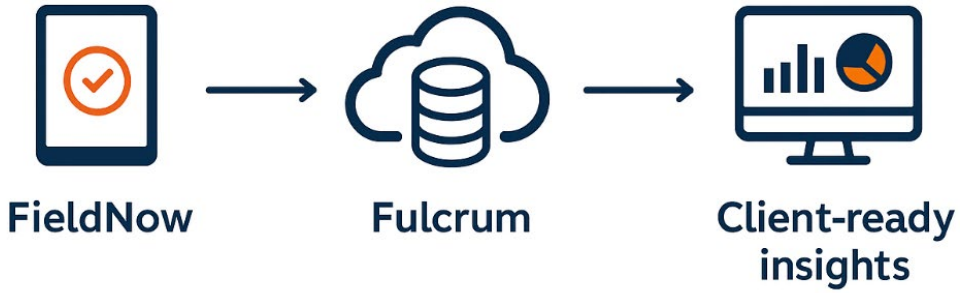




- Diverse data sources and formats
- Integration of real-time and historical data
- Complex site conditions and contamination (convoluted dataset)
- Recognize data patterns and risk identification
- Comprehensive analysis and visualization

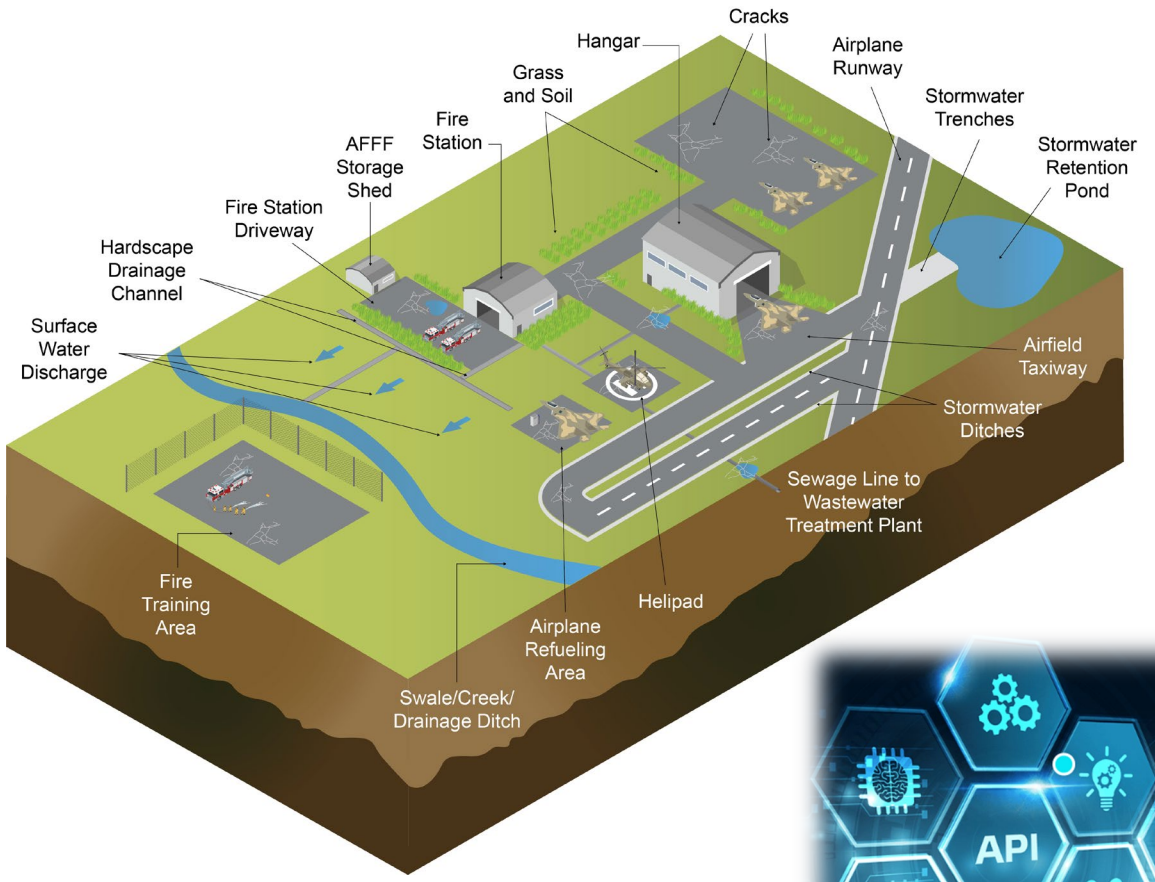
Digital Data Collection

- **FieldNow**: Real-time field data capture & QA/QC
- **Fulcrum**: Centralized cloud database for analysis & visualization
- Reduces errors, accelerates reporting, improves transparency
- Direct integration with digital twins & dashboards



Detect: Understanding the Problem

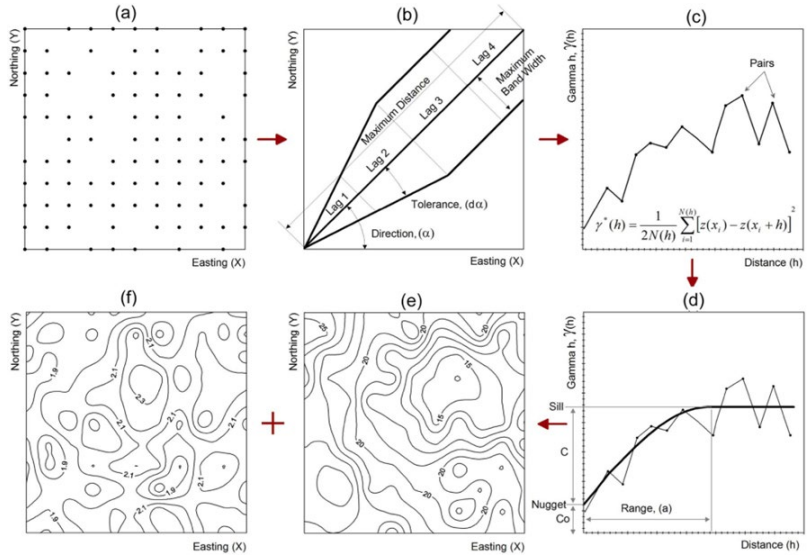
- Conceptual site models & risk assessment
- Identify sources, pathways, vulnerabilities
- Detect patterns and prioritize remediation

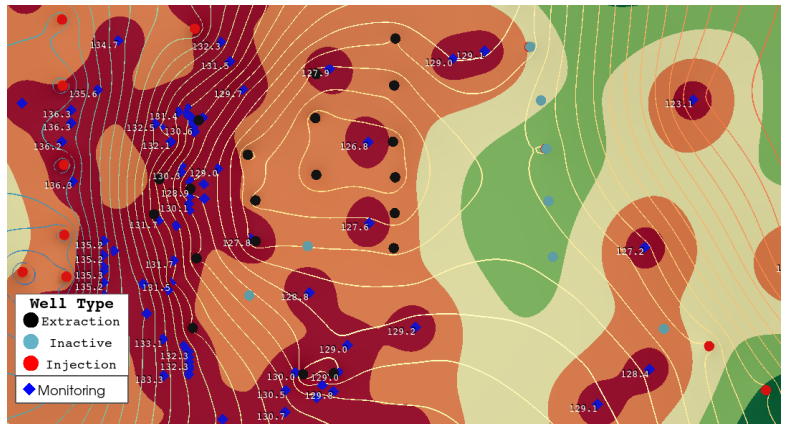


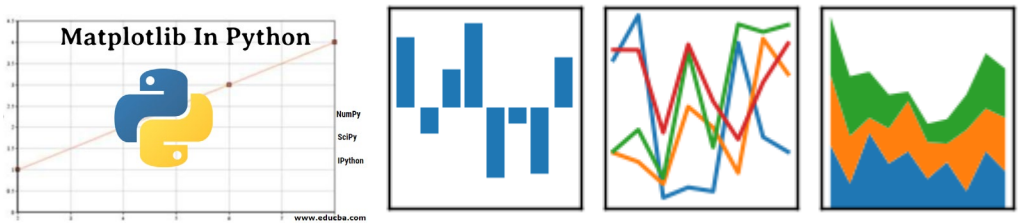
Risk = Hazard x Consequence x Probability

Enhancing Remedial Decisions with Advanced Statistics & Geostatistics

- Optimize sampling locations and frequency
- Statistical & spatial analysis for trends & anomalies
- Automation & ML for predictive modeling and efficiency
- Support risk-based corrective actions
- Improve visualization for stakeholder communication







Decision -making: Multi-Criteria Evaluation

Transparent, evidence-based evaluation

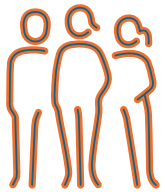
Comprehensive risk assessments by simulating various climate scenarios and their potential impacts on different sectors, helping prioritize adaptation and mitigation measures.

Decision Support

Valuable insights into the effectiveness of different resilience strategies, facilitating informed decision-making and resource allocation.

Scenario Planning

Planning for uncertainty, allowing stakeholders to develop robust strategies that are flexible and adaptive to changing conditions.



Stakeholder & regulator engagement for acceptance

Communicate complex climate information to diverse stakeholders through visualizations and interactive tools, fostering greater understanding and engagement in resilience efforts.

Forecast is a Prediction (the “trend is your friend”)

Design: Sustainable & Resilient Solutions

Site Specific Strategies

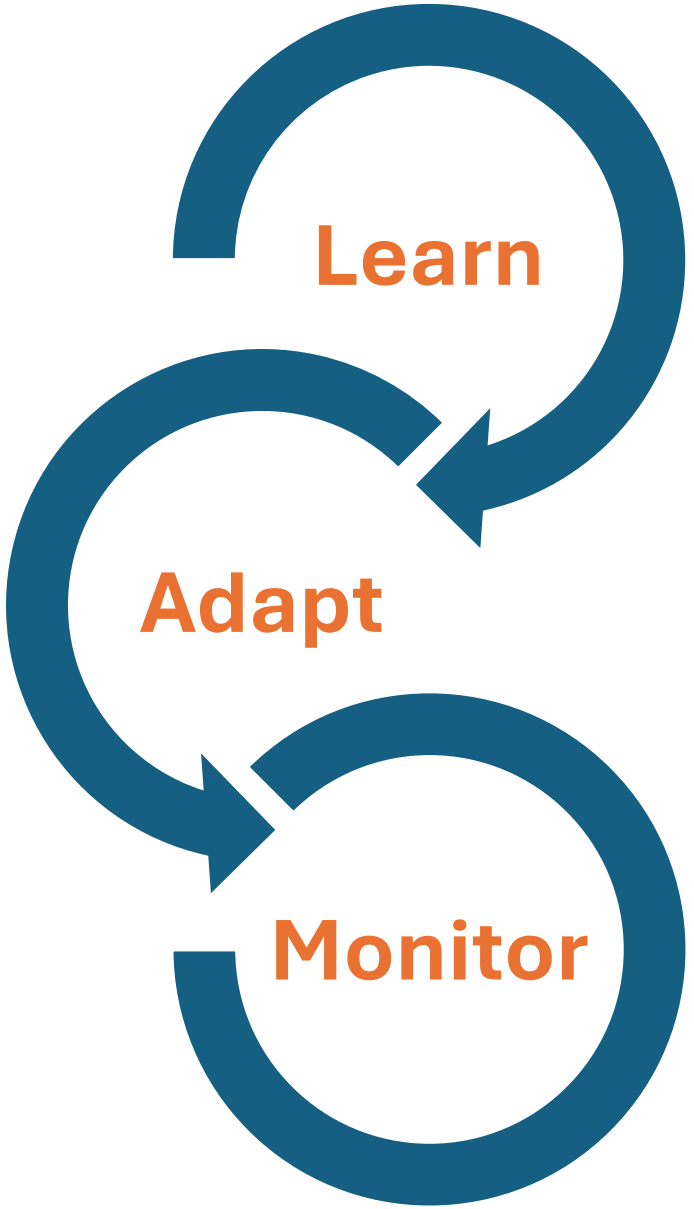
Energy Efficiency & Nature Based Solutions

Redundancy & resilience to climate variability

Dynamic: Adaptive Management

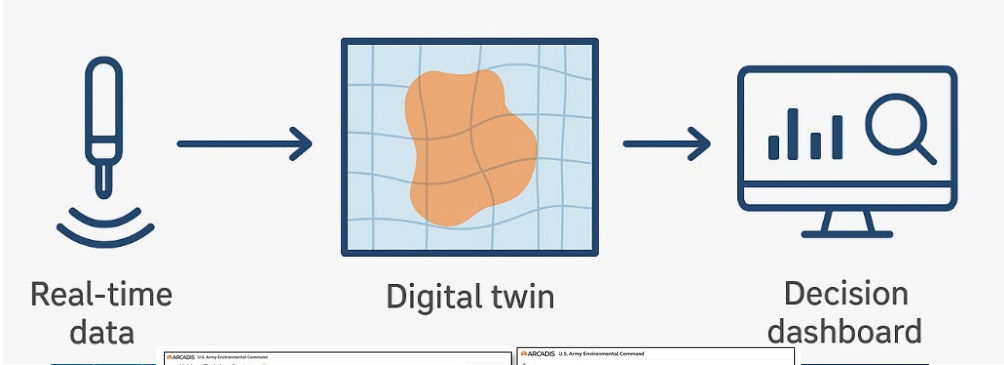
Identifying Vulnerability

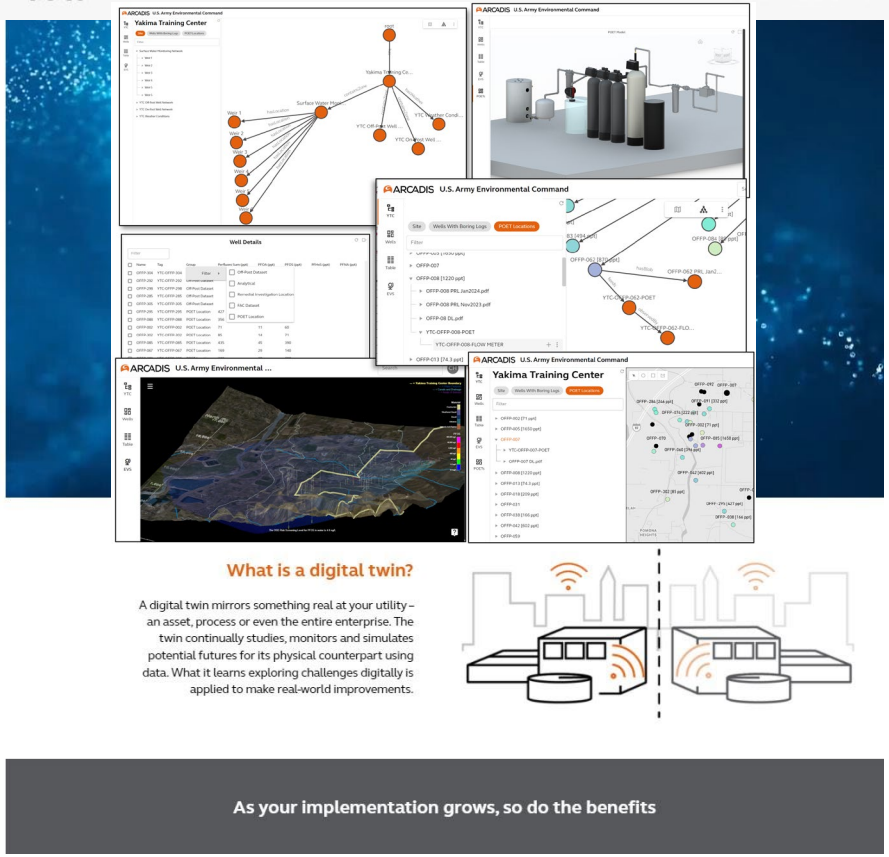
- Real-time monitoring & iterative adjustments
- Address climate, regulatory, or unexpected changes
- Continuous performance optimization



Digital Twinning & Smart Monitoring

- Real-time data integration from sensors & monitoring networks
- Digital twins: living, adaptive site models, automate data transformations
- Supports predictive remediation & adaptive management





Benefits of 5-D Dynamic Approach

Resilience

Resiliency planning fits within established site investigation/remediation decision-making with a dynamic CSM

Optimized Outcomes

Sustainable design and stakeholder engagement maximize positive impact

Cost-effectiveness

Early identification of risks and adaptive management reduce expensive corrective actions

Think in 5-D (3D + T + $)

Arcadis Differentiators

Turning complexity into clarity, and data into resilient, sustainable remediation outcomes
Solid Collaboration among FieldNow, Digital Twin, and GeoStatistics Teams

Data-driven, site-specific solutions

Work Efficiency (Automation, ML, and advanced analytics integration)

Efficient decision support & stakeholder engagement

Sustainable, cost-effective, actionable outcomes

FATE AND TRANSPORT MODELING

SITE INVESTIGATIONS AND REMEDY OPTIMIZATION

GEOLOGIC MODELING AND VISUALIZATION

PROGRAMMING & SCRIPTING

GEOSTATISTICAL AND RISK ANALYSIS

WATER SUSTAINABILITY AND CLIMATE RESILIENCY

Living our brand begins with you. RemPlex

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Thank you for joining us!

Questions? please reach out to:

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