DECISION SUMMARY - METALS AREAS
CRAB ORCHARD NATIONAL WILDLIFE REFUGE
MARION, ILLINOIS

I. SITE NAME, LOCATION AND DESCRIPTION

Sangamo/Crab Orchard National Wildlife Refuge
Carterville, Illinois

The Crab Orchard National Wildlife Refuge (the Refuge) site lies near Marion, Carterville and Carbondale, Illinois, primarily within Williamson County, extending into Jackson, Union and Johnson Counties in southern Illinois (See Figure 1 in Appendix A). The Refuge consists of approximately 43,000 acres of multiple-use land. The land is used as a wildlife refuge, and also for recreational, agricultural and industrial purposes.

The western end of the Refuge around Crab Orchard Lake is used for recreational purposes while the eastern end is used for manufacturing facilities. Access to the eastern portion is closed to the public, except for limited access to workers at the industrial sites and restricted access to hunters. The study sites which were the focus of the Remedial Investigation (RI) and Feasibility Study (FS) are located in the eastern, closed portion of the Refuge (See Figure 2 in Appendix A).

There are twelve lakes, including Crab Orchard Lake located within the Refuge. Crab Orchard Lake supports a large population of sports fish and is used as a drinking water source for the Refuge and nearby Marion Federal Penitentiary. Wetlands are found in some areas adjacent to the lakes. Wildlife on the Refuge include many game and non-game species. The Refuge has habitat suitable for one endangered species, the Indiana bat, and definitely houses another, with two active bald eagle nests.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Crab Orchard National Wildlife Refuge is owned by the U.S. government and is currently administered by the U.S. Fish and Wildlife Service (FWS) a bureau of the Department of the Interior (DOI). The Refuge was previously administered by the Department of Defense (DOD). During the DOD administration portions of the Refuge were leased to industrial tenants, primarily for the purpose of munitions and explosives manufacturing. At the end of World War II the DOD transferred the Refuge to the DOI. Several other industries moved onto the site to occupy buildings formerly used by the wartime industries. The production of explosives continued to be the principle industry on the Refuge. Other industry included the manufacturing of PCB transformers and capacitors, automobile parts, fiberglass boats, corrugated boxes, plated metal parts, tape, flares and jet engine starters.

Congress, in passing the law that created the Crab Orchard National Wildlife Refuge, mandated a continuing industrial presence on Refuge property. Congress required that the lands must be used in a manner consistent with the needs of industry, as well as those of agriculture,

recreation, and wildlife conservation. The accompanying legislative history indicates the industrial development of Crab Orchard National Wildlife Refuge as central to the viability of the Refuge.

The Crab Orchard enabling legislation (16 U.S.C. 666g) further provides that no jurisdiction shall be exercised by the Secretary of Interior over that portion of such lands and the improvements thereon utilized by the Department of Army directly or indirectly, until determined by the Secretary of the Army, that utilization is no longer required. The DOD is responsible for the cleanup and environmental restoration of those lands which have been under its jurisdiction in accordance with the law.

Disposal activities at the site apparently included dumping of waste material in unused areas of the site, and landfilling of waste materials in unlined landfills which were covered with earth. Other disposal might have included discharge of liquid material to surface water bodies and impoundments. The types of materials disposed of at the Refuge reflect the broad range of substances used in the various industrial and Refuge activities. There are no good estimates of the total volume of disposed material.

The site was proposed for the National Priorities List (NPL) in 1984 and finalized on the NPL in July 1987. The relative roles and responsibilities of other Federal Agencies and the United States Environmental Protection Agency (U.S. EPA) at Federal Facilities like Crab Orchard National Wildlife Refuge are prescribed in Section 120 of CERCLA and Executive Order Number 12580. DOI is responsible for remedial action and compliance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended. The U.S. EPA is responsible for providing assistance and oversight to DOI for actions at the site taken to comply with CERCLA. In addition, U.S. EPA is responsible for final remedy selection at the site.

In addition to the roles and responsibilities of the DOI and U.S. EPA at the Refuge discussed above, DOD may have responsibility for the hazardous substances at the Site, in accordance with Section 107 of CERCLA and under the Defense Environmental Restoration Program. Various other private parties may have responsibility for the hazardous substances at the Refuge in accordance with Section 107 of CERCLA.

In February 1986, the U.S. EPA and FWS entered into a Federal Facility Initial Compliance Agreement, which required the performance of a Remedial Investigation and Feasibility Study (RI/FS). The FWS, in conjunction with Sangamo Weston, Inc., a potentially responsible party (PRP) at the site, began a RI/FS at the Refuge in May 1986. In August 1988, an RI Report was finalized and made available to the public. In August 1989 the FS Report and proposed plans for the first two operable units at the site were made available to the public. The U.S. EPA served as the supporting agency during the RI/FS, and was lead Agency for the development of the proposed plans and this Record Of Decision (ROD). The Illinois Environmental Protection Agency (IEPA) served as a supporting agency for the FS, proposed plans and ROD.

A draft Interagency Agreement (IAG), pursuant to CERCLA Section 120(e)(2) is currently being developed between U.S. EPA, DOI, and IEPA. DOD is also potentially a party to the IAG and is involved in the negotiations. Negotiations on this IAG were started in August 1989, and are expected to be completed in June 1990. The IAG, when finalized, will delineate Agency roles and responsibilities and will stipulate schedules for completion of the remedial action specified in this ROD and remedial action for other operable units.

In July 1989, DOI issued letters pursuant to CERCLA Section 104(e), to request information relating to the identification, nature and quantity of materials treated, stored or disposed at the Refuge, or transported to the Refuge; the nature or extent of any releases or threatened releases of a hazardous substance at the Refuge; and information relating to the recipient's ability to pay for a cleanup. DOI and U.S. EPA are jointly reviewing the responses to these letters to determine whether any of the respondents would be considered PRPs at the site. Special notice letters have not been issued to any PRPs at the site to date.

III. COMMUNITY RELATIONS HISTORY

Public participation requirements under CERCLA Sections 113(k)(2)(B) and 117 were satisfied during the remedial process. U.S. EPA has been primarily responsible for conducting the community relations program for this site, with the assistance of FWS. The following milestone activities were conducted during the RI/FS:

- Establishment of an Administrative Record at the Southern Illinois University's Morris Library in Carbondale, Illinois and at U.S. EPA, Region V Office in Chicago, Illinois.

- Establishment of additional information repositories at Marion Carnegie Public Library in Marion, Illinois; Crab Orchard National Wildlife Refuge Headquarters in Carterville, Illinois; and Marion Federal Penitentiary in Marion, Illinois.

- Development of a mailing list of interested citizens, organizations, news media, and elected officials in local, county, state and federal government. Periodic mailings of Fact Sheets and other information.

- Periodic news releases announcing various on-site activities and results of investigations.

- A Fact Sheet in August 1988, explaining the results of the remedial investigation. The Remedial Investigation Report was also released at this time.

- Paid newspaper advertisements in announcing the RI public meeting and the FS and proposed plan availability session and public hearing.

- A public meeting in August 1988, to meet concerned citizens and discuss the results of the remedial investigation. Approximately 100 people attended the meeting.

- A Fact Sheet in January 1989, explaining the Feasibility Study and proposed plan process, discussing remedial technologies under consideration, and announcing a tentative schedule.

- A Fact Sheet in August 1989, explaining U.S. EPA's preferred alternatives for two operable units at the site, and discussing the availability of the FS and proposed plans for those operable units. This Fact Sheet also outlined the other remedial alternatives, announced the public comment period and solicited comment on the alternatives.

- An availability session in August 1989, to informally answer citizens' questions about the FS and proposed plans. Questions were answered by representatives of U.S. EPA, FWS and IEPA.

- A public hearing on August 30, 1989, on the proposed plans and the FS. Comments were taken on the record. Approximately 140 people attended. Presentations were made, and questions were answered by representatives of U.S. EPA, FWS and IEPA.

- A public comment period of thirty days was originally planned, running from August 18, 1989, to September 16, 1989. The public comment period was announced in the proposed plan for the operable unit, in the Fact Sheet of August 1989, and through paid newspaper advertisements in the Southern Illinoisian and the Marion Daily Republic. Based on comment taken at the public hearing on August 30, 1989, the comment period for this operable unit was extended for an additional week, until September 23, 1989. The extension was announced by letters to the individuals and groups on the mailing list, and by a press release.

- An availability session in September 1989, to specifically discuss the Metals Areas operable unit, and to answer questions about this unit. Questions were answered by representatives of U.S. EPA, FWS and IEPA.

A Responsiveness Summary addressing comments and questions received during the public comment period on the RI/FS and proposed plan is included with this Record of Decision as the third section.

This decision document presents the selected remedial action for the Metals Areas operable unit at the Crab Orchard National Wildlife Refuge Superfund site, in Carterville, Illinois, chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the National Contingency Plan. The decision for this operable unit at the site is based on the Administrative Record.

IV. SCOPE AND ROLE OF OPERABLE UNIT

The first step in the RI process was a review of available Refuge files and old analytical results to target "study sites" to be investigated in depth. Thirty-three study sites were investigated during the RI, with seven of these carried into the FS for evaluation of remedial alternatives.

As with many Superfund Sites, the problems at the Refuge are complex. The results of the investigations of the study sites indicated that the Refuge consists of several geographically distinct areas with markedly different characteristics. These include differences in the contaminants, in the parties responsible for the contamination, and in the remedial actions and schedules that would be appropriate. Consequently, the Agency decided to address these areas individually as "operable units" of an overall site remedy. The following four operable units have been created:

> PCB Areas - those areas contaminated with PCBs, which may also be contaminated with other materials, such as lead and cadmium, including study sites 17, 28, 32 and 33.
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> Metal Areas - those areas primarily contaminated with heavy metals, including study sites 15, 22 and 29;
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> Explosive/ Munitions Areas (formerly designated as "DOD Areas") - those areas contaminated with chemicals from explosive or munitions manufacturing, including study sites 3, 4, 5 and 19; and
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> Miscellaneous Areas - those areas that are thought to require no further work or that will need further investigation, monitoring or maintenance, including sites 7, 7A, 8, 9, 10, 11, 11A, 12, 13, 14, 16, 18, 20, 21, 24, 25, 26, 27, 30, 31, 34, and 35.

Under the National Contingency Plan, response actions may be conducted in operable units, provided such units are consistent with achieving a permanent remedy (40 CFR 300.68(c)(1)). Further, implementation of operable units may begin before selection of a final remedial action if such measures are cost-effective (40 CFR 300.68(c)(3)). These conditions are satisfied in this case. First, the proposed operable units are consistent with achieving a permanent remedy at the Site since they will, in fact, provide permanent remedies for the designated areas. Second, proceeding by operable units is cost-effective in this case because the nature of the problems in the different areas require separate remedies. There cannot be one overall solution to the Site's problems. It is therefore appropriate to consider cost-effectiveness on an operable unit by unit basis, rather than for the Site as a whole.

This Record of Decision addresses the Metals Areas operable unit. The three study sites comprising this operable unit are: the Area 7 Plating

Pond (site 15); the Old Refuge Shop Drainage Pool and Creek (site 22); and the Fire Station Landfill (site 29) (See Figure 2 in Appendix A). The remedy selected will address the principle threats of soil and sediment contamination at all three sites comprising the operable unit and will mitigate against future surface water or groundwater contamination.

The remedy for the Metals Areas operable unit is the first of at least four operable units at the Site. The Metals Area operable unit fits into the overall Site strategy by addressing the principle threats from the three sites contaminated with heavy metals. The Agencies propose to remove and treat the contaminated material and dispose the residue in an on-site landfill. Since the Metals Areas pose some of the greatest threats currently identified at the Refuge, the Agencies want to initiate remedial action for those areas as quickly as possible.

Each of the other operable units is on a separate schedule. The schedule for each operable unit will be established in an upcoming revised Interagency Agreement between U.S. EPA, DOI and IEPA (and potentially DOD), which is expected to be completed in June 1990. Depending on additional information, other operable units may be created or combined, as appropriate.

A Proposed Plan for the PCB Areas operable unit was made available at the same time as the Proposed Plan for the Metals Areas. The Proposed Plan and required publication of notice occurred concurrently for the PCB Areas and Metals Areas operable units. Because of public concern about the incineration component of the preferred alternative, the public comment period for the PCB Areas was extended three times for a total of one hundred and five (105) days of public comment. A final remedy selection for the PCB Areas operable unit is expected by June 1990.

V. SITE CHARACTERISTICS

The RI/FS was conducted to identify the types, quantities and locations of contaminants at the Site and to develop ways of solving the problems they present. Because of the size of the Site, the first step in the RI process was a review of available Refuge files and old analytical results to target "study sites" to be investigated in depth. The nature and extent of actual or potential contamination related to the study sites was determined by a series of field investigations, including:

- geophysical surveys;
- surface soil sampling;
- exploratory test pit installation and sampling;
- installation and sampling of groundwater monitoring wells;
- surface water sampling; and
- sediment sampling.

Soil and sediment sampling in the three areas comprising the Metals Areas operable unit indicate the non-uniform presence of chromium, cadmium, cyanide and/or lead, and the less consistent presence of other organic

and inorganic contaminants. The three areas are all located in the portion of the Refuge where access is restricted, so human exposure to the contaminants would be sporadic and occasional. However, the areas are wooded and it is likely that wildlife are currently exposed to the contaminants.

The Area 7 Plating Pond (study site 15) is approximately 50 feet long and 30 feet wide (See Figures 3 and 4 in Appendix A). Water depth is estimated to be four feet, resulting in approximately 45,000 gallons of water in the pond. Sediment samples from the Area 7 Plating Pond indicate the presence of chromium, with other organic and inorganic contaminants of less concern found in the sediments, pond water and groundwater. There is an estimated 280 cubic yards of contaminated pond sediment and underlying soil.

The Old Refuge Shop Drainage Pool (study site 22) apparently collects run-off from an industrial area. The water initially drains into a small drainage pool and then flows in an intermittent stream towards Crab Orchard Lake (See Figures 5 and 6 in Appendix A). Sediments in the drainage stream from the Old Refuge Shop are contaminated with cadmium, chromium, cyanide and lead, with some sediments which are hazardous because of their characteristic to leach cadmium and/or chromium (Resource Conservation and Recovery Act (RCRA) characteristic of EP Toxicity); and groundwater in this area is contaminated primarily with cadmium. Studies indicate that contaminants can be found almost the entire downstream distance of about 4450 feet, with an estimated 5,200 cubic yards of contaminated sediment and soil.

The Fire Station Landfill (study site 29) consists of a large open field approximately 350 feet by 300 feet, located east of the Refuge Fire Station (See Figure 7 in Appendix A). Down-slope drainage areas were also investigated. Soil sampling at the Fire Station Landfill showed some localized spots with lead contamination. An estimated 14,600 cubic yards of soil are contaminated with lead, zinc, magnesium and mercury. In addition, soil and groundwater at this study site showed some other inorganic and organic contamination of less concern. These contaminants will be addressed during confirmation sampling, or as part of remedial activities.

VI. SUMMARY OF SITE RISKS

The RI Report included a risk assessment to define the actual or potential threat that the Site-related contaminants pose to human health and/or the environment. Since the Site is a National Wildlife Refuge, particular attention was paid to the potential impact on wildlife.

The DOI, as trustee for Refuge lands and for fish and wildlife on those lands, must ensure that remedies adequately protect and restore those trustee resources. Doing so, in many cases, requires standards more stringent than or different from those that may apply primarily for human health reasons for some contaminants. The trustee can only agree to a covenant not to sue under Section 122(j) of CERCLA if a PRP agrees to

undertake appropriate actions necessary to protect and restore natural resources damaged by actual or threatened releases of hazardous substances.

The choice of animal species for a risk assessment is dependent upon the availability of information on toxicity, life history, exposure and physiology. Sufficient information is not always available for species that are conspicuous Departmental trust resources. Small mammals are often used in assessments for small contaminated areas because these mammals are frequently at greatest risk. Their limited home range and available toxicity information reduce uncertainties in the resultant assessment. There are no standards for wildlife exposure and wildlife contaminant residues, so risk assessments must be used and exposures must often be compared to toxicity information on other species.

The results of the risk assessment conducted as part of the RI indicate that the following problems present the greatest threat to human health and/or the environment from the three study sites that comprise the Metals Areas operable unit:

- Surface soils and sediments at the Old Refuge Shop could pose a risk to both humans and wildlife by direct contact which results in exposures by ingestion and inhalation;

- Subsurface soils at the Fire Station Landfill threaten burrowing wildlife, especially via inhalation and ingestion exposures; and

- Surface water which may be contaminated by run-off or sediments at the Old Refuge Shop and the Fire Station Landfill threatens wildlife through the ingestion of water or aquatic organisms and threatens humans indirectly through food chain accumulation.

Although contaminants were found in other media (groundwater, sediments at the Area 7 Plating Pond) at the study sites comprising this operable unit, the risk assessment does not indicate that these contaminants currently pose a threat to human health and/or the environment. However, actual or potential future groundwater contamination is of great concern because the aquifer is potentially usable and may discharge to a sensitive ecosystem. The areas comprising the Metals Areas operable unit are within the portion of the Refuge where human access is currently restricted. However, if the restriction is relaxed in the future, the risks to humans could be higher unless remedial action has been taken. Access to wildlife is not restricted.

A summary of the risk assessment from the RI Report for each of the sites comprising the Metals Areas operable unit follows:

A. SITE 15: AREA 7 PLATING POND

1. Contaminant Identification

Limited sampling was done on the sediment, pond water and ground water. Results indicated that the sediment contained chromium at around 500 milligrams per kilogram (mg/kg). The sample was not hazardous by the RCRA characteristic test for leachable metals (EP Toxicity). The pond water contained iron at 1000 micrograms per liter (ug/L), which is above the secondary Maximum Contaminant Level (MCL). The ground water contained chromium and a trace of PCBs.

2. Exposure Assessment

The exposure assessment portion of the RI Report concluded that there is currently no complete route of exposure to the contaminants found at this site.

3. Toxicity Assessment

Chromium exists in two principle states, trivalent (+3) and hexavalent (+6). Trivalent chromium is an essential nutrient required at trace levels for proper glucose metabolism. Chromium's toxicity is principally attributed to the hexavalent state, with potential damage to the liver, kidneys, skin and lungs. Chromium is known to be a human carcinogen by the inhalation route of exposure, but it is not classified by the ingestion route.

4. Risk Characterization

The RI Report found no complete pathway of exposure to humans from contaminants; therefore, a risk characterization could not be completed. Without such exposure there is no risk to man from this site under existing conditions. Although contaminants were found in some media (groundwater, sediments), the risk assessment indicates that these contaminants do not currently pose a threat to human health and/or the environment. The iron found in the pond water was not deemed to be a threat because secondary MCLs are established based on aesthetic (taste and smell) rather than health reasons. There is concern that this Pond, unless it is closed, may contribute in the future to environmental problems such as groundwater contamination. Groundwater, as a resource to be protected both because of the potential for future use and because of the likelihood of discharge to a sensitive ecosystem, is of great concern. Access to the Area 7 Plating Pond is currently restricted. However, if access restriction is relaxed in the future, the risks to humans could be higher unless remedial action has been taken.

The sediment analysis completed for the RI was not comprehensive. The RI states that frogs were present on the

site, but does not give an exposure assessment for frogs. Frogs overwinter in sediment and have more permeable skin than most vertebrates. Depending on the conditions of exposure, an assessment for frogs overwintering in the pond could show that they are exposed to toxic concentrations.

Although the pond represents little risk to humans or the environment under current conditions, it is no longer active, and remedial measures for closure were evaluated as part of the FS in order to mitigate future concerns. Future concerns include the potential of groundwater contamination resulting from contaminants in the Pond leaching to the aquifer. Closure of the Pond will prevent any potential future problems.

B. SITE 22: OLD REFUGE SHOP DRAINAGE POOL

1. Contaminant Identification

Sediments in the drainage channel flowing towards Crab Orchard Lake are contaminated with cadmium (range: less than 0.68 mg/kg to 780 mg/kg), chromium (10 to 889 mg/kg), cyanide (130 to 392 mg/kg), and lead (93 to 166 mg/kg). In general, the levels of contaminants are highest near the drainage sump and decrease downstream nearer to Crab Orchard Lake. The cadmium and chromium levels are high enough that the sediment would be considered RCRA hazardous waste for the characteristic of EP Toxicity. Also, ground water in one well showed elevated levels of cadmium above the MCL (25 ug/L) and cyanide above the Illinois General Use Water Standards (70 ug/L).

2. Exposure Assessment

The exposure assessment conducted as part of the RI concluded that several media could be impacted by the contaminants at this site, and that there were several potential transport routes. Mean soil and sediment values for cadmium and cyanide were used to conduct the risk assessment.

The presence of contaminants in surface soils and sediments indicates that direct contact by wildlife could result in exposure through ingestion of the soil, sediment or water, and through potential consumption of contaminated vegetation and prey because potential food chain exposure is particularly likely with cadmium; through inhalation, especially by burrowing animals; and through ingestion of sediments and organisms associated with surface water as the contaminants continue to migrate towards Crab Orchard Lake. To assess potential wildlife exposure, an assumption of one hour of active burrowing per day was weighted with a resting exposure estimate including breathing, feeding and grooming activities.

Although access to humans is restricted, the exposure

assessment indicates that there is the potential for occasional recreational users to be exposed via inhalation or ingestion of the contaminants, and through potential food chain accumulation. The exposure assessment assumed limited human access of three visits per year for four hours per visit. It was also assumed that a human might inadvertently consume 100 mg of contaminated soil or sediment per visit by ingestion. (Ingestion of soil is a standard pathway for exposure in humans and wildlife risk assessments.) Inhalation exposure would be commonly assumed for FWS personnel on worksites or for incidental visitors to the contaminated sites.

3. Toxicity Assessment

Cadmium is highly toxic with a broad range of systemic effects, particularly to the respiratory, renal and reproductive systems. It is considered a probable human carcinogen by the inhalation route of exposure. Cadmium can bioaccumulate extensively in exposed individuals. Cadmium is particularly toxic to fish, even at low concentrations. It has also been demonstrated to cause birth defects in animals.

The major concern from cyanide exposure is the acute toxicity of hydrocyanic gas (HCN) and simple salts such as sodium cyanide. Cyanide does not bioaccumulate. High levels of cyanide exposure will result in death by cytotoxic anoxia (oxygen will not reach the cells). Also, cyanide can have adverse impacts on the cardiovascular system, the liver, kidneys and the central nervous system.

4. Risk Characterization

Using a unit risk factor of 7.8 $(mg/kg/day)^{-1}$ for human exposure to inhaled cadmium, the unremediated site shows a potential increased cancer risk of 2.3×10^{-5}. This is based on very limited human exposure, as discussed above. However, the risk characterization indicates that no chronic or acute systemic health effects to humans would result from exposure to the contaminants at the site.

Since the Refuge was established to protect wildlife, the risk assessment also considered risk to wildlife, a primary factor in the selection of the remedy. Small mammals are used in assessments for small contaminated areas because these mammals are frequently at greatest risk, and their small home range and available toxicity information reduces uncertainties in the resultant assessment.

The risk characterization for wildlife compared estimated exposures to cadmium and cyanide for deer, rabbits and mice to data from laboratory tests. The conclusion is that the unremediated site may present concerns for reproductive effects

and other systemic toxicity in vertebrate species. A small animal, such as a mouse, will consume a proportionally very high level of cadmium which could have adverse effects on the individual. Although the RI does not address predators or omnivores, it is reasonable to assume that they could be at greater risk, through consumption of organisms with bioaccumulated levels.

C. SITE 29: FIRE STATION LANDFILL

1. Contaminant Identification

Analysis of soil on the surface and in test pits in this landfill and in the down-slope drainage areas indicate that lead (60 to 2,355 mg/kg), magnesium (1,472 to 40,268 mg/kg), mercury (23 to 290 ug/kg) and zinc (23 to 929 mg/kg) were elevated above background levels. The groundwater contained iron (388 to 4,000 ug/L total, less than 25 ug/L dissolved), manganese (43 to 1,790 ug/L total, 24 to 1,770 ug/L dissolved) and selenium (none detected to 41 ug/L total) above the respective MCLs in some of the samples. However, the MCLs for iron and manganese are secondary, based on odor or taste, and the dissolved levels of selenium are below the MCL (dissolved levels may be more representative of contaminant movement than total levels). The groundwater contained acetone (23-11,500 ug/L) which was believed to be a result of laboratory contamination, and benzene (4 ug/L) in one sample only, below the analytical detection level.

2. Exposure Assessment

The exposure assessment conducted as part of the RI concluded that for the contaminants in the landfill the major exposure routes were inhalation and ingestion of soil, sediment or water by wildlife. The calculations indicated that rabbits had the highest levels of exposure, but intake rates for all other wildlife species for which exposure was calculated (mallards, deer and mice) also exceeded chronic no-effect levels for lead.

The presence of contaminants in sediments resulting from erosion from the landfill indicates that direct contact by wildlife could result in exposure to lead through ingestion of the soil, sediment and water; and through inhalation, especially by burrowing animals. To assess potential wildlife exposure, an assumption of one hour of active burrowing per day was weighted with a resting exposure estimate including breathing, feeding and grooming activities. A level of one half of the highest detected lead level was used to estimate wildlife exposure.

Although access to humans is restricted, the exposure assessment indicates that there is the potential for occasional

recreational users to be exposed via inhalation or ingestion of the contaminants which could be eroded from the landfill. Vegetated areas are unlikely to cause significant exposure to humans, but contaminated soils will be exposed by erosion of ditches and areas with a steep grade. The exposure for humans concluded that the greatest potential exposure was associated with the ingestion and inhalation of eroded soils from these areas. The exposure assessment assumed limited human access of three visits per year for four hours per visit. It was also assumed that a human might inadvertently consume 100 mg of contaminated soil or sediment per visit. (Ingestion of soil is a standard pathway for exposure in humans and wildlife risk assessments.) Inhalation exposure would be commonly assumed for FWS personnel on worksites or for incidental visitors to the contaminated sites. The highest level of lead detected at the site was used to calculate human exposure values.

3. Toxicity Assessment

Lead has been shown to distribute in the blood of humans, and can adversely effect the central nervous system, the gastrointestinal tract, the kidneys and blood forming systems. Growing children are particularly sensitive to its impact upon the central nervous system. U.S. EPA has not assessed the carcinogenicity of lead, however there are positive carcinogenicity studies.

4. Risk Characterization

Using a chronic, no-effect level of 0.32 mg/kg/day for human exposure to ingested lead, the unremediated site would not result in an exposure that would result in toxic effects. The risk characterization indicated that no chronic or acute systemic health effects to humans would result from exposure to the contaminants at this site.

Significant wildlife exposure is likely. Since the Refuge was established to protect wildlife, the risk assessment also considered risk to wildlife, a primary factor in the selection of the remedy. The risk characterization for wildlife compared estimated chronic lead exposures for deer, mallard ducks, rabbits and mice to U.S. EPA chronic no-effect levels based on rat studies. The conclusion is that the unremediated site would pose a risk for chronic, toxic effects of lead to wildlife.

While potential adverse impacts were identified, the RI did not measure any actual, current impacts on wildlife. Research done by the FWS have indicated the potential for adverse impacts on wildlife above the Site-specific cleanup criteria established by the FWS. There is on-going research by the FWS, Southern Illinois University and others to continue to assess the impacts of contaminants at the Refuge to wildlife. The

Refuge provides suitable habitat for an endangered species, the Indiana bat. Also, the Refuge definitely houses another endangered species, the bald eagle.

Actual or threatened releases of hazardous substances from the sites comprising this operable unit, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, wildlife, or the environment.

VII. DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for this operable unit explicitly discussed nine alternatives and referenced twenty-two site-specific alternatives that had been developed in the FS. The preferred alternative identified in the Proposed Plan was Alternative 2, which included the following components:

Excavation of Soil and Sediment - Contaminated soil and sediment would be excavated using conventional equipment. The excavated material would be moved to a storage area on-site, where it would be stored until it was treated or disposed.

Stabilization/ Fixation - Soils and sediments which are considered RCRA hazardous because of EP Toxicity (the characteristic to leach metals) would be treated by stabilization/ fixation until they no longer exhibit the characteristic of EP Toxicity and are rendered non-hazardous.

Industrial Landfill - Excavated non-hazardous materials which are untreated or treated by stabilization/ fixation would be placed in an on-site landfill, meeting at a minimum, the applicable or relevant and appropriate requirements of Subtitle D of RCRA and 35 IAC Part 807.

Backfill Excavation - Clean soil would be placed in the areas where contaminated material had been removed.

Monitoring and Maintenance - Groundwater and surface water monitoring would be conducted around the on-site landfill and excavated areas. Inspection and maintenance of the landfill would also be required.

No significant changes have been made to the selected alternative from that discussed in the Proposed Plan for the Metals Areas operable unit.

VIII. DESCRIPTION OF ALTERNATIVES

During the FS, the FWS and Sangamo Weston, Inc. identified and evaluated a list of alternatives that could be used to address the threats and/or potential threats identified at the study sites within the operable unit. The FWS and Sangamo Weston, Inc. narrowed the list of alternatives based

on their effectiveness (i.e. protection of human health and/or the environment, reliability), implementability (i.e. technical feasibility, compliance with identified State and Federal regulations) and relative costs (i.e. capital, operation and maintenance). The FS included detailed analysis of twenty-two (22) site-specific alternatives.

In the Proposed Plan, five remedial technologies which were incorporated into the twenty-two (22) alternatives in the FS were described. In addition, nine alternatives for remedial action which incorporated the remedial technologies were presented. The nine alternatives included a range of actions from containment of the waste in place to treatment to the maximum extent possible. Public comment was solicited on the nine alternatives which were presented in the Proposed Plan, on the twenty two alternatives discussed in the FS, and on the technologies which were combined to create the various alternatives.

Below is a brief description of the nine alternatives presented in the Proposed Plan:

Alternative 1

FS Alternatives: Section 2, 1A; Section 4, 1A; Section 6, 1A
Estimated Total Remedial Cost: $5,463,787 present worth
Estimated Time to Implement: 1 to 2 years

Alternative 1 would address all of the study sites comprising the operable unit, and includes the following components:

Excavation of Soil and Sediment - Contaminated soil and sediment would be excavated using conventional equipment. The excavated material would be moved to a storage area on-site, where it would be stored until treated and/or disposed.

Stabilization/ Fixation - Soils and sediments which are considered RCRA hazardous because of EP Toxicity (the characteristic to leach metals) would be treated by stabilization/ fixation. Stabilization/ fixation is a treatment process where contaminated soils and sediments would be treated with bonding agents which fix contaminants within the stabilized waste. This treatment makes the contaminants more resistant to leaching. Cement-based and lime-based stabilization processes are commonly used for fixation of metals.

Industrial Landfill - Excavated treated and untreated, non-hazardous materials would be placed in an off-Site industrial landfill. This "industrial landfill" would be a solid waste landfill as regulated by Subtitle D of the Resource Conservation and Recovery Act (RCRA) and 35 Illinois Administrative Code (IAC) Part 807. The landfill must have, at a minimum, a single compacted soil liner and drainage layer. After placement of the contaminated soil and sediment, the

landfill would be covered with a cap constructed of compacted soil, a drainage layer, a barrier to prevent burrowing animals, soil fill and topsoil. The final design will be determined by site-specific characteristics, the object being to provide adequate containment of the waste material. Upon completion, the landfill would be vegetated. Groundwater and leachate monitoring, and routine maintenance would be part of the long term requirements.

Backfill Excavation - Clean soil would be placed in the areas where contaminated material had been removed.

Alternative 2: U.S. EPA's Preferred and Selected Alternative

FS Alternatives: Section 2, 1B; Section 4, 1B; Section 6, 1B
Estimated Total Remedial Cost: $2,700,858 present worth
Estimated Time to Implement: 1 to 2 years

This Alternative was U.S. EPA's preferred alternative identified in the Proposed Plan and is being selected through this decision document. Alternative 2 includes all of the components included in Alternative 1, and would address all of the study sites comprising the operable unit. The only difference is the location of the industrial landfill. In Alternative 2, the industrial landfill would be located on the Refuge.

Alternative 3

FS Alternative: Section 6, 2A
Estimated Total Remedial Cost: $1,658,733 present worth
Estimated Time to Implement: 1 to 2 years

Alternative 3 would address only study site 29, the Fire Station Landfill, and includes the following components:

Excavation of Soil and Sediment - Soils and sediments contaminated with high levels of lead, which would be considered hazardous waste, would be excavated, as described in Alternative 1.

Stabilization/Fixation - Excavated, contaminated soils and sediments would be treated by stabilization/ fixation, as described in Alternative 1.

Industrial Landfill - Excavated materials which are treated by stabilization/ fixation would be disposed in an off-site industrial landfill, as described in Alternative 1.

Low Permeability Caps - A low permeability cap would be used to cap the area from which excavation has occurred and where contamination remains. Prior to construction the contaminated

area would be sloped and graded to provide drainage and a good construction surface. The cap would be constructed of compacted soil, a drainage layer, soil fill and topsoil. Routine maintenance of the cover would be part of the long term requirements.

Alternative 4

FS Alternative: Section 6, 2B
Estimated Total Remedial Cost: $1,084,538 present worth
Estimated Time to Implement: 1 to 2 years

Alternative 4 includes all of the components included in Alternative 3, and would address only study site 29, the Fire Station Landfill. The only difference is the location of the industrial landfill. In Alternative 4, the industrial landfill would be located on the Refuge.

Alternative 5

FS Alternatives: Section 2, 2A; Section 4, 2A; Section 6, 3A
Estimated Total Remedial Cost: $7,075,984 present worth
Estimated Time to Implement: 1 to 2 years

Alternative 5 would address all of the study sites comprising the operable unit, and includes the following components:

Excavation of Soil and Sediment - Same as described in Alternative 1.

RCRA Landfill - Contaminated soil and sediment which is considered RCRA hazardous waste because of EP Toxicity would be disposed off-Site in a RCRA Landfill. Hazardous soil and/or sediment is expected only at the Old Refuge Shop and the Fire Station Landfill (study sites 22 and 29). Subtitle C of RCRA regulates certain activities involving hazardous waste. A RCRA landfill is one that meets the design criteria required by Subtitle C of this law. The landfill would be constructed of a composite soil and synthetic bottom liner, a drainage layer, a synthetic membrane liner, and a second drainage layer. After placement of the contaminated material, the RCRA landfill would be covered with a cap constructed of compacted soil, a synthetic membrane, a drainage layer, soil fill, and topsoil. Upon completion, the RCRA landfill would be vegetated. Groundwater and leachate monitoring, and routine maintenance would be part of the long term requirements.

Industrial Landfill - Excavated contaminated soil and sediment which is not a hazardous waste would be disposed of off-Site in an industrial landfill, as described in Alternative 1.

Backfill Excavation - Clean soil would be placed in the areas

where contaminated material had been removed.

Alternative 6

FS Alternatives: Section 2, 2B; Section 4, 2B; Section 6, 3B
Estimated Total Remedial Cost: $2,798,825 present worth
Estimated Time to Implement: 1 to 2 years

Alternative 6 includes the all of the components included in Alternative 5, and would address all of the study sites comprising the operable unit. The only difference is the location of the industrial and RCRA landfills. In Alternative 6, the landfills would be located on the Refuge.

Alternative 7

FS Alternatives: Section 2, 2C; Section 6, 3E
Estimated Total Remedial Cost: $1,047,111 present worth
Estimated Time to Implement: 1 year

Alternative 7 would address the Area 7 Plating Pond and the Fire Station Landfill (study sites 15 and 29) and includes the following components:

Low Permeability Caps - Contaminated soils and/or sediments would be left in place in the Area 7 Plating Pond and the Fire Station Landfill and each would be covered with a low permeability cap, as described in Alternative 3. Prior to construction, any wet areas would be dewatered and the area would be shaped and graded to provide a good construction surface.

Alternative 8

FS Alternative: Section 6, 3C
Estimated Total Remedial Cost: $2,716,361 present worth
Estimated Time to Implement: 1 to 2 years

Alternative 8 would address only the Fire Station Landfill (study site 29) and includes the following components:

Excavation of Soil and Sediment - Soils and sediments contaminated with high levels of lead, which would be considered hazardous waste because of the characteristic to leach metals, would be excavated, as described in Alternative 1.

RCRA Landfill - Excavated contaminated soil and sediment which is considered hazardous waste would be disposed off-site in a RCRA Landfill, as described in Alternative 5.

Backfill Excavation - Clean soil would be placed in the areas

where contaminated material had been removed.

Low Permeability Cap - Contaminated, non-hazardous soils and/or sediments would be left in place at the Fire Station Landfill and would be covered with a low permeability cap, as described in Alternative 3. Prior to construction, any wet areas would be dewatered and the area would be shaped and graded to provide a good construction surface.

Alternative 9

FS Alternative: Section 6, 3D
Estimated Total Remedial Cost: $844,627 present worth
Estimated Time to Implement: 1 to 2 years

Alternative 9 includes the all of the components included in Alternative 8, and would address only study site 29, the Fire Station Landfill. The only difference is the location of the RCRA landfill. In Alternative 9, the RCRA landfill would be located on the Refuge.

No Action Remedial Alternative

FS Alternatives: 15-3, 22-3, 29-4
Estimated Total Remedial Cost: $455,530 present worth
Estimated Time to Implement: less than 1 year

The Superfund program requires that the "no action" alternative be considered at every site. Under this alternative the only actions at any of the contaminated areas might include monitoring, fencing or site use limitations. All wastes, routes of contaminant migration, and long-term human and environmental exposure pathways will remain unchanged. This alternative would not reduce the threats to human health and/or the environment identified at the site.

IX. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

The Selected Alternative for the Metals Areas operable unit at the Crab Orchard National Wildlife Refuge is Alternative 2, as outlined above. This alternative involves excavation of metal-contaminated soil and sediment, treatment of hazardous materials by stabilization/ fixation to render it non-hazardous, and disposal in an on-site industrial landfill. Based on current information, this alternative provides the best balance among the nine criteria that U.S. EPA uses to evaluate alternatives. This section provides a summary of the comparative analysis of the alternatives for the Metals Areas operable unit.

Overall Protection. Each alternative, with the exception of the no action alternative, would provide adequate protection of human health and the environment for those sites specifically addressed. Protection would result by eliminating, reducing,

or controlling risk through treatment, engineering controls, or institutional controls. However, those alternatives which address only one or two of the three study sites comprising the operable unit eliminate, reduce or control risk only for those study sites addressed, and not the whole operable unit. In order to meet the threshold criterion of protectiveness, the Alternatives which address only one or two of the study sites would have to be combined to provide overall protection for the operable unit. The Selected Alternative addresses the principle threats to public health and the environment for all of the study sites by removal and treatment to the maximum extent practicable of contaminated soil and sediment and containment of the residues.

Compliance with ARARs. All alternatives would meet all applicable or relevant and appropriate requirements of Federal and State environmental laws. Potential ARARs for each alternative are extensively discussed in the FS report. The selected alternative, Alternative 2, will comply with all ARARs. Specific ARARs for the remedy are discussed in Section XI.B of this Decision Summary. Upcoming RCRA land disposal restrictions may require characteristic hazardous waste to be treated prior to disposal, which could make certain alternatives (particularly Alternatives 5, 6, 8, and 9) non-compliant with RCRA ARARs.

Long-term Effectiveness and Permanence. The Selected Alternative would provide the greatest long-term effectiveness and permanence. It would involve removal of approximately 20,000 cubic yards of contaminated soil and sediment, of which approximately 9,000 cubic yards is estimated to be RCRA hazardous. This contaminated soil and sediment constitutes the principle threat from this operable unit. The Selected Alternative also addresses the threat from surface water by removing the material that could contaminate the water. All of the hazardous metal contamination will be treated by stabilization/ fixation to render it non-hazardous, with secure containment of the residues. The treatment provides a demonstrated, effective rendering of hazardous material to a state where it is non-hazardous.

The alternatives differ in whether treatment will be utilized, the volumes of soil and sediment to be excavated and/or treated, and ultimate disposal location. Alternative 1 uses the same degree of treatment and containment of the contaminated material as the Selected Alternative, with the only difference being the location of the landfill. However, the Agencies believe that it is easier to ensure the long-term permanence and effectiveness of a dedicated landfill built on-site. Alternatives 5, 6, 7, 8, and 9 do not involve any treatment of the waste, and rely on containment for long-term effectiveness. Alternatives 3, 4, 8, and 9 would require a

smaller volume of the contaminated material to be excavated and some contaminated material would be contained in place. The effectiveness of containment will depend on long-term operation and maintenance. Alternatives 3 and 4 also involve treatment by stabilization/ fixation, but the volume to be treated would be less.

For all of the alternatives, the long-term risks associated with exposure to and migration of the remaining wastes and treatment residues would be reduced by effective treatment and/or engineered controls to ensure operation and maintenance of the landfills, maintenance of the caps/covers, groundwater monitoring and monitoring of drainageways and Crab Orchard Lake.

Reduction of Toxicity, Mobility, or Volume. The Selected Alternative and Alternative 1 will provide treatment to the maximum extent possible for the hazardous wastes. Treatment will render these wastes non-hazardous. The mobility of the metals is reduced by stabilization/ fixation and containment. Although this treatment process increases the volume of the treated material, it does not increase the mass of the hazardous components.

Alternatives 3 and 4 utilize treatment by stabilization/ fixation on some of the hazardous waste. However, the volume to be treated would be less because Alternatives 3 and 4 only address the contamination at one of the three study sites in the operable unit. Therefore, overall reduction of mobility for the operable unit would be less for Alternatives 3 and 4 than for Alternatives 1 and 2. The other alternatives use containment technology to control the mobility of the contaminated material. None of the other alternatives would reduce toxicity, mobility or volume as much as the Selected Alternative and Alternative 1.

Short-term Effectiveness. All of the alternatives under consideration could present a threat to workers and the environment during the construction/implementation phase of the remedial action because of the potential for dust generation or the movement of contaminated sediments in surface water. Some care must be taken during excavation of contaminated sediments from the Old Refuge Shop Drainageway (site 22), involved in Alternatives 1, 2, 5 and 6, to prevent movement of the contaminated sediments into the water, and subsequently into Crab Orchard Lake. This could be accomplished by completing the excavation during the dry season when the intermittent stream is dry. The utilization of various protective measures will minimize threats to workers. The estimated time for implementation is roughly equal for the various alternatives, and is not expected to exceed two years for any of the alternatives.

Implementability. All of the alternatives use standard, reliable technologies which are feasible for implementation. The equipment and labor is readily available for all of the technologies. All of the alternatives would be considered technically implementable.

Administrative feasibility is greatest for the Selected Alternative and Alternatives 4 and 7 because these three avoid potential RCRA land disposal issues and involve on-site construction. Alternatives which utilize off-site disposal (Alternatives 1, 3, 5, and 8) may encounter problems with administrative feasibility because available capacity for off-site disposal is a potential problem. Also, upcoming RCRA land disposal restrictions and existing State of Illinois land disposal restrictions may require characteristic hazardous waste to be treated prior to disposal, which could make certain alternatives infeasible (particularly Alternatives 5, 6, 8, and 9).

Cost. For the Selected Alternative and each other Alternative, the total remedial costs (capital plus operation and maintenance) in present net worth are:

- Selected Alternative (Alternative 2)	$2,700,858
- Alternative 1	$5,463,787
- Alternative 3	$1,658,733
- Alternative 4	$1,084,538
- Alternative 5	$7,075,984
- Alternative 6	$2,789,825
- Alternative 7	$1,047,111
- Alternative 8	$2,716,361
- Alternative 9	$844,627

The Selected Alternative is less expensive than four of the other alternatives. The alternatives that utilize off-site disposal tend to be more expensive than those utilizing on-site disposal.

Support Agency Acceptance. The U.S. Department of Interior supports the Selected Alternative. The State of Illinois has not supported the Selected Alternative at this time. Illinois has expressed concerns with the technical design of the solid waste landfill. (See Appendix C.)

Community Acceptance. A thirty day public comment period was originally scheduled to run from August 18, 1989, to September 16, 1989. Based on concerns expressed at the public hearing on August 30, 1989, the comment period was extended until September 23, 1989. Two commentors presented oral comments at the hearing specifically concerned with the Metals Areas operable unit and several others made comments related to the

Superfund decision-making processes. Thirty-one (31) letters relating to the Metals Areas Proposed Plan were received during the public comment period, including three from organizations. The comments received have been summarized and addressed in the Responsiveness Summary portion of this ROD.

The comments received during the public comment period are one measure of the community's acceptance of U.S. EPA's proposed remedial action. Over half of the comments received were concerned with the Superfund process rather than the specific remedy. The public was very unsatisfied with the Superfund decision-making process, and felt that the process does not accommodate public concerns. Many of the other comments focussed on technical questions and concerns and did not explicitly disagree with the proposed remedy. Some commentors, not the majority, expressed a preference for an alternative remedy to that proposed by the Agencies. The alternative that was most frequently supported by the commentors that expressed a preference different than that proposed was an off-Site landfill rather than an on-Site landfill. These comments are all addressed in the Responsiveness Summary.

Another measure of community acceptance is the activities undertaken by the Agencies pursuant to the Community Relations Plan (CRP). The CRP documents community relations activities, and will provide a measure of community acceptance in addition to the comments received during the comment period. The CRP supports that the community is dissatisfied with the Superfund process and is very concerned with the proposed remedy for the PCB Areas operable unit.

In conclusion, the community near the Refuge does not fully accept the remedy selected for the Metals Areas operable unit. However, the non-acceptance is based more on dissatisfaction with the Superfund process and the community's role in decision-making than with the technical components of the remedy. In order to broaden the community's role at this Site, U.S. EPA is expanding the CRP, and will work with the community to address all comments and concerns as the remedial design and remedial action go forward.

In summary, at this time the Selected Alternative represents the best balance among the alternatives of the evaluation criteria used to evaluate remedies.

X. THE SELECTED REMEDY

The Selected Alternative, Alternative 2 as outlined above, would permanently remediate the three study sites comprising the Metal Areas operable unit. Excavation of contaminated soil and sediment would address the principle threats to human health and the environment that

currently exist, and would prevent future threats and environmental degradation. Stabilization/ fixation of hazardous soil and sediment which is contaminated with metals will constitute treatment to the maximum extent practicable. Containment in a secure, on-Site, solid waste landfill of any metal bearing or stabilized waste will allow safe long-term control of this material. The labor and equipment necessary to implement the Selected Alternative are currently available. Specific details on various aspects of the selected remedy follow.

A. MAJOR COMPONENTS OF REMEDY

Excavation of Soil and Sediment - Contaminated soil and sediment will be excavated using conventional equipment. The excavated material will be moved to a storage area on-site, where it will be stored until it is treated or disposed. Design of the project will include methods to prevent contaminated sediment from moving into surface water and methods to minimize dust. Design will also include considerations to ensure compliance with ARARs. The excavated material will be sampled to determine whether it is hazardous, and hazardous and non-hazardous material will not be mixed.

Stabilization/ Fixation - Soils and sediments which are considered RCRA hazardous because of EP Toxicity (the characteristic to leach metals) will be treated by stabilization/ fixation. Stabilization/ fixation is a treatment process where contaminated soils and sediments will be treated with bonding agents which fix contaminants within the stabilized waste. This treatment makes the contaminants more resistant to leaching. Cement-based and lime-based stabilization processes are commonly used for fixation of metals. During Design, appropriate mixtures of treatment materials will be evaluated to assess their ability to immobilize the contaminants at the Site and to effectively render the material non-hazardous. Also, a treatment quality assurance plan will be developed to document the performance of the full scale treatment process.

Industrial Landfill - Excavated treated and untreated non-hazardous materials will be disposed in an on-Site industrial landfill. This "industrial landfill" will be a solid waste landfill as regulated by Subtitle D of RCRA and 35 IAC Part 807. The landfill will be constructed, at a minimum, with a single compacted soil liner and drainage layer. After placement of the contaminated soil and sediment, the landfill will be covered with a cap constructed, at a minimum, of compacted soil, a drainage layer, a barrier to prevent burrowing animals, soil fill and topsoil. The final design will be determined by site-specific characteristics, the object being to provide adequate containment of the waste material. The final location of the on-Site landfill will be determined by investigations during the remedial design phase to establish good siting characteristics. Upon completion, the landfill will be covered and vegetated. Groundwater and leachate monitoring, and routine maintenance will be part of the long term requirements.

Backfill Excavation - Clean soil will be placed in the areas where

contaminated material had been removed.

Monitoring and Maintenance - The on-Site landfill and excavated areas will require monitoring of groundwater and surface water. Long-term maintenance will be required for the landfill.

The components of this Selected Remedy are conceptual, and are based on desired performance standards and ARARs. As a result of the remedial design and construction processes some changes may be made to the design features outlined above.

B. CLEAN UP TARGETS

Clean up targets have been set for the study sites comprising the Metals Areas operable unit. The targets are based on the risk assessment performed in the RI Report, which evaluates potential risk to human health and the environment. The targets were then further refined to reflect DOI's specific concerns and statutory mandates for the protection of fish and wildlife at the Refuge, and U.S. EPA's regional and national policies in establishing clean up targets. The clean up standards for the study sites in the Metals Areas operable unit are discussed briefly below. Since some compounds will remain at the Refuge in an on-site landfill, the effectiveness of the remedy will have to be re-evaluated at least every five years.

1. Site 15: Area 7 Plating Pond

Discharge standards for the pond water will be established to comply with the effluent standards and water quality standards of the Clean Water Act and State requirements.

All sludges in the pond and contaminated underlying soil containing chromium in excess of naturally occurring background levels will be removed.

2. Site 22: Old Refuge Shop Drainage Pool

Attempts will be made to complete all remedial action for this site during the dry season so that there is no water in the drainage stream. If water must be discharged during the remediation, standards will be established to comply with the effluent standards and water quality standards of the Clean Water Act and State requirements.

All sediments and soil containing cadmium in excess of 10 mg cadmium per kg dry soil will be removed. Removal based upon this criterion should address all of the other contaminants at the site. However, the risk from all of the chemical contaminants present above naturally occurring background levels in the soil and sediment shall not exceed an excess cancer risk of one in one million (10^{-6}) and shall not exceed any non-cancer chronic health effects.

The groundwater will be monitored during and after remediation of the site. The monitoring results will be evaluated to assure that after completion of the remediation of the contaminated soils and sediments the risk from all of the contaminants in the groundwater above naturally occurring background levels shall not exceed an excess cancer risk of one in one million (10^{-6}) and shall not exceed any non-cancer chronic health effects.

3. Site 29: Fire Station Landfill

All contaminated soil and sediment in this landfill in excess of 450 mg lead per kg dry soil will be removed. Lead contamination was only found in isolated "hot spots" at this study site.

The groundwater will be monitored during and after remediation of the site. The monitoring results will be evaluated to assure that after completion of the remediation of the contaminated soils and sediments the risk from all of the contaminants in the groundwater above naturally occurring background levels shall not exceed an excess cancer risk of one in one million (10^{-6}) and shall not exceed any non-cancer chronic health effects.

C. COST

1. Direct Capital Costs

The direct capital cost estimates include site preparation, excavation, treatment, placement, landfill construction, cover construction, backfilling of excavated areas, verification sampling, construction health and safety, and installation of fencing and monitoring wells. The breakdown for each study site follows:

Site 15:	280 cubic yard	$55,876
Site 22:	5,200 cubic yards	$370,467
Site 29:	14,600 cubic yards	$859,910

2. Indirect Capital Costs

The indirect capital cost estimates include a contingency allowance of 25 percent, engineering fees of 15 percent, and legal fees of 5 percent of the direct capital costs. The breakdown for each study site follows:

Site 15:	$25,148
Site 22:	$166,710
Site 29:	$386,960

3. Operation and Maintenance Costs

Operation and maintenance cost estimates include site maintenance and inspection, sampling and analysis, and a reserve fund and insurance. The breakdown for annual costs for operation and maintenance for each study site follows:

Site 15:	$9,228
Site 22:	$18,269
Site 29:	$26,874

4. Total Present Value Cost

The total present value cost estimate includes all of the costs listed above for each of the sites, and estimates an operation and maintenance period of thirty years with a five percent interest rate. The total present worth cost estimate for the selected remedy is $2,700,858.

XI. STATUTORY DETERMINATIONS

A. PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The Selected Alternative is protective of public health and the environment for the three study sites comprising the Metals Areas operable unit. Also, the chosen remedy is consistent with the mission of the Refuge, which is to provide a safe and protective setting for wildlife. The Selected Alternative provides adequate protection by a combination of treatment of contaminated soil and sediment by stabilization/ fixation, the engineered control of an on-site solid waste landfill for the treated and untreated contaminated material, and institutional controls by continuing to restrict public access, particularly to the constructed landfill. The remedial alternatives, including on-site landfills, were developed with the understanding that the site would continue to be a wildlife refuge, with restricted public access in order to protect the wildlife. An interagency agreement will require DOI maintain the on-site landfill and to provide access restrictions for the landfill if the land use were to change in the future.

The cleanup targets for the study sites comprising the operable unit have been established so that human exposure levels will be reduced for the sum of all contaminants to no greater than a 10^{-6} excess cancer risk level. In addition, the non-carcinogenic hazard indices for the sum of all contaminants shall be less than one. Also, chemical specific cleanup targets have been established by the FWS which are believed to be protective of wildlife at this site. The cleanup targets established in this document are consistent with DOI's concerns and statutory mandates. Implementation of the selected remedy will not pose unacceptable short-term risks and will not cause cross-media impacts.

The Selected Alternative would clean up the three study sites that comprise the operable unit so that future access restrictions to those areas would not be needed. Because the chosen remedy will leave contaminants at the site in an on-site landfill, CERCLA Section 121(c) requires that the remedy be reviewed at least every five years to ensure that it continues to be protective to public health and the environment.

B. COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The selected remedy will comply with all Federal and any more stringent State ARARs. No waiver of an ARAR will be required. The major ARARs that will be attained by the components of the selected remedy are listed below. The ARARs listed below may not be all inclusive, and implementation of the ARARs will be determined during remedial design and remedial action.

1. Surface Water Discharge

Clean Water Act

- If pond water from site 15 or stream water from site 22 must be discharged to a surface water body during site preparation, the discharge shall meet the effluent standards and prohibitions established under Sections 301, 302, 303, 307, 318 and 405 of the Clean Water Act (40 CFR 122.41 and 122.44).

2. Excavation of Soil and Sediment

Resource Conservation and Recovery Act, Subtitle C

- Excavated material which is RCRA hazardous will be handled and stored in accordance with the substantive technical standards applicable to generators of hazardous waste and for owners and operators of hazardous waste storage facilities (40 CFR 262.34; and 264, Subparts B, C, I, J, and L).

- Excavated material which is RCRA hazardous will be handled and stored in accordance with the land disposal restrictions (40 CFR 268).

- The excavation activities, when completed shall meet the closure performance standards for clean closure (40 CFR 264, Subpart G)

- The excavation and storage activities must also meet any more stringent State of Illinois equivalent provisions (35 IAC Part 724 design requirements).

Clean Air Act

- During excavation the national ambient air quality standards

(NAAQS) for particulate matter and lead shall not be exceeded (40 CFR 50.6 and 50.12).

3. Stabilization/ Fixation

Resource Conservation and Recovery Act, Subtitle C

- RCRA hazardous material will all be treated by this process to render it non-hazardous. The treatment shall be in accordance with any promulgated treatment standards for waste which is EP Toxic for cadmium, chromium or lead (40 CFR 268 for D006, D007 and/or D008 waste).

- Treatment shall be in units designed to meet the substantive technical requirements for either containers, tanks, waste piles or miscellaneous units (40 CFR 264, Subparts I, J, L or X).

- Treatment units must meet any more stringent regulatory design standards of the State of Illinois (35 IAC Part 724).

Clean Air Act

- During treatment the NAAQS for particulate matter and lead shall not be exceeded (40 CFR 50.6 and 50.12).

4. Disposal or Decontamination of Equipment

Resource Conservation and Recovery Act, Subtitle C

- During closure all equipment, structures and soils that are used on/with RCRA hazardous materials must be properly decontaminated or disposed (40 CFR 264.114).

- Decontamination of equipment structures and soils that are used on/with RCRA hazardous materials must meet any more stringent regulatory decontamination or disposal standards of the State of Illinois (35 IAC Part 724).

5. Industrial Landfill

Solid Waste Disposal Act as amended by RCRA Subtitle D

- The design and operation of the on-site solid waste disposal cell will meet the substantive technical requirements of the RCRA, Subtitle D guidelines for the land disposal of solid waste (40 CFR 241, Subpart B).

- The design and operation of the landfill will meet any more stringent technical regulations of the State of Illinois (35 IAC Part 807).

6. Backfill Excavation

Clean Air Act

- During backfilling activities the NAAQS for particulate matter shall not be exceeded (40 CFR 50.6).

7. Monitoring and Maintenance

Resource Conservation and Recovery Act, Subtitle C

- Groundwater monitoring for the excavated study sites shall be in accordance with the groundwater monitoring requirements of RCRA (40 CFR 264, Subpart F).

Solid Waste Disposal Act as amended by RCRA Subtitle D

- Groundwater and leachate monitoring for the on-site landfill shall be in accordance with the RCRA Subtitle D, solid waste landfill requirements (40 CFR 241.204).

- Groundwater and leachate monitoring for the on-site landfill will meet any more stringent technical regulations of the State of Illinois (35 IAC Part 807).

8. Personnel Protection

Occupational Safety and Health Act (OSHA)

- During all remedial activities the requirements of the Occupational Safety and Health Act for the training and safety of workers will be observed (29 CFR 1910.120 and 1926, Subparts C, D, E, and P).

9. Cleanup Standards

Crab Orchard Enabling Legislation (16 U.S.C. 666f and g)

National Wildlife Refuge Administration Act (16 U.S.C. 668dd)

- The chemical specific cleanup targets which have been established for the study sites comprising the Metals Areas, and any others that will be established for this operable unit will be consistent with DOI concerns and statutory requirements, such as those cited above.

In implementing the selected remedy, U.S. EPA, DOI and IEPA have agreed to consider a number of procedures that are not legally binding. These include, but are not limited to: U.S. EPA's Risk Assessment Guidance for Superfund; U.S. EPA's Superfund Remedial Design and Remedial Action Guidance; U.S. EPA's RCRA Technical Enforcement Guidance Document; State of Illinois Waste Management Facilities Design Criteria; State of

Illinois Monitoring Well Construction and Installation Criteria; FWS Master Plan for Crab Orchard National Wildlife Refuge; and FWS Refuge Manual.

C. COST EFFECTIVENESS

The selected remedy for this operable unit appears to be cost-effective. The costs are reasonable for the overall effectiveness of the chosen remedy. Other Alternatives which provided less long-term effectiveness and permanence; less reduction of toxicity, mobility or volume; or less implementability were more costly.

D. UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The Selected Alternative for the Metals Areas operable unit utilizes permanent solutions and treatment technologies to the maximum extent practicable.

The evaluation of the five primary balancing criteria is discussed in Part IX, above. The analysis of the criteria supports the selection of Alternative 2, as being the best balance among the Alternatives. The analysis of the criteria supports that the Selected Remedy utilizes permanent solutions to the maximum extent practicable. A brief review of the five primary balancing criteria follows:

Long-term Effectiveness and Permanence. The Selected Alternative would provide the greatest long-term effectiveness and permanence. It would involve removal of approximately 20,000 cubic yards of contaminated soil and sediment, of which approximately 9,000 cubic yards is estimated to be RCRA hazardous. This contaminated soil and sediment constitutes the principle threat from this operable unit. All of the RCRA hazardous metal contamination will be treated by stabilization/ fixation with secure containment of the residues and the untreated non-hazardous waste. The treatment provides a demonstrated, effective rendering of hazardous material to a state where it is non-hazardous. The long-term risks associated with exposure to and migration of the wastes and treatment residues would be reduced by excavation of all of the contaminated material, effective treatment and secure engineered controls.

Reduction of Toxicity, Mobility, or Volume. The Selected Alternative will provide treatment to the maximum extent possible for the approximately 9,000 cubic yards of RCRA hazardous wastes. Treatment will render these wastes non-hazardous. The mobility of the metals is reduced by stabilization/ fixation and containment. Although this treatment process increases the volume of the treated material, it does not increase the mass of the hazardous components.

Short-term Effectiveness. All of the alternatives under consideration could present a threat to workers and the environment during the construction/implementation phase of the remedial action because of the potential for dust generation or the movement of contaminated sediments in surface water. The estimated time for implementation is roughly equal for the various alternatives, and is not expected to exceed two years for any of the alternatives. The short-term effectiveness should be roughly equal for any of the alternatives.

Implementability. The Selected Alternative uses standard, reliable technologies which are feasible for implementation. The equipment and labor is readily available for all of the technologies. The Selected Alternative would be considered technically implementable.

Administrative feasibility is greatest for the Selected Alternative, among others, because it avoids potential RCRA land disposal issues and involves on-Site construction. Alternatives which utilize off-Site disposal may encounter problems with administrative feasibility because available capacity for off-Site disposal is a potential problem. Also, upcoming RCRA land disposal restrictions and existing State of Illinois land disposal restrictions may require characteristic hazardous waste to be treated prior to disposal, which could make certain alternatives infeasible.

Cost. The Selected Alternative is less expensive than four of the other alternatives. The alternatives that utilize off-Site disposal tend to be more expensive than those utilizing on-Site disposal.

Alternative 2 was selected as the final remedial action for the Metals Areas operable unit because it provides the greatest long-term effectiveness and permanence and reduction of toxicity, mobility and volume through treatment. The costs are in the middle of costs for all of the alternatives, and its short-term effectiveness is equivalent to the other alternatives. Also, the Selected Alternative is equally implementable from a technical point of view, and will avoid future RCRA land disposal restrictions.

E. PREFERENCE FOR TREATMENT AS A PRINCIPLE ELEMENT

The selected remedy uses treatment as a principle element to address the threats posed by the sites comprising the Metal Areas operable unit. The results of the risk assessment conducted as part of the RI indicate that the greatest threat to human health and/or the environment is from contaminated soil and sediment, and potential surface water contamination resulting from run-off from the uncontrolled areas. The Selected Alternative requires that excavated soil and sediment which is hazardous because of the characteristic to leach metals be treated by stabilization/ fixation to render the material non-hazardous and to

reduce mobility of the contaminants. This treatment technology has been demonstrated to be extremely effective for soil and sediment contaminated with metals.