



95 ABW

Cleanup Technologies

Environmental Restoration Program

Edwards AFB, CA

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20 May 2010





Topic Overview



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- **What kind of technologies are used to clean contamination from soil and groundwater at Edwards?**
 - Removal/Containment Technologies
 - Ex Situ Technologies
 - In Situ Technologies



Key Terms and Concepts



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- **In situ — in its original place; unmoved, unexcavated; remaining at the site or in the subsurface**
- **Ex situ — moved from its original place; excavated; removed or recovered from the subsurface**
- **Aerobic – living or occurring only in the presence of oxygen**
- **Anaerobic – not capable of living in the presence of free oxygen**



Finding the “Right” Tool



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- **No single technology meets all needs**
- **Selection based on site specific characteristics:**
 - Soil/groundwater conditions
 - Types of contamination
 - Contaminant concentrations
- **Develop cleanup alternatives**
 - Remedial action objectives
 - Potential treatment, recovery and containment technologies
 - Technology effectiveness, implementability and cost



Removal/Containment Technologies



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- **Excavation and Disposal**
- **Cap Technology**
- **Soil Stabilization**



Excavation



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South Base

- **Removal of contaminated soil**
- **Limited in depth and aerial extent**
- **Used when contamination is not affecting groundwater**
- **Soil transported off site**



Cap Technology



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- **A cap is a protective layer that covers a site**
- **Commonly referred to as “capping”**
- **Contains and isolates the contamination**
- **Capping**
 - Reduces surface exposure pathways
 - Reduces surface water exposure to contamination
 - Reduces leaching of contaminants down to underlying groundwater
 - Future use may be restricted

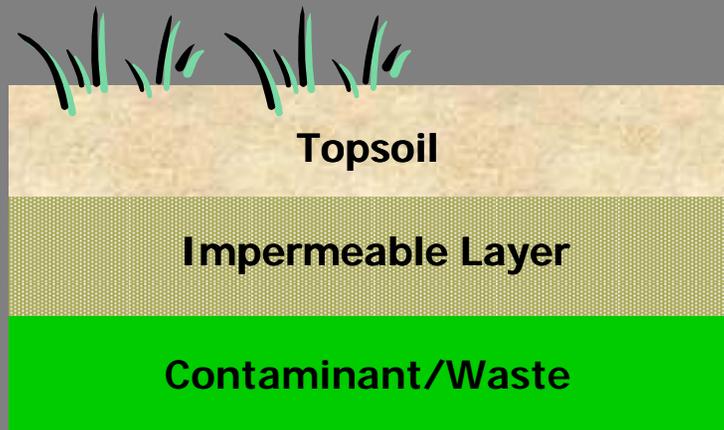


Cap Technology (continued)

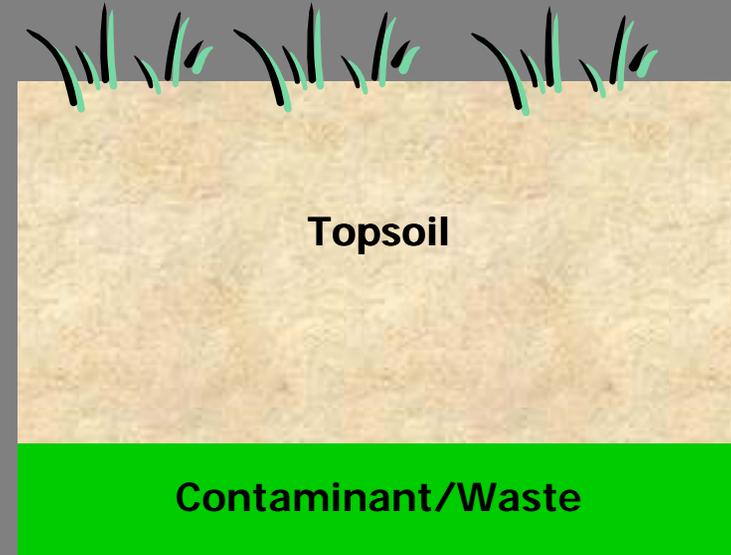


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EPA Standard Cover Design



Alternative Design





Cap Technology (concluded)



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Site 13



Soil Stabilization



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Site 417

- **Cement mixed with contaminated soil and allowed to harden**
- **Locks contaminants in the soil**
- **Principle use is on metals and inorganic compounds**
- **Reduction in mobility of contaminants**



Ex Situ Technologies



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- **Groundwater Pump and Treat**
 - Granular Activated Carbon
 - Ion Exchange (Perchlorate)
- **Soil Vapor Extraction (SVE)**
- **Dual Extraction**
- **Free-product Recovery**
- **Land Farming**



Groundwater Pump and Treat



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- **Extraction of groundwater through wells**
- **Pump contaminated groundwater to treatment system**
- **May be designed to contain plume**
- **Lowers groundwater table making more contamination available for soil vapor extraction**
- **Historically most common form of groundwater remediation, but may be very costly**

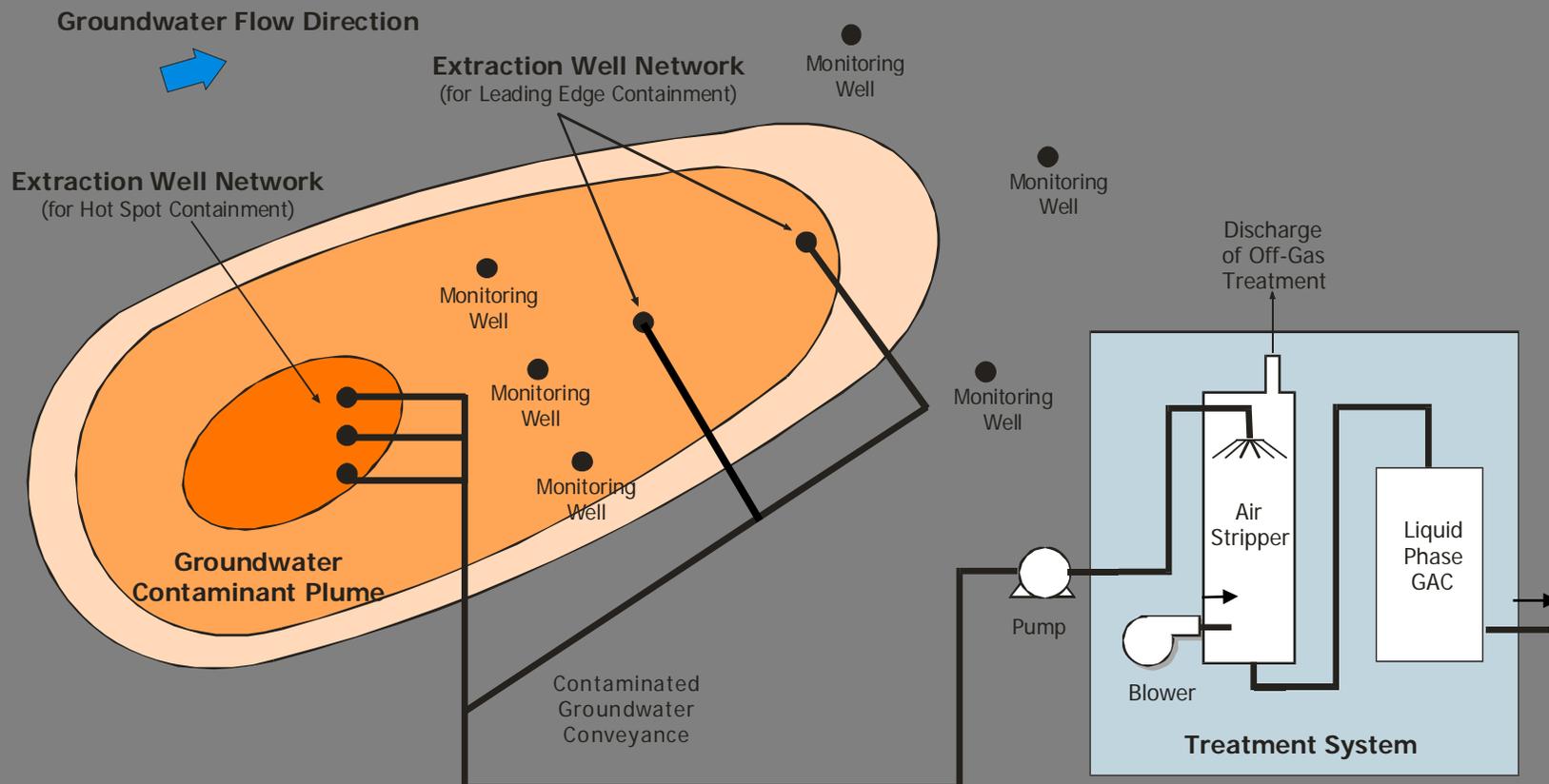


Groundwater Pump and Treat (concluded)



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“Full Plume Containment” Groundwater Pump and Treat System





Soil Vapor Extraction (SVE)



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Site 16

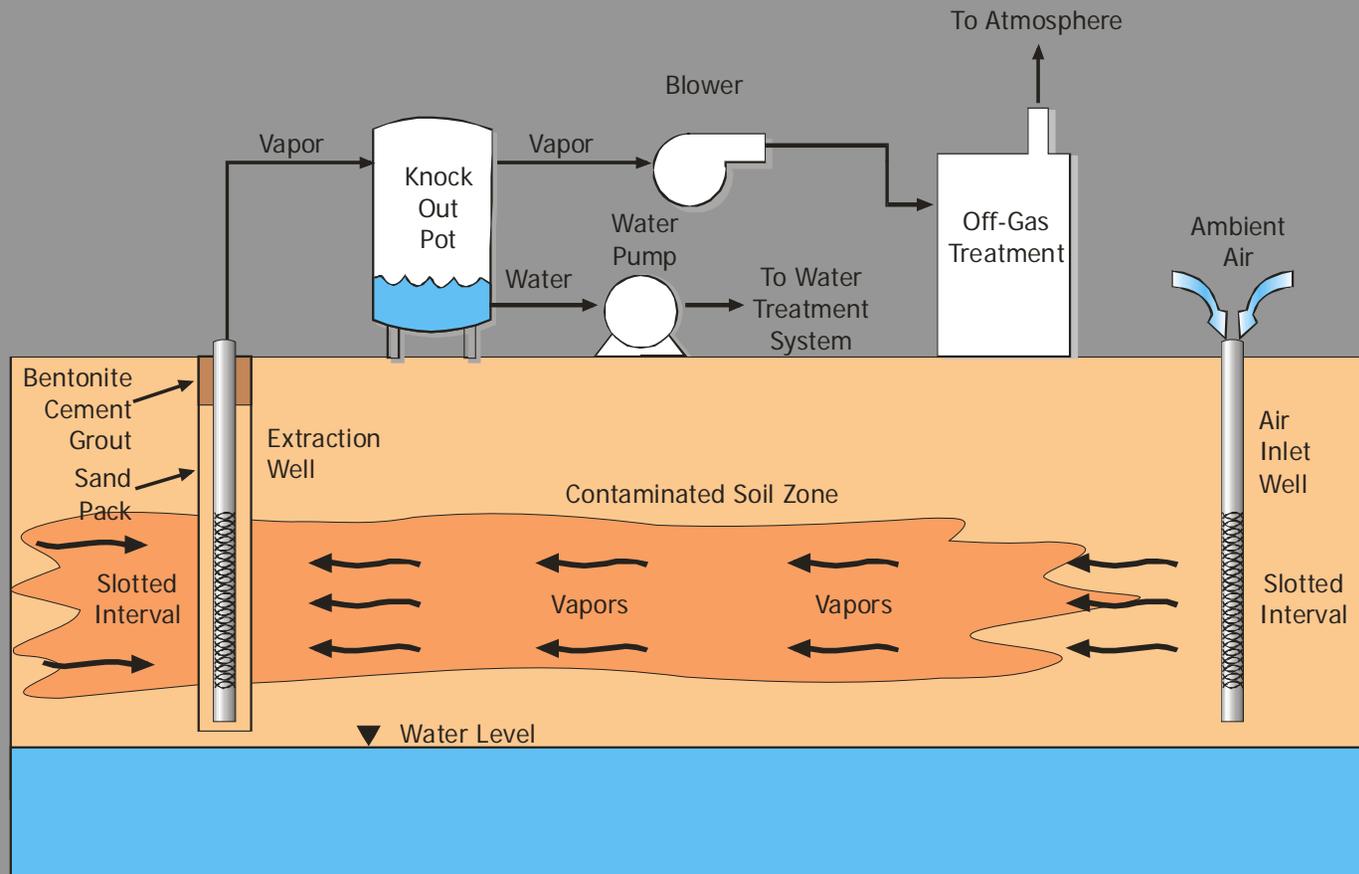
- **Extraction of volatile organic compounds (VOCs) such as gasoline from the soil using a vacuum system**
- **Works best in permeable soils: sands, gravels**
- **The vacuum pulls air through the soil and physically removes the vapor**
- **Extracted vapors are treated/destroyed**
- **Does not work for oils, metals, and some other compounds**



Soil Vapor Extraction (SVE) (concluded)



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In Situ Technologies



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- **There are three types of in situ technologies**
 - Biological
 - Chemical
 - Mechanical



In Situ Technologies



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- **Biological**
 - Soil Bioventing
 - Oxygen Releasing Compounds
 - Whey Powder Injection
 - Toluene Injection
 - Soybean Oil Injection
- **Chemical**
 - Nano-scale Zero Valent Iron Injection
 - Potassium Permanganate Injection
- **Mechanical**
 - Steam Injection
 - Air Sparging/Vapor Extraction
 - Electrical Resistivity
 - Soil Flushing



Soil Bioventing



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Site 5

- **Primary use is remediation of soil contaminated with fuels**
- **Injection of oxygen and water into the soil to promote in-place biologic degradation of contaminants**
- **Uses naturally occurring bacteria in the soil to break down the contaminants**

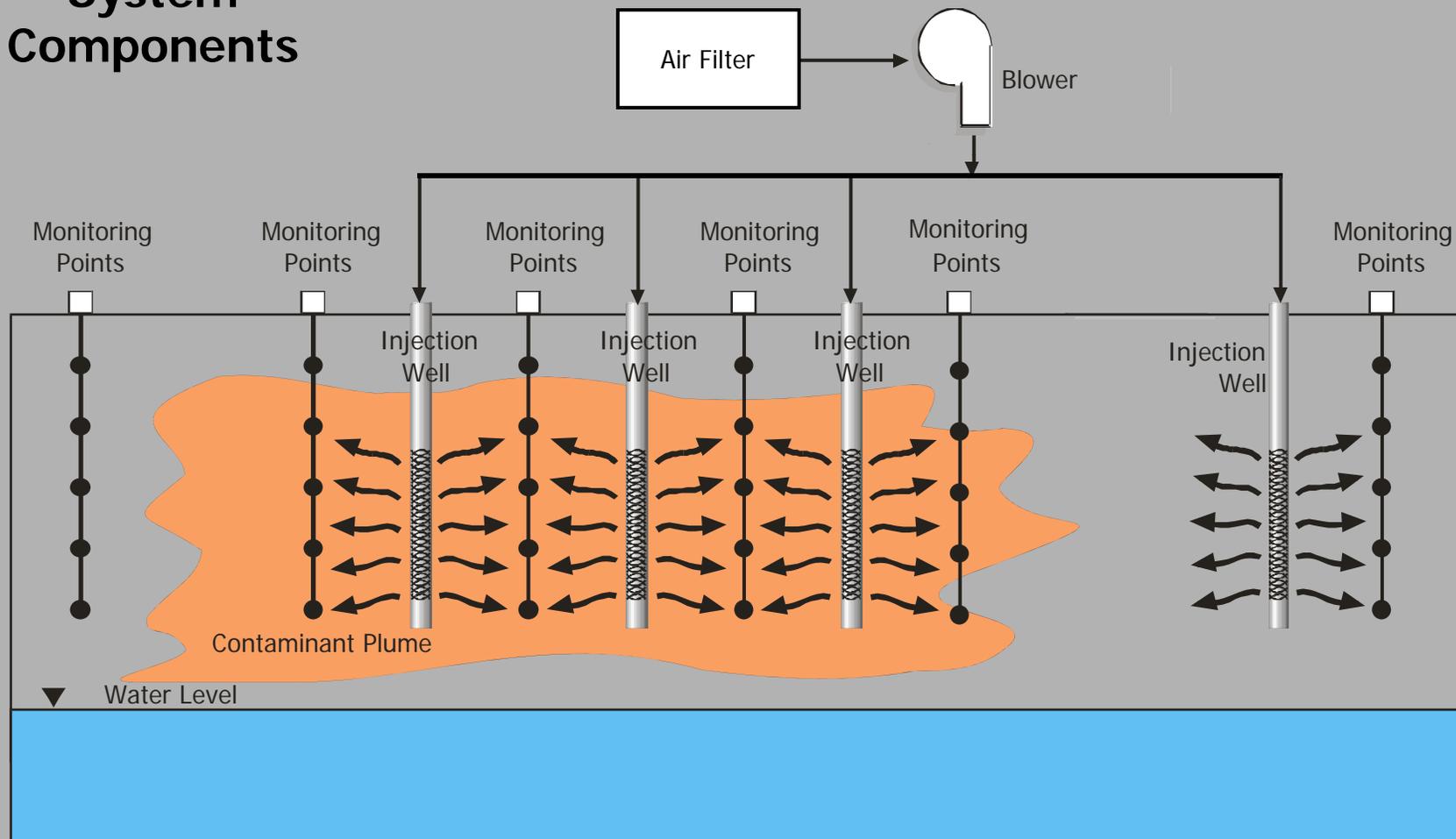


Soil Bioventing (concluded)



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Bioventing System Components





Monitored Natural Attenuation (MNA)



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- **Natural mechanisms leading to mass reduction**
 - Aerobic or anaerobic degradation
 - Chemical transformation
 - Dispersion
 - Dilution
 - Sorption
 - Volatilization
- **Requires performance monitoring to track progress**



Cleanup Technologies



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Questions?