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**OVERHEADS AND HANDOUTS FROM MAY, 1993 OU-5 ISA
PRESENTATION TO THE PUBLIC**

05/00/93

DOE-FN PUBLIC
55
OVERHEADS



OU-5 ISA PRESENTATION

Graphics 2162.2 5/93

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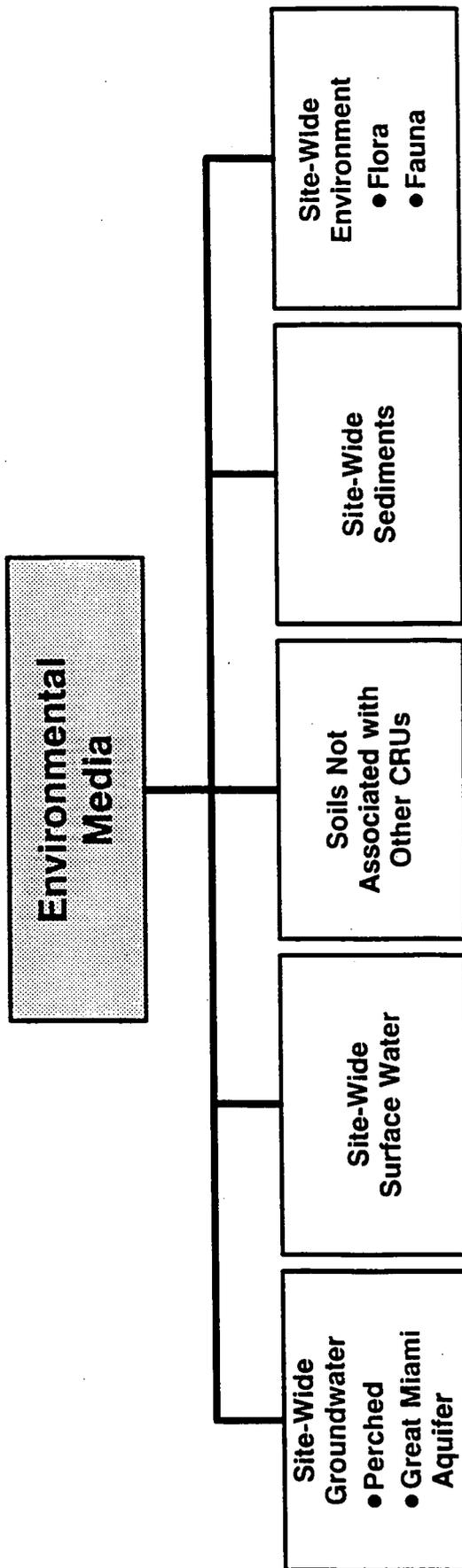
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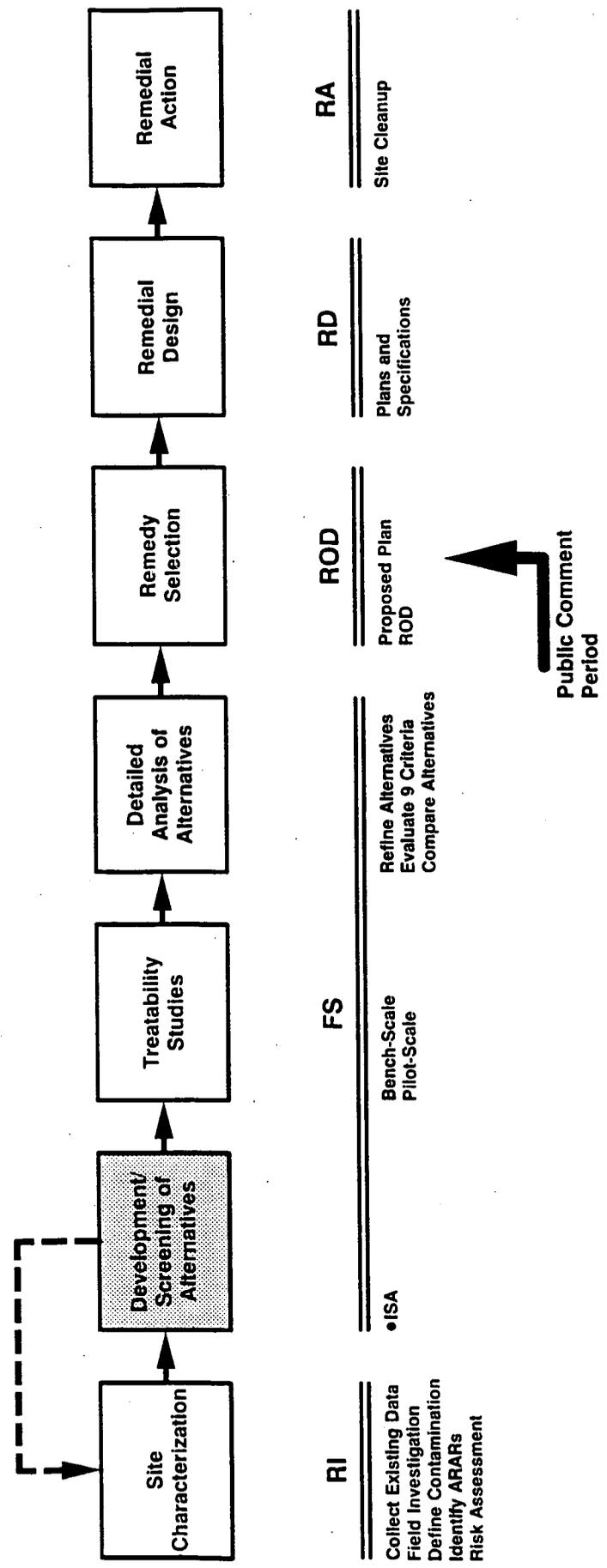
OPERABLE UNIT 5 - ENVIRONMENTAL MEDIA

FERNALD



CERCLA PROCESS

FERNALD



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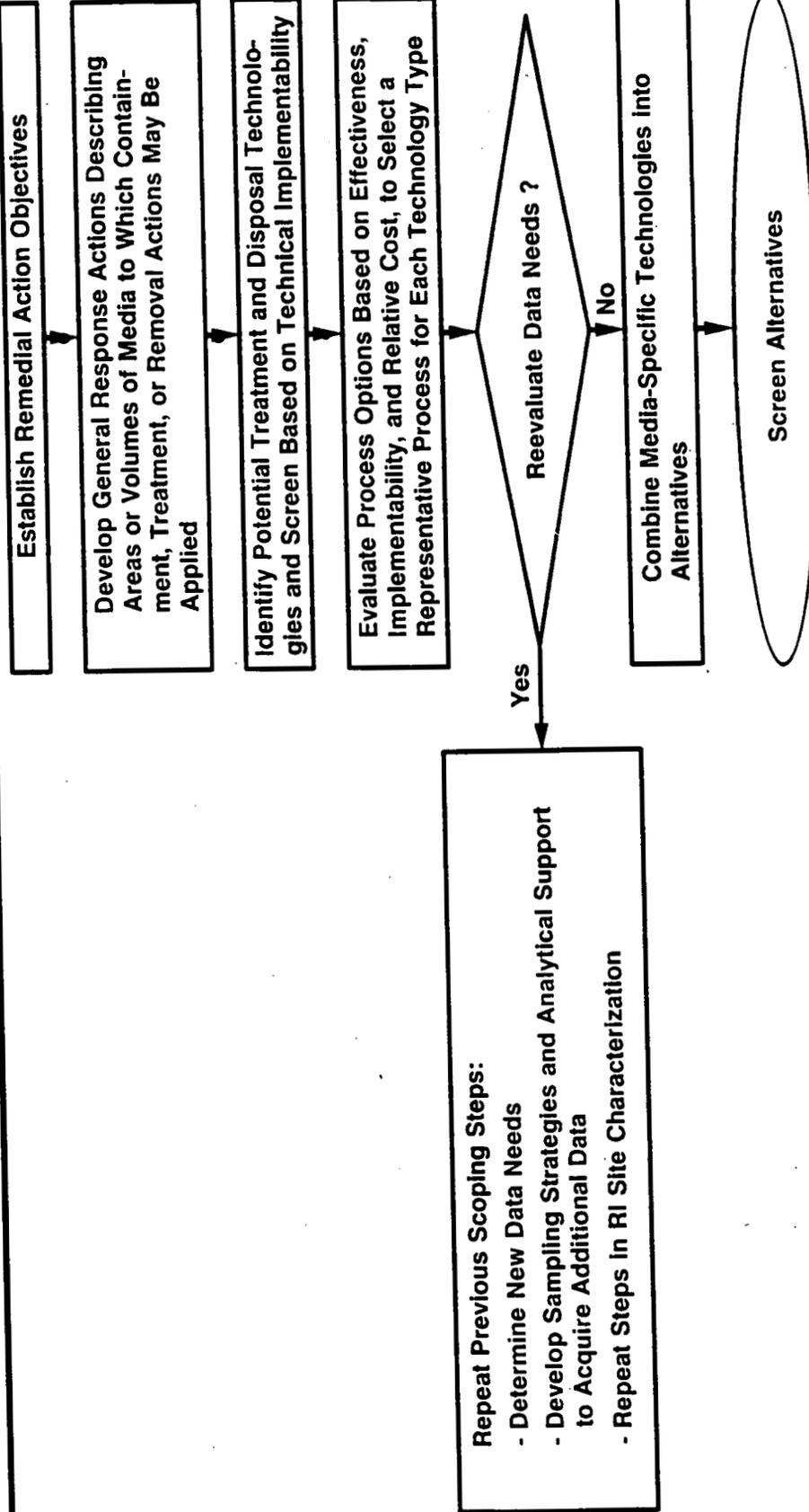
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THE ISA PROCESS

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IDENTIFICATION AND INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

FERNALD

- **For Groundwater, Soils, and Sediments, Potentially Feasible Remedial Technologies and Process Options Have Been Identified for Each of the Relevant Response Actions.**
- **These Technologies Were Compiled From Various EPA Documents as Well as Other Applicable References.**



INITIAL SCREENING CRITERIA

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- How Well Does the Technology Work ?
- How Practical is it to Use the Technology ?
- How Much Does the Technology Cost ?



GROUNDWATER



Great
Miami
Aquifer



Perched
Water



GROUNDWATER CONTAMINANTS OF CONCERN

FERNALD

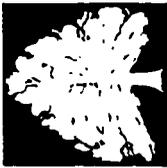
- **Radionuclides**
- **Organic Compounds**
- **Metals**
- **Levels of Contamination -- Called PRGs --
Are Used to Estimate the Amount of
Contaminated Groundwater.**

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RETAINED GROUNDWATER TECHNOLOGIES

FERNALD

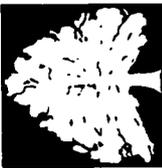
<u>General Response Action</u>	<u>Remedial Technology</u>	<u>Process Options</u>
No Action	None	Not Applicable
Institutional Actions	Monitoring Use/Access Restrictions	Groundwater Monitoring Land Acquisition ⁽¹⁾ Deed Restrictions
Control/Containment	Pumping Wells	Extraction Wells Injection Wells Slurry Walls ⁽¹⁾
Removal	Vertical Barriers Pumping Wells Gravity Drainage	Extraction Wells Wellpoint System French Drains and/or Interceptor Trenches
Treatment	Physical Physicochemical	Air Stripping Reverse Osmosis Adsorption Precipitation Ion Exchange Solvent Extraction ⁽¹⁾
Discharge	Discharge to Surface Water Underground Discharge	Great Miami River (Option 1) Paddy's Run (Option 2) Injection Wells

⁽¹⁾ Support Technology

Graphics 2162.10 5/93

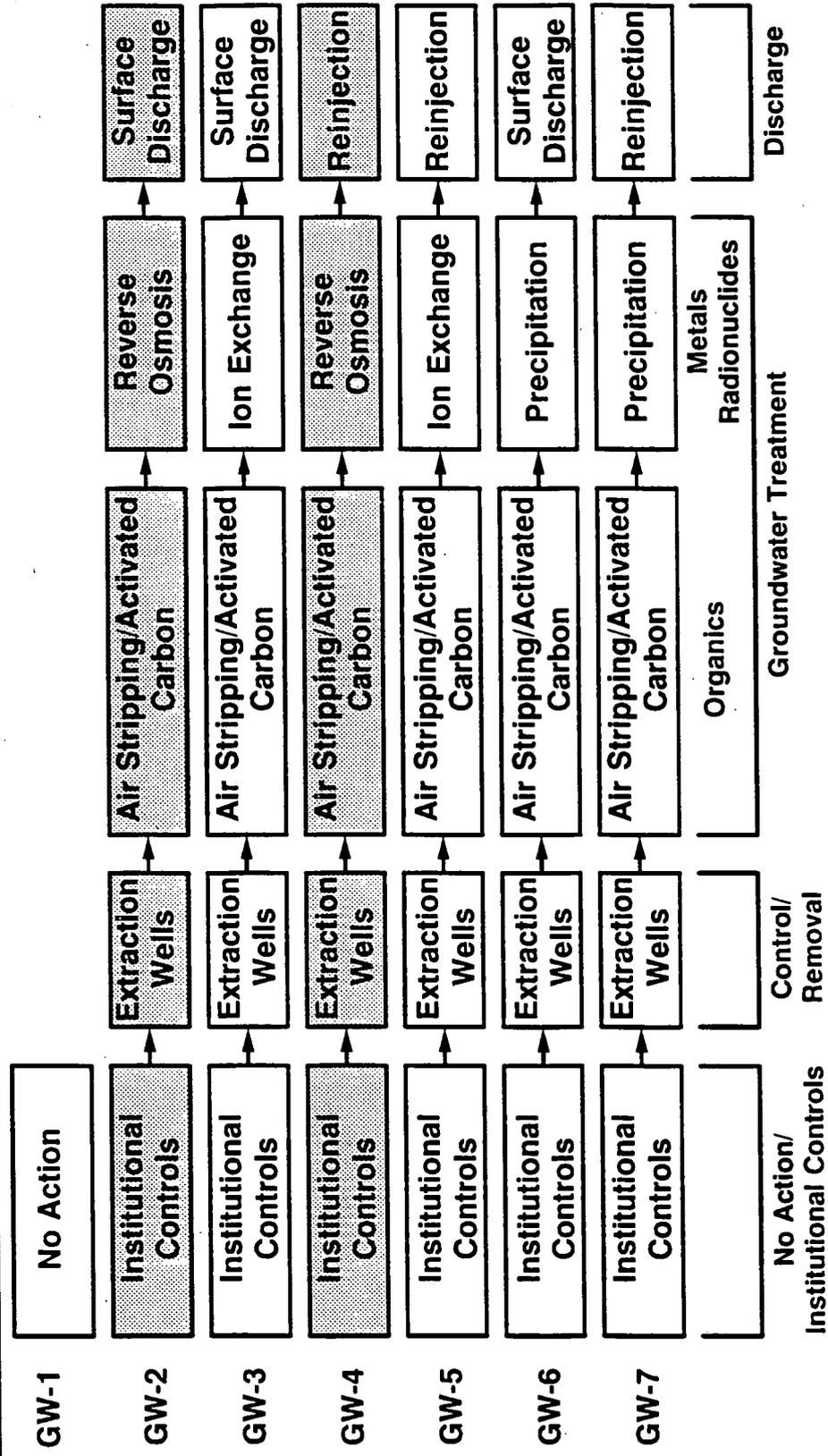
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Fernald Environmental Management Project



GROUNDWATER REMEDIAL ALTERNATIVES SCREENING

FERNALD



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SUMMARY OF GROUNDWATER REMEDIAL ALTERNATIVES SCREENING

FERNALD

Alternative	Effectiveness	Implementability	Cost	Evaluation
GW-1 No Action	Low	High	\$0	Retained
GW-2 Reverse Osmosis/ Surface Water Discharge	High	Moderate <ul style="list-style-type: none"> ● Constructability & Reliability Concerns ● Specialized Equipment 	\$216.5M	Eliminated
GW-3 Ion Exchange/ Surface Water Discharge	High	Moderate to High <ul style="list-style-type: none"> ● Specialized Equipment 	\$161.7M	Retained
GW-4 Reverse Osmosis/ Reinjection Discharge	High	Low to Moderate <ul style="list-style-type: none"> ● Constructability & Reliability Concerns ● Specialized Equipment ● Subsurface Discharge Not Favored by Regulatory Agency 	\$217.3M	Eliminated

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Graphics 2162.13 5/93



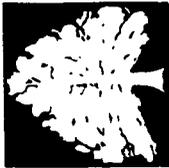
SUMMARY OF GROUNDWATER REMEDIAL ALTERNATIVES SCREENING (CONT.)

FERNALD

Alternative	Effectiveness	Implementability	Cost	Evaluation
GW-5 Ion Exchange/ Reinjection Discharge	High	Moderate <ul style="list-style-type: none"> • Somewhat Specialized Equipment • Subsurface Discharge Not Favored by Regulatory Agency 	\$194.3M	Retained
GW-6 Precipitation/ Surface Water Discharge	Moderate to High <ul style="list-style-type: none"> • Conventional Treatment • Treatability Testing Required 	High	\$1820.2M	Retained
GW-7 Precipitation/ Reinjection Discharge	Moderate to High <ul style="list-style-type: none"> • Conventional Treatment • Treatability Testing Required 	Moderate to High <ul style="list-style-type: none"> • Subsurface Discharge Not Favored by Regulatory Agency 	\$1821.1M	Retained

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SOILS/SEDIMENTS

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SOIL/SEDIMENT CONTAMINANTS OF CONCERN

FERNALD

- **Radionuclides**
- **Organic Compounds**
- **Metals**
- **Levels of Contamination -- Called PRGs --
Are Used to Estimate the Amount of
Contaminated Soil/Sediments.**



RETAINED SOIL/SEDIMENT TECHNOLOGIES

FERNALD

<u>General Response Action</u>	<u>Remedial Technology</u>	<u>Process Options</u>
No Action	None	Not Applicable
Institutional Actions	Access/Use Restrictions	Physical Barriers Deed Restrictions
Control/Containment	Capping	Single Layer Cap ⁽¹⁾ Multilayer Cap
Removal	Excavation	Mechanical Excavation
Treatment	Biological	Soil Aeration ⁽¹⁾
	Physical	Soil Vapor Extraction ⁽¹⁾
	Physicochemical	Soil Washing
	Solidification/Stabilization	Cement-based/Pozzolanic-based Batch Vitrification
Intermediate Storage	Storage Facility	Storage Pile/Surface Impoundment
On-site Disposal	Engineered Disposal Facility On-site Backfilling	Engineered Disposal Facility Backfilling of Treated Residuals
Off-site Disposal	Engineered Disposal Facility	Engineered Disposal Facility

⁽¹⁾ Support Technology

Graphics 2162.19 5/93

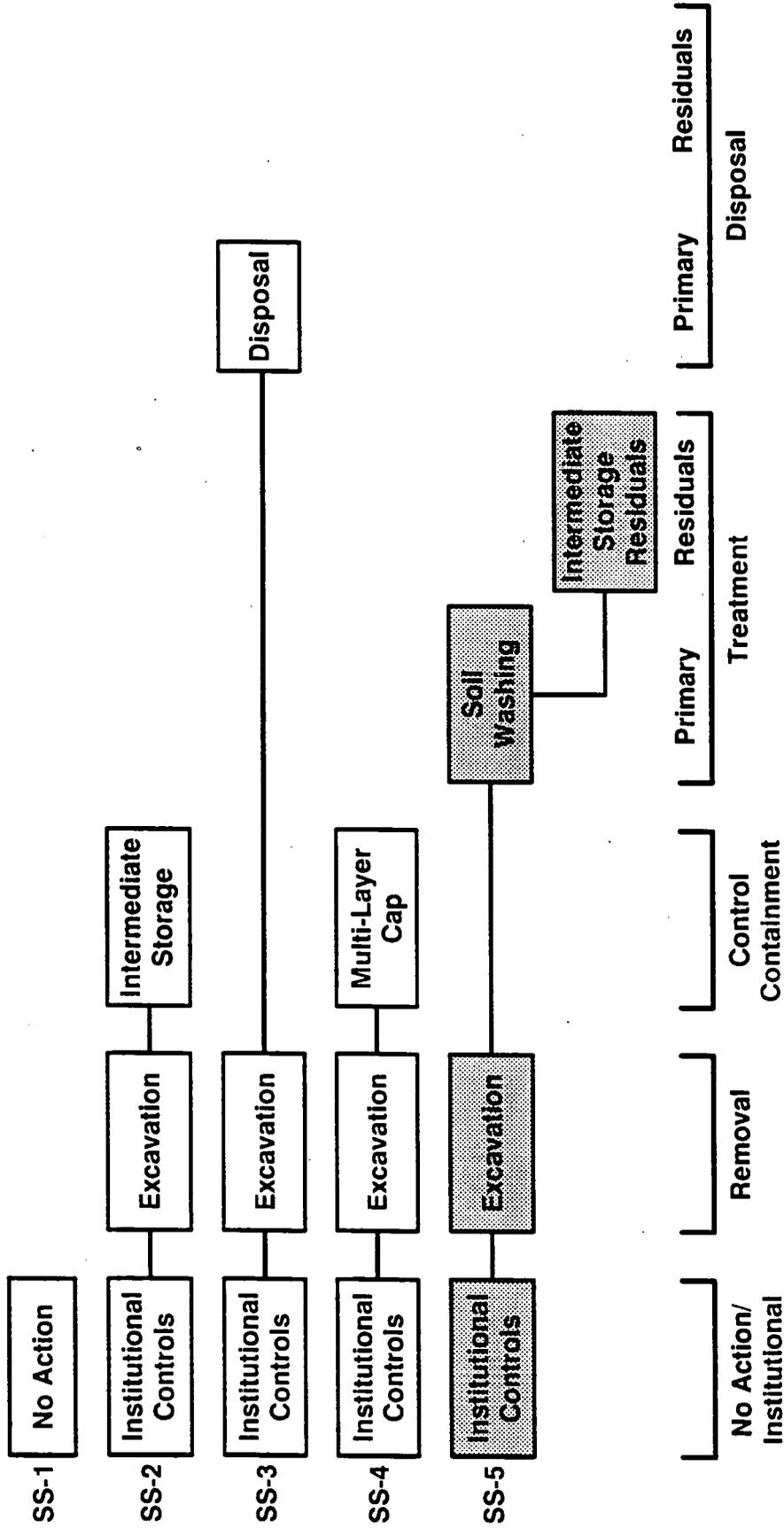
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SOILS/SEDIMENT REMEDIAL ALTERNATIVES SCREENING

FERNALD



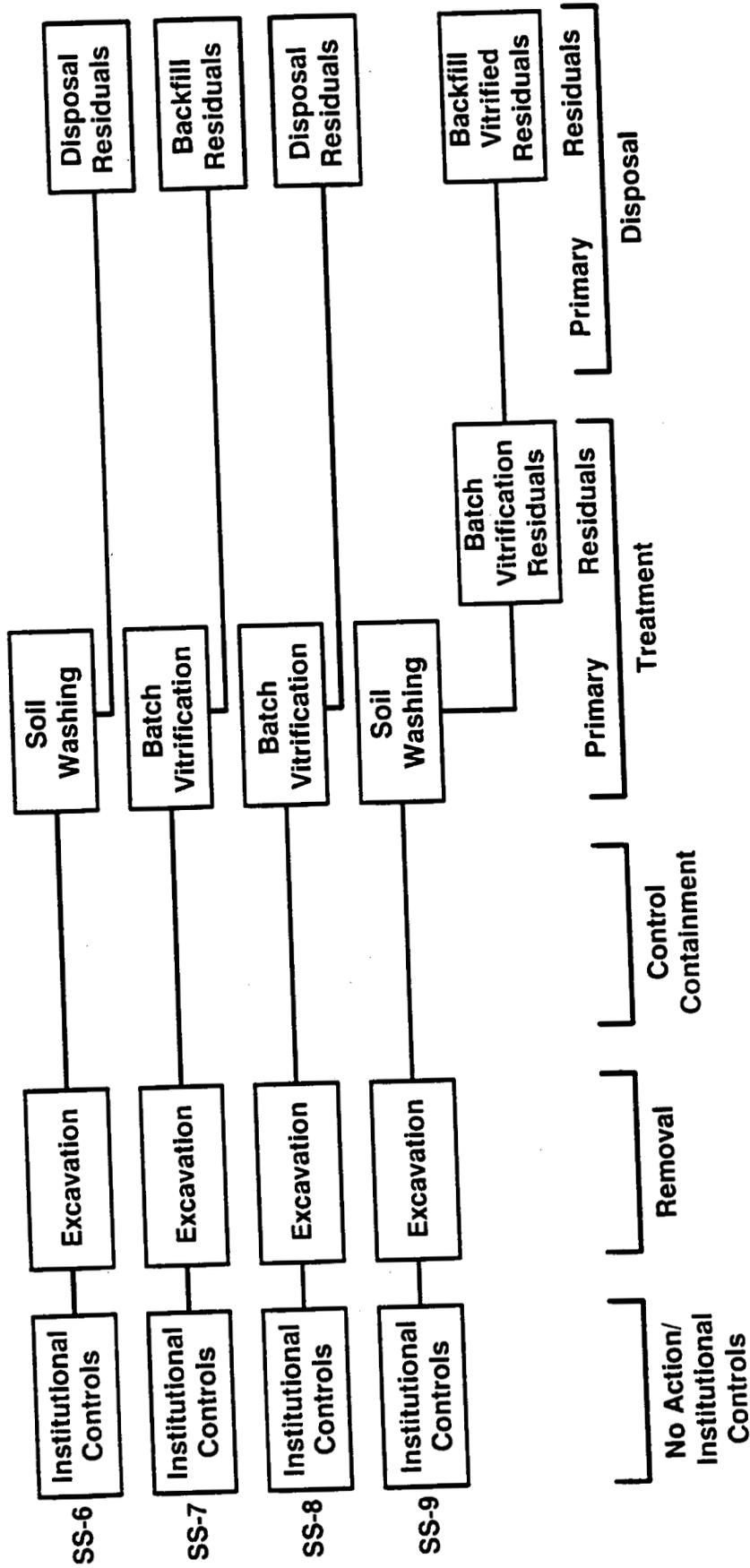
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SOILS/SEDIMENT REMEDIAL ALTERNATIVES SCREENING (CONT.)



FERNALD



Fernald Environmental Management Project

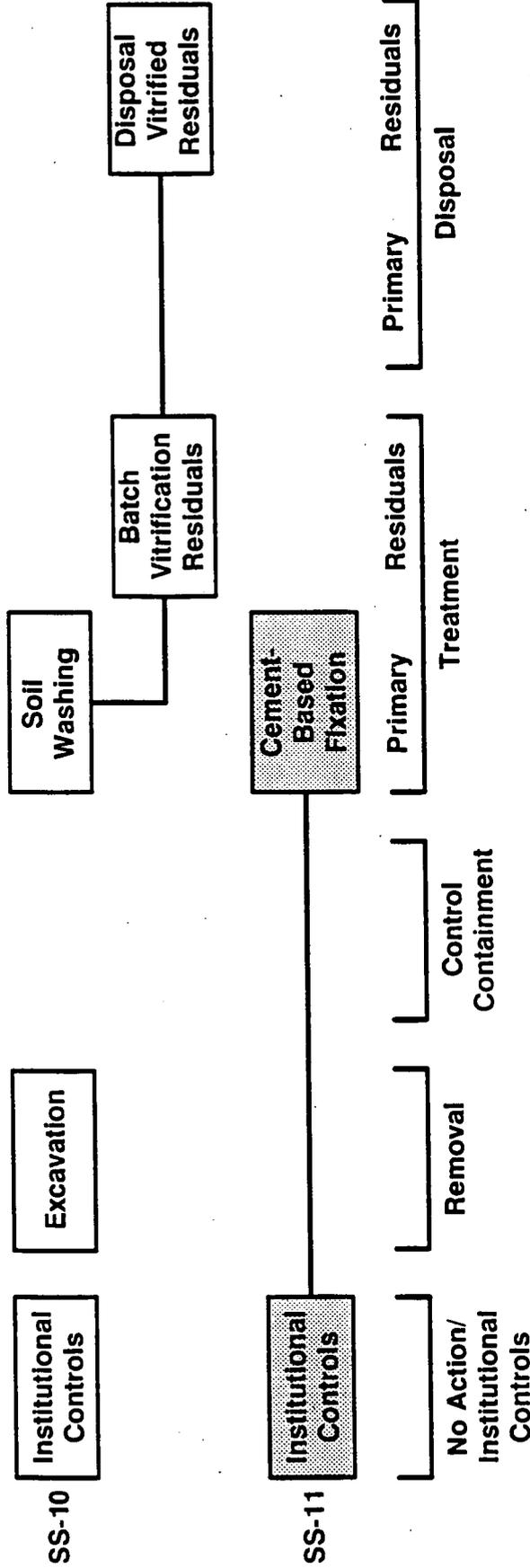
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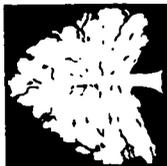
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SOILS/SEDIMENT REMEDIAL ALTERNATIVES SCREENING (CONT.)



FERNALD





SUMMARY OF SOIL & SEDIMENTS REMEDIAL ALTERNATIVES SCREENING

FERNALD

Alternative	Effectiveness	Implementability	Cost	Evaluation
SS-1 No Action	Low	High	\$0	Retained
SS-2 Intermediate Storage	Low to Moderate ● Confines Contaminant Toxicity, Mobility & Volume	High	\$79.5M	Retained
SS-3 Disposal (On-site or Off-site)	Low to Moderate ● Confines Contaminant Toxicity, Mobility & Volume	High	\$106.9M & \$200.4M	Retained



SUMMARY OF SOIL & SEDIMENTS REMEDIAL ALTERNATIVES SCREENING (CONT.)

FERNALD

Alternative	Effectiveness	Implementability	Cost	Evaluation
SS-4 Capping	Low to Moderate ● Reduces Contaminant Toxicity But Not Mobility & Volume	High	\$22.8M	<i>Returned</i> Eliminated
SS-5 Soil Washing W/Storage of Residuals	Moderate ● Concentrated Contaminants In Residuals ● Treatability Testing	High	\$131.9M	Eliminated
SS-6 Soil Washing W/Disposal of Residuals (On-site or Off-site)	Moderate ● Concentrated Contaminants In Residuals ● Treatability Testing	High	\$135.9M & \$164.9M	Retained



SUMMARY OF SOIL & SEDIMENTS REMEDIAL ALTERNATIVES SCREENING (CONT.)

FERNALD

Alternative	Effectiveness	Implementability	Cost	Evaluation
SS-7 Vitrification W/Backfilling of Residuals	Moderate • Long-Term Protection Concern	Moderate • Constructability Concerns • Specialized Equipment	\$194M	Retained
SS-8 Vitrification W/Disposal of Residuals (On-site or Off-site)	High	Moderate • Constructability Concerns • Specialized Equipment	\$248.5M & \$339.4M	Retained
SS-9 Soil Washing W/Backfilling of Vitrified Residuals	Low to Moderate • Questionable Long-Term Protection • Treatability Testing • Concentrated Contaminants In Residuals	Moderate • Constructability Concerns • Specialized Equipment	\$148.5M	<i>Retained</i> Eliminated

Fernald Environmental Management Project



SUMMARY OF SOIL & SEDIMENTS REMEDIAL ALTERNATIVES SCREENING (CONT.)

FERNALD

Alternative	Effectiveness	Implementability	Cost	Evaluation
<p>SS-10 Soil Washing W/Disposal of Vitrified Residuals (On-site or Off-site)</p>	<p>High ● Treatability Testing</p>	<p>Moderate ● Constructability Concerns ● Specialized Equipment</p>	<p>\$151M & \$201M</p>	<p>Retained</p>
<p>SS-11 Cement-Based Fixation</p>	<p>Low to Moderate ● Questionable Long-Term Protection ● Reduces Contaminant Mobility But Not Toxicity or Volume</p>	<p>Moderate</p>	<p>\$89.4M</p>	<p>Eliminated</p>

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Initial Screening of Alternatives for Operable Unit 5
June 1, 1993

SIGN-IN

Name: Eldon Steiner

Address: 

Telephone: 

Do you want to be added to the Fernald mailing list? Yes No

Name: Steve James

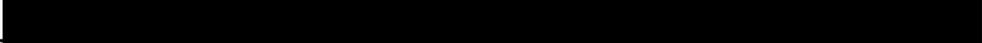
Address: ODH/Bureau of Rad. Health

Telephone: 614-647-2727

Do you want to be added to the Fernald mailing list? Yes No

Name: ROBERT C. TAYLOR

Address: 

Telephone: 

Do you want to be added to the Fernald mailing list? Yes No

Name: _____

Address: _____

Telephone: _____

Do you want to be added to the Fernald mailing list? Yes No

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Initial Screening of Alternatives for Operable Unit 5
June 1, 1993

SIGN-IN

Name: Edwa Yocum

Address: [REDACTED]

Telephone: [REDACTED]

Do you want to be added to the Fernald mailing list? Yes No

Name: Margene Merritt

Address: [REDACTED]

Telephone: [REDACTED]

Do you want to be added to the Fernald mailing list? Yes No

Name: Lisa Crawford

Address: [REDACTED]

Telephone: [REDACTED]

Do you want to be added to the Fernald mailing list? Yes No

Name: PAM DUON

Address: [REDACTED]

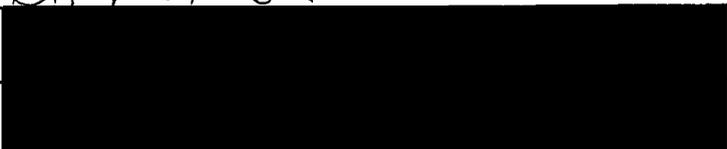
Telephone: [REDACTED]

Do you want to be added to the Fernald mailing list? Yes No

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

Initial Screening of Alternatives for Operable Unit 5
June 1, 1993

SIGN-IN

Name: GARY STORER
Address: 
Telephone: 

Do you want to be added to the Fernald mailing list? Yes No

Name: _____
Address: _____
Telephone: _____

Do you want to be added to the Fernald mailing list? Yes No

Name: _____
Address: _____
Telephone: _____

Do you want to be added to the Fernald mailing list? Yes No

Name: _____
Address: _____
Telephone: _____

Do you want to be added to the Fernald mailing list? Yes No

Fernald Environmental Glossary

This fact sheet has been prepared as part of the effort to familiarize the public with the specific vocabulary used in discussions about environmental restoration and waste management at Fernald.

ALARA - As Low As Reasonably Achievable, or keeping radiation emissions and exposures to levels set as far below regulatory limits as is reasonably possible in order to protect public health and the environment.

alpha radiation - The most energetic but least penetrating form of radiation. It can be stopped by a sheet of paper and cannot penetrate human skin. However, if an alpha-emitting isotope is inhaled or ingested, it will cause highly concentrated local damage.

aquifer - A permeable body of rock capable of yielding quantities of groundwater to wells and springs.

AR - Administrative Record, a required, comprehensive file of documents that forms the basis of decisions made regarding cleanup at Fernald. It is available for public review and comment. (See PEIC).

ARARs - Applicable or relevant and appropriate requirements, a comprehensive set of laws and regulations that are relevant to guide the selection of cleanup activity at a particular site.

asbestos - A strong and incombustible fiber widely used in the past for fireproofing and insulation. The small, buoyant fibers are easily inhaled or swallowed, causing a number of serious diseases including: asbestosis, a chronic disease of the lungs that makes breathing more and more difficult; cancer; and mesothelioma, a cancer (specific to asbestos exposure) of the membranes that line the chest and abdomen.

atom - The smallest particle of an element having the chemical properties of that element; the fundamental building block of matter.

AWWT - Advanced wastewater treatment

background radiation - The natural radioactivity in the environment. Natural radiation consists of cosmic rays, filtered through the atmosphere from outer space, and radiation from the naturally radioactive elements in the earth (primarily uranium, thorium, radium and potassium). Also known as natural radiation.

baseline risk assessment - (See BRA).

BDN - Bionitrification, the process of breaking down nitrates into harmless elements through the use of living bacteria.

beta radiation - High-energy electrons (beta particles) emitted from certain radioactive material. Can pass through 1 to 2 centimeters of water or human flesh and can be shielded by a thin sheet of aluminum. Beta particles are more deeply penetrating than alpha particles but, because of their smaller size, cause less localized damage.

biological effects - The early or delayed results of biological damage caused by nuclear radiation (alpha, beta gamma).

biosphere - The part of the earth and its atmosphere in which living things exist.

BRA - Baseline risk assessment, the study and estimation of risk from taking no activity. Involves estimates of probability and consequence.

carcinogen - A cancer-causing agent.

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act (also known as Superfund), the federal law that guides cleanup of hazardous waste sites.

characterization - Facility or site sampling, monitoring and analysis activities to determine the extent and nature of a release. Characterization provides the basis for acquiring the necessary technical information to develop, screen, analyze, and select appropriate cleanup techniques.

CIS - Characterization investigation study

cleanup - The general term for environmental restoration, the process designed to ensure that risks to the environment and to human health and safety from waste sites either are eliminated or reduced to prescribed, safe levels.

closure plan - Documentation prepared to guide the deactivation, stabilization and surveillance of a waste management unit or facility under the Resource Conservation and Recovery Act.

Consent Agreement - Signed agreement between DOE and U.S. EPA that establishes a framework for cleaning up the site. The Amended Consent Agreement (1991) revised the original schedule for the completion of milestone events.

conservation - The preservation of resources through efficient and careful use.

contamination - The presence of foreign materials, chemicals or radioactive substances in the environment (soil, sediment, water or air) in significant concentrations.

CRU - CERCLA/RCRA unit, another term for the operable units at Fernald.

cubic meters - A volume equal to the volume of a cube measuring one meter in each dimension.

curie - A unit of radioactivity that represents the amount of radioactivity associated with one gram of radium. To say that a sample of radioactive material exhibits one curie of radioactivity means that the element is emitting radiation at the rate of 3.7 million times a second. Named after Marie Curie, an early nuclear scientist.

daughter product - An element formed by the radioactive decay of another element; often daughter products are radioactive themselves

DEs - Drum equivalents

decay - The process whereby radioactive particles undergo a change from one form, or isotope, to another, releasing radioactive particles and/or energy.

decontamination - The removal of unwanted material (typically radioactive material) from facilities, soils, or equipment by washing, chemical action, mechanical cleansing or other techniques.

defense wastes - Radioactive wastes resulting from weapons research and development, the operation of naval reactors, the production of weapons materials, the reprocessing of defense spent fuel, and the decommissioning of nuclear-powered ships and submarines.

dioxin - One of the most hazardous of all chemicals, can cause both acute and long-term effects ranging from chloracne, a skin disease, to cancer, reproductive failures, and reduced resistance to infectious disease.

disposal - Waste emplacement designed to ensure isolation of waste from the biosphere, with no intention of retrieval for the foreseeable future.

DOE - U.S. Department of Energy

DOE-FN - U.S. Department of Energy Fernald Field Office

dose - Quantity of radiation or energy absorbed; measured in rads. (See rad).

dose equivalent - A term used to express the amount of effective radiation received by an individual. A dose equivalent considers the type of radiation, the amount of body exposed, and the risk of exposure. Measured in rems. (See rem).

EE/CA - Engineering evaluation and cost analysis

effluent - A waste discharged as a liquid.

EIS - Environmental impact statement, required by the National Environmental Policy Act. (See NEPA).

electron - An elementary particle with a unit negative charge and a mass 1/1837 that of the proton. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

element - Any of the 109 substances that cannot be broken down further without changing its chemical properties. Singly or in combination, the elements constitute all matter.

EM - Environmental Restoration and Waste Management

EMAC - Environmental Restoration and Waste Management Advisory Committee was created by DOE July 1992.

EMR - Environmental monitoring report also called the Annual Site Environmental Report

environmental restoration - The process of environmental cleanup designed to ensure that risks to the environment and to human health and safety from waste sites either are eliminated or reduced to prescribed, safe levels.

ERMC - Environmental restoration and management contractor

erosion control - Methods to control land surface features to prevent erosion by surface water or precipitation runoff.

EWMF - An engineered waste management facility, designed to store low-level radioactive wastes.

exposure - A measurement of the displacement of electrons from atoms caused by x-rays or by gamma radiation. Acute exposure generally refers to a high level of exposure of short duration; chronic exposure is lower-level exposure of long duration.

FEMP - Fernald Environmental Management Project, the name given Fernald when its missions was transferred from weapons production to environmental restoration

FERMCO - Fernald Environmental Restoration Management Corporation, the contractor selected in August 1992 to clean up Fernald

FFCA - Federal Facility Compliance Agreement, an agreement signed in 1986 between DOE and U.S. EPA; predates the Consent Agreement and the Amended Consent Agreement.

final disposition - Methods for permanent disposal of waste or contaminated media residuals following excavation/treatment.

fission - The splitting of a heavy nucleus into two or more radioactive nuclei, accompanied by the emission of gamma rays, neutrons and a significant amount of energy. Fission usually is initiated by the heavy nucleus absorbing a neutron, but it also can occur spontaneously.

FMPC - Feed Materials Production Center, the name of Fernald until 1991

FRESH - Fernald Residents for Environment, Safety and Health

friable asbestos - Asbestos insulation that is loose and capable of becoming airborne.

FS - Feasibility study, the Superfund study following a remedial investigation which identifies, develops, evaluates and selects remedial action alternatives.

gamma rays - Penetrating electromagnetic waves or rays emitted from nuclei during radioactive decay, similar to x-rays. Dense materials such as concrete and lead are used to provide shielding against gamma radiation.

geohydrologic - Pertaining to groundwater and its movements through the geologic environment.

geohydrology - The science dealing with underground water, often referred to as hydrogeology.

groundwater - Waste beneath the earth's surface that fills pores between materials such as sand, soil or gravel. Groundwater is a major source of water for agricultural and industrial purposes and is an important source of drinking water for about half of all Americans.

half-life - The time required for a radioactive substance to lose 50 percent of its activity by decay. The half-life of the radioisotope plutonium-239, for example, is about 24,000 years. Starting with a pound of plutonium-239, in 24,000 years there will be one-half pound of plutonium-239, in another 24,000 years there will be one-fourth pound, and so on. (A pound of material remains, but it gradually becomes a stable element.)

hazardous waste - A solid waste or combination of solid wastes that, because of quantity, concentration or physical, chemical or infectious characteristics, may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness or pose a substantial hazard to human health or the environment when improperly treated, stored, transported, disposed or otherwise managed. About 290 million tons of hazardous wastes are generated in the United States each year. A small percentage (about 4 percent) is recycled. The rest is treated, stored or disposed. Of the hazardous wastes disposed, most are injected as a liquid into the ground in specially designed injection wells. A large quantity is placed in surface impoundments (pits, ponds and lagoons). A small portion is placed directly on the land or buried.

heavy metals - Metals that are dense. Examples include mercury, lead, silver, gold and uranium.

HEPA - High-efficiency particulate air

high-level radioactive wastes - Highly radioactive material, containing fission products, traces of uranium and plutonium, and other transuranic elements, that results from chemical reprocessing of spent fuel. Originally produced in liquid form, high-level waste must be solidified before disposal.

ion - Atomic particle, atom or chemical radical bearing an electric charge, either negative or positive.

ionization - Removal of electrons from an atom, for example, by means of radiation, so that the atom becomes charged.

ionizing radiation - Radiation that has enough energy to remove electrons from substances it passes through, forming ions.

isotopes - Atoms of the same element that have equal numbers of protons, but different numbers of neutrons. Isotopes of an element have the same atomic number but different atomic mass. For example, uranium-238 and uranium-235.

leachate - The solution formed when soluble components have been removed from a material.

leaching - To remove a soluble substance from a material by dissolving it in a liquid, and then removing the liquid from what is left.

LLW - Low-level waste, discarded radioactive material such as rags, construction rubble, glass, etc., that is only slightly or moderately contaminated. This waste usually is disposed of by land burial.

MAWS - Minimum Additive Waste Stabilization program is an innovative approach to combining vitrification, water treatment and soil washing processes to minimize waste.

MCL - maximum contaminant level

millirem - A unit of radiation dosage equal to one-thousandth of a rem. A member of the public can safely receive up to 500 millirems per year, according to federal standards, but the U.S. EPA ordinarily limits public exposure to 25 to 100 mrem/year.

mixed waste - Contains both radioactive and hazardous components.

mobility - The ability of radionuclides to move through food chains in the environment.

monitoring well - A hole drilled into the ground with a pipe inserted to allow for the collection of groundwater samples.

natural radiation - Radiation that is always present in the environment from such sources as cosmic rays and radioactive materials in rocks and soils. Also known as background radiation.

NCP - National Oil and Hazardous Substances Pollution Contingency Plan

NEPA - National Environmental Policy Act, requires a study of the impacts of activities at federal facilities.

neutron - A particle that appears in the nucleus of all atoms except hydrogen. Neutrons are one of three basic particles that make up the atom. Neutrons have no electrical charge.

NLO - National Lead of Ohio, Inc., the company that operated Fernald from 1951 until 1986

NOA - Notice of availability, published when a document on some aspect of Fernald cleanup is issued. Documents are available in the administrative record and public reading room.

NOV - Notice of violation

NPDES - National Pollutant Discharge Elimination System

NPL - National Priorities List, the list of the nation's worst Superfund sites. Fernald was added in 1989.

NRC - Nuclear Regulatory Commission

NTS - Nevada Test Site, a repository for radioactive wastes.

nuclear radiation - Ionizing radiation originating in the nuclei of atoms; alpha, beta, and gamma radiation.

nucleus - The central part of an atom that contains protons, neutrons and other particles.

OEPA - Ohio Environmental Protection Agency

OSHA - Occupational Health & Safety Act

OU - Operable unit, or area of study that contains similar characteristics or problems. There are five operable units at Fernald.

pathways - The means by which contaminants move. Possible pathways include air, surface water, groundwater, plants and animals.

PCB - Polychlorinated byphenyl, a synthetic, organic chemical once widely used in electrical equipment, specialized hydraulic systems, heat transfer systems, and other industrial products. Highly toxic and a potent carcinogen. Any hazardous wastes that contain more than 50 parts per million of PCBs are subject to regulation under the Toxic Substances Control Act.

PEIC - Public Environmental Information Center, which houses the administrative record and the public reading room.

PEIS - Programmatic environmental impact statement, being conducted nationally by DOE.

plume - A defined area of groundwater containing contamination that originates from a particular source such as a waste unit.

plutonium - An artificially produced element that is fissile and radioactive. It is created when an atom of uranium-238 captures a slow neutron in its nucleus.

PP - Proposed plan, a CERCLA document on which the public comments that summarizes what cleanup remedy has been selected, and why.

RA - Risk assessment, the study and estimation of risk from a current or proposed activity. Involves estimates of the probability and consequence of an action.

rad - Radiation absorbed dose, a measurement of ionizing radiation absorbed by any material. A rad measures the absorption of a specific amount of work (100 ergs) in a gram of matter.

radiation - Fast particles and electromagnetic waves emitted from the nucleus of an atom during radioactive disintegration.

radioactive - Giving off, or capable of giving off, radiant energy in the form of particles (alpha or beta radiation) or rays (gamma radiation) by the spontaneous disintegration of the nuclei of atoms.

Radioisotopes of elements lose particles and energy through the process of radioactive decay. Elements may decay into different atoms or a different state of the same atom.

radioactive waste - A solid, liquid or gaseous material of negligible economic value that contains radionuclides in excess of threshold quantities except for radioactive material from post-weapons-test activities.

radioisotope - An unstable isotope of an element that eventually will undergo radioactive decay (i.e., disintegration). Radioisotopes with special properties are produced routinely for use in medical treatment and diagnosis, industrial tracers, and for general research.

radionuclide - A radioactive species of an atom.

radon - A radioactive gas produced by the decay of one of the daughters of radium. Radon is hazardous in unventilated areas because it can build up to high concentrations and, if inhaled for long periods of time, may cause lung cancer.

RCRA - Resource Conservation and Recovery Act, the federal environmental law designed to account for and ensure proper management of hazardous wastes, from creation to disposition

rem - Roentgen equivalent man, a unit used in radiation protection to measure the amount of damage to human tissue from a dose of ionizing radiation. Incorporates the health risks from radiation.

remedial action - Long-term cleanup activities

remediation - Those activities performed to remove or treat hazardous waste sites or to relieve their effects.

removal action - Interim cleanup activities that are identified as needed to protect public health and the environment

restoration - (See **environmental restoration**)

RI - Remedial investigation, the CERCLA process of determining the extent of hazardous substance contamination and, as appropriate, conducting treatability investigations.

RI/FS - Two distinct, but related studies, the remedial investigation and feasibility study. Together, they characterize environmental

problems and outline remedial actions to solve those problems.

Risk assessment - (See RA)

ROD - Record of decision, a written decision that identifies the selected method for long-term cleanup of contamination at a site

SARA - Superfund Amendments and Reauthorization Act

scoping - In CERCLA, scoping is the initial planning phase of the cleanup process, when requirements are discussed and the projects defined. In the NEPA process, scoping relates to public involvement to help identify significant issues early so that efforts can be focused on those areas requiring resolution and to present a balanced environmental impact statement.

solidification - The conversion of either liquid or loose hazardous waste into a solid.

solubility - A measure of how much of a given substance will dissolve in a liquid. Usually measured in weight per unit volume.

somatic effects - Effects of radiation limited to the exposed individual, as distinguished from genetic effects, which also affect subsequent, unexposed generations.

stable isotope - An isotope of an element that is not radioactive.

SWCR - Site-wide characterization report

thorium - A naturally-occurring radioactive element

threshold dose - The minimum dose of radiation that will produce a detectable effect.

toxic - Relating to a harmful effect by a poisonous substance on the human body by physical contact, ingestion or inhalation.

toxicology - The science that deals with poisons and their effects on plant, animal and human life.

transuranic wastes - Waste materials contaminated with isotopes above uranium in the periodic table. Transuranic waste is long-lived, but only moderately radioactive.

treatment - Any activity that alters the chemical

or physical nature of a waste to reduce its toxicity or prepare it for disposal.

uranium - The heaviest element found in nature. Approximately 99 out of every 1000 uranium atoms are uranium-238. The remaining 3 atoms are the fissile uranium-235. The uranium-235 atom splits, or fissions, into lighter elements when its nucleus is struck by a neutron.

U.S. EPA - United States Environmental Protection Agency, sometimes referred to as EPA.

UST - Any underground storage tank or associated piping containing hazardous materials.

vitrification - A method of immobilizing waste that produces a glass-like solid that permanently captures the radioactive materials.

VOCs - Volatile organic compounds, chemicals that contain carbon and commonly also contain hydrogen, oxygen and other elements. The prefix "volatile" means that the compound evaporates rapidly. Most industrial solvents are volatile. Found in some liquid and air waste releases.

waste minimization - Employing new techniques to reduce the amount of hazardous and radioactive wastes generated to as low a level as possible.

WEMCO - Westinghouse Environmental Management Company of Ohio, the contractor who ran Fernald from 1986 until December 1, 1992. Formerly WMCO, for Westinghouse Materials Company of Ohio.

x-rays - Electromagnetic radiations used in medical diagnosis; a penetrating electromagnetic radiation, usually generated by accelerating atoms to high velocity and suddenly stopping them by collision with a solid body.

LIST OF ACRONYMS

AEC	U.S. Atomic Energy Commission
ARAR	applicable or relevant and appropriate requirement
AWQC	ambient water quality criteria
BDAT	best demonstrated available technology
CAA	Clean Air Act
CB	cement-bentonite
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COD	chemical oxygen demand
CRQL	contract required quantitation limit
CSF	cancer slope factor
CWA	Clean Water Act
CWAO	Catalyzed Wet Air Oxidation
DCG	derived concentration guides
DOE	U.S. Department of Energy
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
FFCA	Federal Facility Compliance Agreement
FICWD	Federal Interagency Committee for Wetlands Delineation
FS	feasibility study
GAC	granular activated carbon
GMA	Great Miami Aquifer
GPR	ground penetrating radar
HDPE	high density polyethylene
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HSL	hazardous substance list
IRIS	Integrated Risk Information System
ISA	Initial Screening of Alternatives
IT	IT Corporation
K	hydraulic conductivity
LLW	low-level radioactive waste
LSA	low specific activity
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MDL	minimum detection limit
MPRSA	Marine Protection Research and Sanctuaries Act
NAAQS	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NLO	National Lead Company of Ohio, Inc.
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NRC	U.S. Nuclear Regulatory Commission

LIST OF ACRONYMS
(Continued)

NTS	Nevada Test Site
O&M	operation and maintenance
ODH	Ohio Department of Health
ODNR	Ohio Department of Natural Resources
ODW	Office of Drinking Water
OEPA	Ohio Environmental Protection Agency
OU	operable unit
OWQS	Ohio Water Quality Standards
ORAU	Oak Ridge Associated Universities
PAH	polycyclic aromatic hydrocarbon
PASA	Production and Additional Suspect Areas
PCB	polychlorinated biphenyl
PCF	plasma centrifugal furnace
PGW	perched groundwater
PMCL	proposed maximum contaminant level
PMCLG	proposed maximum contaminant level goal
PRG	preliminary remediation goal
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI/FS	Remedial Investigation/Feasibility Study
RO	reverse osmosis
ROD	Record of Decision
RSC	relative source contribution
SARA	Superfund Amendments and Reauthorization Act
SB	soil-bentonite
SDWA	Safe Drinking Water Act
SOWC	Southwestern Ohio Water Company
SSOD	storm sewer outfall ditch
SVE	soil vacuum extraction
SVOC	Semivolatile Organic Compound
SWCR	Site-Wide Characterization Report
SWOAPCA	Southwestern Ohio Air Pollution Control Agency
TBC	guidance to be considered
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
THI	target hazard index
THQ	target hazard quotient
TKN	total Kjeldahl nitrogen
TMV	toxicity, mobility, or volume
TOC	total organic carbon

LIST OF ACRONYMS
(Continued)

TON	total organic nitrogen
TOX	total organic halides
TPH	total petroleum hydrocarbons
TR	target risk level
TSCA	Toxic Substances Control Act
TSD	treatment, storage, or disposal
TSP	total suspended particulates
TSS	total suspended solids
UIC	underground injection control
US ACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
UV	ultraviolet
VOC	volatile organic compounds
WEMCO	Westinghouse Environmental Management Company of Ohio
WMCO	Westinghouse Materials Company of Ohio

**INITIAL SCREENING OF ALTERNATIVES
FOR OPERABLE UNIT 5**

**FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO**

REMEDIAL INVESTIGATION and FEASIBILITY STUDY

March 1993

**U.S. DEPARTMENT OF ENERGY
FERNALD FIELD OFFICE**

FINAL

000035

EXECUTIVE SUMMARY

The Feed Materials Production Center, renamed on August 23, 1991 and hereinafter called the Fernald Environmental Management Project (FEMP), is a contractor-operated federal facility for the production of purified uranium metal located on 1050 acres in a rural area approximately 18 miles northwest of downtown Cincinnati, Ohio. Owned by the U.S. Department of Energy (DOE), production operations at the FEMP were suspended in July 1989 and the facility was formally closed in June 1991. On July 18, 1986, a Federal Facility Compliance Agreement (FFCA) was jointly signed by the U.S. Environmental Protection Agency (EPA) and DOE to ensure that human health and environmental impacts associated with the past activities at the FEMP are thoroughly investigated so that appropriate remedial actions can be assessed and implemented. In response to the FFCA, a Remedial Investigation/Feasibility Study (RI/FS) has been initiated to develop these remedial actions.

The 1986 FFCA was amended by a Consent Agreement under Section 120 and 106(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Consent Agreement was signed on April 9, 1990 and became effective on June 29, 1990. In 1991, a renegotiation of the Consent Agreement was initiated to establish a revised schedule for cleanup of the FEMP. This Amended Consent Agreement became effective on December 19, 1991.

A technical strategy eventually adopted under the RI/FS was to divide the site into five operable units to facilitate remedial actions. As a result of the renegotiations of the 1991 Amended Consent Agreement, the scope of Operable Unit 5 has been modified. The broad definition of Operable Unit 5 remains unchanged and still includes those environmental media that represent pathways and/or environmental receptors presently or potentially affected by FEMP contaminants. However, soil and perched groundwater previously identified as components of Operable Unit 3 are now included within the scope of Operable Unit 5.

This document presents the initial screening of alternatives (ISA) for Operable Unit 5. Although a previous ISA report for Operable Unit 5 was approved, the rescoping of Operable Unit 5 in the Amended Consent Agreement in 1991 necessitates the preparation of a revised report. The primary objective of this phase of the FS is to develop an appropriate range of waste management options that will be analyzed more fully in the detailed analysis phase of the FS. Appropriate waste management options that ensure the protection of human health and the environment may involve, depending on site-specific circumstances, the complete elimination or destruction of hazardous substances at the site, the reduction of concentrations of hazardous substances to acceptable health-based levels, and prevention of exposure to hazardous substances via engineering or institutional controls, or some combination of the above (EPA 1988a). Alternatives are typically developed concurrently with the RI site characterization, with the results of one influencing the other in an iterative fashion (i.e., RI site

characterization data are used to develop alternatives and screen technologies, whereas the range of alternatives developed guides subsequent site characterization and/or treatability studies).

The results of the screening of alternatives that are presented in this document are limited by several factors. Specifically, this document has been prepared prior to the completion of several RI field activities for Operable Unit 5. While virtually all of the currently available data have been reviewed and evaluated, detailed analysis of the data is still ongoing in conjunction with the RI effort for this operable unit. The baseline risk assessment, which is fundamental to the establishment of cleanup criteria, is also still in progress awaiting the collection, analysis, and validation of the complete RI database.

Since the baseline risk assessment may identify different cleanup criteria for soil and sediment than that used for this initial evaluation and since additional areas or contaminants of concern may be identified during the ongoing RI data development task, the remedial alternatives identified in this screening may require modification as the FS process proceeds. It is unlikely, however, that completion of the risk assessment and RI will negate any of the results of technology and process option identification and evaluation contained in this report. It is also unlikely that substantive changes would be required in remedial alternative components identified in this report. As currently envisioned, any modifications would likely be an expansion or contraction of actual areas/volumes within various media requiring remediation. Any necessary modifications will be addressed and incorporated during the detailed analysis of alternatives and later stages of the FS.

Therefore, the data evaluation completed for this initial screening of alternatives provides an appropriate framework for the development and evaluation of remedial alternatives to address potential contamination problems associated with Operable Unit 5.

In Section 1.0, a description of the site and its operational history is presented, as well as discussions concerning wastes and waste streams generated during the operating phase of the FEMP. The regulatory framework and history of the site are also presented, along with the definition of operable units and Operable Unit 5 in particular.

The important physical properties and characteristics of Operable Unit 5 are discussed in Section 2.0, including information on geology, hydrogeology, hydrology, land use, and ecology of the site and surrounding area.

Section 3.0 presents a summary of federal and state statutes and regulations that might pertain to the FEMP, as well as other environmental guidelines or regulations that should be considered as potentially applicable. Applicable or Relevant and Appropriate Requirements (ARARs) for the remediation of FEMP are then discussed and evaluated. From the ARARs and other criteria,

advisories, and guidance, a set of preliminary remediation goals (PRG) are developed for reach
environmental medium.

Section 3.0 also discusses the nature and extent of contamination for the various environmental media
within Operable Unit 5. Based on the current site data, uranium is the major contaminant of concern
in the groundwater, surface water, soils, and sediments as well as vegetation, benthic macro-
invertebrates, and fish.

Several organic contaminants of concern have been detected in the overburden soils, perched
groundwater, and isolated portions of regional groundwater. Organic contaminants of greatest concern
include tetrachloroethene, trichloroethene, and vinyl chloride. Biological samples collected within
Operable Unit 5, including grass, fish, and mammal tissues, were analyzed for semivolatile organic
compounds, pesticides, and polychlorinated biphenyls (PCBs). None of these compounds were
detected in any of the biological samples.

Section 4.0 discusses the media-specific response actions developed for Operable Unit 5. These
response actions are identified for contaminants of concern with emphasis to satisfy the remedial
action objectives and to protect human health and the environment. For groundwater (both perched
and the Great Miami Aquifer), soils, and sediments, potentially feasible remediation technologies and
process options are identified for each of the relevant response actions.

In Section 5.0, the remedial technologies and process options are discussed and an initial screening is
performed to eliminate those options which do not appear to be applicable or appropriate for the
conditions at the FEMP, based on technical effectiveness or implementability. Costs for each of these
technologies and process options are discussed in a qualitative manner. The following technologies
and actions for controlling/remediating groundwater contamination were retained for additional review
and evaluation after preliminary screening:

- Institutional actions:
 - Groundwater monitoring
 - Deed restrictions
 - Land acquisition
- Groundwater control/containment:
 - Extraction/injection wells (to modify hydraulic gradients)
- Groundwater removal:
 - extraction wells
 - wellpoint system
- Groundwater Treatment:
 - air stripping and carbon adsorption (to remove organics)
 - ion exchange (to remove radionuclides and selected metals)

- reverse osmosis (to remove radionuclides and selected metals) 1
- precipitation (to remove radionuclides and selected metals) 2
- Treated Water Disposal: 3
 - discharge to Great Miami River via the FEMP pipeline currently under construction (Option 1) or discharge to Paddys Run (Option 2) 4
 - discharge to groundwater via injection wells, with or without gradient control 6

The following technologies and actions for controlling/remediating contaminated soils and sediments were retained for additional review and evaluation after preliminary screening: 7

- Institutional actions: 9
 - Fence site areas 10
 - Deed restrictions 11
- Control/containment: 12
 - Multilayer capping 13
- Removal: 14
 - Mechanical excavation 15
- Treatment: 16
 - Soil washing 17
 - Batch vitrification 18
 - Pozzolanic-based/cement-based stabilization/solidification 19
- Storage/Disposal: 20
 - Intermediate storage (on site or off site) 21
 - Disposal (on site or off site) 22

In Section 6.0, two sets of remedial action alternatives were developed. Seven alternatives were developed to address the contaminated groundwater utilizing the technologies and process options retained in Section 5.0. For these alternatives, perched water will be remediated in conjunction with regional groundwater. 23

Eleven alternatives were developed to address the contaminated soils and sediments. The remedial action alternatives for soils and sediments are combined, since the technologies and process options are applicable to each of these media. 27

Section 7.0 describes the initial screening of the remedial action alternatives and presents those alternatives selected for detailed evaluation in the next phase of the FS process. The alternatives were qualitatively screened against three general criteria: effectiveness, implementability (technical and administrative feasibility), and cost. 30

Five groundwater remedial action alternatives were retained for detailed evaluation in the next phase of the FS process: 1
2

- GW-1: No action 3
- GW-3: Institutional actions, extraction/injection wells, extraction wells and wellpoint system, air stripping, adsorption, ion exchange, surface water discharge (Great Miami River or Paddys Run) 4
5
6
- GW-5: Same as GW-3 above, except that treated water would be discharged to reinjection wells 7
- GW-6: Institutional actions, extraction/injection wells, extraction wells and wellpoint system, air stripping, adsorption, precipitation, surface water discharge 8
9
- GW-7: Same as GW-6 above, except that treated water would be discharged to reinjection wells 10

For these alternatives (excluding no action), the exact nature of institutional actions is flexible, and the use of extraction/injection wells to control hydraulic gradients is optional. The alternatives listed above will be refined or modified during the later stages of the RI/FS process, as more information becomes available and the technologies have been evaluated in detail. 11
12
13
14

Nine remedial action alternatives for soil and sediments were retained for detailed evaluation in the next phase of the FS process: 15
16

- SS-1: No action 17
- SS-2: Institutional actions, excavation, intermediate storage 18
- SS-3: Institutional actions, excavation, disposal (on site or off site) 19
- SS-4: Institutional actions, excavation of sediments, multilayer capping of soils/sediments 20
- SS-6: Institutional actions, excavation, soil washing, disposal of residuals (on site or off site) 21
- SS-7: Institutional actions, excavation, batch vitrification, backfilling of treated residuals 22
- SS-8: Institutional actions, excavation, batch vitrification, disposal (on site or off site) 23
- SS-9: Institutional actions, excavation, soil washing, batch vitrification of residuals, backfilling of vitrified residuals 24
25
- SS-10: Institutional actions, excavation, soil washing, batch vitrification of residuals, disposal (on site or off site) 26
27

***A Brief Discussion of the
Initial Screening of Alternatives
for Operable Unit 5***

The cleanup of the Fernald Environmental Management Project (FEMP) must be conducted according to the procedures established under the federal environmental law known as CERCLA. Federal and state regulators, as well as the public, work with site officials during the entire cleanup process. CERCLA requires that the site provide information about all aspects of the cleanup to the regulators and the public. This can be accomplished in several ways, including public meetings and formal documentation. These documents cover topics ranging from initial planning (for example, the RI/FS Work Plan) to reports on the results of sampling and analysis programs (the Remedial Investigation Report for Operable Unit 5 is one example). The Initial Screening of Alternatives (ISA) is a CERCLA document prepared early in the cleanup process, and it presents a wide range of cleanup options for the site. Because the cleanup of the FEMP involves a variety of situations — ranging from the K-65 Silos to the Solid Waste Landfill — the site has been divided into five operable units. Each operable unit must prepare an ISA according to the step-by-step process designed by U.S. EPA to provide a systematic and consistent approach for analyzing potential cleanup alternatives.

Operable Unit 5 is responsible for the environmental media, which include groundwater, surface water, soils, sediment, flora, and fauna. The ISA for OU5 focuses on developing and screening cleanup alternatives for the two primary categories of contaminated media in OU5: 1) perched and regional groundwater, and 2) soils and stream sediments. During later stages of the Feasibility Study (FS), OU5 will evaluate — in greater detail — alternatives for the entire scope of the operable unit.

The following paragraphs describe eight major steps in the ISA screening process, and identify sections in the OU5 ISA where additional information can be found.

Initial Screening of Alternatives for Operable Unit 5

- ***Developing remedial action objectives to protect human health and the environment:*** For the ISA, a remedial action objective (RAO) is a specific goal established to protect human health and the environment. In general, an RAO considers the contaminants of concern (for the FEMP the primary contaminant of concern is uranium), the pathways contaminants may take to a receptor, and the concentration of contaminants which may be allowed in soil and groundwater. (The contaminant concentrations are known as Preliminary Remediation Goals (PRG), and the PRGs for OU5 are defined in Section 3.2 and listed in Tables 3-1, 3-2, and 3-3. The PRGs are used in the ISA only as "screening tools" to help investigators determine how much soil or groundwater may need to be cleaned up, and therefore, which technologies may be appropriate.) For soils and sediment in OU5, some of the preliminary remedial action objectives include preventing people from directly contacting soil above a certain radioactivity; preventing soils from eroding which then could contaminate surface water; and preventing contaminants from migrating through soil into the aquifer. (See Section 4.2.)
- ***Developing general response actions to satisfy the remedial action objectives:*** These response actions represent groups of technologies with common characteristics which could be used to meet the RAOs mentioned previously. Examples of these actions are containing, treating, and disposing of waste to reduce the likelihood that it could reach people or the environment. (See Section 4.3.)
- ***Estimating the volumes and areas of contaminated environmental media:*** The ISA estimates the nature and extent of contamination in order to develop and evaluate cleanup alternatives at an early stage of the CERCLA process. Although this estimate is based on extensive review of the available data, it is

Initial Screening of Alternatives for Operable Unit 5

neither as comprehensive nor as precise as it will be in the OU5 Remedial Investigation report or in the detailed analysis of alternatives which will occur for the FS Report. (See Section 3.0.)

- ***Identifying and screening technologies and process options for each of the general response actions:*** In Section 4 of the ISA, OU5 has developed a list of the potential technologies as well as specific process options for each of the technologies that can apply to the cleanup of soil and groundwater. This list contains a wide range of technologies (from monitoring to biological treatment). During the first screening step, process options and entire technology types can be eliminated if they are found to be ineffective or not possible to implement for a particular type or amount of contaminated soil or groundwater. In other instances, a technology can be used to support a different primary technology.
- ***Evaluating process options:*** The list of technologies and process options is further evaluated against three criteria: effectiveness, implementability, and cost. The main emphasis is on how effective each process option is, and whether its design can be modified if new data indicate changes are necessary. Cost plays a limited role in the initial screening process. (See Section 5.0.)
- ***Developing and describing remedial action alternatives:*** At this stage of the screening process, similar process options for soil and groundwater are grouped together into remedial action alternatives. These alternatives represent possible ways the soil and groundwater could be cleaned to meet the remedial action objectives presented in Section 4.0. For the OU5 ISA, the process options selected in Section 5.0 were assembled into seven remedial

Initial Screening of Alternatives for Operable Unit 5

alternatives for groundwater, and 11 remedial alternatives for soils. These alternatives are presented in Section 6.0.

- **Screening remedial action alternatives:** In this step, the alternatives assembled in Section 6.0 are screened according to the same three broad criteria used to screen technologies and process options: effectiveness, implementability, and cost. This is done to reduce the number of alternatives which will be analyzed in detail later in the Feasibility Study. The evaluation process is described in Section 7.0.
- **Selecting specific alternatives for detailed evaluation:** After evaluating the alternatives, the ISA screening process kept five of the seven groundwater and nine of the 11 soil/sediment alternatives for OUS. These alternatives — which will be screened much more rigorously against nine specific criteria and factors in a later report — are listed on page 7-31 and 7-37, respectively.

This initial screening of alternatives provides a basis for developing and evaluating cleanup options. It is important to note, however, that changes and refinements can be made concerning the choice of technologies and process options if new information developed during the RI/FS so warrants. Nevertheless, the ISA plays an important role in the cleanup of Operable Unit 5.