Active-to-Passive Environmental Cleanup Transition Strategies

Savannah River Site

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Presentation Outline

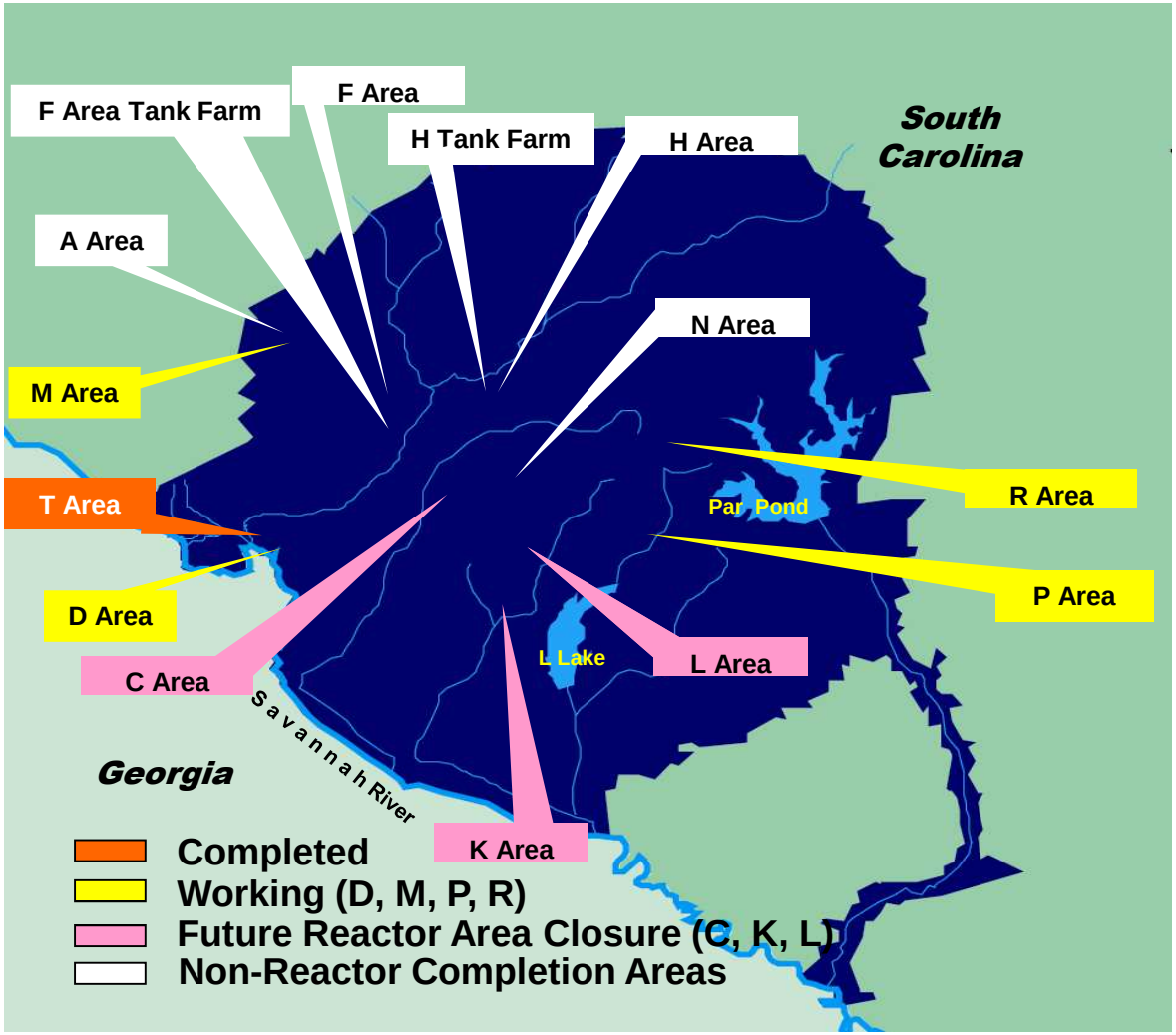
Active-to-Passive Environmental Cleanup Transition Strategies

- **Savannah River Site Cleanup Program**
- **Matching of Remedies to Site-Specific Conditions**
- **Transitioning from Active Remediation to More Passive Approaches (Monitored Natural Attenuation/Enhanced Attenuation)**
- **Active-to-Passive Success Stories at the Savannah River Site**
  - **F-Area Barrier Wall with Base Injection and Silver Chloride Injection**
  - **T-Area Edible Oil Deployment**

Savannah River Site Cleanup Program

Active-to-Passive Environmental Cleanup Transition Strategies

- 14 Area Completion Areas
- 515 Waste Sites (399 complete)
- 14 Groundwater Contamination Areas

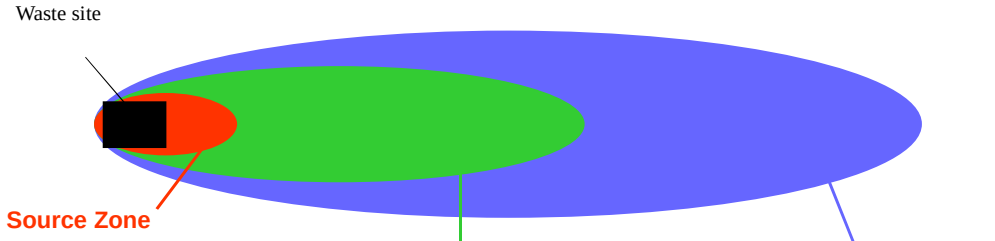


Anatomy of a Plume

Active-to-Passive Environmental Cleanup Transition Strategies

SRS Remediation Strategy

Diagnosing and Treating a Contaminated Site



Costs:
$/lb contaminant or $/cu yd. Removal examples:
< $50-$100/cu yd or
< $100/lb for chlorinated solvents

hot spot characterization reduces cleanup volume

Costs:
$/treatment volume (gallon/cu ft) example:
<$0.5-$10 / 1000 gallons

zone of capture characterization needed, optimize extraction to reduce treatment volume

Costs:
Operation and maintenance costs $/time

mass transfer and flux characterization needed

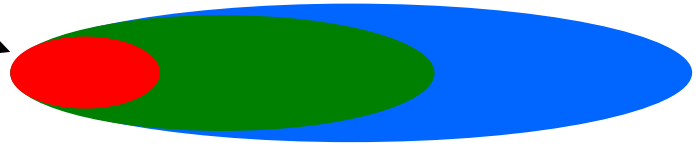
Active Remediation — **Enhanced Natural Remediation** — **Passive Monitored Natural Attenuation**

High cost → **Low Cost**

Savannah River Site Cleanup Program (cont.)

Active-to-Passive Environmental Cleanup Transition Strategies

Source Zone



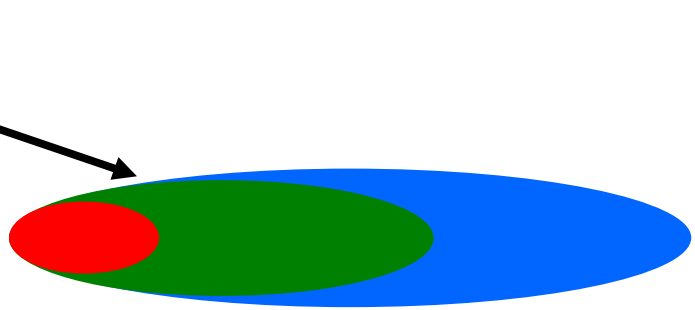
Remediation Examples:

- Excavation
- Low permeability covers
- Thermal technologies
- In-situ chemical oxidation
- Soil vapor extraction (SVE)

Savannah River Site Cleanup Program (cont.)

Active-to-Passive Environmental Cleanup Transition Strategies

Primary Plume



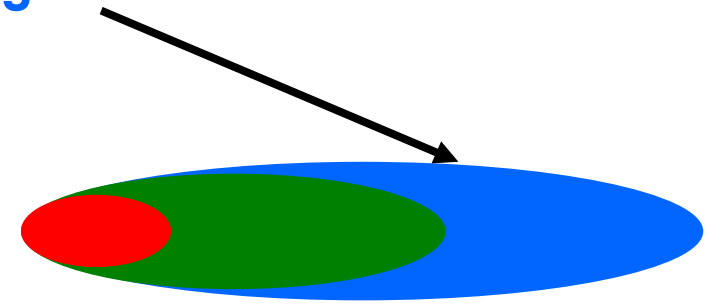
Remediation Examples:

- **Hydraulic Control**
  - Pump and Treat
  - Barrier walls
- **In situ**
  - Airlift recirculation wells
  - Base injection
  - Chemical oxidation injection
  - Nutrient injection to enhance bioremediation

Savannah River Site Cleanup Program (cont.)

Active-to-Passive Environmental Cleanup Transition Strategies

Dilute Plume Fringe

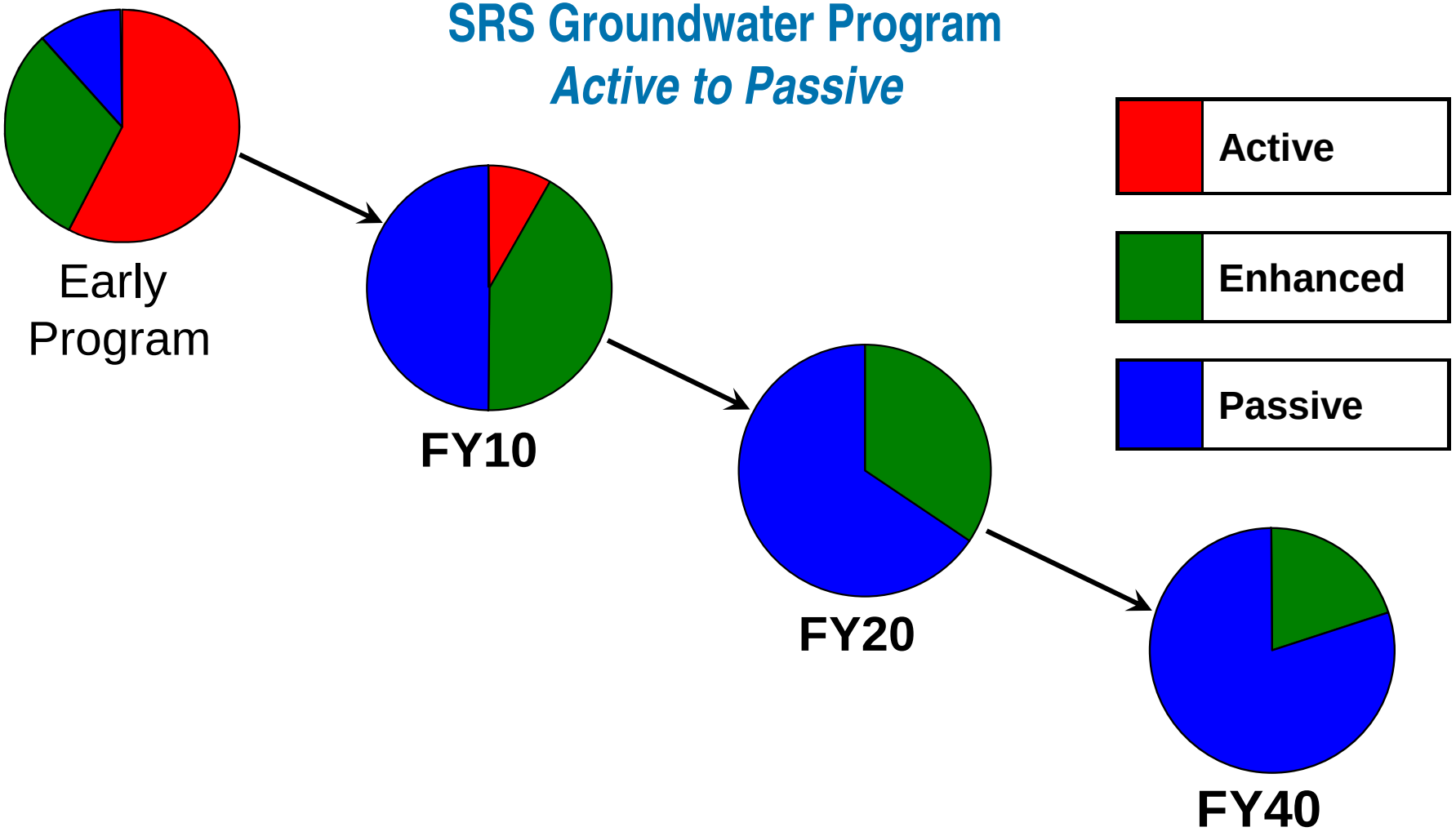


Remediation Examples:

- **Phytoremediation**
- **Enhanced Attenuation**
- **Monitored Natural Attenuation**

Savannah River Site Cleanup Program (cont.)

Active-to-Passive Environmental Cleanup Transition Strategies



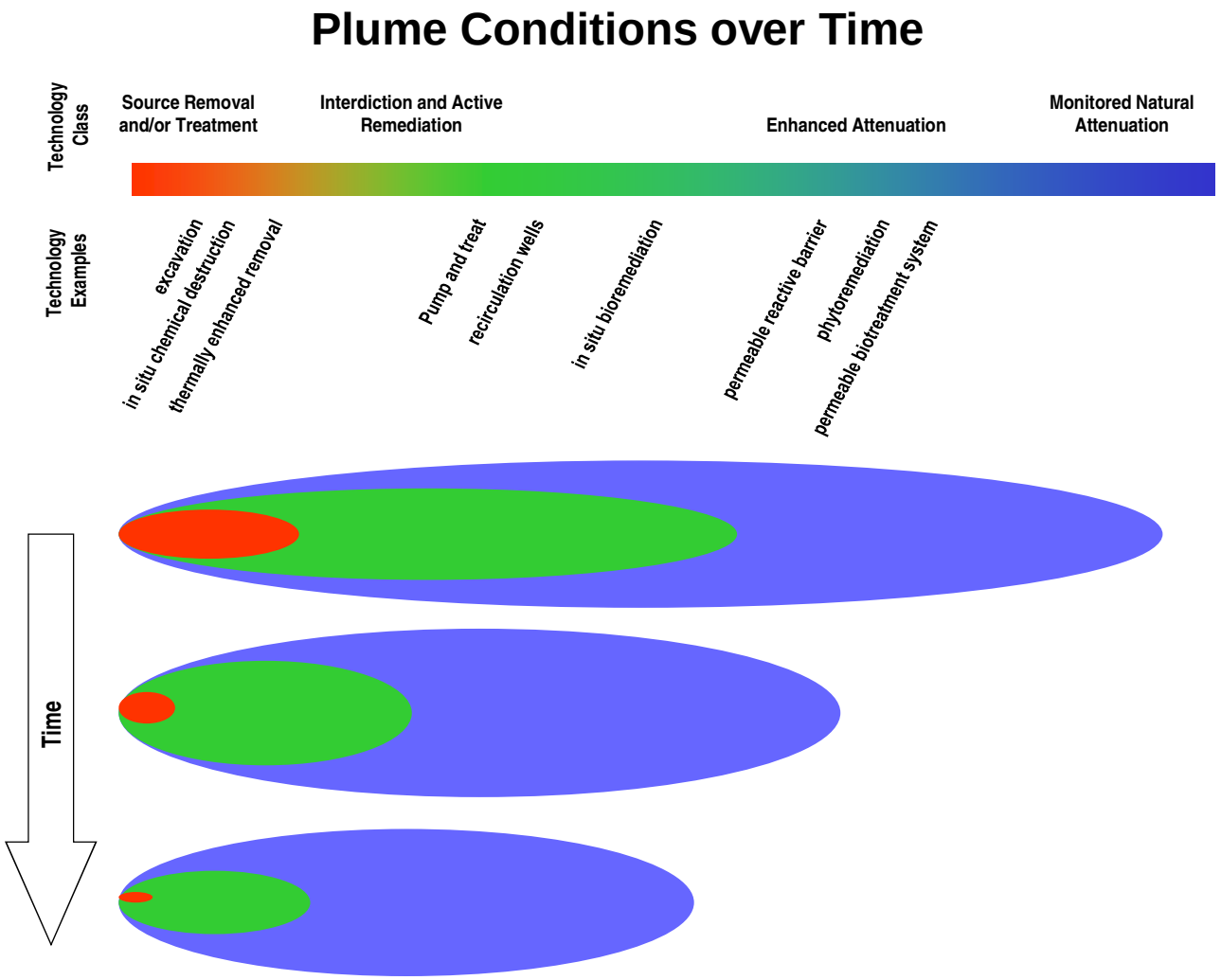
Matching of Remedies to Site-Specific Conditions

Active-to-Passive Environmental Cleanup Transition Strategies

- Matching of remedies to site-specific conditions is critical to long-term success in environmental cleanup and restoration
- Remedy selection must consider factors such as implementability, expected performance, uncertainties/risks, and costs for actions as they apply to the various target zones
- "Plume status" is a form of a mass balance where the mass release rate (discharge or flux) determines the stability (expanding or shrinking) of the plume
- This is a dynamic process with conditions that change in both space and time

Matching of Remedies to Site-Specific Conditions (Cont.)

Active-to-Passive Environmental Cleanup Transition Strategies



Transitioning from Active Remediation to More Passive Approaches

Active-to-Passive Environmental Cleanup Transition Strategies

- The Savannah River Site (SRS) has a variety of examples of transitioning from active remediation systems to both passive and enhanced-passive systems
- Completely passive systems utilize the natural capability of the subsurface or media to reduce or stabilize contamination
- Enhanced-passive systems rely on a one-time or infrequent addition of an enhancement to jump start or sustain the natural process
- Example
  - F-Area Barrier Wall with Base Injection and Silver Chloride Injection

Active-to-Passive Success Stories at the Savannah River Site

Active-to-Passive Environmental Cleanup Transition Strategies

F-Area Barrier Wall with Base Injection and Silver Chloride Injection

- **Background**
  - The F Area Seepage Basins received acidic and radioactive liquids from the F and H Separations Facilities
  - Release created a low pH plume containing tritium, metals and radionuclides
  - The plumes discharge into Fourmile Branch at SRS

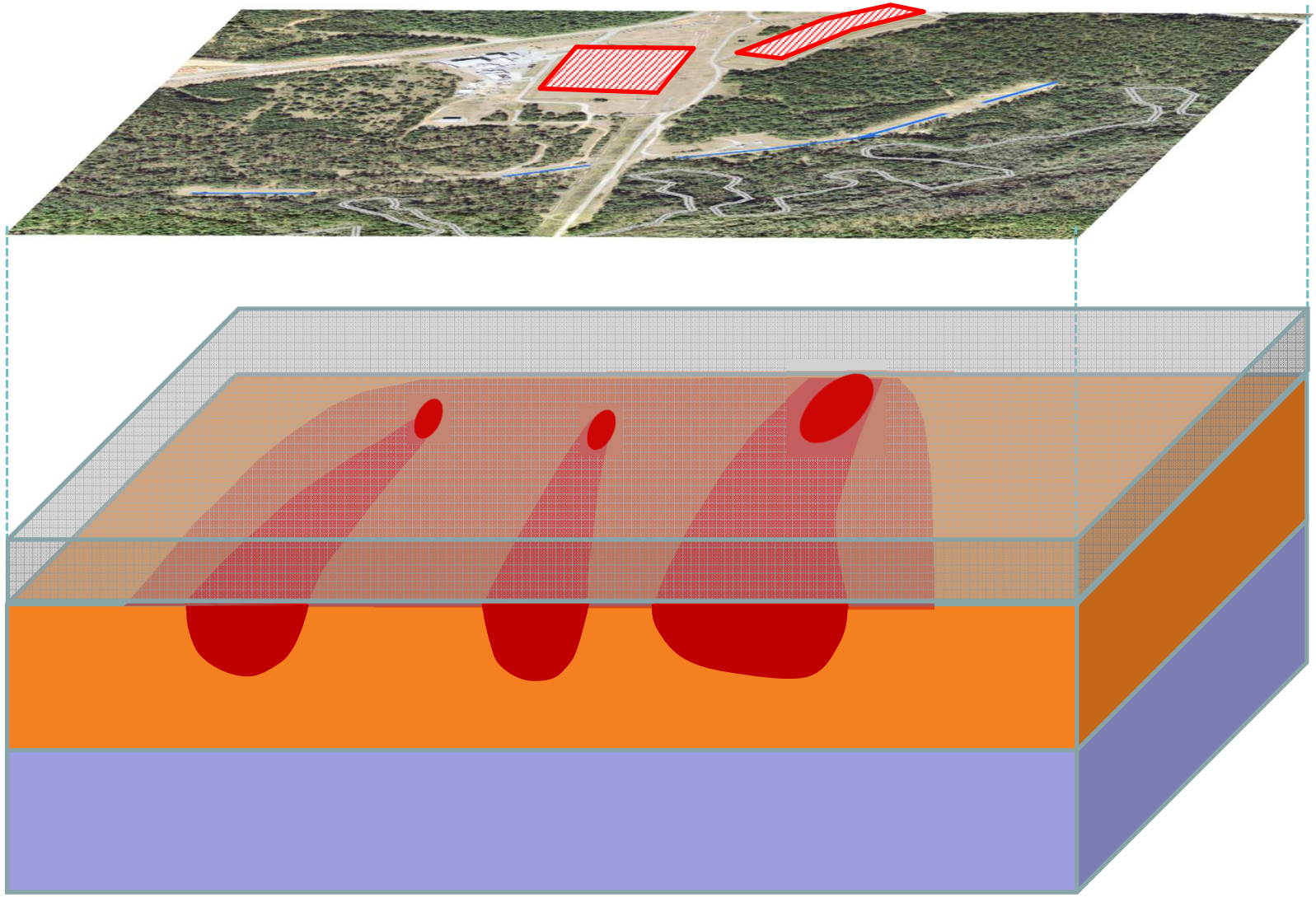
Active-to-Passive Success Stories at the Savannah River Site

Active-to-Passive Environmental Cleanup Transition Strategies

F-Area Metals and Rads

- **Original Remedial Strategy**
  - Releases to the basins were stopped in the mid 1980s
  - The basins were capped in the early 1990s
  - A pump/treat/reinject system was started in 1997 and terminated in 2003
  - Consisted of ion exchange, reverse osmosis, and flocculation treatment to remove metals and metallic radionuclides
  - Injected tritiated water upgradient of extraction
  - Cost over $1M/month to operate 30 year costs at $360M
  - Did not have a significant impact on releases to Fourmile Branch

Conceptual Site Model F-Area1990-2004

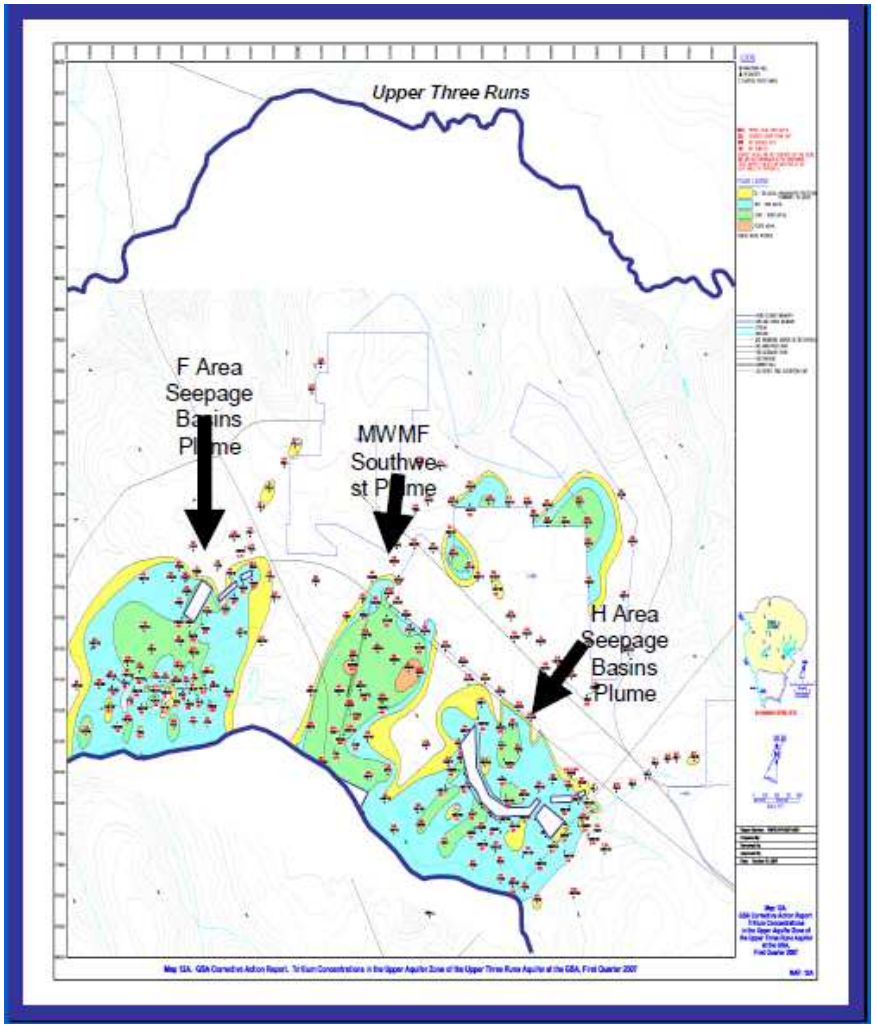


Active-to-Passive Success Stories at the Savannah River Site

Active-to-Passive Environmental Cleanup Transition Strategies

F-Area Barrier Wall with Base Injection and Silver Chloride Injection

- **Remedial Goals**
  - Reduce tritium discharge to Fourmile Branch by 70%
  - Reduce all other contaminants below standards in Fourmile Branch
- **Geology Controls Groundwater Flow**
  - Troughs in lower confining clay
  - Highest flow in channels
  - Lower part of section is more contaminated than top

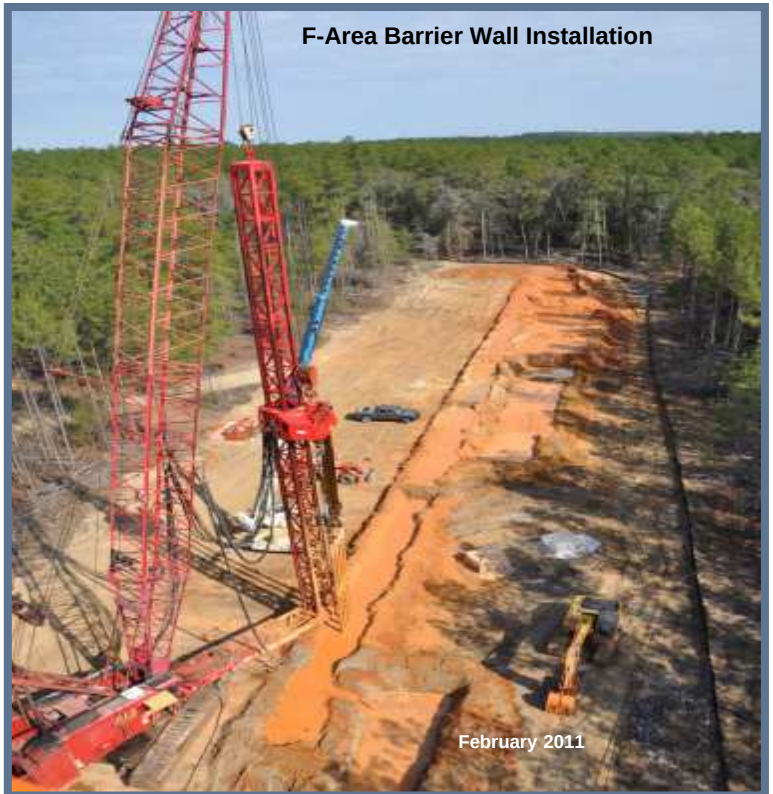


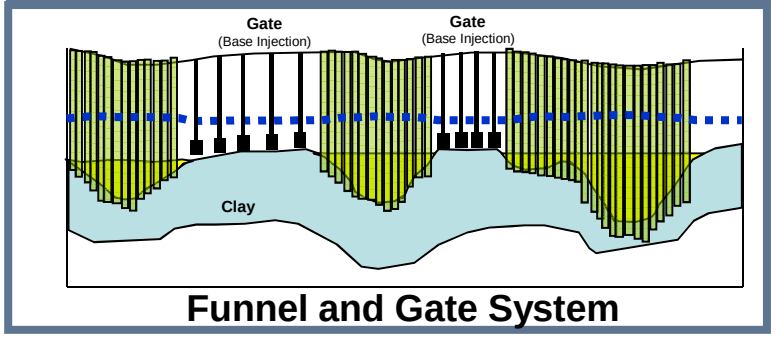
Active-to-Passive Success Stories at the Savannah River Site

Active-to-Passive Environmental Cleanup Transition Strategies

F-Area Barrier Wall with Base Injection and Silver Chloride Injection

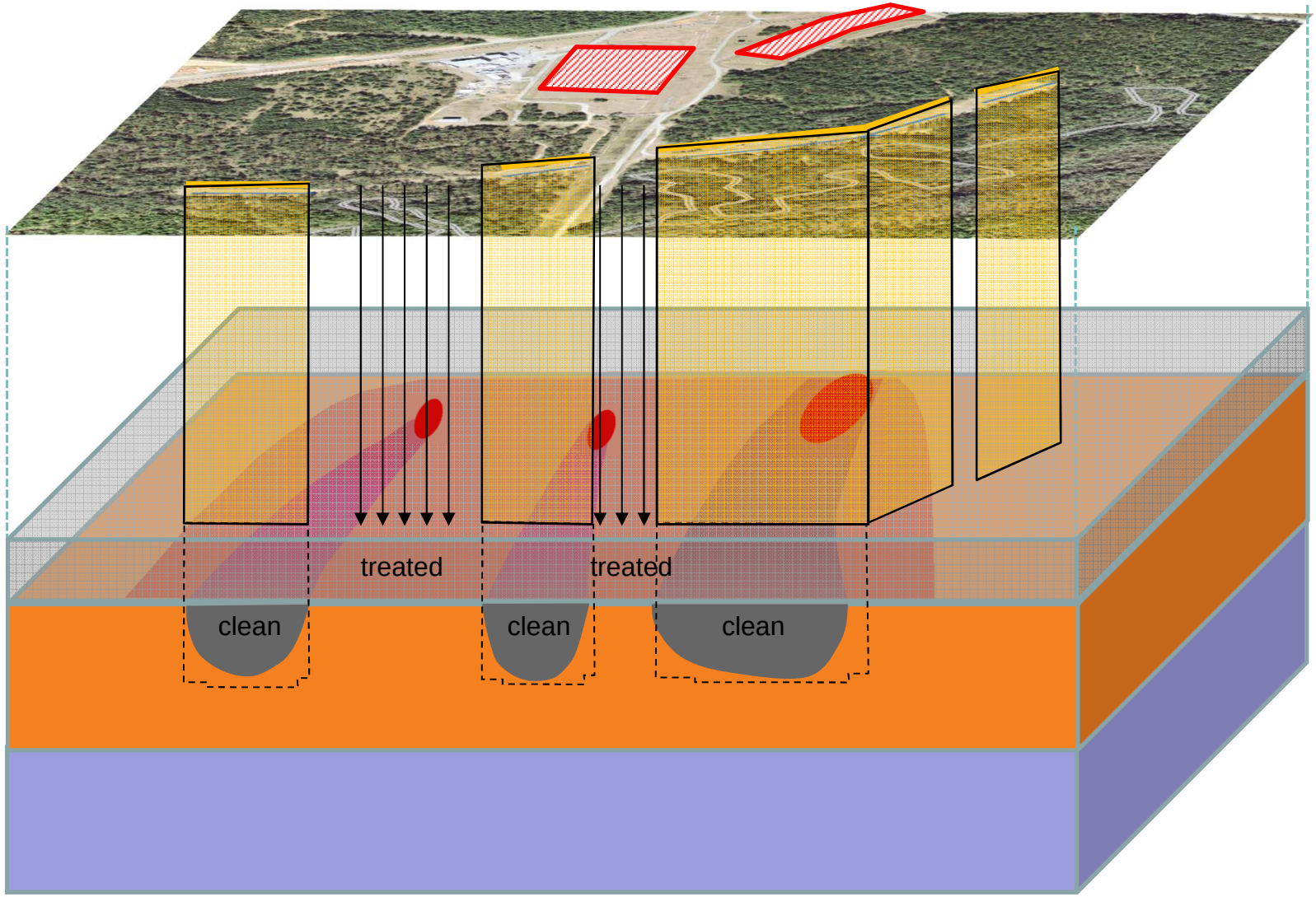
- **New Innovative Strategy**
  - Funnel and Gate System
  - Barrier wall to interrupt flow to Fourmile Branch
  - In-situ treatment by base injection at Gates to precipitate metals and metallic radionuclides
  - Innovative technology using silver chloride (AgCl) to capture I-129, an element unaffected by the injection of sodium hydroxide





Funnel and Gate System

Conceptual Site Model 2004 to present

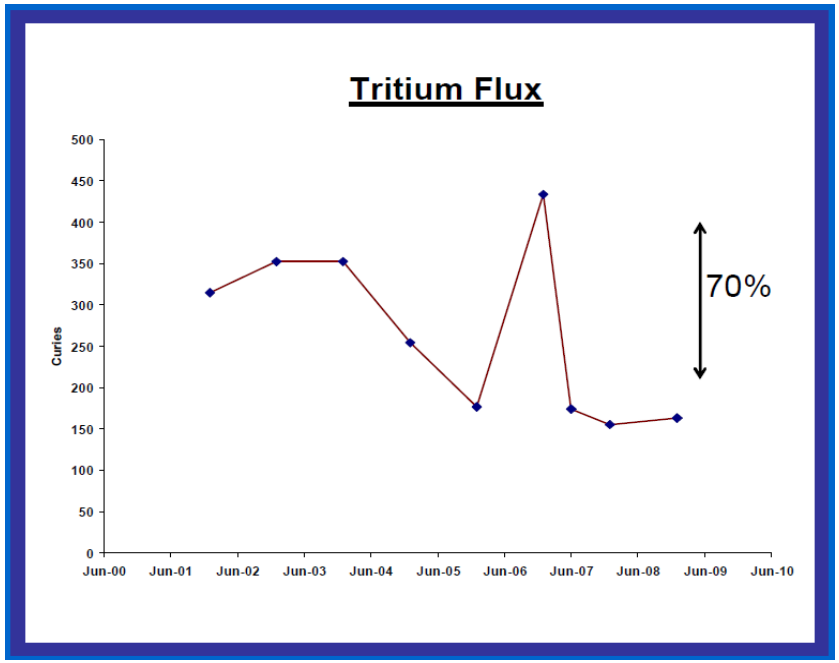


Active-to-Passive Success Stories at the Savannah River Site

Active-to-Passive Environmental Cleanup Transition Strategies

F-Area Barrier Wall with Base Injection and Silver Chloride Injection

- **Effects of the System**
  - 70% reduction in tritium flux to Fourmile Branch
  - Reduction in metals and radioactive metals in Fourmile Branch
  - Monitoring effectiveness of in-situ treatment for I-129
  - Cost reduction from over $1M/month to $1M/year to operate base injection and monitoring system



NNSA –Groundwater Sites

Sites: Livermore Main Site, Kansas City, Pantex -- Pump and Treat Operations have been ongoing for more than a decade

Propose technical assistance teams visit to perform site-specific evaluation of system performance

- **Focus of recommendations would be on optimization of existing system to match current plume status.**
- **Propose strategy for eventual transition from active remediation to strategic low energy/cost passive solutions.**
- **Allow site to develop criteria and technical justification for transitioning system to next phase of remediation as appropriate.**

NNSA –Groundwater Sites

Site: Livermore Site 300

Propose technical assistance teams visit to perform site-specific of proposed remedial solutions

- **Due to very low levels of precipitation, traditional pump and treat systems are generally not appropriate**
- **Focus of recommending innovative technical strategies and toolbox to address contamination at each of the individual sites**
- **Propose eventual strategy for eventual transition from active remediation to strategic low energy/cost passive solutions.**