PUBLIC TRAINING SESSION AGENDA
August 13, 2002

Purpose:

- To familiarize people with technical processes and terms associated with the cleanup of MED/AEC wastes in North St. Louis County FUSRAP sites.

- To help people understand the cleanup documents when they are released for public review.

Schedule:

6:00 – 6:30 p.m.	Opening Remarks / FUSRAP Background by Sharon Cotner, U.S. Army Corps of Engineers FUSRAP Program Manager
6:30 – 7:30 p.m.	Radiation Basics by Jim Moos, Science Applications International Corporation
7:30 – 7:40 p.m.	*** Break ***
7:40 – 8:20 p.m.	Risk Assessment by Jim Moos, Science Applications International Corporation
8:20 – 8:30 p.m.	*** Break ***
8:30 – 9:00 p.m.	ARARs (Applicable or Relevant & Appropriate Requirements) by Michelle French, Science Applications International Corporation
9:00 p.m.	Closing remarks

POST TEST

Radiation

1. What is radiation?
   a. Energy that travels in the form of waves or particles.
   b. A fast clicking noise or static
   c. A material that seeks out biological matter
   d. None of the above

2. Name the two categories of radiation.

3. Match the type of radiation with the distance it can travel and shielding material.

Alpha	a. Several hundred feet	1. skin, paper
Beta	b. 1 – 2 inches	2. plastic, glass
Gamma	c. about 10 feet	3. concrete, lead

4. Which unit of measurement is used to identify the radiation dose rate? *(circle one)*

millirem (mrem) picocurie (pCi)

Risk Assessment

5. True or False – The risk assessment tells us what needs to be cleaned up, where, and to what level.

6. Name the two elements that a risk assessment looks at?

7. Which of the following is not a source of risk uncertainty?
   a. inadequate data
   b. using animal studies to estimate human risk
   c. incomplete information about exposure pathways
   d. none of the above

ARARs

8. What does the term ARAR mean?

9. What are the three types of ARARs?
   a. chemical, human and substance specific
   b. chemical, location and action specific
   c. pathway, source and site specific
   d. none of the above

10. True or False – If ARARs are not available or are not sufficiently protective, risk-based cleanup goals are developed.

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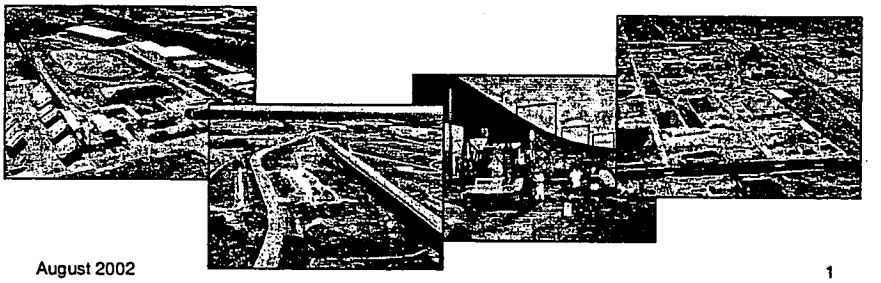
FUSRAP Introduction



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Getting started!

- Introductions
- Name tags
- Basic necessities --- Restrooms, beverages, no smoking in room, breaks
- Ground rules

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Objectives of Training Session

- To familiarize people with technical processes and terms associated with the cleanup of MED/AEC wastes in North St. Louis County.
- To help people better understand the cleanup documents when they are released for public review.

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Agenda

- **August 13th**
  - North County FUSRAP History / Intro to CERCLA
  - Radiation Basics
  - Risk Assessment
  - Applicable, or Relevant and Appropriate Requirements
  - Dose & Sum of Ratios
- **August 20th**
  - Risk Range
  - Cleanup/ property release
  - Long-term stewardship
  - Missouri Solid Waste laws

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A Little Background

- Moving on to "specifics"
  - What is FUSRAP?
  - What is the CERCLA process?
  - Who is involved?
  - The St. Louis Connection
  - Current work in St. Louis

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What is FUSRAP?

Formerly Utilized Sites Remedial Action Program

A Federal program to address the clean-up of contamination resulting from activities associated with the Manhattan Engineer District/Atomic Energy Commission during the Nation's early atomic weapons program.

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Key Considerations

- **Protection of human health and the environment.**
- **Execute the approved alternative for cleaning up radioactive contamination above health-based cleanup guidelines.**
- **Minimize adverse effects on area business operations**
- **Follow the CERCLA / National Oil and Hazardous Substances Contingency Plan (NCP) process**

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The CERCLA Process

- **Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA)**
  - More commonly know as Superfund
  - The process is outlined in the National Oil & Hazardous Substances Contingency Plan (NCP)

Process	CERCLA Document
Define the problem	Remedial Investigation (RI)
Evaluate possible solutions	Feasibility Study (FS)
Propose a remedy	Proposed Plan (PP)
Select a remedy	Record of Decision (ROD)
Implement the plan	Remedial Design / Remedial Action

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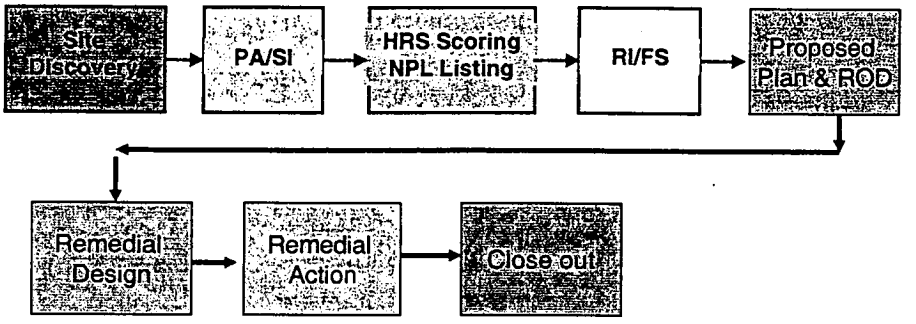
CERCLA Process Flowchart



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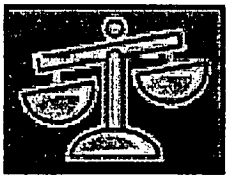
CERCLA Process

- **The CERCLA Process / path to consensus**
  - **Nine Criteria in Evaluating the Remedy**
    - Threshold Criteria (must be met)
      - **Overall Protection of Human Health and the Environment**
      - **Compliance with ARARs**
    - Primary Balancing Criteria
      - **Long term effectiveness & permanence**
      - **Reduction of toxicity, mobility & volume**
      - **Short Term Effectiveness**
      - **Implementability**
      - **Cost**
    - Modifying Criteria
      - **State Acceptance**
      - **Community Acceptance**



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Who Is Involved?

- USACE
- EPA
- MDNR
- Oversight Committee
- The Public

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The St. Louis Connection

- Aug 1939 - Einstein writes to President Roosevelt
- June 1941 - Office of Scientific Research and Development (OSRD) is created (*to mobilize for war*)
- Dec 1941 - US declares war on Germany & Japan
- Apr 1942 - OSRD Physicist (Arthur Compton) asks his friend, Edward Mallinckrodt of St. Louis, for assistance in preparing highly purified uranium compounds.

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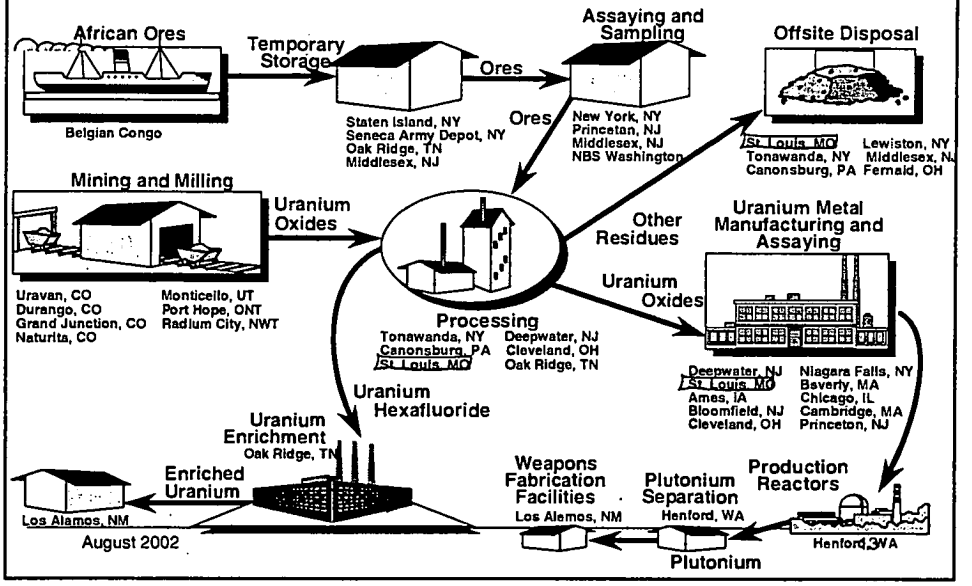
Uranium Paths During the Manhattan Project



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St. Louis Sites

- **St. Louis Downtown Site (SLDS)**
  - Where it all began at Mallinckrodt
- **St. Louis Airport Site (SLAPS)**
  - Stores Mallinckrodt residues
- **Hazelwood Interim Storage Site/Latty Ave.**
  - Residues transferred from SLAPS & and miscellaneous vicinity properties (roads & utilities)
- **SLAPS Vicinity Properties**
  - Contaminated during transportation from one site to another or by natural migration

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Current Work on North County

- St. Louis Airport Site (SLAPS)
  - Interim cleanup document (1998 Engineering Evaluation/Cost Analysis)
  - 200,000 cubic yards removed
- Hazelwood Interim Storage Site (HISS) / Latty Avenue Properties
  - Interim cleanup document (1998 Engineering Evaluation/Cost Analysis)
  - 57,000 cubic yards removed
- SLAPS Vicinity Properties
  - Interim cleanup document
  - Limited removal actions & Characterization activities
- Coldwater Creek
  - Characterization activities

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Presentations this Evening

- Radiation basics
- Protectiveness
  - Risk Assessment
    - 1st of the 9 Criteria: Protection of human health & the environment
  - Applicable or Relevant & Appropriate Requirements (ARARs)
    - 2nd of the 9 Criteria: Compliance with ARARs

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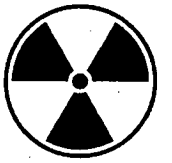
NEXT????

- **Radiation Basics!!!!**



Einstein's letter to Roosevelt

Albert Einstein
Old Grove Road
Nassau Point
Peconic, Long Island

August 2nd, 1939

F. D. Roosevelt
President of the United States,
White House
Washington, D. C.

Sir:

Some recent work by E.Fermi and L. Szilard, which has been communicated to me in a manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of this situation which has arisen seem to call for watchfulness and, if necessary, quick action on the part of the Administration. I believe therefore that it is my duty to bring to your attention the following facts and recommendations:

In the course of the last four months it has been made probable - through the work of Joliot in France as well as Fermi and Szilard in America - that it may become possible to set up a nuclear chain reaction in a large mass of uranium, by which vast amounts of power and large quantities of new radium-like elements would be generated. Now it appears almost certain that this could be achieved in the immediate future.

This new phenomena would also lead to the construction of bombs, and it is conceivable - though much less certain - that extremely powerful bombs of a new type may thus be constructed. A single bomb of this type, carried by boat and exploded in a port, might very well destroy the whole port together with some of the surrounding territory. However, such bombs might very well prove to be too heavy for transportation by air.

The United States has only very poor ores of uranium in moderate quantities. There is some good ore in Canada and the former Czechoslovakia, while the most important source of uranium is Belgian Congo.

In view of this situation you may think it desirable to have some permanent contact maintained between the administration and the group of physicists working on chain reactions in America. One possible way of achieving this might be for you to entrust with this task a person who has your confidence and who could perhaps serve in an inofficial capacity. His task might comprise the following:

a) to approach Government Departments, keep them informed of the further development, and put forward recommendations for Government action, giving particular attention to the problem of securing a supply of uranium or for the United States;

b) to speed up the experimental work,which is at present being carried on within the limits of the budgets of University Laboratories, by providing funds, if such funds be required, through his contacts with private persons who are willing to make contributions for this cause, and perhaps also by obtaining the co-operation of industrial laboratories which have the necessary equipment.

I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such an early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizsacker, is attached to the Kaiser-Wilhelm-Institute in Berlin where some of the American work on uranium is now being repeated.

Yours very truly,

[Einstein's Signature]

(Albert Einstein)

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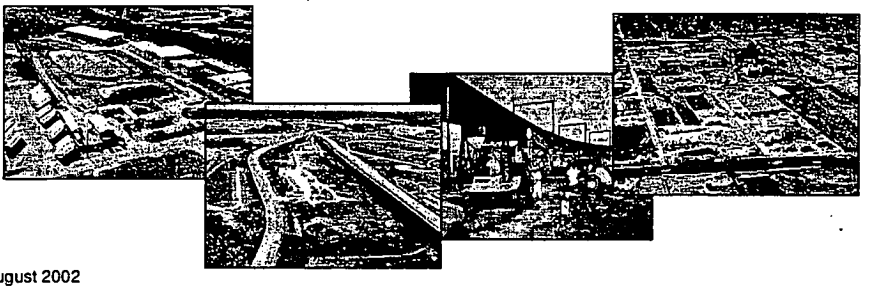
Radiation and Radioactivity



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Agenda

- Presentation Objective
- Defining Radiation
- Different Types of Radiation
- Common Sources of Ionizing Radiation
- Other Key Terms & Concepts
- Measuring Radiation & Radioactivity
- Health Effects of Radiation Exposure
- Controlling Radiation Exposure

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Presentation Objective

"To provide workshop participants a basic understanding of radiation and radioactivity fundamentals; the relative risks of exposure to radiation and radioactive materials; and key concepts and practices for controlling exposures."

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Defining Radiation

- **What is radiation?**
  - Energy that travels through space and matter in the form of waves or particles
- **How is radiation produced?**
  - Radiation (energy) is emitted from *unstable atoms* or various radiation producing devices such as television and x-ray machines

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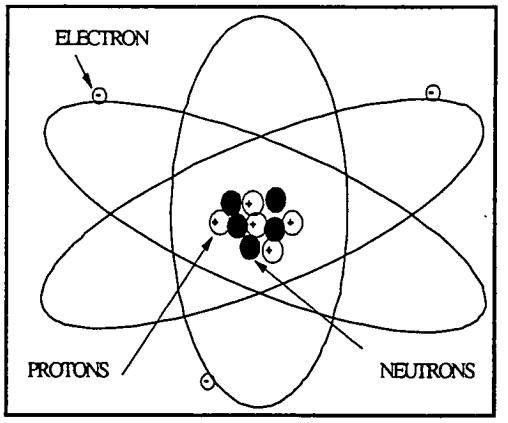
Defining Radiation

Atoms



- Atoms are the basic units of matter (chemical element) – they are the building block of all things
- Made up of 3 basic particles
  - Protons [(+), nucleus]
  - Neutrons [neutral, nucleus]
  - Electrons [(-), orbit nucleus]
- Atoms are unique for each element. Examples include gold, silver, lead, hydrogen, oxygen, etc.

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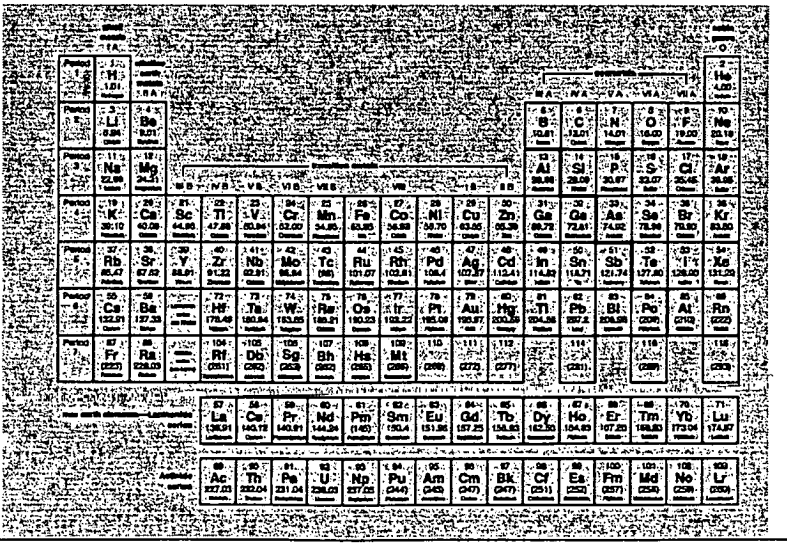
Defining Radiation

Periodic Table of the Elements



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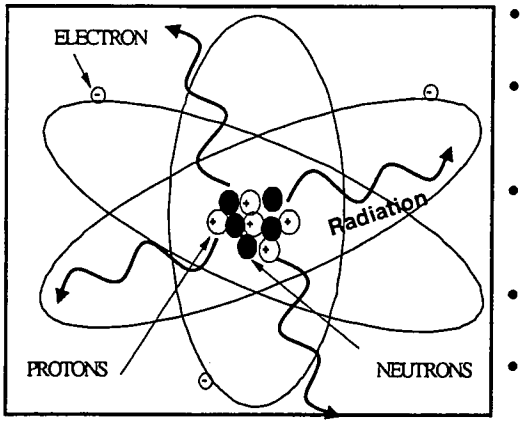
Defining Radiation

Unstable Atoms



- Most atoms are stable and do not emit excess energy
- Atoms with too much energy in their nucleus are considered **unstable**
- Atoms rid themselves of excess energy to return to their normal (stable) state
- Excess energy emitted by atoms is **radiation**
- The process of unstable atoms releasing radiation is called **radioactivity**

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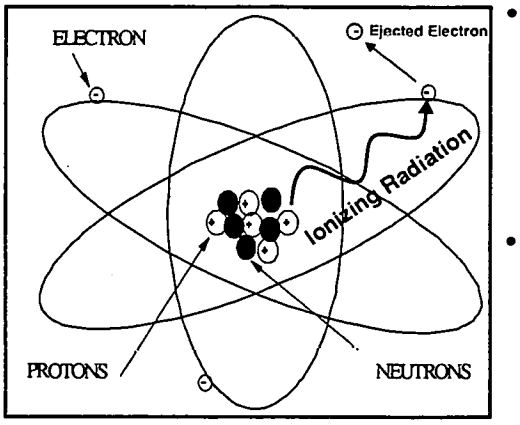
Different Types of Radiation

Ionizing vs. Nonionizing Radiation



- **Ionizing Radiation** - radiation that has enough energy to remove electrons from atoms
  - Alpha particles
  - Beta particles
  - Neutrons
  - Gamma Rays (x-rays)
- **Nonionizing Radiation** – radiation that does not have enough energy to remove an electron
  - Microwaves
  - Radio waves
  - Light (visible, IR, UV)
  - Heat

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Different Types of Radiation

Principles of Ionizing Radiation

Type	*Charge*	*Hazard*	*Penetrating Distance*	*Shielding Material*
Alpha	Positive	Internal	1 to 2" in air; Not through skin	Paper, Skin
Beta	Negative	Internal & External	= 10 feet in air; Penetrates skin	Plastic, Glass, Metal foils
Gamma / X-ray	No Charge	External Whole Body	Several hundred feet in air	Concrete, Lead, Steel
Neutrons	No Charge	External Whole Body	Several hundred feet in air	Water or material containing hydrogen

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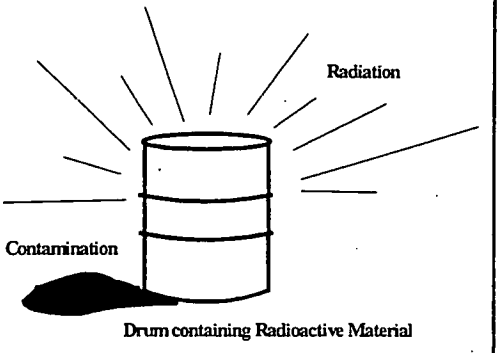
Other Key Terms & Concepts

Radiation - Energy that travels through space and matter in the form of waves or particles

Radioactivity - The process of unstable atoms releasing radiation; sometimes quantified as the "rate of release"

Radioactive Material – Any material containing unstable (radioactive) atoms that emit radiation; quantified by amount of radioactivity

Radioactive Contamination – Radioactive material in an unwanted place



Isotope – Atoms of the same element which have the same number of protons but different numbers of neutrons. Isotopes have the same chemical properties but their nuclear properties can be quite different.

- Major FUSRAP isotopes - U-238, U-234, U-235,Th-230, Ra-226

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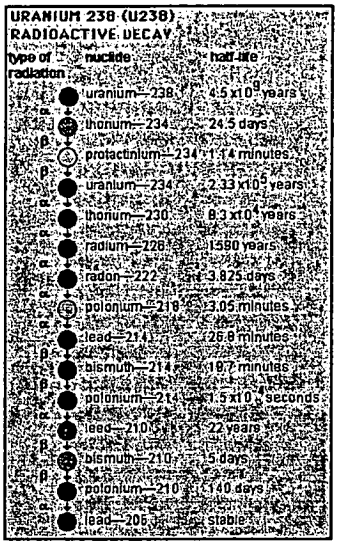
Uranium Decay Chain



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Measuring Radiation

- Radiation Units
  - Roentgen, rad and rem (United States)
  - Gray and sievert (International)
  - The "rem"...
    - Most common in U.S. to quantify exposure to people
    - Simply a measure of how much radiation energy is deposited in the body and its biological effect
  - The "millirem"...
    - The rem is a very large unit when compared to common everyday exposures
    - There are 1,000 millirem (mrem) in a rem
  - Dose Rate
    - Dose is how much exposure you receive; rate is the time period the exposure was received
    - Dose Rate, then, is how much exposure you receive over a certain amount of time (mrem/hour, mrem/year, etc.)

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Measuring Radioactivity

- Radioactivity/Contamination Units
  - DPM, Curie (United States)
  - DPS, Becquerel (International)
  - The "DPM"...
    - DPM (disintegrations per minute) - measure of the actual number of radioactive atoms which decay from given object or source of radioactive material in one minute of time
  - The "Curie (Ci)"...
    - Most common in U.S. to quantify the amount of radioactivity in soil, water and air samples
    - 1 Ci = 2,200,000,000,000 DPM
  - The "microcurie (uCi)" and "picocurie (pCi)"...
    - The Curie is a very large unit when compared to environmental levels of radioactivity
    - 1 uCi = 2,200,000 DPM
    - 1 pCi = 2.2 DPM

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Measuring Radiation & Radioactivity
Examples of Use

- Comparing Units
  - 1 mrem does not equal 1 pCi
  - Remember...the mrem is a radiation (energy) unit and pCi is a radioactivity (material) unit
  - An easy way to remember....

    Picture a fireplace with a nice fire burning. In a fireplace, the burning wood radiates heat. In this case, the amount of wood (fuel) is analogous to the number of pCi of radioactivity; whereas, the amount of heat (energy) given off by the fireplace is analogous to the number of mrem of radiation energy
- Radiation Dose Rate vs. Radioactivity Concentration
  - Dose Rate:
    - mrem/year, mrem/hour – Public Exposure Limit (100 mrem/yr)
  - Radioactivity Concentration
    - uCi/gram (uCi/g) or pCi/gram (pCi/g) - soil
    - uCi/liter (uCi/L) or pCi/liter (pCi/L) – water, air
    - uCi/milliliter (uCi/ml) - air

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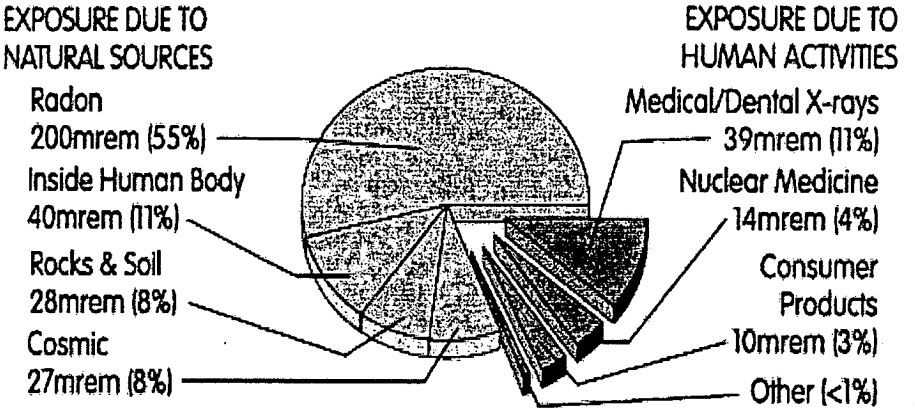
Sources of Ionizing Radiation

Natural and Manmade



Total Average Annual Exposure = 360 mrem/year

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Sources of Ionizing Radiation

Based on the typical U.S. Population

Source of Exposure	Amount of Exposure
Average Cigarette Smoker (1 pack/day)	1300 mrem/year
Nuclear Medicine Examination of Brain	650 mrem/exam
Nuclear Medicine Examination of the Thyroid	509 mrem/exam
Upper Gastrointestinal Tract Series	245 mrem/exam
Nuclear Medicine Examination of the Lungs	150 mrem/exam
CT Scan of the Head and Body	110 mrem/exam
Dental X-ray	6 mrem/x-ray
Foods Grown with Phosphate Fertilizers	5 mrem/year
Highway and Road Construction Materials	4 mrem/year
Gas Mantles for Camping Lantern	2 mrem/year
Cross Country Airline Trip	1.5 mrem/year
Domestic Water Supply	1 to 6 mrem/year
Television Receivers	1 mrem/year
Eating ½ Pound of Brazil Nuts	0.5 mrem/year
Sleeping with Spouse (or significant other)	0.1 mrem/year

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Occupational Exposures

- Typical Occupational Exposures in U.S.

Occupation	mrem/year
Airline Flight Crew	400-600
Nuclear Power Plant Worker	300
DOE/USACE Contractors	75
Medical Personnel	70

- The whole body occupational exposure limit in the U.S. is 5,000 mrem/year.

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Health Effects of Radiation

- Ionizing radiation has the ***potential*** to cause adverse biological effects
- Potential biological effects depend on ***how much*** and ***how fast*** the radiation dose is received
- Two categories of exposure
  - ***Acute Radiation Dose*** – a large radiation dose received in a short period of time
    - Dangers include massive cell damage, nausea, blood changes, hair loss
    - Potential very small; Examples – Hiroshima/Nagasaki, Chernobyl
  - ***Chronic Radiation Dose*** – a small radiation dose received over a long period of time
    - Does not result in rapid physical changes to the body
    - May impact normal cell function causing adverse effects (e.g., increase incidence of cancer) although not seen in doses below 10,000 mrem/year
    - Most likely exposure in U.S.

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Health Effects of Radiation

- Three Categories of Effects
  - **Exposed Individual (Somatic)**
    - Effect experienced by the exposed individual
    - Primary concern is an increased incidence of cancer
    - Background cancer rate in U.S. is ≈ 20 to 25%
    - Cumulative dose of 1,000 mrem would increase chances of developing cancer to less than 0.1% above background cancer rate
  - **Genetic Effect (Heritable)**
    - Effect that is inherited or passed on to offspring
    - Has never been observed in humans including the 77,000 children conceived to bomb survivors after Hiroshima/Nagasaki
  - **Prenatal Effect (Teratogenic)**
    - Effects that occur to the embryo/fetus
    - Effects have been observed in some children exposed while in the womb
    - Significant increase in risk above 15,000 mrem
    - Strict controls in U.S. to limit embryo/fetus exposure below 500 mrem

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Risks in Perspective

Estimated Days-of-Life Expectancy Lost Based on Risk

Risk	Avg. Est. Days Lost
Unmarried Male	3500
Cigarette Smoking	2250
25% Overweight	777
Alcohol (U.S. Average)	365
Working in a Mine/Quarry	328
Construction Worker	302
Agriculture (Farmer)	277
Radiation Dose of 5,000 mrem/year for 50 years*	250
Driving a Motor Vehicle	207
Utility Worker	164
100 mrem/year for 70 years*	10
Coffee Drinker	6

* Radiation exposure values are above the the U.S. total average background radiation exposure of 360 mrem/year.

Activities Creating a Risk of 1 in a Million Chances of Dying

Activity
Smoking 1.4 cigarettes (lung cancer)
Eating 40 tablespoons of peanut butter
Eating 100 charcoal broiled steaks
Spending 2 days in New York City (air pollution
Driving 40 miles in a car (accident)
Flying 2500 miles in a jet (accident)
Canoeing for 6 minutes
Receiving 2.5 mrem of radiation (cancer)

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Controlling Radiation Exposures

- Internal Exposures
  - Three main routes of internal exposure
    - Inhalation
    - ingestion
    - skin absorption
  - Controls focus on minimizing and/or eliminating exposures through these pathways
  - Examples: containment, ventilation, coveralls, gloves, respirators, good hygiene, water suppression of dust
- External Exposures
  - Controlled by following the ALARA concept
  - ALARA = As Low As Reasonably Achievable
  - Three basic principles:
    - Time – reduce the amount of time near a source of radiation
    - Distance – stay as far away from the source as possible
    - Shielding – keep shielding between the source and people

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Summary

- **Radiation and Radioactivity**
  - The two categories of radiation are ***ionizing*** and ***nonionizing***
  - ***Alpha***, ***beta*** and ***gamma*** are the three naturally occurring types of ionizing radiation
  - Radiation is ***energy***, contamination is ***material***
  - 1 mrem ***does not equal*** 1 pCi!
  - ***Chronic radiation*** dose is a small dose over a long period of time
  - Primary chronic dose health concern is ***cancer***, although potential for occurrence is considered to be very low
  - ALARA: Time, Distance and Shielding
- **Sources of Additional Information:**

  www.nrc.gov/what-we-do/radiation/about-radiation.html

  www.epa.gov/air/radiation/index.html

  www.mvs.usace.army.mil/engr/fusrap/home2.htm

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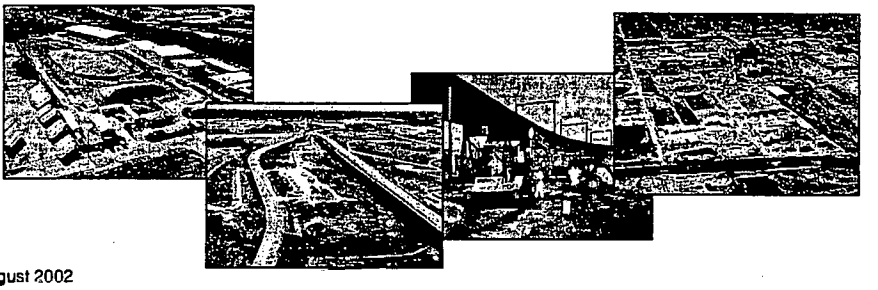
Risk Assessment



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The Problem

"All substances are poisons; there is none that is not a poison. The right dose differentiates a poison from a remedy."

Paracelsus
(1493 – 1541)

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Agenda

- Overview of Risk Assessment
- Risk Assessments in Superfund
- Human Health Risk Assessment (HHRA) Components
- Ecological Risk Assessment (Eco-Risk) Components
- HHRA and Eco-Risk Differences
- Key Points for a Radiological Risk Assessment
- Risk Management
- Summary

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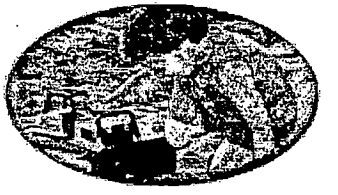
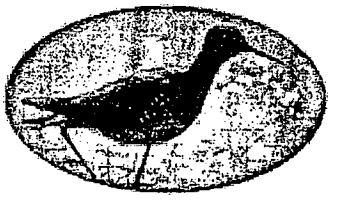
Defining "Risk"

- **Risk -**
  The chance that some harmful event will occur



- In the case of environmental cleanups, risk is the probability that humans or the environment will suffer some adverse consequence as a result of exposure to hazardous substances



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Overview of Risk Assessment

- **Risk Assessment -**

  Method to quantify threats to human health and the environment; used to decide what needs to be cleaned up, where, and to what level

- **Answers:**
  - Is there a hazard? [Hazard Identification]
  - How bad (toxic) is it? [Toxicity Assessment]
  - Who is exposed, to how much, how often, and for how long? [Exposure Assessment]
  - What does the risk assessment tell us? [Risk Characterization]
- **Guidance**
  - EPA's *Risk Assessment Guidance for Superfund (RAGS)* series that is available on the EPA's web site www.epa.gov

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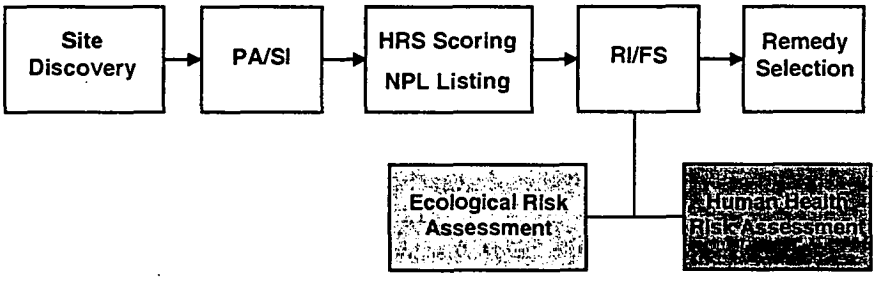
Risk Assessments in Superfund



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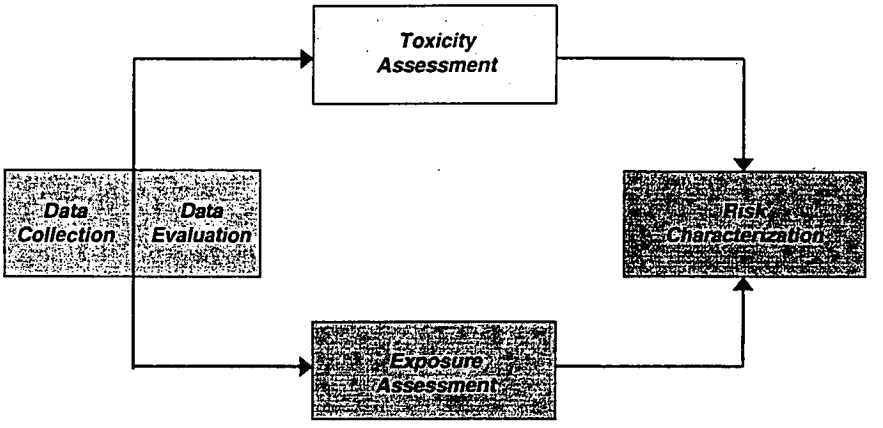
Human Health Risk Assessment



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Human Health Risk Assessment

- ***Data Collection***
  - Answers which substances and how much are present in the environment (soil, air and water)
  - Must follow strict protocols to ensure quality and integrity of environmental samples
  - Aids in identifying site-related chemicals of potential concern (COPC)
- ***Data Evaluation***
  - Ensures that collected data meets the pre-defined data quality objectives (DQOs) and is sufficient to assess risk
  - May include use of computer models to help predict chemical movement in the environment

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Human Health Risk Assessment

- ***Exposure Assessment***
  - *Answers 3 key questions:*
    1. How are people exposed?
    2. Who could be exposed?
    3. How much of the chemical are people exposed to?
  - ***Exposure occurs:***
    - if there is a source of contamination and a pathway
  - ***Conceptual Site Model***
    - used to determine if exposure pathways exist
    - helps develop exposure scenarios
  - ***Reasonable Maximum Exposure (RME)***
    - highest dose reasonably expected to occur
  - ***EPA Exposure Factors Handbook***
    - summary of various factors used in assessing human exposure
    - Includes factors for water consumption, soil ingestion, inhalation rates, skin absorption factors, consumption of food products, human activity factors, consumer product use, and residential characteristics

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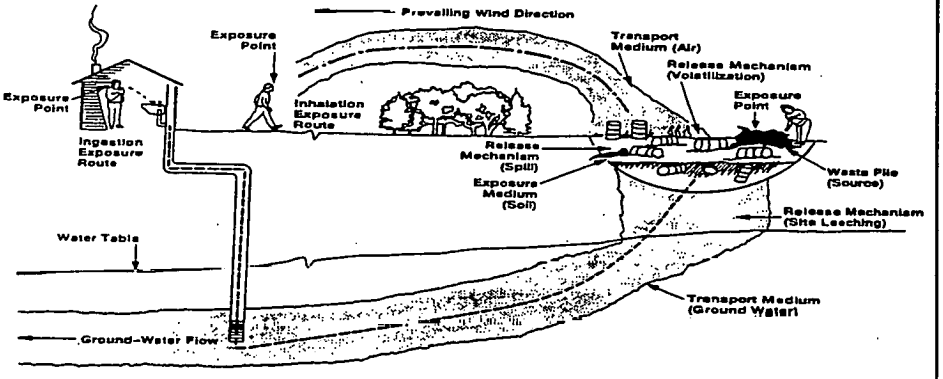
Conceptual Site Model



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Human Health Risk Assessment

- ***Toxicity Assessment***
  - Addresses potential health effects of chemical and how much exposure causes adverse health effects
  - Remember..... ***'The dose makes the poison'***
  - Two effects evaluated
    - Cancer & non-cancer effects
  - Many sources of toxicity information used:
    - Integrated Risk Information System (IRIS)
    - Heath Effects Assessment Summary Tables (HEAST)
    - ATSDR Toxicological Profiles
    - Other (criteria documents, peer-reviewed literature)

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Risk Characterization

- Input from first three steps is used to calculate "risk"
- Risk is presented as a number
  - ***Cancer Risk***
    - Expressed in terms of "excess cancer risk"
    - Example:
      - » 10^{-4} which means 1 in 10,000 chance of "excess cancer risk"
  - ***Non-Cancer Risk***
    - Expressed in terms of Hazard Index (HI)
    - Below 1.0 is OK, above 1.0 requires action or further analysis.
  - Since FUSRAP involves radioactive substance, risk also expressed in terms of radiation exposure (mrem/year)

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Human Health Risk Assessment

- ***Risk Characterization***
  - ***Risk Uncertainty***
    - Uncertainty is a part of all risk assessments simply because scientists lack sufficient information on actual exposures and on how some chemicals harm individuals and the environment
  - ***Sources of uncertainty***
    - Inadequate sampling data
    - Incomplete information about pathways
    - No information on how chemical might harm people
    - Using experimental animal studies to estimate human risk
  - ***Margins of safety***
    - Many "margins of safety" built into the exposure assessment, toxicity assessment and risk characterization to prevent underestimating the potential risk

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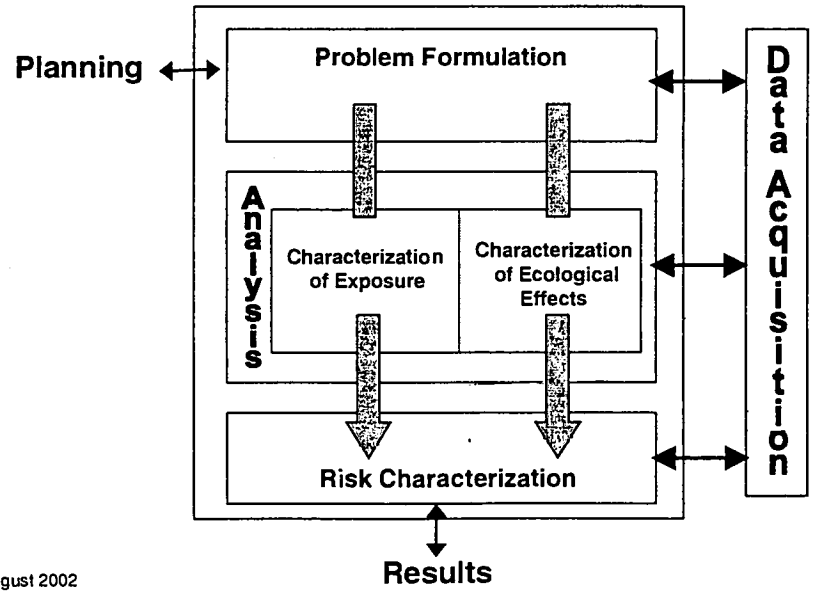
Ecological Risk Assessment



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Ecological Risk Assessment

- ***Purpose:***
  - Evaluate the likelihood that adverse ecological effects may occur or are occurring as a result of exposures to stressor(s)
- ***Parts:***
  - Data Acquisition
  - Problem Formulation
  - Exposure Characterization (Analysis)
  - Ecological Effects Characterization (Analysis)
  - Risk Characterization
- ***Guidance Documents***
  - *Ecological Risk Assessment Guidance for Superfund* (EPA 1998)
  - Wildlife Exposure Factor Handbook, Volume I and II (EPA 2001)

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Human Health & Ecological Risk Assessment Differences

Human Health	Ecological
• Only humans	• Many species
• Individual risk	• Population risk
• Assess both cancer and non-cancer risk	• Assess non-cancer risk
• Limited exposure pathways	• Complex exposure pathways and food web

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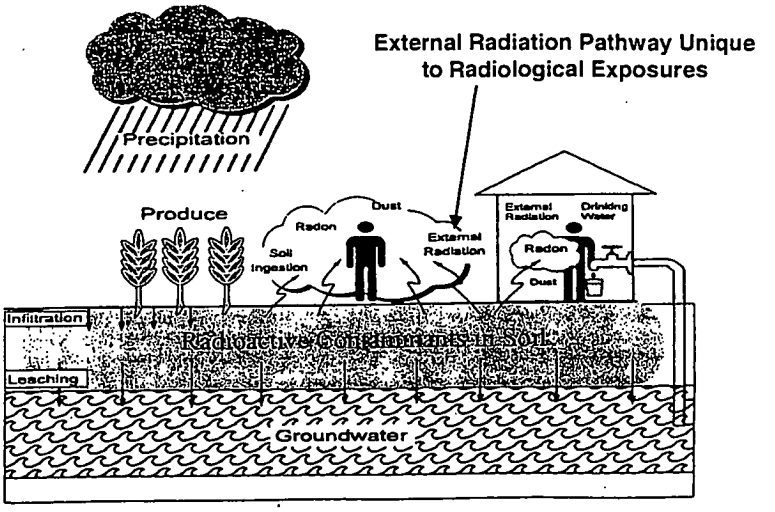
Radiological Risk Assessment



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Radiological Risk Assessment

- Closely parallels chemical risk assessment
  - Differences include:

    measurement units; exposure terms and concepts; field and laboratory procedures and detection limits; background radiation; toxicity criteria
- Computer models used to perform radiological risk assessment
  - RESRAD, RESRAD-Build (Argonne National Lab)
  - D&D Model (Nuclear Regulatory Commission)
- Additional information on the differences between a chemical and radiation risk assessment can be find on the EPA's web site at www.epa.gov

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Risk Management

- Risk Assessment results are used during development and evaluation of cleanup alternatives
- Remedial alternative evaluation follows EPA's 9 Criteria
  - ***Overall protection of human health and the environment***
  - Compliance with applicable or relevant and appropriate requirements
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility or volume of contamination through treatment
  - Short-term effectiveness
  - Implementability
  - Cost
  - State Acceptance
  - Community Acceptance

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Summary

- **Risk Assessment:**
  - Method that helps analyze what needs to be cleaned up, where, and to what level based on exposure effects
  - Two parts are human health & environment
  - Helps identify the hazard, define the exposure risks and toxicity levels, and characterize the risk
  - Risks are assessed for a variety of exposure scenarios
  - Radiological risk assessment is very similar to chemical risk assessment
  - Used to develop and evaluate cleanup alternatives
- **Additional Information:**

  www.epa.gov/superfund/programs/risk/index.htm

  www.epa.gov/radiation/assessment/

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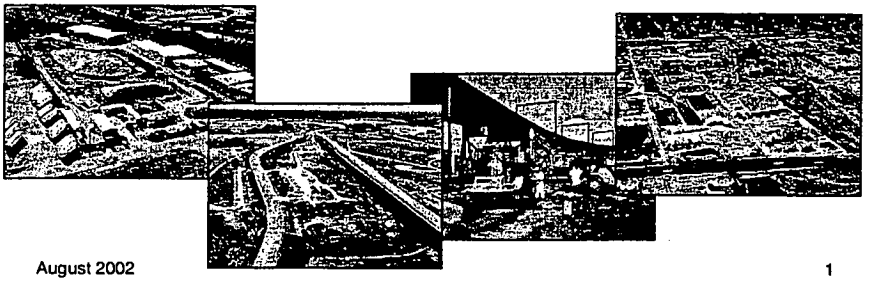
ARARs



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Agenda

- Definition of ARARs
- Why bother with ARARs?
- Applicable versus relevant and appropriate
- Development of ARARs
- Types of ARARs: Chemical-, Location-, and Action-Specific
- What Requirements Must Be Met?
- Compliance with ARARs
- Summary / Questions and Answers

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Definition of ARARs

- ARAR = Applicable or Relevant and Appropriate Requirement

Refers to any state or federal statute that pertains to protection of human health and the environment in addressing specific conditions or use of a particular cleanup technology at a Superfund site

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Why bother with ARARs?

1980: Congress passed CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as Superfund)

➢ Directed agencies to identify abandoned or uncontrolled hazardous waste sites and to prioritize clean up.

An agency's authority to initiate a response is triggered by the release or threatened release of a hazardous substance into the environment.

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Why bother with ARARs?

1986: Congress passed SARA (Superfund Amendments and Reauthorization Act) to amend CERCLA

- Shifted focus of cleanups from temporary to permanent solutions.
- Added CERCLA §121 "Cleanup Standards" - requires that CERCLA actions be protective of human heath and the environment and comply with ARARs.

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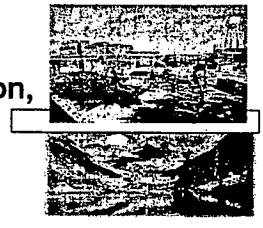
"Applicable" versus "Relevant and Appropriate"

Applicable: the requirement must *directly* and *fully* address the CERCLA activity. The state or federal requirement must "...*specifically* address:

- a hazardous substance, pollutant, or contaminant,
- remedial action,
- location, or
- other circumstance at the CERCLA site."



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"Applicable" versus "Relevant and Appropriate"

If requirement is not applicable it may be:

- ***Relevant*** because it addresses problems or situations similar to those encountered at the site, and
- ***Appropriate*** because its use is well suited to the particular site.

Requirement must be both relevant and appropriate to be designated as an ARAR for the site. In some cases, only a portion of the requirement may be relevant and appropriate.

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Development of ARARs

- Developed during the Remedial Investigation (RI) and Feasibility Study (FS) phases
- ARARs are identified on a site-by-site basis and are based on site-specific factors such as the hazardous substance(s) present, the location, the physical features, and the remedies being considered.

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Development of ARARs - FUSRAP

- Corps of Engineers (lead agency) responsible for identifying the potential ARARs and ensuring compliance with ARARs.
- State agencies participate in identifying and reviewing potential ARARs.
- EPA has concurrence authority over the selection of remedial actions at FUSRAP sites

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Types of ARARs

ARARs have been classified into three types:

- Chemical-specific requirements,
- Location-specific requirements, and
- Action-specific requirements.

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Types of ARARs

Chemical-Specific ARARs:

- **State or federal standards (health, risk or technology-based numerical standards) or methods for particular hazardous substances in environmental media.**
- **Information required for developing Chemical-Specific ARARs include:**
  - (1) what will be undergoing remediation;
  - (2) what hazardous substances are identified as COCs, at what levels and where are they located; and
  - (3) what types of waste are present at site.
- **In general, use the most stringent ARAR for the particular hazardous substance.**

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Types of ARARs

Location-Specific ARARs:

- **Based on particular characteristics or locations of the site.**

Action-Specific ARARs:

- **Requirements that establish performance or design standards or requirements for specific remedial activities.**

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What requirements must be met?

On-site remedial actions need only comply with substantive, not administrative, requirements.

- Administrative requirements pertain to administrative methods & procedures (e.g., permits, records, reports).
- Substantive requirements pertain to actions or conditions in the environment that directly influence activity at a site (e.g., chemical concentrations limits, design standards).

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Remediation Goals

Remediation goals (cleanup levels) – RGs - for CERCLA sites are developed based on ARARs.

- RGs = amount of contaminants in the targeted media above which remedial action should be considered to prevent exposures to levels higher than the limits specified in the ARARs.
- Risk-based RGs are established if ARARs are either not available or do not adequately address the risk.

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Compliance with ARARs

Once the Record of Decision (ROD) is signed, all requirements identified as ARARs become legally binding unless a waiver is granted.

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Summary

KEY POINTS TO REMEMBER

- The identification of ARARs is an iterative, negotiable process.
- Remediation goals are developed for CERCLA sites based on ARARs. If ARARs are not available or are not sufficiently protective, risk-based remediation goals are developed.
- Remedial actions must meet all ARARs identified in the signed ROD.

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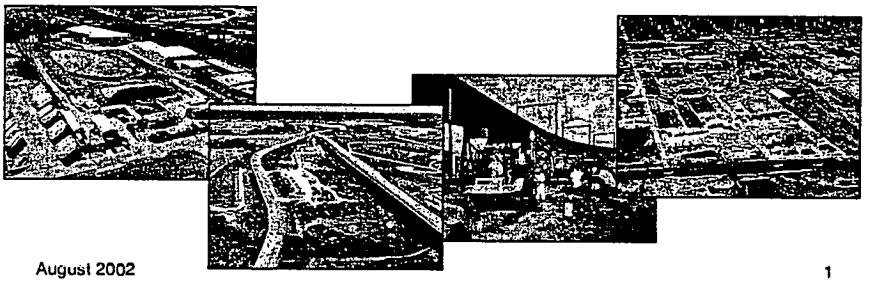
How ARARs are applied at FUSRAP sites



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Examples of how ARARs are applied at FUSRAP sites

Dose and Risk

- The dose represents the energy absorbed from exposure to ionizing radiation. It is expressed in units of mrem/year.
- Total dose is based on the concentrations of the radioactive contaminants present in various media (soil, sediments, surface water, ground water, and air) and the potential exposure pathways at the property.
- A health risk level is determined for the site based on the total dose calculation.
- Remediation goals are derived based on site-specific exposure assumptions, and with the objective of meeting the acceptable CERCLA risk range (10^{-4} to 10^{-6})

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Examples of how ARARs are applied at FUSRAP sites

Remediation goals (cleanup levels) – RGs - for CERCLA sites are developed based on ARARs.

- **40 CFR Part 192 Subpart B provides the basis for the RGs for radium under unrestricted land use (*5 pCi/g Ra-226 above background in surface soils and 15 pCi/g Ra-226 above background in subsurface soils).***
- **10 CFR 40 Appendix A Criterion 6(6) provides basis for the derivation of RGs for non-radium radionuclides (particularly uranium and thorium) in soil.**

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Examples of how ARARs are applied at FUSRAP sites

SOR Approach: When multiple radionuclides are present, a "sum of ratios" (SOR) approach Is used to ensure that the sum of the radiation doses from all the radionuclides present does not exceed ARAR- or risk- based remediation goals.

- **The above-background concentration of each of the primary radiological COCs is divided by its respective RG. The sum of the ratios is then compared to 1.**

Example:

$$SOR = \frac{[\text{Ra-226}]}{RG_{\text{Ra-226}}} + \frac{[\text{Th-230}]}{RG_{\text{Th-230}}} + \frac{[\text{U-238}]}{RG_{\text{U-238}}}$$

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Examples of how ARARs are applied at FUSRAP sites

Example:

Radium-226 soil concentration in sub-surface soil is 2.7 pCi/g.
Thorium-230 soil concentration in sub-surface soil is 6.8 pCi/g.
Uranium-238 soil concentration in sub-surface soil is 3.2 pCi/g.

Assume sub-surface soil Remediation Goals: 15 pCi/g Ra-226; 15 pCi/g Th-230; 50 pCi/g U-238

$$SOR = \frac{[Ra\text{-}226]}{RG_{Ra\text{-}226}} + \frac{[Th\text{-}230]}{RG_{Th\text{-}230}} + \frac{[U\text{-}238]}{RG_{U\text{-}238}}$$

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Examples of how ARARs are applied at FUSRAP sites

Example:

$$SOR = \frac{[Ra\text{-}226]}{RG_{Ra\text{-}226}} + \frac{[Th\text{-}230]}{RG_{Th\text{-}230}} + \frac{[U\text{-}238]}{RG_{U\text{-}238}}$$

$$SOR = \frac{2.7\ pCi/g}{15\ pCi/g} + \frac{6.8\ pCi/g}{15\ pCi/g} + \frac{3.2\ pCi/g}{50\ pCi/g}$$

$$SOR = 0.18 + 0.45 + 0.06$$

$$SOR = 0.70 < 1.00 \quad \textbf{COMPLIANCE}$$

PUBLIC TRAINING SESSION AGENDA
August 20, 2002

Purpose:

- To familiarize people with technical processes and terms associated with the cleanup of MED/AEC wastes in North St. Louis County FUSRAP sites.

- To help people understand the cleanup documents when they are released for public review.

Schedule:

6:00 – 6:15 p.m.	Opening Remarks by Sharon Cotner, U.S. Army Corps of Engineers FUSRAP Program Manager
6:15 – 6:45 p.m.	CERCLA Acceptable Risk Range by Debbie McKinley, U.S. Army Corps of Engineers
6:45 – 7:15 p.m.	Cleanup Process by Lou Dell'Orco, U.S. Army Corps of Engineers
7:15 – 7:25 p.m.	*** Break / Sampling Demonstration ***
7:25 – 7:55 p.m.	Cleanup Process (continued) by Lou Dell'Orco, U.S. Army Corps of Engineers
7:55 – 8:25 p.m.	Long-term Stewardship by Harry Hamell, U.S. Army Corps of Engineers
8:25 – 8:55 p.m.	Missouri Solid Waste Regulations Prohibiting the Disposal or Spread of Radiological Contamination by Eric Gilstrap, Missouri Dept. of Natural Resources
8:55 - 9:00 p.m.	Closing remarks

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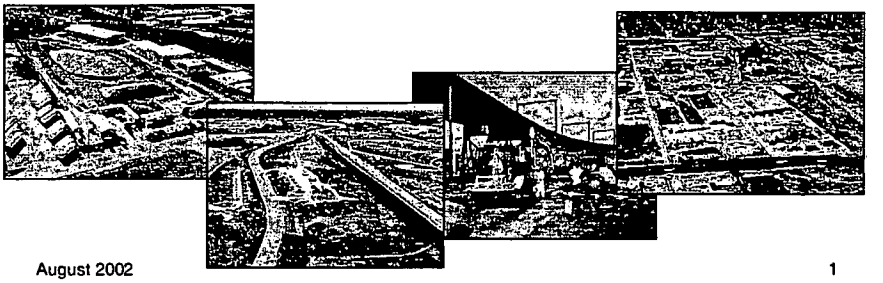
Opening Remarks



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Getting started!

- Introductions
- Name tags
- Basic necessities --- Restrooms, beverages, no smoking in room, breaks
- Ground rules

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Objectives of Training Session

- To familiarize people with technical processes and terms associated with the cleanup of MED/AEC wastes in North St. Louis County.
- To help people better understand the cleanup documents when they are released for public review.

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Agenda

- August 13th
  - North County FUSRAP History / Intro to CERCLA
  - Radiation Basics
  - Risk Assessment
  - Applicable, or Relevant and Appropriate Requirements
  - Dose & Sum of Ratios
- August 20th
  - Risk Range
  - Cleanup/ property release
  - Long-term stewardship
  - Missouri Solid Waste laws

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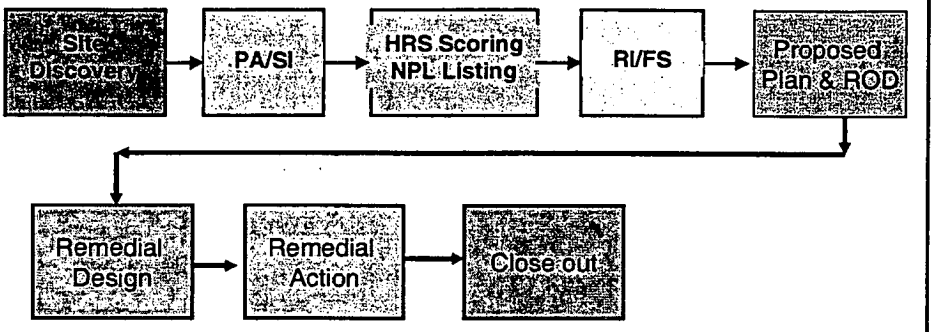
CERCLA Process Flowchart



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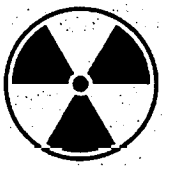
NEXT????

- **Risk Range!!!!**



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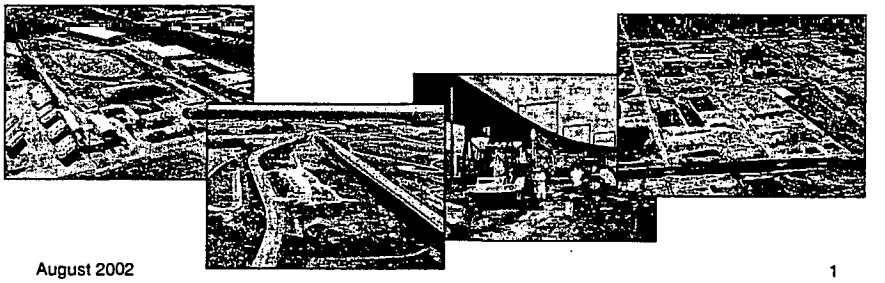
Acceptable Risk Range



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Agenda

- What is the CERCLA acceptable risk range?
- When is the risk range is used?
- How is the risk range used in the CERCLA process?

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What is the CERCLA Acceptable Risk Range?

- 1 in 10,000 to 1 in 1,000,000 additional cancers above the background cancer risk
  - Expressed as 10^{-4} to 10^{-6}
  - Background cancer risk due to ordinary exposures from daily activities, family history, genetics etc. is 2,000 cancer cases in a population of 10,000 people
- Additional cancer cases estimated for a site are those above the expected cases from ordinary everyday activities

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When / How is the CERCLA Acceptable Risk Range Used?

- Remedial Investigation (RI)
  - during the Baseline Risk Assessment to assess need for action
- Feasibility Study (FS)
  - during the development of remediation goals
- Site Closeout
  - during the Post Remedial Action Report (PRAR) to document protectiveness of final site conditions

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Remedial Investigation

Baseline Risk Assessment

- **Purpose**
  - determine if unacceptable potential current or future risks exist
  - quantify current or future potential risks
- **Comparison to risk range of 10^{-4} to 10^{-6}**
  - If total risk using Reasonable Maximum Exposure (RME) assumptions is greater than 10^{-4}, risk is potentially unacceptable and action is generally warranted
- **Risk Assessment identifies constituents of potential concern**

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Feasibility Study

Remedial Goals

- **Cleanup levels developed**
  - First step is to identify Applicable or Relevant & Appropriate Requirements (ARARs)
  - ARAR levels can be protective even if outside the risk range
- **Multiple pathways or chemicals**
  - Levels are added up and compared to the risk range
  - If total risk is greater than 10^{-4}, ARARs may not be protective and site-specific cleanup goal may be required
  - Total risk level of 10^{-6} is used as the starting point
- **Final cleanup goal can be anywhere within the risk range given site-specific factors (exposure, technical, uncertainty)**

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Site Closeout

Post Remedial Action Report (PRAR)

- Verify that the residual site risk is within the CERCLA acceptable risk range of (10^{-4} to 10^{-6})
- Assess the need for Institutional Controls
- Documented in Post Remedial Action Reports (PRAR) and Site Closeout Reports

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Summary

- CERCLA acceptable risk is a range between 10^{-4} to 10^{-6}, not a single value
- Risk range represents <u>additional</u> cancers above the background cancer risk 2,000 cancers in a population of 10,000
- Risk range used in Risk Assessment, Feasibility Study and Site Closeout
- Risk of 10^{-4} to 10^{-6} is protective

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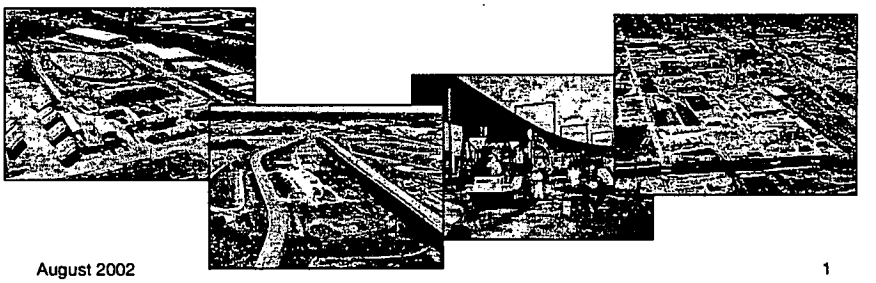
Informational Training Session

The Cleanup Process



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Agenda

- Presentation Objective
- How is the Cleanup Determined?
- The Cleanup Process
- Preliminary Design Investigation
- Remedial Design
- Remedial Action
- Post Remedial Action Report
- 5 Year Review
- Site Closeout

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How is the Cleanup Determined?

- **A Feasibility Study, which proposes a range of remedies, is published by the agency executing the cleanup. The FS examines cleanup options and the Proposed Plan describes the preparing agency's preferred remedy for comment. The range of remedies can be options such as:**
  - No further action
  - Consolidation / Capping
  - On site storage disposal cell
  - Treatment
  - Institutional Controls
  - Partial excavation
  - Complete excavation
  - Comments from the public and site regulators are received during review of the Feasibility Study / Proposed Plan and incorporated into the ROD.
- **The selected remedy and affected media (soils, sediments, groundwater, surface water, emissions) are defined in the Record of Decision (ROD) along with the response to the comments received on the FS/PP.**

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The Cleanup Process

- **The cleanup process is composed of separable phases completed in a logical order and common processes which are applied to a majority of these phases.**
  - **Phases**
    - Preliminary Design Investigation
    - Remedial Design
    - Remedial Action
    - Final Status Survey
    - Post Remedial Action Report
    - 5 Year Review
    - Site Closeout
  - **Common Processes**
    - Data Quality Objectives, Multi-Agency Survey and Site Investigation Manual (MARSSIM), Site Operations Control, Environmental Monitoring and Public Safety and Community Relations

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Getting Started - Establishing the Data Quality Objectives

1. STATE THE PROBLEM
2. IDENTIFY THE DECISION
3. IDENTIFY INPUTS TO THE DECISION
4. DEFINE THE STUDY BOUNDARIES
5. DEVELOP A DECISION RULE
6. SPECIFY LIMITS ON DECISION ERRORS
7. OPTOMIZE THE DESIGN FOR OBTAINING DATA

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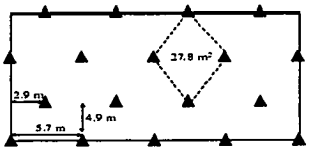
MARSSIM

- **Multi Agency Radiation Survey and Site Investigation Manual**
  - **Provides a consensus approach for the planning, conduct, evaluation and documentation of radiological surveys to demonstrate compliance with the ROD**
- **For radiological contaminants, defines impacted areas and classifies these areas based on contamination potential**
  - **Class 1, Class 2 & Class 3**
  - **Types of Surveys**
  - ***Final Status*** →



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Pre-Design Investigation

- **The purpose of the Pre-Design Investigation is to locate and characterize the extent of contamination with greater certainty.**
  - Estimate volumes for the selected remedy, determine geotechnical characteristics of soil, determine depth of groundwater and the nature of chemical and/or radiological contamination
  - **Information from previous studies are reviewed**
    - Analysis of existing data, the Remedial Investigation

Characterization

Fate and Transport

Nature & Extent

Pathways

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Pre-Design Investigation Process

- **Review and analysis of site historical use**
  - **Maps**
  - **Former workers information**
  - **News reports**
- **Identification of potentially impacted areas**
  - **Which areas were used for what**
- **Walkover area to identify and quantify radiological contamination in surface soils**
- **For radiological and chemical contamination**
  - **Define impacted media (soil, groundwater,..)**
  - **Sample to determine the nature and extent of the ROD contaminants**
  - **Using results, define precise areas of the site requiring the ROD remedy**

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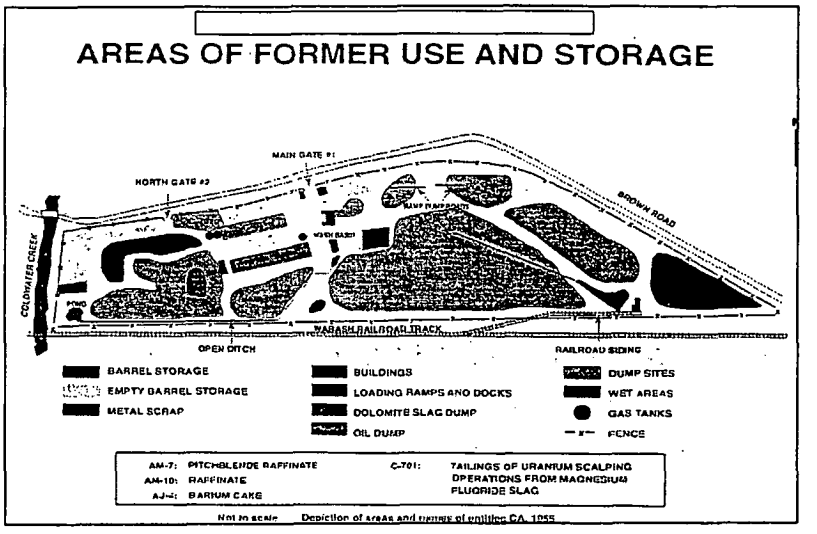
Pre Design Investigation Historical Use



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Pre-Design Investigation- Radiological Walkover Survey

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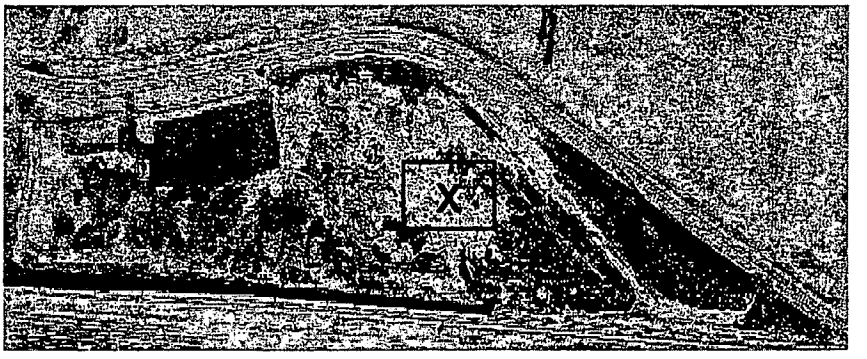
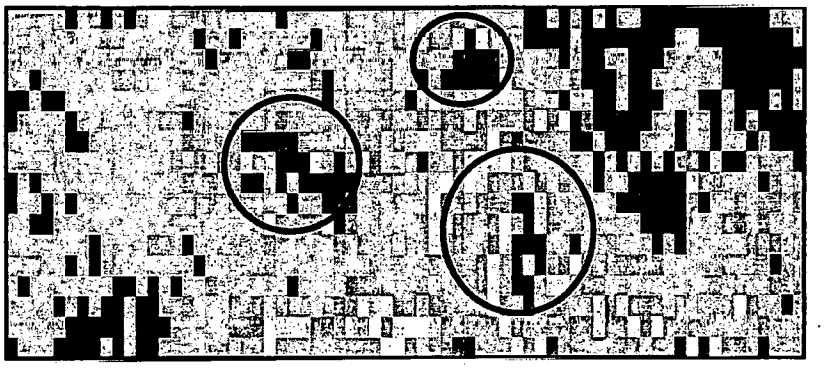
Walkover Survey Product



St. Louis District

Walkover Survey Product



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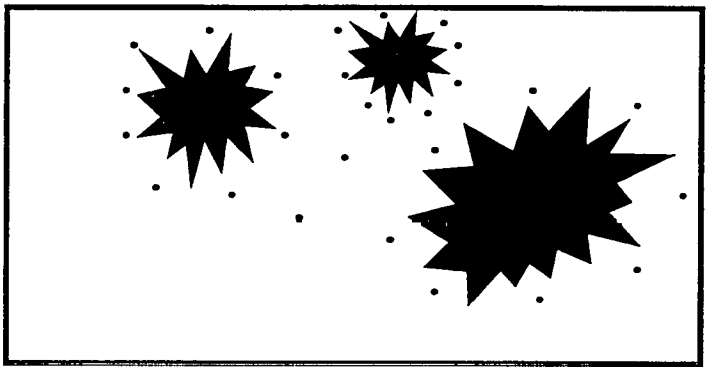
Definition of Impacted Areas



Iterative Process

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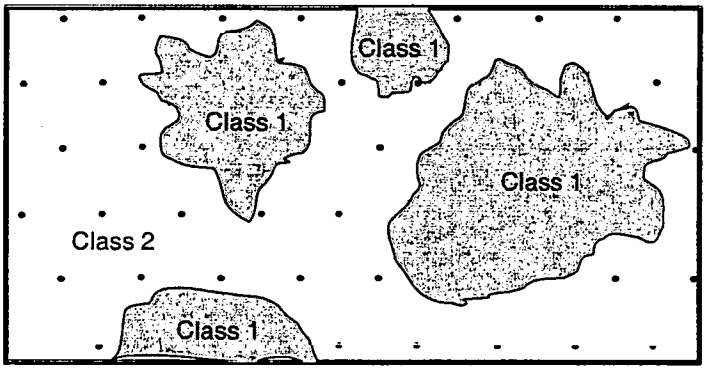
Delineation of Impacted & Unimpacted Areas



Final Status Survey - Class 2 area

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Remedial Design Process

- Commences after the Preliminary Design Investigation Report, which defines the nature and extent of contamination, is completed.
  - The purpose of the Remedial Design is to develop the engineering approach, procedures and policies to be followed in the excavation, handling, backfill, transportation and disposal.
- The Corps develops the design and provides it to the regulators for review and comment.
  - Comments are addressed and then the design is finalized.

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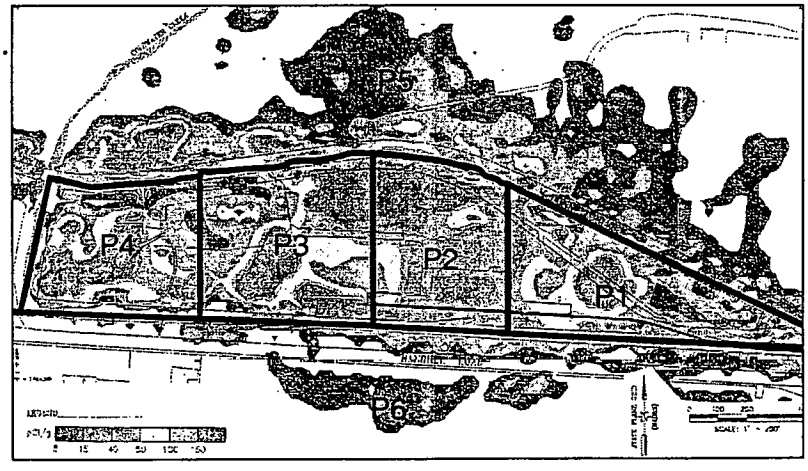
Remedial Design Phased Designs



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Remedial Design
Define Site Operations

- Site work zones are established and access restricted
  - Exclusion Zone - Where the contamination is (The Work Area)
  - Contamination Reduction Zone - Personnel decontamination area (The Buffer Between the Work Area and the Support Zone)
  - Support Zone - Logistic area (offices, support facilities)
- Area orientation / training / Personnel Protective Equipment Requirements
- Notifications to landowners made
- Underground utilities located
- Order and coordination of work defined

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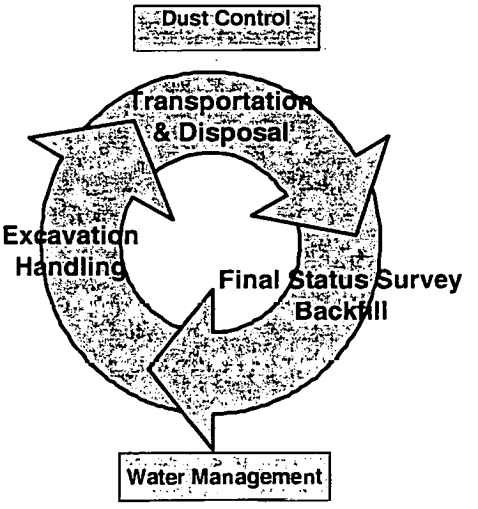
Remedial Action
System Approach



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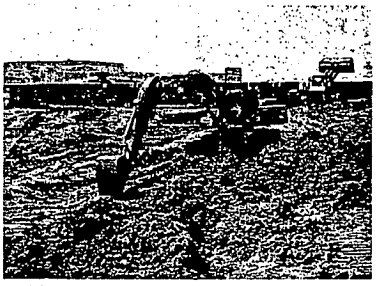
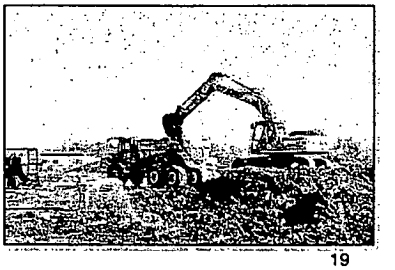
Excavation and Handling

- Excavation steps for soils and sediments
  - Gross
  - Guided or "Precision"
- Groundwater
  - Minimize volume
- Surfacewater
  - Minimize interface
- Handling
  - Minimize





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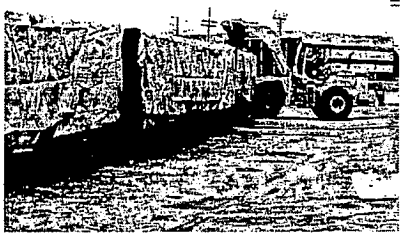
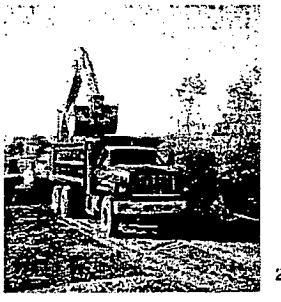
Transportation and Disposal

- Transportation
  - Soils / sediments / water
    - Loaded and packaged in container prior to shipment
    - Tested to ensure it meets disposal facility waste acceptance criteria
- Disposal
  - Contamination is sent to a disposal facility that is licensed / permitted to accept the waste. Provide certificate of disposal back to the Corps





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Final Status Survey Process

- Applies to all soil contamination
- The key step in the MARSSIM process
- To ensure an area is cleaned to criteria for radiological contamination
  - Remedial Action (RA) Contractor notifies USACE that the "bottom of the hole" is ready for Final Status Survey / soil sampling for release. A preferential pathway analysis is also conducted.
  - A/E contractor defines MARSSIM based sampling plan, walks over area, identifies and samples any elevated areas and collects systematic samples.
  - A/E contractor performs MARSSIM analysis of sampling results
  - USACE gives authorization to backfill or directs further remediation
  - USACE prepares Post Remedial Action Report (PRAR) to document residual site conditions, including residual risk.

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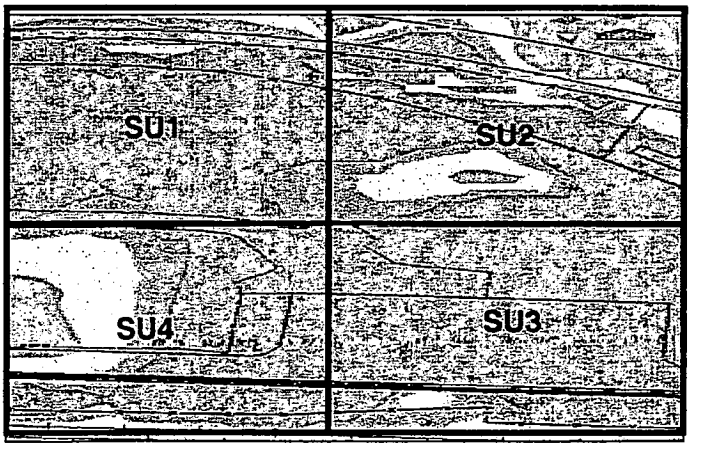
Phased Remediation Survey Units



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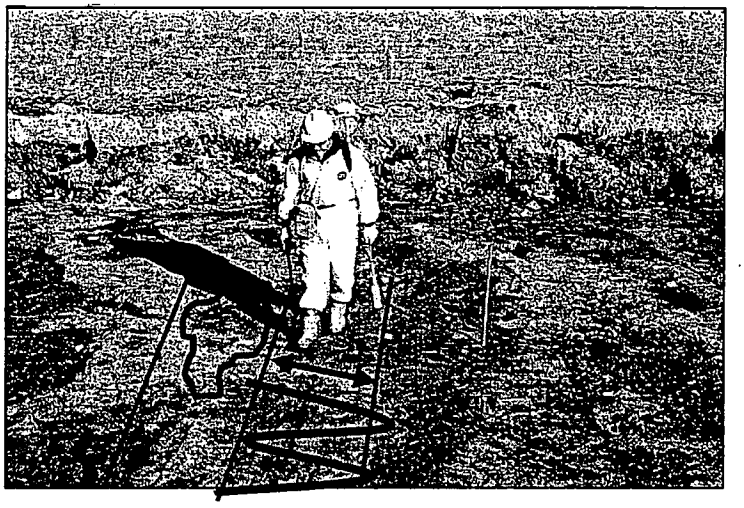
Final Status Survey



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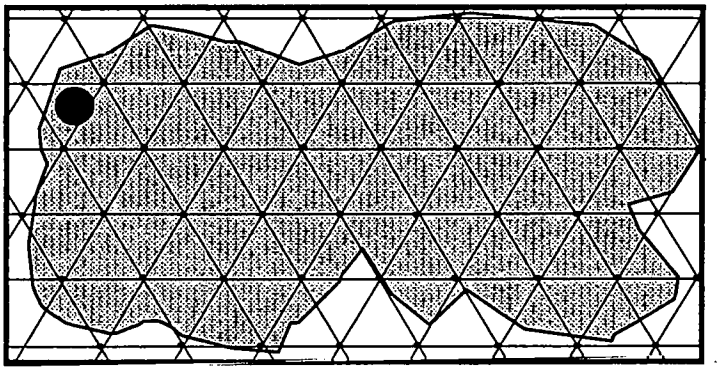
Final Status Survey of Excavated Area



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Sum of the ratios

- **Used when multiple contaminants affecting a human organ system are present**
- **The SOR is used to determine if an area exceeds the cleanup criteria specified in the ROD.**
  - **Formula may be applied to surface and subsurface**

$$\frac{\text{Contaminant}}{\text{Criteria}} + \frac{\text{Contaminant}}{\text{Criteria}} < 1.0$$

$$\frac{5x}{5} + \frac{4y}{5} > 1.0$$

$$1.0 + .8 \quad (1.8) > 1.0$$

  - **If the SOR is 1.0 or greater, the contamination must be addressed.**
  - **If the SOR for the SU is less than 1.0, USACE provides a determination that it meets the ROD criteria and directs the contractor to backfill the area.**

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Post Remedial Action Report

- **What is a PRAR and what is its purpose?**
  - **A PRAR is a report that compares residual contamination with the requirements of the Record of Decision. The PRAR also defines areas which allow for "unrestricted use and unlimited exposure" and those that require the imposition of Institutional Controls.**
    - Uses Final Status Surveys to document that the remedial action achieves ROD requirements
    - Institutional controls and five year reviews required for these areas which do not achieve "unrestricted use and unlimited exposure".
      - (Example) A given property may require controls (e.g., zoning) to prevent unanticipated changes in land use if residual contamination exceeds unrestricted use criteria
  - **Provides the property owner the status of the site**
  - **Assists the landowner in the event of a sale, adding facilities to the site, property improvements.**

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5 Year Review

- The purpose of a 5 year review is to evaluate the performance of the remedy in order to determine if the remedy is, or will be protective of human health and the environment.
  - Required for sites which have contaminants above levels that allow for unlimited use and unrestricted exposure
  - Conducted at 5-year intervals beginning with initiation of ROD cleanup action.
  - Components typically include document review, site inspection, monitoring results, interviews and a remedy effectiveness assessment
    - Documents the effectiveness of institutional controls

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Site Closeout

- The site closeout document is a stand alone document that provides a consolidated record of all removal activities for the entire site.
- It ensures that
  - All response actions are complete and all cleanup levels achieved - the site poses no threat to human health or the environment.
  - No further action is appropriate
- It facilitates
  - Removal of site from the NPL

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Environmental Monitoring Program / Public safety

- Objectives
  - Protect the health and safety of the public and site workers
  - Comply with federal and state regulations
  - Provide information on the fate and transport of contaminants
- Monitoring
  - Groundwater - aquifer wells, trenches
  - Surface water / sediments - area where surface water exists the site, permitted outfalls, downstream locations
  - Air - at site fence lines (borders) and site surfaces
- Reporting
  - Results are documented quarterly and summarized in an annual report.

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How is the Public Kept Informed

- From the PDI to the Site Closeout is a process that typically takes years to complete.
- Proactive Community Relations
  - Open Houses, Workshops, Public Meetings, Newsletters, News Releases, Interviews to the Media
  - Developed in a Community Relations Plan
- Administrative Record
  - Files that document the entire process retained on site and In local libraries

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Summary

- The objective of the cleanup process is to meet the requirements of the ROD.
- MARSSIM is used to demonstrate compliance with the ROD for radiological contamination.
- Unlimited use and unrestricted exposure results in no Institutional Controls or 5 Year Reviews

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U.S. Army Corps of Engineers

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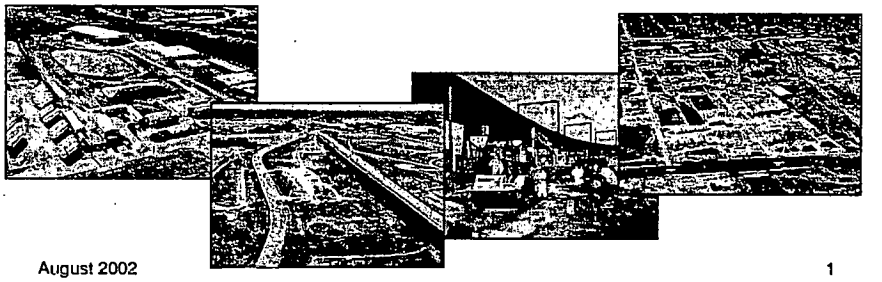
Training Session

LONG-TERM STEWARDSHIP



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Expectations

Long-Term Stewardship (LTS)

- LTS - to be or not to be!
- Application of LTS principles
- Why LTS now ...

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Stewardship Goals

LTS applies to sites or areas where residual contamination exceeds an acceptable risk.

- Protect human health and environment from risk of exposure
- Manage risks at residual sites
- Establish and maintain response capability

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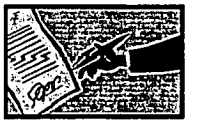
Stewardship Objectives

- Maintain proprietary interest in MED / AEC hazardous materials
- Containment of residual source sites
- Sustain integrity of remedial measures
- Secure legitimate access and remedial permissions
- Public awareness and notice

*** In Perpetuity ***



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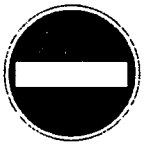
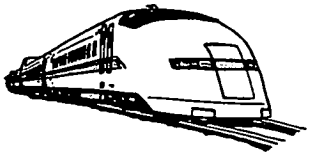
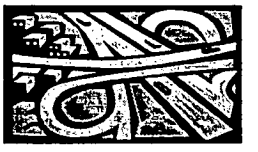
Stewardship Components

- **Site Description**
  - Identify "Inaccessible Areas"
  - Contaminants of Concern
  - Media - air, water, and soil



- **Institutional controls**
  - Physical - engineered unit, fences, signs, monuments
  - Proprietary - deed, easement, restrictive covenant
  - Governmental - zoning, inspections, permits





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Stewardship Components

- **Accountability and responsibility matrix**
  - Clearly defined stakeholder responsibilities
- **Frequency and duration time factors**
  - Shelf-life
  - Advances in technology
  - Changed site conditions
- **Stakeholders** (Corps, DOE, EPA, MDNR, Municipalities, Landowners)
  - Commitment and compliance

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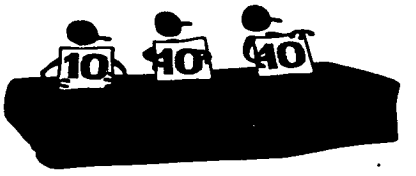
Stewardship Success

Depends on LTS being:

- ✓ Protective – to health and environment
- ✓ Perpetual – durable and transferable
- ✓ Sustainable – redundant and legally enforceable
- ✓ Assurance – competent, dependable, and responsive



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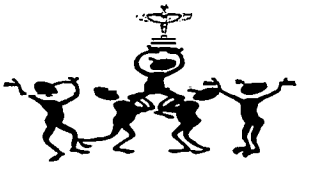
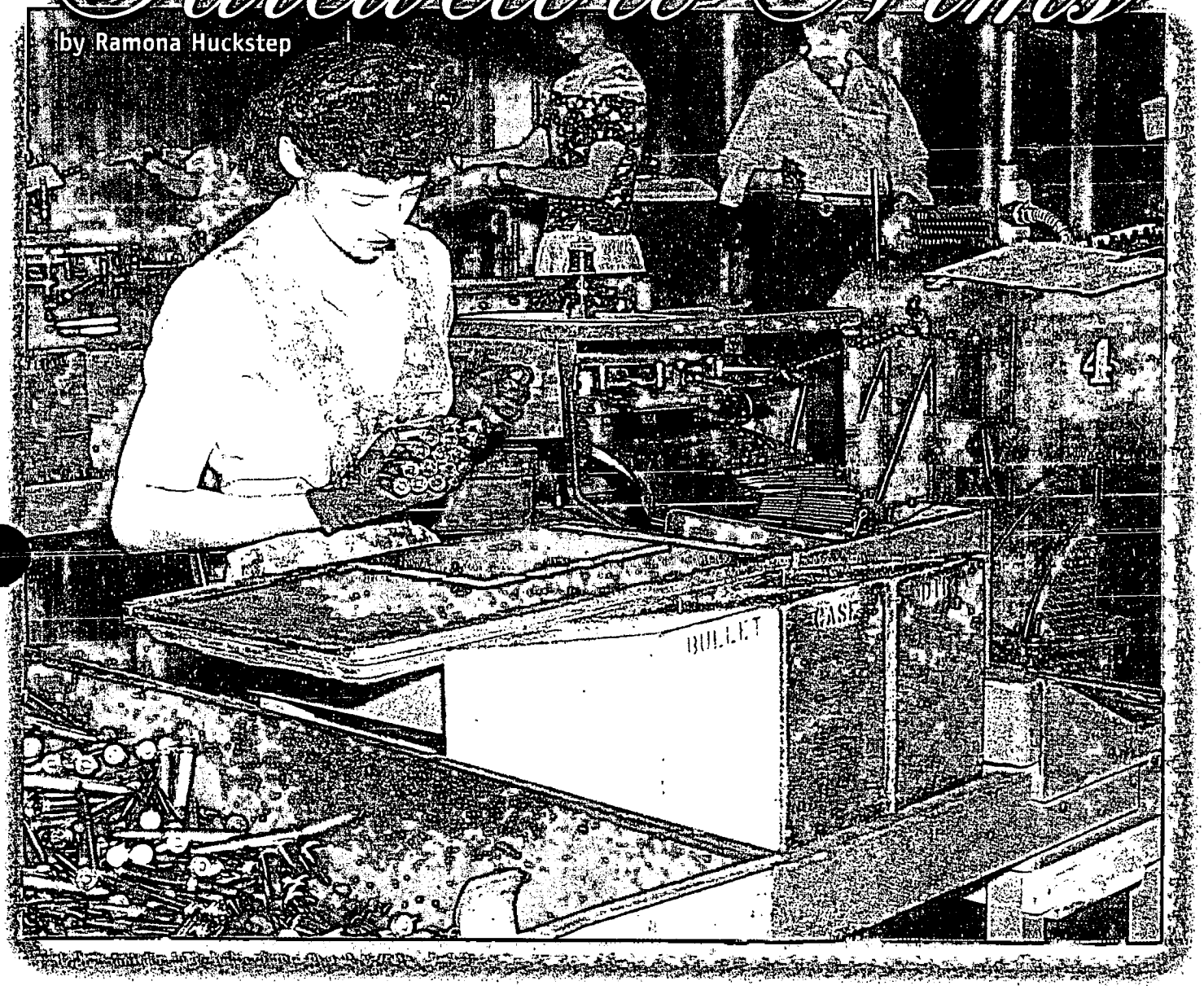
Summary

- LTS addresses residual contamination above cleanup criteria
- LTS planning is a joint effort between stakeholders
- Redundant layers of ICs are not enough – requires community commitment and compliance
- LTS ensures institutional knowledgeable
- ICs are presently envision for Inaccessible areas, only
- Plan is flexible to allow innovation
- The Plan lives as long as the hazard exists



Farewell to Arms

by Ramona Huckstep



Missouri Department of Natural Resources
Air and Land Protection Division
Hazardous Waste Program

Adapted from *Missouri Resources*, Winter 2000 - 2001

Missouri Department of Natural Resources

Information Sheet
Regulations Prohibiting the Disposal or Spread of Radiological Contamination
August 20, 2002

INTRODUCTION

One of the issues that has arisen at the Formerly Utilized Sites Remedial Action Program or FUSRAP sites is the potential dispersal of contamination during the construction of new buildings or utilities at the more than 80 Vicinity Properties. Vicinity Properties are not part of the heavily contaminated areas of FUSRAP where uranium production by-products were stored, but instead are neighboring properties suspected of contamination from airborne dust or spillage. Missouri state law and regulations prohibit this contamination from being placed within Missouri landfills.

KEY POINTS

- Missouri Solid Waste Regulations prohibit the placement of radiological waste, production by-products, or otherwise radioactively contaminated materials into Missouri landfills, except that naturally occurring radioactive materials may be accepted for disposal with prior written approval from the department.
- Use of these same materials, as "clean fill" at other Missouri properties is not specifically addressed; however this act is prohibited the same as any uncontrolled placement of a solid waste or contaminant. [Chapter 260.10 Revised Statutes of Missouri (RSMo) specifies disposal actions must be done only at state permitted disposal facilities.]
- Good records and technical services must be maintained to help landowners, utility companies, and municipalities identify contamination left after remedial actions by the USACoE, and to prevent its spread to other Missouri properties.

HISTORY

The Department of Natural Resources' rule pertaining to the Design and Operation of Sanitary Landfills within the state of Missouri was updated as of July 30, 1999. The rule, 10 Code of State Regulations (CSR) 80-3.010, as a whole, sets forth requirements to ensure that the design, construction and operation of sanitary landfills will protect public health, prevent nuisances and meet applicable environmental standards. The specific rule, 10 CSR 80-3.010 (3) (A) 2., was intended to prevent Missouri sanitary landfills from becoming the nation's radiological waste dumping grounds.

MISSOURI REGULATIONS

Radioactively-contaminated materials, as defined under 10 CSR 80-3.010 (3) (A) 2, are restricted from disposal of in Missouri. The regulation reads as follows:

(3) Solid Waste Excluded.

(A) Requirement. The following are excluded from disposal:

1. Regulated quantities of hazardous waste;

2. Radioactive materials as follows:

A. The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content as defined in the Atomic Energy Act of 1954, 42 U.S.C. section 2014(e)(2)(1996);

B. Any radioactively-contaminated material used in or resulting from the cleanup of radioactively-contaminated sites;

C. Any byproduct, source or special nuclear material regulated by the Atomic Energy Act of 1954;

FREQUENTLY ASKED QUESTIONS

Can I construct buildings or otherwise improve the FUSRAP vicinity property in my possession?

Yes!! Grading plans in many cases can be designed to allow development to continue while keeping all soils on-site or soils that are not contaminated can **be transported elsewhere within the state with no more restrictions than any other soils or debris.** The majority of soils within the FUSRAP properties will likely fall into this category.

Does FUSRAP radiological contamination include elements found naturally within soils? If so, how will the decision be made that my property has been contaminated?

Yes. The same radiological elements in FUSRAP contamination can be found in all North St. Louis County soils in trace amounts. Any soil on north St. Louis County FUSRAP properties with quantities of those elements exceeding what is expected to occur naturally will be considered contaminated by the department.

Who do I contact for help if I suspect my property is impacted by FUSRAP materials and I have questions about the applicability of Missouri Solid Waste Regulations?

Please call the Missouri Department of Natural Resources Florissant field office at (314) 877-3250. An alternative contact is available by calling the Jefferson City office at (573)751-3907.

CONTACTS

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Missouri Department of Natural Resources
Federal Facilities Section
PO Box 176
Jefferson City, MO 65102
1-800-361-4827
(573) 751-3907

Eric Gilstrap
Jo Anne Wade
Jill Groboski
Missouri Department of Natural Resources
FUSRAP Field Office
917 North Hwy. 67, Suite 104
Florissant, MO 63031
(314) 877-3250

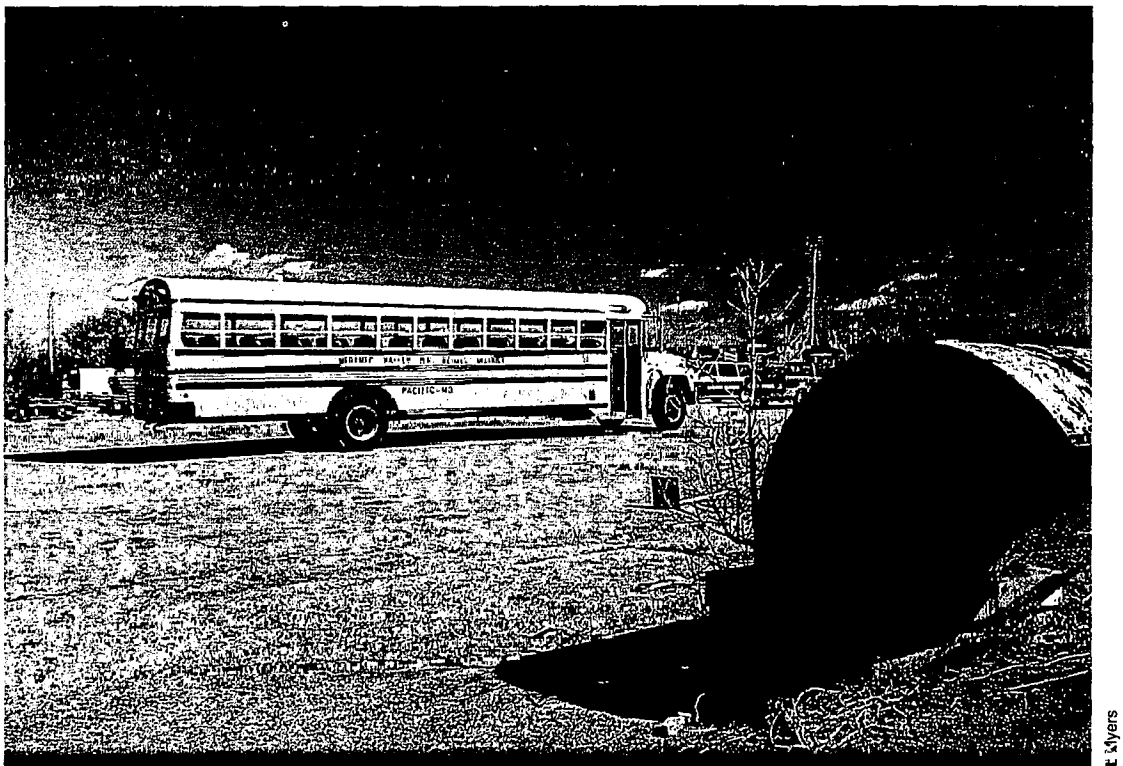
REFERENCES

Missouri Department of Natural Resources – Federal Facilities Section:
http://www.dnr.state.mo.us/alpd/hwp/ffss.htm

Missouri Department of Natural Resources – Solid Waste Management Program:
http://www.dnr.state.mo.us/alpd/swmp/homeswmp.htm

US Army Corps of Engineers – St. Louis District:
http://www.mvs.usace.army.mil/engr/fusrap/home2.htm

Missourians from St. Louis to Kansas City and Kirksville to Neosho have served the United States during times of war. Missouri has produced great military leaders like Generals John J. Pershing and Omar Bradley, and sent many everyday citizens to the trenches. Our state's contribution, however, has extended beyond those who served in uniform.



Missiles to shoot down enemy bombers once were housed at this Nike St. Louis 60 site. Although vents and elevator doors for missile launches are still present, the area is used these days to provide parking space for the Meramec Valley R-3 School District.

DNR photo by Scot Myers

Missouri has been home to numerous Air Force bases and Army and National Guard training sites. Many families from Missouri and surrounding states remember driving along Route 66, now Interstate 44, to take a soon-to-be-soldier to basic training at Fort Leonard Wood. Military personnel still receive training today at Fort Leonard Wood and other military bases including Camp Crowder, Whiteman Air Force Base and parts of Weldon Spring Ordnance Works. Through the years, Missouri also produced weapons and supplies to support the military at various sites. In some cases, the waste left behind from creating weapons, chemicals and machinery damaged the environment.

The departments of Defense and Energy realize that former and current military sites need to be cleaned up. The main issues center on what to do with contamination left behind from the production of materials used for national defense and how these federal facility sites will be used in the future. "The U.S. Department of Energy and U.S. Department of Defense recognize their role during the Cold War and acknowledge their long-term responsibility to protect our citizens from the legacy of weapons production in our state," said Missouri Department of Natural Resources Director Steve Mahfood.

The Department of Natural Resources has identified 37 former or current Department of Defense or Department of Energy sites that need to be returned to a level protective of human health and the environment. Five of these sites are on the U.S. Environmental Protection Agency's (EPA) National Priority List of Superfund sites. At the EPA's request, the Department of Natural Resources also is reviewing and investigating an additional 58 Formerly Used Defense Sites. The task at hand is cleaning up these rural and urban sites from the 1940s, '50s and '60s.

Ammunition is still produced today at the Lake City Army Ammunition Plant in Independence. Lake City is a government-owned facility established in the early 1940s to produce small-caliber ammunition. To this day, military personnel preparing for missions or training are likely to find the Lake City Army Ammunition Plant stamp on the bottom of their shell casing. It is the only small-caliber ammunition manufacturing facility within the Department of Defense. During the Vietnam War, Lake City produced more than 14 billion rounds of ammunition of various sizes.

Years of unregulated waste handling and typical disposal practices for the time at Lake City resulted in widespread environmental contamination by hazardous substances including oil, grease, solvents, explosives and metals. The Army now is using various methods to clean up the site. To reuse idle portions of the plant, Department of Defense officials are encouraging private industry to use the facilities and equipment. Sixty different companies have expressed an interest in using parts of the plant.

Aircraft engines were produced and tested at the Department of Energy's Kansas City Plant on Bannister Road before its current mission of making non-nuclear components for weapons systems. Over time, soil and groundwater at the plant became contaminated with trichloroethylene (TCE) and other solvents, metals and polychlorinated biphenyls (PCBs).

Department of Army photo-illustration

TCE was used extensively at many federal facilities and industrial sites in the 1950s and 1960s as a degreaser and belongs to a family of compounds called chlorinated solvents. Chlorinated solvents are common contaminants in soil and groundwater. Highly volatile, TCE is an effective cleaner, degreaser and dry-cleaning compound. However, TCE is toxic to humans even at relatively low concentrations and is particularly harmful when inhaled.

The Department of Energy is trying several methods to remove contamination from groundwater at the site such as a permeable reactive barrier to break down chemicals, as well as continued monitoring. The Department of Natural Resources has suggested steam injection and other technologies in this effort.

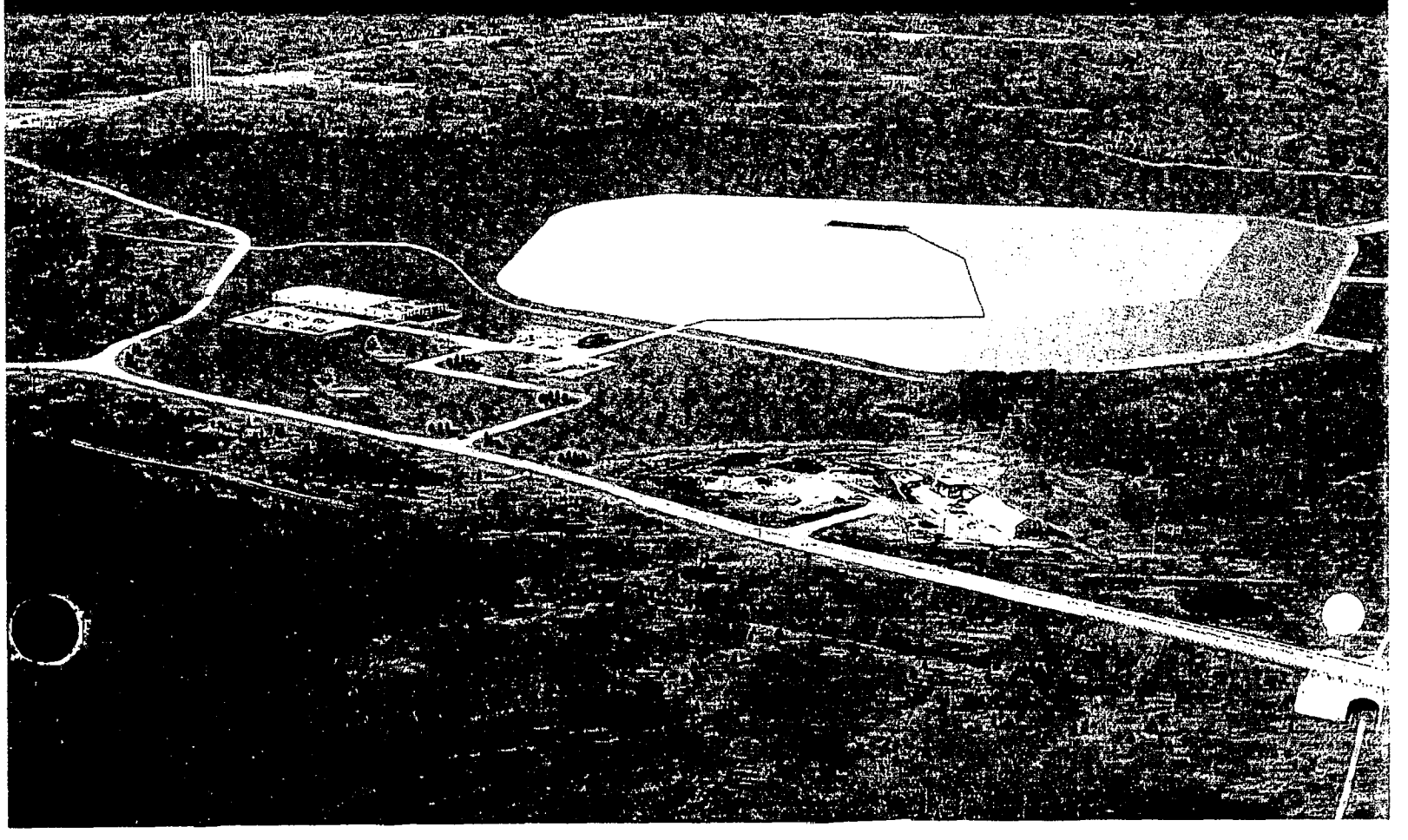
It did not have to explode, fly or even be launched to have the potential to pollute. At any given time during the Cold War, there were at least 150 Minuteman II missile sites armed and ready for deployment throughout the state. These underground silos were under the supervision of Whiteman Air Force Base in Johnson County. The missiles were decommissioned in the 1990s, but on-site petroleum tanks that heated the facilities and ran the emergency generators remain. Although the tanks were properly closed in place and the petroleum was removed, long-term groundwater monitoring is under way to detect any leakage that may have occurred during past use.

In the early 1940s, the largest producer of trinitrotoluene (TNT) in the world was the Weldon Spring Ordnance Works, 30 miles west of St. Louis. An estimated 740 million pounds of TNT and DNT (a munitions propellent) had been produced by the time the 17,000-acre Department of Defense site closed in 1945. From July 27, 1998, to March 31, 1999, an incinerator was used to destroy the TNT and DNT contamination in 71,000 tons of soil before it was returned to the excavations.

Uranium processing also took place at the Weldon Spring site in support of the Manhattan Project, which created the atomic bomb. A uranium processing plant continued to operate at the site under contract with the Mallinckrodt Chemical Works from 1957 to 1966. An average of 16,000 tons of uranium material was processed each year. This generated wastes such as uranium, nitrates and nitroaromatics.

Two major cleanups currently are being performed that relate to atomic projects: the Formerly Utilized Sites Remedial Action Program

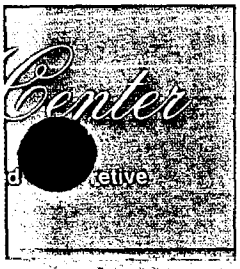
Weldon Spring Disposal Facility and Interpretive



Artist's drawing shows the 45-acre disposal cell where the contaminated buildings and equipment from Weldon Spring were entombed. The pla
center and Hamburg Extension that will link the site to Katy Trail State Park also are pictured.

(FUSRAP) and the Weldon Spring Sites Remedial Action Project (WSSRAP). FUSRAP includes many sites within the St. Louis area. The WSSRAP site contains approximately 1.48 million cubic yards of waste generated by the former ordnance- and uranium-processing plants. This waste has been placed in a specially engineered 75-foot high, 45-acre disposal cell.

Eric Gilstrap, senior project manager at the department's FUSRAP Federal Facilities Field Office in Florissant, said, "It is our job to provide oversight on the cleanup of radiological and chemical contamination generated by military activities in this area." Ben Moore, senior project manager at the department's WSSRAP Federal Facilities Field Office in St. Charles, said, "We are working with federal facilities to clean up sites now so future generations will be informed when using the land."



Cold War engine testing was not confined to jet aircraft. For 16 years, starting in 1957, rocket engines for missiles such as the Atlas, Thor and Saturn were tested at Air Force Plant 65, which is now part of Camp Crowder near Neosho. The U.S. Air Force developed the Atlas as America's first Intercontinental Ballistic Missile. Its Cold War mission was to deter nuclear attack. The Atlas was retired from military service without ever being used, but water and soil contamination caused by cleaning the rocket engines with TCE still is present.

DNR photo by Nick Decker

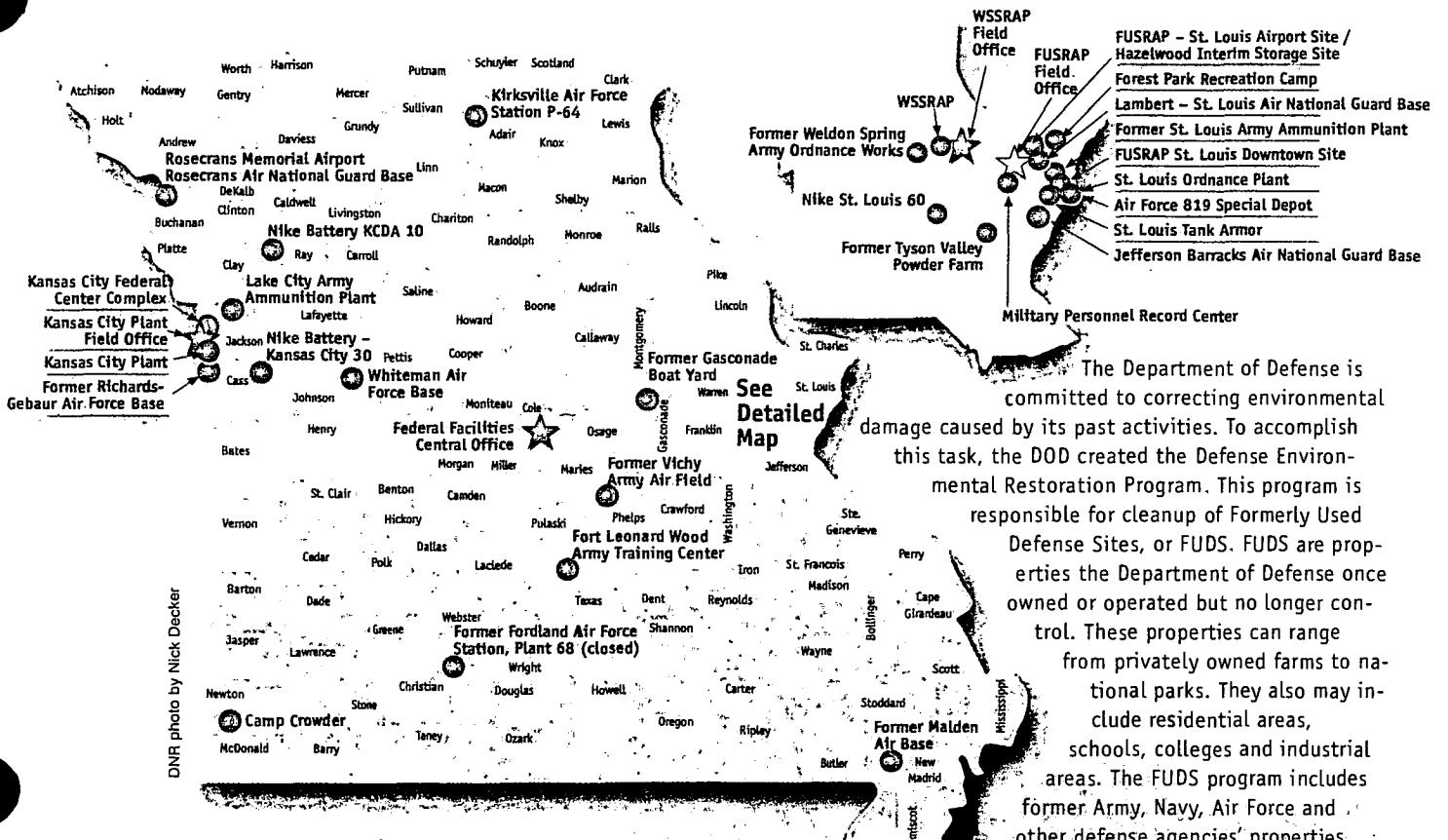
This uranium processing building at WSSRAP has been dismantled and placed in a 45-acre disposal cell.

To address the TCE contamination, sources of the contamination are being identified, soil is being removed for treatment and the groundwater is being pumped and cleaned to prevent further migration. The cleanup is being performed by the Department of Defense with oversight by the EPA and the Department of Natural Resources.

What do we do with these former federal facilities once remedies have been applied? In some instances, property has been turned over to local schools, universities and local and state governments. Francis Howell High School, in St. Charles County, is located on parcels of land that were part of the former Weldon Spring Ordnance Works. Other land has gone to conservation agencies for nature centers and wildlife areas.

To help put the land back into productive use, a trail and interpretive center recently were proposed at Weldon Spring. The trail would link the facility with Katy Trail

Federal Facility Sites in Missouri



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The Department of Defense is committed to correcting environmental damage caused by its past activities. To accomplish this task, the DOD created the Defense Environmental Restoration Program. This program is responsible for cleanup of Formerly Used Defense Sites, or FUDS. FUDS are properties the Department of Defense once owned or operated but no longer control. These properties can range from privately owned farms to national parks. They also may include residential areas, schools, colleges and industrial areas. The FUDS program includes former Army, Navy, Air Force and other defense agencies' properties. During WWII, many of these sites had purposes that included rifle ranges, storage areas, cemeteries and even Prisoner of War internment camps.

The incinerator at Weldon Spring now has been dismantled as part of the cleanup at the site.

State Park. The "Hamburg Extension," as the trail is called, is on land that was formerly occupied by the towns of Hamburg, Toonerville and Howell, which became part of the ordnance works in 1941. Former Department of Energy Secretary Bill Richardson said, "Not only will the Hamburg Trail expand public accessibility to the Weldon Spring learning center, but it will be a symbol of our efforts to serve as environmental stewards and protect land for the benefit of future generations."

Other former defense sites being used for new purposes include Vichy Army Air Field, now called the Rolla Airport, and the Malden Air Field, which currently are municipal airports. Richards-Gebaur Air Force Base is now part of an intermodal rail system, under the direction of the city of Kansas City, installed to transport new automobiles through the United States. The base also houses Marine Corps regiments with classrooms and living quarters for military and civilian personnel.

A site once known as Tyson Valley Powder Farm tested and stored ammunition in Eureka. St. Louis County and Washington University now operate parts of Tyson for such diverse activities as recreation and ecological and educational studies.

The war has been fought, but the battle to clean up these sites remains. Cleaning up federal facilities and identifying future restoration and containment is an ongoing effort. By doing our part now, the spoils of war will no longer spoil the environment.

Ramona Huckstep is community relations coordinator for the Hazardous Waste Program, Federal Facilities Section within the department's Air and Land Protection Division.

Front Cover: On the production line at Lake City Ordnance Plant in 1943, a worker inspects .50-caliber cartridges. Weapons manufacturing continued through several wars leaving widespread contamination.

Department of Army photo

DNR photo by Scot Myers

Stewardship

The Cold, Hard Facts

Environmental stewardship as defined in a 1998 U.S. Department of Energy stakeholder report is "acceptance of the responsibility and the implementation of activities necessary to maintain long-term protection of human health and of the environment from hazards posed by residual radioactive and chemically hazardous materials." Stewardship from this perspective refers directly to the continued care and monitoring of contaminated areas by the federal government that will be necessary to address contamination that is not cleaned up.

Based on current technology there are limits to how much contamination can be cleaned up. Realistically, all contaminated sites cannot be returned to a pristine condition. So the object of stewardship planning is to ensure responsible long-term management of areas that cannot be completely cleaned up.

Some components of stewardship plans are to preserve information on the location and longevity of residual contamination, as well as to develop the means to monitor and restrict access and use of these sites to ensure that future generations do not inadvertently disturb contaminated areas. The Missouri Department of Natural Resources and the federal government are working together to include stewardship planning in their cleanup activities and are hopeful that communities will provide input and support to ensure that these issues continue to be addressed for future generations.

Although the future use of many of these sites may change, by developing appropriate long-term plans, many of the potential concerns and some of the uncertainty can be addressed or removed.

Moss grows inside the abandoned Weldon Spring Ordnance Works powerhouse.

FUSRAP Document Management System

Year: 00
ID: 3343
Further Info? ☐

Operating Unit: North County
Site:
Area:
MARKS Number: FN:1110-1-8100g

Primary Document Type: Public Affairs/Community Relation
Secondary Document Type: Fact Sheets/Newsletters

Subject or Title: Public Training Session Materials handed out at 8/13/02 and 8/20/02 sessions

Author/Originator:
Company: CEMVS
Date: 8/20/2002

Recipient (s): Distribution
Company (-ies):
Version: Final

Original's Location: Central Files
Document Format: Paper
Confidential File? ☐

Include in which AR(s)?

- ☑ North County
- ☐ Madison
- ☐ Downtown
- ☐ Iowa

Comments:
ETL: 8.11

SAIC number:
Filed in Volume: 8

Bechtel ID: