ENGINEERING EVALUATION/COST ANALYSIS DEVELOPMENT McARTHUR DRIVE LANDFILL ST. JOSEPH, MISSOURI

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EXECUTIVE SUMMARY

The McArthur Drive Landfill (Landfill) is located in the northwestern corner of the City of St. Joseph (City) in Buchanan County, Missouri, along the east bank of the Missouri River near River Mile 450. Landfill operations at the site were conducted in the 1950's and early to mid-1960's.

The Landfill, which is owned by the City, is a closed municipal/industrial waste landfill covering an area of approximately 14 acres. The trench method was used to dispose of waste in the Landfill. The area used for waste disposal consisted of approximately 10 acres.

The Landfill is listed as one of the United States Environmental Protections Agency's Superfund sites. Under Superfund, the City agreed to stabilize the portion of the site that forms the Missouri Riverbank and to evaluate alternatives to perform a non-time critical removal action to place an upgraded cover on the remainder of the site. Stabilization of the riverbank was completed in the Spring of 1997. This report presents the Engineering Evaluation/Cost Analysis (EE/CA), including a streamlined risk assessment.

A risk evaluation was conducted to identify potential exposure routes typical to facilities such as the Landfill. The potential exposure routes included soils, sediments, groundwater, surface water, air, landfill gas, and leachate. The evaluation concluded that the only exposure route of concern was soil.

The risk evaluation was conducted using the streamlined approach outlined in Presumptive Remedy for CERCLA Municipal Landfill Sites EPA September 1993. The risk evaluation focused on the risks posed by contaminants present in surface and subsurface soils at the Landfill.

Previous investigations at the Landfill had identified surface and subsurface soil contamination to a depth of 20 feet. The risk evaluation quantitatively evaluated chemicals of concern and the affected media with respect to potential exposure pathways and receptors for the removal action. The potential pathways for human exposure to the soil at the Landfill include ingestion directly from the soil, inhalation of dust, and dermal contact with contaminated soils and fugitive dusts. Potential human receptors include temporary on-site workers, parking lot users, and trespassers.

To mitigate the risk posed by contaminated surface and subsurface soils, three removal alternatives were identified to be used in conjunction with the completed riverbank stabilization project. The removal alternatives evaluated include the placing of a soil cap over the entire Landfill, placing a reduced soil cap and asphalt paving the entire Landfill, and using a soil cap for part of the landfill and asphalt paving the remainder.

The removal alternatives were evaluated based on their effectiveness, implementability, and cost. Each of the alternatives would meet the Presumptive Remedy for CERCLA Municipal Landfill Sites.

The recommended alternative for the non-time critical removal action at the Landfill consists of capping the site with a combined soil and asphalt cover system. The cover on the western portion of the site will consist of sub-base over compacted soils overlain by an asphaltic surface. The cap will be designed so that it has hydraulic properties equal to or greater than a soil cap and will maintain its structural integrity based on site conditions. The east portion of the site will consist of two feet of compacted soil cap with a hydraulic conductivity equal to or less than 1×10^{-5} centimeters per second with six inches of topsoil.

This alternative will reduce erosion potential by improving surface drainage and establishing a consistent vegetative cover on the Landfill surface. The alternative satisfies risk assessment concerns at the site by employing an alternative which is technically and administratively feasible.

The capital costs to be borne by the City for this capping project are significant, but the enhancement of the site through this alternative which includes possible parking for up to 1,000 vehicles is attractive given the increased utilization of this riverfront area of the City.

SECTION 1

SITE CHARACTERIZATION

BACKGROUND

The McArthur Drive Landfill (Landfill) is located in the northwestern corner of the City of St. Joseph (City) in Buchanan County, Missouri, along the east bank of the Missouri River near River Mile 450. The Landfill is within the 100-year and 500-year flood plains. Roy's Branch makes up the eastern and southern boundaries, and McArthur Drive makes up the northern boundary of the site. Immediately south of the Landfill is the confluence of Roy's Branch and the Missouri River. Figure 1-1 shows existing site topography, site boundaries, and approximate location of known waste deposits.

The Landfill, which is owned by the City, is a closed municipal/industrial waste landfill covering an area of approximately 14 acres. The trench method was used to dispose of waste in the Landfill. The area used for waste disposal was approximately 10 acres in size. Contaminated soils are present from the surface to a depth of approximately 20 feet within portions of this area.

The Landfill is listed as one of the United States Environmental Protection Agency's (EPA) Superfund sites. Under Superfund, the City agreed to stabilize the portion of the site that forms the Missouri Riverbank and to evaluate alternatives to perform a non-time critical removal action to place an upgraded cover on the remainder of the area. Stabilization of the riverbank was completed in the Spring of 1997. The latter investigation, the performance of an Engineering Evaluation/Cost Analysis (EE/CA), including a streamlined risk assessment, is the focus of this report.

SURFACE DRAINAGE

Moderate vegetation covers the Landfill site, particularly during the growing season. The Landfill surface shows signs of settlement, especially in the former trench areas. During the Fall of 1993, flood waters submerged the Landfill for an extended period. The flood waters scoured part of the riverbank, exposing areas of disposed waste. During the riverbank stabilization project, the amount of waste exposed was found to be significantly less than anticipated.

The land surface at the site gently slopes to the southwest. Annual precipitation in the area averages approximately 34 inches. The site is neither the recipient of significant storm water run on nor the source of runoff, based on the relief displayed at the site and the lack of identifiable erosion.

GROUNDWATER

The site is located on the eastern edge of the Missouri River floodplain and is underlain by 0 to 5 feet of fill over Quaternary alluvium. Pennsylvanian limestone and shale is present at depths of approximately 60 feet below ground surface. The depth to groundwater ranges from approximately 12 to 25 feet. The groundwater flow direction is generally toward the Missouri River and varies

from a west-southwest to a west-northwest direction. The groundwater gradient is generally less than 1 percent.

CONTAMINATION

Previous investigations conducted in 1983 by the United States Environmental Protection Agency (EPA) and in 1986 and 1988 by the City, identified contaminants in the surface soil, sediments, subsurface soil, and groundwater.

Soil Samples

Soil samples were collected from the landfill cap as part of the 1983 investigation. The analytical results for these samples indicated the following contaminants were present.

Aldrin
Bis(2-ethylhexyl) phthalate
Butyl benzyl phthalate
Chlordane
4,4-DDD
4,4-DDE
4,4-DDT
Heptachlor
Heptachlor epoxide
Metals

Soil samples were collected from the landfill cap as part of the 1986 investigation. The analytical results for these samples indicated that the contaminants were detected in lower concentrations than detected during the 1983 investigation. However, lead and zinc were detected in higher concentrations than in the 1983 investigation. Soil samples collected from the landfill cap as part of the 1988 investigation indicated concentrations of aldrin, dieldrin, 4,4-DDD and 4,4-DDT.

The overall results of the soil sampling indicated that elevated concentrations of aldrin, chlordane, dieldrin, 4,4-DDD, heptachlor, heptachlor epoxide, and lead are present in surface soils and landfill cap at the site.

Sediment Samples

Sediment samples along Roy's Branch were collected and analyzed as part of the 1986 investigation. Sediment samples were collected at five locations between the upstream and downstream portions of Roy's Branch. The analytical results indicated that there were some increases in organic constituents and metals in downstream samples compared to upstream samples. However, the increases were not significant and a consistent correlation could not be made.

Water Samples

Groundwater samples were collected as part of the investigations conducted in 1983, 1986, 1988, and 1997.

Groundwater sampling and analysis conducted in 1983 indicated the presence of tetrachloroethene; chloroform; trans-1,2-dichloroethene; throbis-methane; bis (2-ethylhexyl) phthalate; di-n-butyl phthalate; hexadecanoic acid; isobenzofurandione; 2-pentanone,5-hydroxy,4-methyl; sulfur; 1,2,4-trithiolane; dieldrin, 4,4-DDT; 4,4-DDD; aluminum; arsenic; barium; boron; cadmium; chromium; copper; iron; manganese; nickel; selenium; and zinc in groundwater at the site. Several of these constituents exceeded EPA maximum contaminant levels.

Groundwater sampling and analysis conducted in 1986 indicated the presence of 1,1,2,2 tetrachloroethane; chloroform; aluminum; arsenic; barium; boron; chromium; lead; and zinc in groundwater at the site. Several of these constituents exceeded EPA maximum contaminant levels.

Groundwater sampling and analysis was conducted in 1997. The groundwater samples collected were analyzed for organic (volatile and semi-volatile) compounds, inorganic compounds, cyanide, and pesticide priority pollutants. The results of the sampling and analysis indicated the following.

- Volatile and semi-volatile organics, pesticides, and cyanide were not detected in groundwater samples collected from the site.
- Concentrations of arsenic above the MCL were detected in groundwater samples collected at the site. However, the concentrations are within the range that occurs naturally within the Missouri River alluvial aquifer.
- Concentrations of aluminum, iron, and manganese were detected above secondary MCLs in groundwater samples collected at the site. However, the concentrations are within the range that occurs naturally within the Missouri River alluvial aquifer.

Surface water samples were collected from Roy's Branch as part of the investigation conducted in 1986. The results of the sampling and analysis indicated that metals and organic compounds were not leaching from the Landfill into Roy's Branch.

Air Sampling

During construction of the river bank stabilization project, air monitoring was conducted as part of the Health and Safety Plan developed for project construction. The monitoring did not indicate the presense of methane from the production of landfill gas. The results of the monitoring were as expected, since the landfill was operated at a time when residential waste in St. Joseph was generally burned prior to being placed and covered in the landfills. Burning the waste removed the organic material needed to provide methane. During the work on the site, there has been no evidence of methane production or migration.

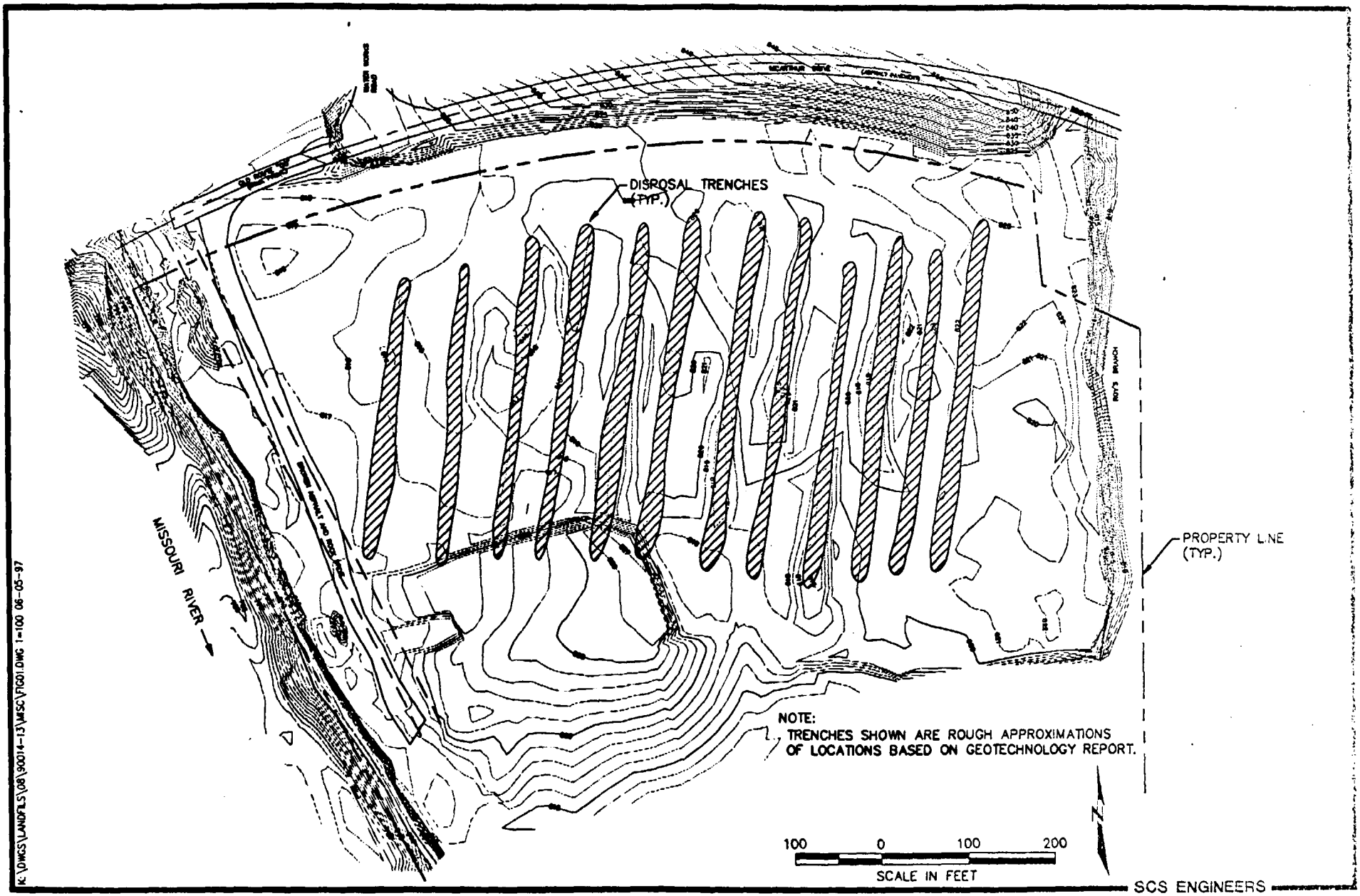


FIGURE 1-1 - EXISTING SITE TOPOGRAP

SECTION 2

RISK ASSESSMENT AND IDENTIFICATION OF REMOVAL ACTION GOALS

This section first presents the risk assessment to document unacceptable risks at the site. This is followed by a description of the proposed removal actions, the scope of removal activities, the project schedule, and constraints to completing the project. The goal of the removal actions are to reduce or eliminate visually identified areas of concern, address the identified unacceptable risks associated with soils, sediment, groundwater, surface water, and air; and to prevent adverse impacts to public health or the environment.

RISK EVALUATION

The risk evaluation presented an evaluation of the potential exposure media typical for the McArthur Drive Landfill Site (Landfill). The potential exposure media include soils, sediments, groundwater, surface water, air, landfill gas, and leachate.

Background

The Landfill is closed and received municipal and industrial wastes during the 1950's and 1960's. The Landfill contains at least twelve disposal trenches which are located immediately adjacent to the east bank of the Missouri River. Previous investigations were conducted in 1983 by the EPA and in 1986, 1988, and 1997 by the City. These investigations characterized soils, sediments, groundwater, and surface water at the Landfill.

Potential Exposure Media

The potential exposure media addressed as part of the risk evaluation include soils, sediments, groundwater, surface water, air, and leachate.

Soils–

Previous investigations at the Landfill have characterized surface and subsurface soils. These investigations identified the following chemicals in the soils:

- Pesticides - aldrin, chlordane, 4,4-DDD; 4,4-DDE; 4,4-DDT, dieldrin, and heptachlor.
- Organics - bis(2-ethylhexyl) phthalate and butyl benzyl phthalate.
- Metals - lead and zinc.

Soil samples were collected from the landfill cap as part of the 1986 investigation. The analytical results for these samples indicated that the contaminants were detected in lower concentrations than detected during the 1983 investigation. However, lead and zinc were detected in higher concentrations than the 1983 investigation. Soil samples collected from the landfill cap as part of the 1988 investigation indicated concentrations of aldrin, dieldrin, 4,4-DDD and 4,4-DDT.

The overall results of the soil sampling indicated that elevated concentrations of aldrin, chlordane, dieldrin, 4,4-DDD, heptachlor, heptachlor epoxide, and lead are present in surface soils and landfill cap at the site.

The previous investigations indicated that the chemicals identified in the soils were found at various locations across the Landfill and that there was no evidence that hot spots are present on the site.

This exposure medium is a concern for the Landfill and further quanitifiaction of the risk will be conducted.

Sediments--

Sediment samples along Roy's Branch were collected and analyzed as part of the 1986 investigation. Sediment samples were collected at five locations between the upstream and downstream portions of Roy's Branch. The analytical results indicated that there were some increases in organic constituents and metals in downstream samples compared to upstream samples. However, the increases were not significant and a consistent correlation could not be made. It appears that the Landfill has not impacted sediments in Roy's Branch.

This exposure medium was found not to be a concern for the Landfill and as a result, a risk was not quantified.

Groundwater--

Groundwater samples were collected as part of the investigations conducted in 1983, 1986, 1988, and 1997.

Groundwater sampling and analysis conducted in 1983 indicated the presence of tetrachloroethene; chloroform; trans-1,2-dichloroethene; throbis-methane; bis (2-ethylhexyl) phthalate; di-n-butyl phthalate; hexadecanoic acid; isobenzofurandione; 2-pentanone,5-hydroxy,4-methyl; sulfur; 1,2,4-trithiolane; dieldrin, 4,4-DDT; 4,4-DDD; aluminum; arsenic; barium; boron; cadmium; chromium; copper; iron; manganese; nickel; selenium; and zinc in groundwater at the site. Several of these constituents exceeded EPA maximum contaminant levels.

Groundwater sampling and analysis conducted in 1986 indicated the presence of 1,1,2,2 tetrachloroethane; chloroform; aluminum; arsenic; barium; boron; chromium; lead; and zinc in groundwater at the site. Several of these constituents exceeded EPA maximum contaminant levels.

Groundwater sampling and analysis was conducted in 1997. The groundwater samples collected were analyzed for organic (volatile and semi-volatile) compounds, inorganic compounds, cyanide, and pesticide priority pollutants. The results of the sampling and analysis indicated the following.

- Volatile and semi-volatile organics, pesticides, and cyanide were not detected in groundwater samples collected from the site.

- Concentrations of arsenic above the MCL were detected in groundwater samples collected at the site. However, the concentrations are within the range that occurs naturally within the Missouri River alluvial aquifer.

- Concentrations of aluminum, iron, and manganese were detected above secondary MCLs in groundwater samples collected at the site. However, the concentrations are within the range that occurs naturally within the Missouri River alluvial aquifer.

This exposure medium was found not to be a concern for the Landfill and, as a result, a risk was not quantified.

Surface Water--

Surface water samples were collected from Roy's Branch as part of the investigation conducted in 1986. The results of the sampling and analysis indicated that metals and organic compounds were not leaching from the Landfill into Roy's Branch.

This exposure medium was found not to be a concern for the Landfill and, as a result, a risk was not quantified.

Air--

Fugitive dust is addressed as part of the soils evaluation. The other potential exposure medium for air is landfill gas. During construction of the river bank stabilization project, air monitoring was conducted as part of the Health and Safety Plan developed for project construction. The monitoring did not indicate the presense of methane from the production of landfill gas. The results of the monitoring were as expected since the landfill was operated at a time when waste was placed in trenches and burned. This would remove the organic material needed to produce methane. During the work on the site, there has been no evidence of methane production or migration.

The landfill gas exposure medium was found not to be a concern for the Landfill and, as a result, a risk was not quantified.

Leachate--

Field activities associated with the river bank stabilization involved excavation of materials contained in the Landfill. Leachate was not encountered during these excavation activities. In addition, groundwater sampling and analysis was conducted in 1997 did not indicate leachate impacts on groundwater quality.

This exposure medium was found not to be a concern for the Landfill and, as a result, a risk was not quantified.

Risk Evaluation Methodology

The risk evaluation was conducted using the streamlined approach outlined in the Presumptive Remedy for CERCLA Municipal Landfill Sites EPA September 1993. The risk evaluation focused on the risks posed by contaminants present in surface and subsurface soils at the Landfill and provides a quantitative analysis of human health risks under the current site conditions.

To establish the risk for the Landfill, a comparison was conducted of contaminant concentrations to standards that are chemical specific, applicable, or relevant and appropriate. For this risk evaluation the Missouri Department of Health Any-Use Soil Levels for Residential Settings will be used for comparison.

The Any-Use Soils Levels assume that the site may be developed for residential use. However, the current end use plan for the site involves developing the site as a parking lot with capacity for approximately 1,000 vehicles. The use of the Any-Use Soil Levels for Residential Settings is a conservative approach for the risk evaluation given the current end use plans for the site.

Although future use of the site for residential purposes is unlikely, it is not certain. Recent property development along the riverfront near the Landfill includes a Missouri Department of Conservation boat ramp access, a river boat casino, and a hotel. Due to the uncertainty in future development of the riverfront area near the Landfill, a conservative approach using the Any-Use Soil Levels for Residential Settings is appropriate.

Identification of Chemicals of Concern - Soils

During the previous investigations at the Landfill, surface and subsurface soil sampling and analysis was conducted. Soil samples were collected to a maximum depth of 20 feet below ground surface. The following chemicals and ranges of concentration were identified in the soils:

Chemical	Range of Concentration (ppm)
Aldrin	80.1 - 102.0
Bis(2-ethylhexyl) phthalate	<0.115 - 4.1
Butyl benzyl phthalate	<0.065 - 1.1
Chlordane	<0.080 - 45.8
4,4-DDD	<0.020 - 23.4
4,4-DDE	<0.020 - 2.53
4,4-DDT	<0.020 - 6.18
Dieldrin	ND - 0.673
Heptachlor	<0.020 - 10.3
Heptachlor epoxide	<0.020 - 1.91
Lead	19 - 720
Zinc	20 - 1,200

Toxicity Information For Chemicals of Concern - Soils

Information pertaining to the chemical use and health effects of the chemicals found in soils is presented below.

Aldrin--

Aldrin is an organochlorine insecticide. Potential media of exposure include inhalation, skin absorption, and ingestion. Symptoms of exposure may include nausea, vomiting, convulsions, and coma. Aldrin is acutely toxic to most forms of life and poses a substantial risk of cancer to humans.

Bis(2-Ethylhexl) phthalate--

Bis(2-Ethylhexl) phthalate is a suspected human carcinogen. Exposure may result in effects to the gastrointestinal tract in humans. It is also a mild eye and skin irritant.

Butyl benzyl phthalate--

Potential exposure media for butyl benzyl phthalate include inhalation, skin absorption, and ingestion. Symptoms of toxic exposure include nausea, dizziness, and hallucination.

Chlordane--

Chlordane exposure may cause confusion, vomiting, diarrhea, and convulsions. Chlordane is relatively persistent in the environment. Exposure may occur through inhalation, skin absorption, and ingestion.

4,4-DDD (Dichloro-2,2 bis-chlorophenyl ethane)--

4,4-DDD is moderately irritating to skin and causes lethargy, but no convulsions. Chronic effects include atrophy of adrenal cortex and liver damage. It should be handled with caution because the effects may become similar to the effects related to exposure to DDT.

4,4-DDE--

4,4-DDE is a contaminant of 4,4-DDT. The chemical use and health effects of 4,4-DDE are similar to 4,4-DDT.

4,4-DDT (Dichlorodiphenyl trichloroethane)--

4,4-DDT is toxic to man and most other organisms. Potential media of exposure include inhalation, skin absorption, and ingestion. Systems may include tremors, confusion, dizziness,

and convulsions. DDT is highly persistent in soil and water and is bioaccumulative. Fish and some lower aquatic organisms are extremely sensitive to the acute toxicity of DDT.

Dieldrin--

Dieldrin is an organochlorine insecticide. Potential media of exposure include inhalation, skin absorption, and ingestion. Dieldrin is acutely toxic to most forms of life and poses a substantial risk of cancer to humans. Symptoms of exposure may include nausea, vomiting, convulsions, and coma. Dieldrin is extremely persistent in the environment.

Heptachlor--

Heptachlor is an organochlorine pesticide which has been demonstrated to be highly toxic to aquatic life, persistent in the environment, and bioaccumulative. Media of exposure include inhalation, skin absorption, and ingestion. Symptoms of exposure may include tremor, convulsions, and liver damage.

Heptachlor Epoxide--

Heptachlor Epoxide is an organochlorine pesticide which has been demonstrated to be highly toxic to aquatic life, persistent in the environment, and bioaccumulative. Media of exposure include inhalation, skin absorption, and ingestion. Symptoms of exposure may include tremor, convulsions, and liver damage.

Lead--

Lead is a stable metal used in the manufacture of batteries, pigments and ceramics, ammunition, and solder. Lead in soil is relatively immobile. Lead poisoning occurs gradually over a period of time from the accumulation of lead and can cause developmental defects in children. Exposure to high concentrations of lead can cause encephalopathy with imminent risk of death, permanent mental retardation, and motor deficits. Chronic exposure can cause decreased fertility, renal dysfunction, and anemia.

Zinc--

Zinc is described as having toxic effects when in the forms of fumes or salts. Exposure to zinc fumes may result in a sweet taste in the mouth, throat dryness, cough, weakness, generalized aching, chills, fever, nausea, vomiting, injury to mucous membranes, and skin irritation. Exposure to zinc salts may lead to nausea and or vomiting.

Medical attention should be sought for any exposure with emergency attention given to exposure where symptoms are present.

Risk Evaluation - Soils

This risk evaluation quantitatively evaluates chemicals of concern and the affected media with respect to potential exposure pathways and receptors for the removal action. The removal action involves upgrading the existing cover over the former disposal area, stabilizing the riverbank, and integrating the upgrade to the landfill cover with the stabilized riverbank.

The potential pathways for human exposure at the Landfill include direct ingestion of soil, inhalation of dust, and dermal contact with contaminated soil and fugitive dusts. Potential human receptors include temporary on-site workers, parking lot users, and trespassers.

To establish the risk for the Landfill, a comparison of chemical concentrations in soils at the Landfill to the Missouri Department of Health Any-Use Soil levels for Residential Settings will be made. The any-use soil levels (ASL) are based on a residential setting and utilize a risk level of 1×10^{-5}. The risk level is the additional lifetime cancer risk posed by a concentration of a carcinogen.

A summary of the chemicals of concern in soils at the Landfill, maximum concentrations, and the ASL level for each chemical is presented below.

Chemical	Concentration Maximum (ppm)	ASL (ppm)
Aldrin	102.0	0.29
Bis(2-ethylhexyl) phthalate	4.1	100
Butyl benzyl phthalate	1.1	5,600
Chlordane	45.8	3.4
4,4-DDD	23.4	21
4,4-DDE	2.53	15
4,4-DDT	6.18	15
Dieldrin	0.673	0.31
Heptachlor	10.3	1.1
Heptachlor Epoxide	1.91	0.55
Lead	720	240
Zinc	1,200	17,000

The any-use soil levels were exceeded for aldrin, chlordane, 4,4-DDD, dieldrin, heptachlor, heptachlor epoxide, and lead. The results of the comparison of the chemicals of concern present in surface and subsurface soils to the any-use soil levels indicates that site conditions pose a health risk associated with direct contact with surface and subsurface soil at the Landfill.

To mitigate the risk posed by contaminated surface and subsurface soils, a capping system for the landfill is proposed.

REMOVAL ACTIVITIES

The removal activities focus on two separate areas of the Landfill, the Missouri Riverbank stabilization and the upgrade of the final cap system. The following describes the objectives for each area. The Landfill cap removal activities are further defined in Section 3 of this report.

Riverbank Stabilization

The riverbank stabilization project was successfully completed in the Spring of 1997. The primary objectives of the project included the following:

- Minimizing erosion of the riverbank.
- Preventing exposure of the landfilled materials.
- Stabilizing the riverbank to prevent future erosion.

Landfill Cap

The final step is to complete the work conducting an EE/CA pertaining to upgrading the Landfill cap. The potential removal alternatives are described in Section 3 of this report. However, the objectives of the Landfill cap upgrade include the following:

- Providing and maintaining a cover system to protect human health and the environment.
- Minimizing erosion of the cap.
- Provide topographic relief which minimizes infiltration through the cap into the Landfill.
- Minimizing erosion of cover soils during flooding of the Missouri River.
- Minimizing opportunities for public exposure to landfill debris, thus reducing real and perceived health risks.

LOCATION AND EXTENT OF CONTAMINATION

The Landfill site covers an area of approximately 14 acres. The trench method was used to dispose of waste in the Landfill. The area used for waste disposal is approximately 10 acres in size.

The contaminated soils are present from the surface to a depth of approximately 20 feet within this area. The approximate location of waste trenches as documented in an earlier report were shown on Figure 1-1.

REMOVAL ACTION SCHEDULE AND CONSTRAINTS

The non-time critical removal actions will be implemented according to a schedule which reflects time required for: reaching a decision on the type of removal action needed; collection of field data for use in design; finalizing construction documents; bidding and construction process; and City budgeting for the capital expenditure. At this time the City plans to begin final design upon agreement of the removal action and anticipates construction during the late Summer or Fall of 1998.

The scheduling constraints envisioned include the ability for the City to finance the project in 1998 and potential negotiations with the Missouri Department of Conservation to assist in the cost of paving for additional parking at their boat launch being constructed on the north side of the site.

SECTION 3

IDENTIFICATION AND SCREENING OF REMOVAL ACTION TECHNOLOGIES

This section describes the applicable or relevant and appropriate screening alternatives used for the development of the removal actions. The removal action selected for the Landfill includes capping, either with soil, asphalt paving, or a combination of each.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

A Superfund requirement is that removal alternatives be considered with respect to how they would comply with Applicable or Relevant and Appropriate Requirements (ARARs), performance standards, and specifications. The three alternatives to be considered are similar in that each involves placement and maintenance of a permanent cap upon the Landfill. For this reason the discussion which follows applies to each removal alternative. The ARARs analysis is summarized in this section:

a. *The EPA Presumptive Remedy for CERCLA Municipal Landfills.*

This document is relevant because it provides the basis for narrowing the search of technologies. Briefly, this study by the EPA of 30 randomly selected CERCLA municipal landfill sites found that containment was selected as a remedy at each site. Based on these findings, EPA allows other landfill investigations to bypass the RI/FS process and adopt the presumed remedy of source containment.

In addition, measures to control landfill leachate, affected leachate and landfill gas may be implemented as part of the presumptive remedy. Based on findings from the most recent groundwater and surface water sampling, neither groundwater and surface water sampling nor surface water remediation goals need be considered for the Landfill. Following the guidance provided in this ARAR, the technologies which are appropriate for this site can be narrowed to a single technology without the need for a matrix analysis of various goals and technologies.

b. *The Missouri Solid Waste Management (MSWM) law 1988 (Sections 260.200 to 260.245. RSMo, supplement 1973), and the MSWM Regulations, 10 CSR 80 (Effective December 29, 1988).*

Current Missouri Department of Natural Resources (MDNR) Solid Waste Management Regulations (10 CSR 80) for unlined landfills require at least two feet of compacted soil with a hydraulic conductivity of 1×10^{-5} centimeters per second (cm/sec) or less, overlain with one foot of soil capable of sustaining vegetative growth. The earlier version of the regulations cited above did not carry a requirement for the hydraulic conductivity of the two foot soil cap.

Conversations with the EPA indicate that a variance from the MDNR regulations could be granted if it can be demonstrated that an alternative capping method is equivalent to two feet of soil with a hydraulic conductivity of 1×10^{-5} cm/sec or less. An economic analysis that used geosynthetics with a reduced soil cap did not indicate a cost savings to the City. Therefore, geosynthetics were not considered in any of the cap systems. An asphalt cap can be demonstrated to perform with

hydraulic conductivity less than or equal to that of the soil cap. Such a demonstration will be made as part of the final design effort. If equivalence is demonstrated, alternative capping systems may be used to enhance site development.

c. The Resource Conservation and Recovery Act (RCRA) of 1976, as amended by the Hazardous and Solid Waste Amendments of 1984.

RCRA is not applicable or relevant and appropriate, due to the fact that all disposal took place before 1980.

d. The EPA Technical Guidance Document Construction Quality Assurance for Hazardous Waste Land Disposal Facilities, EPA 530-SW-86-031, OSWER Policy Directive Number 9472.00-3, October 1986.

This document was consulted in developing Construction Quality Assurance (CQA) requirements for the riverbank stabilization project and will be similarly consulted in preparation of final construction documents for the capping effort.

e. Section 404 of the Clean Water Act (CWA) and Section 10 of the River and Harbor Act of 1899 as they apply to the Site due to riverbank stabilization, dredging or fill material activities.

The U.S. Army Corps of Engineers (COE) was involved in review of the riverbank stabilization effort. SCS submitted an application for a Permit 13 and received notification that because the site was a Superfund site, such a permit was not required. The City assumes that the COE will similarly defer to the EPA for permits on the capping effort.

f. Federal and State endangered species regulations.

The U.S. Fish and Wildlife Service (Columbia, Missouri office) reviewed the riverbank stabilization project for Threatened and Endangered Species. The review found that the proposed activities would not endanger any species. Because the completed review was not limited to the riverbank area, another submittal is not planned for the Landfill cap project.

g. Missouri National Pollutant Discharge Elimination System (NPDES)

Contractors are required to comply with NPDES requirements during construction by utilizing available means to control surface water runoff. This could include construction of temporary or permanent sedimentation ponds depending on the final design.

h. Any upgrade required for the landfill cover and riverbank stabilization shall use soils free of organic contamination. As part of its evaluation of removal alternatives, Respondent shall propose a source for soil to be used for this purpose.

Construction documents for the riverbank stabilization required that capping materials be previously undisturbed soils from offsite location(s). Specifications for the capping project will be similarly written, if required by state and/or federal solid waste laws.

i. An investigation of the presence of methane in the landfill area and , if appropriate, a proposal for a methane venting system in the landfill cover.

MDNR regulations for active landfills require monitoring for methane gas at the property limits, but there are no such requirements for closed sites. Similarly, the New Source Performance Standards (NSPS) issued by the Federal Government March 10, 1996, does not apply to landfills closed prior to November 8, 1987.

During the riverbank stabilization project, a monitoring program was established to monitor for the presence of methane in the construction area. Methane was not encountered during the monitoring.

In addition, the absence of methane should be expected in an old landfill which burned waste before covering. Prior to the completion of the final design, additional gas monitoring will be conducted to verify that methane will not impact the anticipated removal action.

i. Each alternative shall be designed to accomplish the installation of the landfill cover and riverbank stablilization in a manner that will reduce the possibility of destruction of the cover due to upward hydrostatic pressures caused by flood conditions.

The riverbank stabilization provided a low permeability cover overlain with riprap. The cover was designed for saturated soil conditions which could result during periods of flooding. Installation of the cap should improve the site's ability to withstand flood conditions.

CAP DESIGN ALTERNATIVES

Three capping options for use in conjunction with the completed riverbank stabilization effort to provide suitable removal alternatives are considered in this section. The alternatives include the following:

- Removal Alternative 1 - Grading Entire Landfill with a Soil Cap
- Removal Alternative 2 - Grading Entire Landfill with Asphalt Paving
- Removal Alternative 3 - Grading Landfill with a Soil Cap and Paving

Removal Alternative No. 1 - Grading Entire Landfill with a Soil Cap

This alternative requires the grading of the site as presented on Figure 3-1. The following criteria were used for the soil cap alternative:

- Minimize fill. This grading plan, with two small mounds, was designed to minimize the amount of off-site material required for adequate drainage over the capped area.

- Minimum slopes for the soil cap of 5 percent. This allows adequate drainage, while reducing the chances of "ponding" due to differential settlement from the waste. Differential settlement should not be a problem due to the age of the landfill and relatively small surface area disturbed by disposal trenches.

- Minimum slopes for drainage swales of 1 percent. This allows for adequate storm water drainage to the temporary siltation ponds, while minimizing the need for off-site soils.

- Two foot soil cap with a permeability less than or equal to 1×10^{-5} cm/sec, per MDNR Solid Waste Management Regulations, (10 CSR 80).

- One foot vegetative cover soil per MDNR Solid Waste Management Regulations, (10 CSR 80).

- Use of institutional controls as appropriate to minimize the opportunities for exposure routes.

- Temporary storm water retention ponds as needed.

Temporary storm water retention ponds may be constructed in the northeast and southwest corners of the site. These ponds are required during construction to control sedimentation into Roy's Branch and the Missouri River. A temporary NPDES permit would be required during construction. After the Landfill is certified as closed, an NPDES permit would no longer be needed. Maintenance of the sedimentation ponds would not be required.

Removal Alternative No. 2 - Grading Entire Landfill with Asphalt Paving

This alternative uses a 4 inch pavement with a six inch base over the entire landfill area. The grading plan for this alternative is presented in Figure 3-2. Under this alternative, two storm water retention ponds would be constructed. Final elevations indicated on Figure 3-2 were developed assuming some disturbance of in-place wastes to allow adequate grading prior to paving. The asphalt cap would be graded to a minimum slope of 1 percent.

MDNR Solid Waste Program will be contacted, if disturbance of in-place waste is required. Waste encountered during the stabilization project was noted and relocated onsite to an area which received a soil cap.

The following design criteria were used for the asphalt cap:

- Minimize fill. The grading plan minimizes the amount of off-site material required for adequate drainage over the paved/capped area.

- Slopes for the paved area were graded at minimum slopes of 1 percent.

- Drainage pipes with minimum slopes of 0.5 percent will be used to carry storm water to the temporary storm water retention ponds.

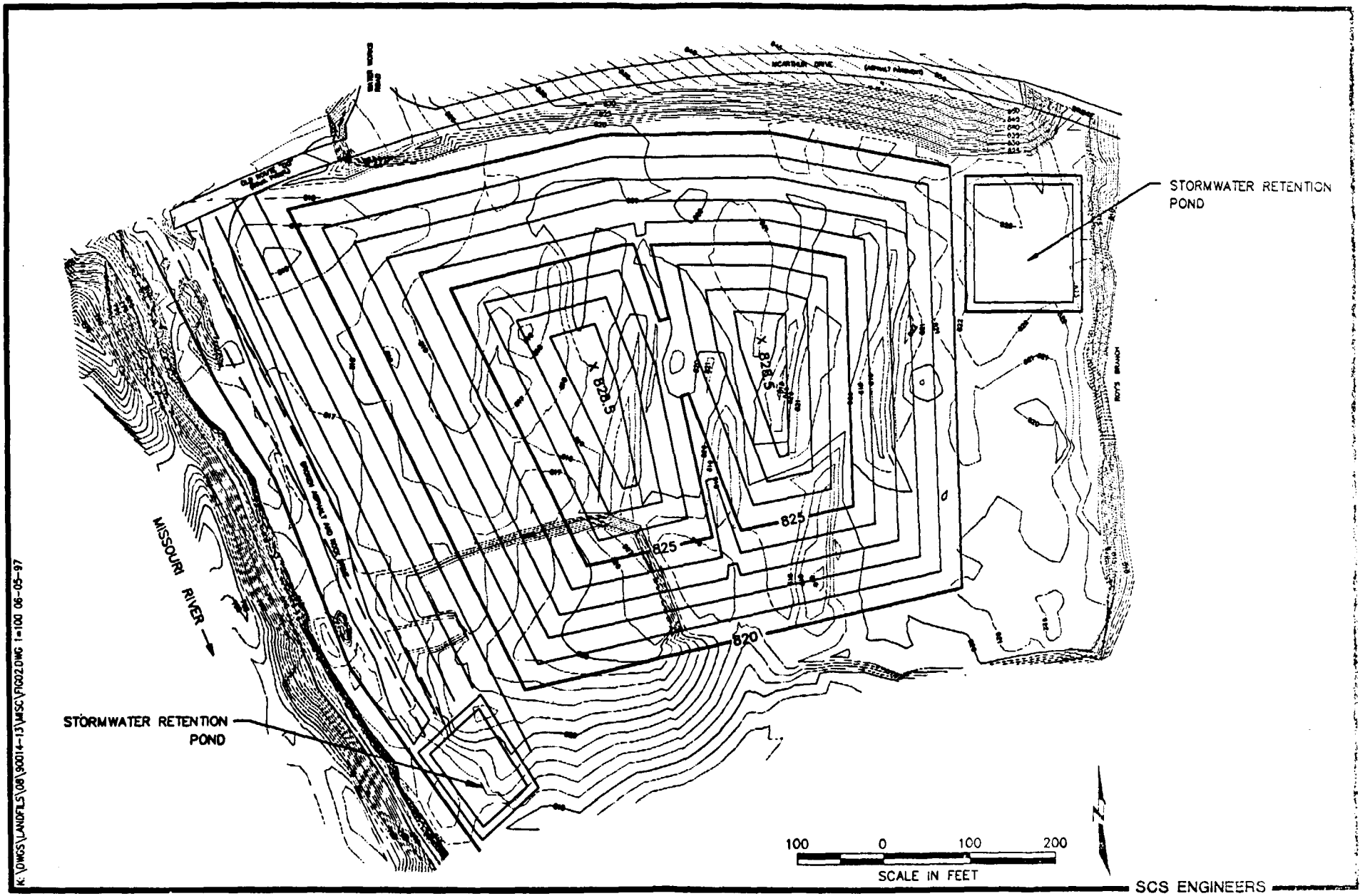
- The paved area consists of an alternative cover which can be demonstrated to provide the hydraulic properties equivalent to those of the two foot soil cap. (For cost estimating purposes it is assumed to be 4 inches of asphalt cement over a 6 inch sub-base.)

- In addition to monitoring for methane during construction, if warranted, a methane gas monitoring location will be proposed in the vicinity of the parking lot.

- Use of institutional controls as appropriate to minimize the opportunities for exposure routes.

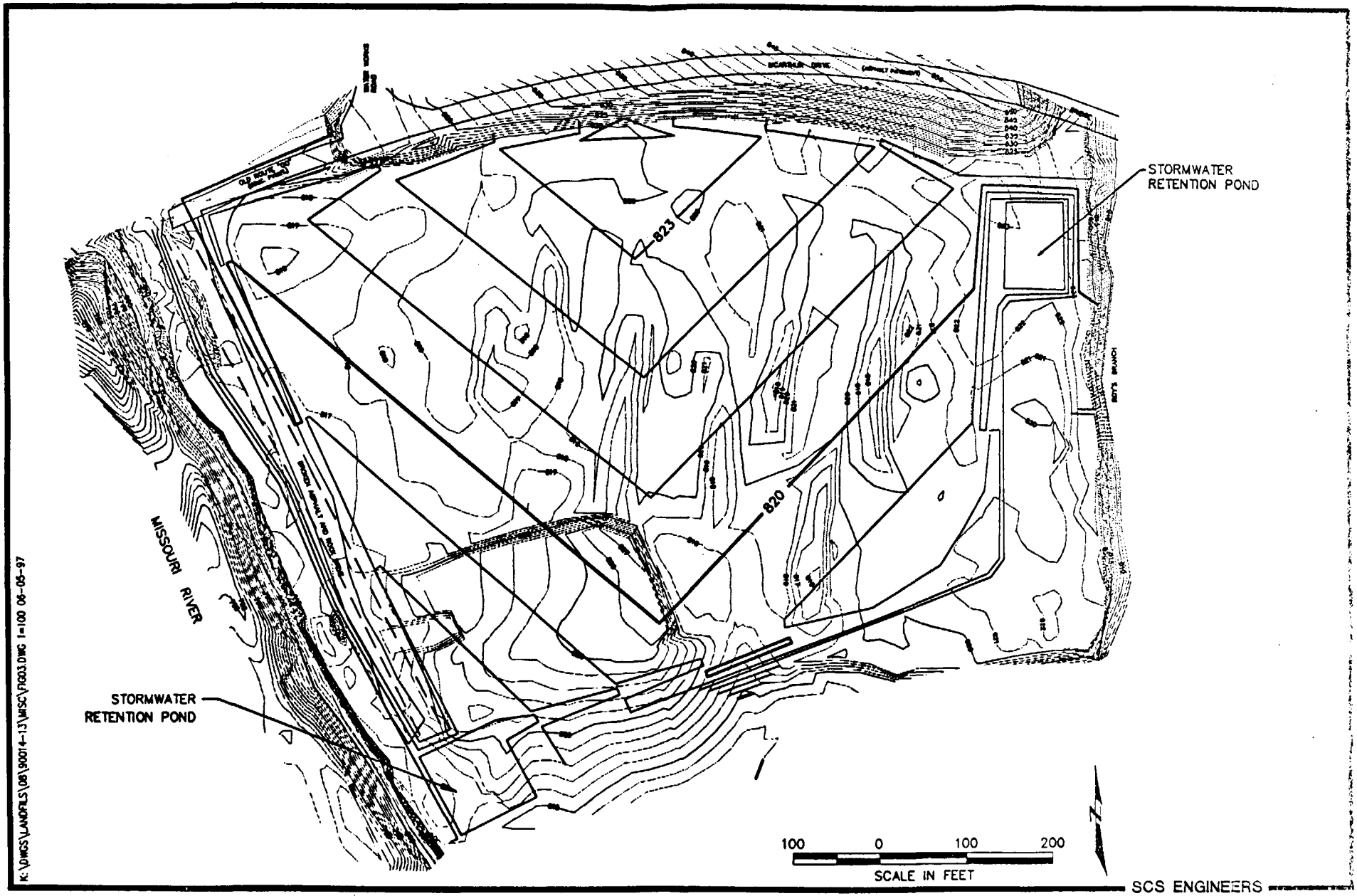
Removal Alternative No. 3 - Grading Landfill with a Soil Cap and Asphalt Paving

This alternative is a combination of the previous two alternatives. The grading plan for this alternative is presented in Figure 3-3. The western portion of the site would be graded at a minimum slope of 1 percent and a parking lot constructed over that area. The eastern portion of the site would be constructed with a minimum 5 percent slope and would receive a soil cap. Temporary and permanent storm water retention ponds would be required. The design criteria will be similar to those for the two previously described removal alternatives. This includes notification of the MDNR if disturbance of waste is anticipated and if landfill gas monitoring probes around the parking area indicate the presence of methane gas.



SCS ENGINEERS

FIGURE 3-1 - SOIL C



SCS ENGINEERS

FIGURE 3-2 - ASPHALT PAVING

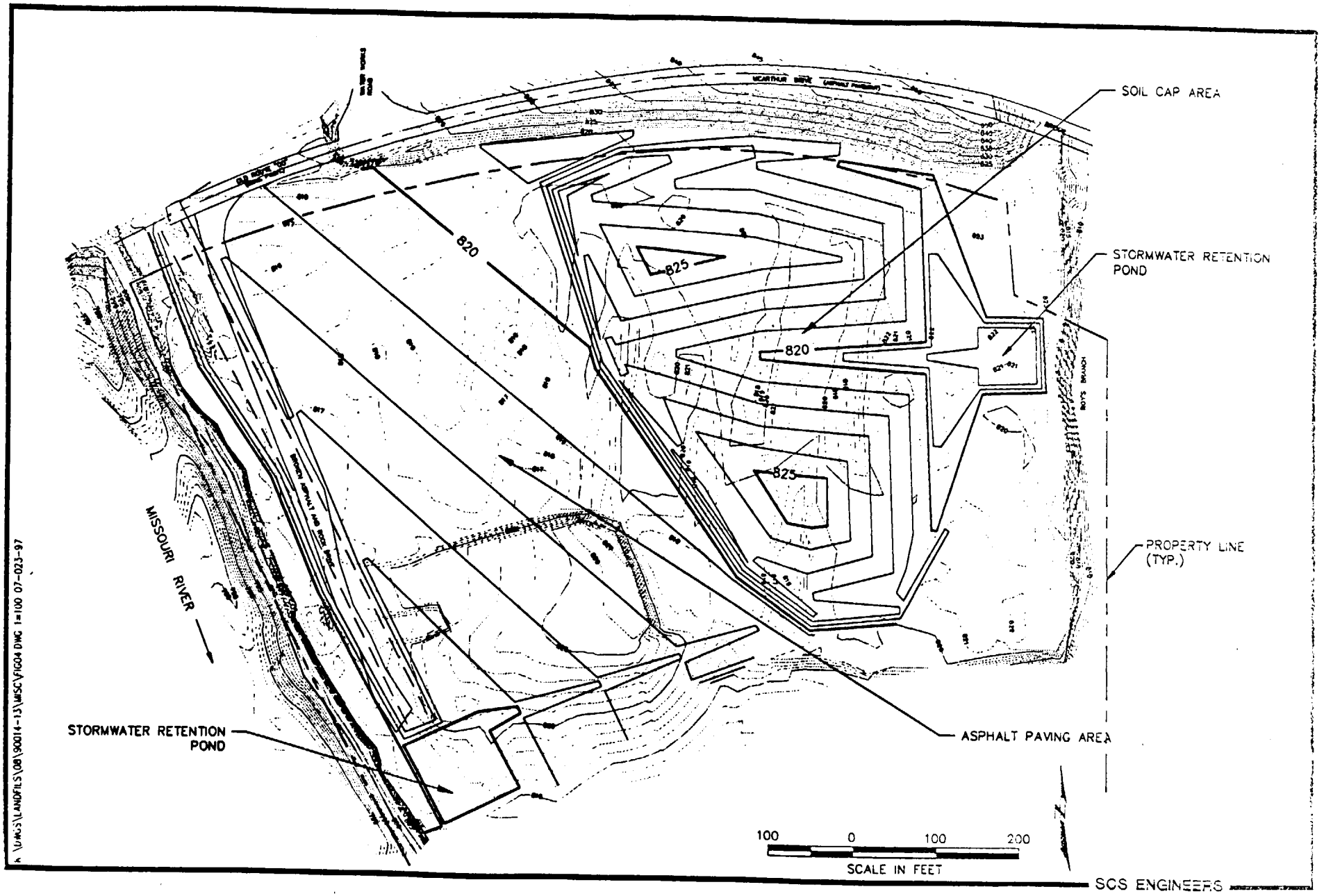


FIGURE 3-3 - SOIL CAP AND ASPHALT PAV

SECTION 4

REMOVAL ALTERNATIVES AND REMOVAL ACTION SCHEDULE

The degree to which each of the proposed removal alternatives can meet the removal action objectives and a comparative analysis of each alternative based on the factors listed below is presented in this section.

- Effectiveness: Evaluate the degree to which each alternative mitigates threats to human health and the environment.
- Implementability: Determine the technical and administrative feasibility of implementing the removal alternative. Advantages and disadvantages of the alternative will be listed to address implementability.
- Cost Analysis: Provide capital costs and annual maintenance costs for each removal alternative.

COMPARATIVE ANALYSIS OF REMOVAL ALTERNATIVES

The following describes the three removal alternatives. Advantages and disadvantages as well as estimated costs for each removal alternative are presented. The quantities for the riverbank stabilization have been included in the line items on the cost spreadsheets presented in the Appendices. However, since the riverbank stabilization project is complete, the Engineer's Estimate of $578,000 for that work has been subtracted from the overall costs.

Removal Alternative No. 1 - Grading Entire Landfill with a Soil Cap

Effectiveness--

As a technology for meeting the presumptive remedy of containment; use of a soil cap is effective.

Implementability--

The proposed technology is proven and readily available in the area. The interest shown in the capping portion of the bank stabilization by regional contractors is further evidence that this alternative is implementable. The following describes the advantages and disadvantages of this alternative.

Advantages--

- Cap would provide protection to human health and the environment by isolating the contaminated soils under the cap.
- This alternative is the least costly for initial construction.

- Additional permitting problems would be minimal for this alternative since proving a cap "equivalence" is not needed.

- Long-term maintenance costs would be the least costly for this alternative. The primary long-term care would be semi-annual mowing of the capped area. Cost for maintenance issues are presented in Exhibit 4 in Appendix B.

Disadvantages--

- With this alternative there would be minimal future end-use opportunities for this property. Development and use of the site would be restricted.

- Because this area's use would be restricted, it may adversely affect the value of the properties surrounding the site.

- This alternative requires the greatest amount of off-site soil.

Cost--

The estimated capital cost for this alternative, as developed in Exhibit 1 in Appendix A, is approximately $1,161,000. Unit costs were taken from Means Heavy Construction Cost Data and, where available, unit bid prices which SCS is aware of on projects in the St. Joseph area. Annual maintenance costs for this alternative are estimated to be $9,854 as shown in Exhibit 4 in Appendix B. Net Present Value of Alternative No. 1 is $1,340,436 as developed in Exhibit 5 in Appendix C.

Removal Alternative No. 2 - Grading Entire Landfill with Asphalt Paving

Effectiveness--

As a technology for meeting the presumptive remedy of containment; use of an asphalt cap with appropriate maintenance is effective.

Implementability--

The proposed technology has been used for the capping and partial capping of other CERCLA sites. With proper quality control and quality assurance, this type of construction can be performed by regional contractors. The following describes the advantages and disadvantages of this alternative.

Advantages--

- This alternative would provide approximately 9.2 acres of parking for the City. This large parking area could have multiple uses including:

  - Additional parking for the Missouri Conservation Department's boat launch.
  - Parking for adjacent land development.

- A parking area on this property may enhance the value and use of neighboring properties.

Disadvantages--

- Initial costs are highest for this alternative.
- Development of structures in flood plains is limited.
- Long-term maintenance for this alternative is higher than other alternatives. Annual inspection, repairing and sealing of the asphalt parking area may be required. Annual maintenance of the sedimentation ponds will be required. Maintenance costs are presented in Exhibit 4 in Appendix B.

Cost--

The estimated capital cost for this alternative, as developed in Exhibit 2 in Appendix A, is approximately $1,283,000. Unit costs were taken from Means Heavy Construction Cost Data and, where available, unit bid prices which SCS is aware of on projects in the St. Joseph area. Annual maintenance costs for this alternative are estimated to be $47,880 as shown in Exhibit 4 in Appendix B. Net Present Value of this alternative is $2,154,672 as developed in Exhibit 5 in Appendix C. .

Removal Alternative No. 3 - Grading Landfill with a Soil Cap and Asphalt Paving

Effectiveness--

As a technology for meeting the presumptive remedy of containment; the use of a soil cap in conjunction with an asphalt cap with appropriate maintenance is effective.

Implementability--

Regional contractors familiar with both soil capping and asphalt paving are available. The asphalt cap will require use of quality control and quality assurance measures beyond those required for traditional asphalt projects. The following describes the advantages and disadvantages of this alternative.

Advantages--

- This alternative would provide approximately 5 acres of parking for the City. This large parking area could have multiple uses including:
  - Additional parking for the Missouri Conservation Department's boat launch.
  - Parking for adjacent land development.
- Costs for this alternative are less than those associated with Alternative No. 2.

Disadvantages--

- Initial costs are higher for this alternative than for the soil cap.

- Long-term maintenance for this alternative is higher than Alternative No. 1. Annual inspection and repairing and sealing of the asphalt parking area may be required. Annual maintenance of the western sedimentation pond will be required. Maintenance cost are presented in Exhibit 4 in Appendix B.

Cost--

The estimated cost for this alternative, as developed in Exhibit 3 in Appendix A, is approximately $1,273,000. Unit costs were taken from Means Heavy Construction Cost Data and, where available, and unit bid prices which SCS is aware of on projects in the St. Joseph area. Annual maintenance costs for this alternative are estimated to be $32,164 as shown in Exhibit 4 in Appendix B. Net Present Value of Alternative 3 is $1,776,281 as developed in Exhibit 5 in Appendix C.

SECTION 5

PROPOSED REMOVAL ALTERNATIVE

The recommended alternative for non-time critical removal action at the closed City of St. Joseph (City) McArthur Drive Landfill (Landfill) is Removal Alternative No. 3. This alternative includes capping the remaining site with a combined soil and asphalt cover system. It involves filling and grading most of the site and installing two cover systems. The cover on the western portion of the site will consist of a sub-base over compacted soils overlain by an asphaltic surface. This cap will be designed so that it has hydraulic properties equal to or greater than a soil cap and will maintain its structural integrity atop potentially unstable soils. The east portion of the site will consist of a two foot soil cap with hydraulic conductivity equal to or less than 1×10^{-5} cm/sec with six inches of topsoil.

This alternative will reduce erosion potential by improving surface drainage and establishing a consistent vegetative cover on the Landfill surface. Leaching potential will be reduced by eliminating the opportunities for retention of storm water in the soils. Identified ARARs can be satisfied by the implementation of this alternative. The option satisfies risk assessment concerns at the site by employing an alternative which is technically and administratively feasible.

The capital costs to be borne by the City for this capping project are significant, but the enhancement of the site through this alternative which includes possible parking for up to 1,000 vehicles is attractive given the increased utilization of this riverfront area of the City. The City has the resources to commit to maintaining both the soil and asphaltic covers included in this alternative.

APPENDIX A

CAPITAL COSTS

MCARTHUR DRIVE LANDFILL, ST. JOSEPH, MO.
STREAM BANK STABILIZATION and CAPPING
SCS File 890014.13

EXHIBIT 1

ALTERNATIVE 1 - RIPRAP BLANKET/GRADING ENTIRE LANDFILL WITH A SOIL CAP

ITEM DESCRIPTION	QUANTITY	UNIT	MATERIAL COST UNIT COST	MATERIAL COST SUB-TOTAL	LABOR COST UNIT COST	LABOR COST SUB-TOTAL	EQUIPMENT COST UNIT COST	EQUIPMENT COST SUB-TOTAL	COMBINED COST UNIT COST	COMBINED COST SUB-TOTAL
DIVISION 1 GENERAL										
MOBILIZATION/DEMOBILIZATION (2% OF TOTAL CONST. COST)	1	LS								$22,095
DIVISION 2 SITEWORK										
CLEAR AND GRUB LIGHT, TREES TO 6" DIAM., CUT & CHIP, GRUB STUMPS AND REMOVE (MEANS 021 100 104 0010 & 0150)	1	ACRE			$1,293.00	$647	$1,910.00	$955	$3,203.00	$1,602
STRIP 2" TOPSOIL, STOCKPILE FOR LATER USE (MEANS 021 140 144 0100)	230	CY			$0.25	$58	$0.74	$170	$0.99	$225
WASTE EXCAVATION (ONSITE WASTE DEPOSIT)(FROM STREAMBAN (SCS)	4,300	CY			$12.00	$51,600	$3.00	$12,900	$15.00	$64,500
OFF SITE BORROW (SCS)	17,100	CY	$6.00	$102,600		$0		$0	$6.00	$102,600
EXCAVATION, BULK, SCRAPERS, (MEANS 022 200 246 0300)	12,000	CY			$0.56	$6,720	$1.55	$18,600	$2.11	$25,320
BACKFILL, BULK (SCS)	33,400	CY			$1.00	$33,400	$2.00	$66,800	$3.00	$100,200
24" INFILTRATION LAYER (SCS)	37,400	CY	$8.00	$299,200					$8.00	$299,200
SPREADING AND COMPACTION OF INFILTRATION LAYER (MEANS 022 200 226 5640)	37,400	CY			$0.22	$8,228	$0.42	$15,708	$0.64	$23,936
SPREADING OF INTERMEDIATE COVER (MEANS 022 200 226 5640)	18,700	CY			$0.22	$4,114	$0.42	$7,854	$0.64	$11,969
SPREADING OF 12 in TOPSOIL (MEANS 029 200 204 5200)	18,700	CY	$12.50	$233,750	$0.57	$10,659	$2.22	$41,514	$15.29	$285,923
HYDROSEEDING (SEED, FERTILIZER & WOOD MULCH) (MEANS 029 300 308 2400)	520	MSF	$22.50	$11,700	$6.60	$3,432	$7.20	$3,744	$36.30	$18,876
RIPRAP RANDOM, BROKEN STONE, MACHINE PLACED FOR SLOPE PROTECTION (MEANS 022 700 712 0100)	6,500	CY	$10.00	$65,000	$6.30	$40,950	$7.60	$49,400	$23.90	$155,350
PAVEMENT BASE, 6 in deep (MEANS 022 300 308 0100)	648	SY	$4.42	$2,865	$0.23	$149	$0.29	$188	$4.94	$3,202
ASPHALTIC CONCRETE PAVEMENT, 2 in Binder (MEANS 025 300 104 0120)	648	SY	$2.71	$1,756	$0.30	$194	$0.26	$169	$3.27	$2,119
ASPHALTIC CONCRETE PAVEMENT, 2 in Wearing (MEANS 025 300 104 0380)	648	SY	$2.98	$1,931	$0.33	$214	$0.30	$194	$3.61	$2,340
EXCAVATING, TRENCH, 6' to 10' (MEANS 022 200 254 0510)	0	CY			$0.97	$0	$1.38	$0	$2.35	$0
BEDDING, CRUSHED STONE, 3/4"-1/2" (MEANS 026 010-012 0100)	0	CY	$13.00	$0	$3.43	$0	$1.39	$0	$17.82	$0
BACKFILL, STRUCTURAL, no compaction (MEANS 022 200 208 2020)	0	CY			$0.29	$0	$0.29	$0	$0.58	$0
PIPING SUBDRAINAGE, 8 in Plastic (MEANS 027 100 111 0080)	0	LF	$2.25	$0	$0.45	$0			$2.70	$0
CATCH BASIN (MEANS 027 150 152 1120)	0	EA	$385.00	$0	$171.00	$0	$69.50	$0	$625.50	$0
SUBTOTAL (CONSTRUCTION COST)										$1,119,758

MCARTHUR DRIVE LANDFILL, ST. JOSEPH, MO.
STREAM BANK STABILIZATION and CAPPING
SCS File 890014.13

EXHIBIT 1 (CONTINUED)

ALTERNATIVE 1 - RIPRAP BLANKET/GRADING ENTIRE LANDFILL WITH A SOIL CAP

ITEM DESCRIPTION	QUANTITY		MATERIAL COST		LABOR COST		EQUIPMENT COST		COMBINED COST	
		UNIT	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL
PERMITTING										
SURVEYING (AREA FOR WASTE REDEPOSIT)	1	LS				COMPLETED				$0
HEALTH & SAFETY PLAN	1	LS				$5,000				$5,000
PERMIT APPLICATIONS USACOE - INDIVIDUAL PERMIT WATER QUALITY CERTIFICATE WETLAND PERMIT	1	LS				$20,000				$20,000
WETLAND DELENEATION (FOR AREAS THAT WILL BE DISTURBED BY THE STABILIZATION ACTIVITY AND AREAS THAT HAVE BEEN SCOURED.)	1	LS				COMPLETED				$0
WASTE RELOCATION PLAN (FOR MDNR)	1	LS				COMPLETED				$0
CONSTRUCTION QA CERTIFICATION	1	LS				$30,000				$30,000
SUBTOTAL (CONSTRUCTION AND PERMITTING COSTS)										$1,174,758
ADMINISTRATIVE										
MATERIAL SUBTOTAL				$718,803						
LABOR SUBTOTAL 15% LABOR MARKUP						$215,364 $32,305				
SUBTOTAL										$1,207,063
15% OVERHEAD AND PROFIT (MEANS 010 062 0400)										$181,059
SUBTOTAL (CONSTRUCTION, AND PERMITTING COSTS)										$1,388,123
SUBTOTAL 1% PERFORMANCE BOND ON CONSTRUCTION COST										$1,207,063 $12,071
SUBTOTAL 3.5% ESCALATION										$1,400,199 $49,007
SUBTOTAL CONTINGENCY, 20%										$1,449,206 $289,840
TOTAL PROJECT COST										$1,739,046

MCARTHU E LANDFILL, ST. JOSEPH, MO.
STREAM BANK STABILIZATION and CAPPING
SCS File 890014.13

EXHIBIT 2

ALTERNATIVE 2 - RIPRAP BLANKET/ASPHALT PAVING

ITEM DESCRIPTION	QUANTITY		MATERIAL COST		LABOR COST		EQUIPMENT COST		COMBINED COST	
		UNIT	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL
DIVISION 1 GENERAL										
MOBILIZATION/DEMOBILIZATION (2% OF TOTAL CONST. COST)	1	LS								$23,916
DIVISION 2 SITEWORK										
CLEAR AND GRUB LIGHT, TREES TO 6" DIAM., CUT & CHIP, GRUB STUMPS AND REMOVE (MEANS 021 100 104 0010 & 0150)	0.5	ACRE			$1,293.00	$647	$1,910.00	$955	$3,203.00	$1,602
STRIP 2" TOPSOIL, STOCKPILE FOR LATER USE (MEANS 021 140 144 0100)	230	CY			$0.25	$58	$0.74	$170	$0.99	$228
WASTE EXCAVATION (ONSITE WASTE DEPOSIT)(FROM STREAMBAN (SCS)	4,300	CY			$12.00	$51,600	$3.00	$12,900	$15.00	$64,500
OFF SITE BORROW (SCS)	8,900	CY	$6.00	$53,400		$0		$0	$6.00	$53,400
EXCAVATION, BULK, SCRAPERS, (MEANS 022 200 246 0300)	17,500	CY			$0.56	$9,800	$1.55	$27,125	$2.11	$36,925
BACKFILL, BULK (SCS)	30,700	CY			$1.00	$30,700	$2.00	$61,400	$3.00	$92,100
24" INFILTRATION LAYER (SCS)	0	CY	$8.00	$0					$8.00	$0
SPREADING AND COMPACTION OF INFILTRATION LAYER (MEANS 022 200 226 5640)	0	CY			$0.22	$0	$0.42	$0	$0.64	$0
SPREADING OF INTERMEDIATE COVER (MEANS 022 200 226 5640)	20,667	CY			$0.22	$4,547	$0.42	$8,680	$0.64	$13,227
SPREADING OF 12 in TOPSOIL (MEANS 029 200 204 5200)	0	CY	$12.50	$0	$0.57	$0	$2.22	$0	$15.29	$0
HYDROSEEDING (SEED, FERTILIZER & WOOD MULCH) (MEANS 029 300 308 2400)	28	MSF	$22.50	$630	$6.60	$185	$7.20	$202	$36.30	$1,016
RIPRAP RANDOM, BROKEN STONE, MACHINE PLACED FOR SLOPE PROTECTION (MEANS 022 700 712 0100)	6,500	CY	$10.00	$65,000	$6.30	$40,950	$7.60	$49,400	$23.90	$155,350
PAVEMENT BASE, 6 in deep (MEANS 022 300 308 0100)	62,000	SY	$4.42	$274,040	$0.23	$14,260	$0.29	$17,980	$4.94	$306,280
ASPHALTIC CONCRETE PAVEMENT, 2 in Binder (MEANS 025 300 104 0120)	62,000	SY	$2.71	$168,020	$0.30	$18,600	$0.26	$16,120	$3.27	$202,740
ASPHALTIC CONCRETE PAVEMENT, 2 in Wearing (MEANS 025 300 104 0380)	62,000	SY	$2.98	$184,760	$0.33	$20,460	$0.30	$18,600	$3.61	$223,820
EXCAVATING, TRENCH, 6' to 10' (MEANS 022 200 254 0510)	2,000	CY			$0.97	$1,940	$1.38	$2,760	$2.35	$4,700
BEDDING, CRUSHED STONE, 3/4"-1/2" (MEANS 026 010 012 0100)	100	CY	$13.00	$1,300	$3.43	$343	$1.39	$139	$17.82	$1,782
BACKFILL, STRUCTURAL, no compaction (MEANS 022 200 208 2020)	2,000	CY			$0.29	$580	$0.29	$580	$0.58	$1,160
PIPING SUBDRAINAGE, 8 in Plastic (MEANS 027 100 111 0080)	1,400	LF	$2.25	$3,150	$0.45	$630			$2.70	$3,780
CATCH BASIN (MEANS 027 150 152 1120)	15	EA	$385.00	$5,775	$171.00	$2,565	$69.50	$1,043	$625.50	$9,383
SUBTOTAL (CONSTRUCTION COST)										$1,195,916

MCARTHUR . LANDFILL, ST. JOSEPH, MO.
STREAM BANK STABILIZATION and CAPPING
SCS File 890014.13

EXHIBIT 2 (CONTINUED)

ALTERNATIVE 2 - RIPRAP BLANKET/ASPHALT PAVING

ITEM DESCRIPTION	QUANTITY		MATERIAL COST		LABOR COST		EQUIPMENT COST		COMBINED COST	
		UNIT	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL
PERMITTING										
SURVEYING (AREA FOR WASTE REDEPOSIT)	1	LS				COMPLETED				$0
HEALTH & SAFETY PLAN	1	LS				$5,000				$5,000
LANDFILL GAS SURVEY	1	LS				$2,500				$2,500
PERMIT APPLICATIONS USACOE - INDIVIDUAL PERMIT WATER QUALITY CERTIFICATE WETLAND PERMIT	1	LS				$20,000				$20,000
WETLAND DELENEATION (FOR AREAS THAT WILL BE DISTURBED BY THE STABILIZATION ACTIVITY AND AREAS THAT HAVE BEEN SCOURED.)	1	LS				COMPLETED				$0
WASTE RELOCATION PLAN (FOR MDNR)	1	LS				COMPLETED				$0
CONSTRUCTION QA CERTIFICATION	1	LS				$30,000				$30,000
SUBTOTAL (CONSTRUCTION AND PERMITTING COSTS)										$1,253,410
ADMINISTRATIVE										
MATERIAL SUBTOTAL				$756,075						
LABOR SUBTOTAL						$255,363				
15% LABOR MARKUP						$38,305				
SUBTOTAL										$1,291,714
15% OVERHEAD AND PROFIT (MEANS 010 062 0400)										$193,757
SUBTOTAL (CONSTRUCTION, AND PERMITTING COSTS)										$1,485,472
SUBTOTAL										$1,291,714
1% PERFORMANCE BOND ON CONSTRUCTION COST										$12,917
SUBTOTAL										$1,498,389
3.5% ESCALATION										$52,444
SUBTOTAL										$1,550,832
CONTINGENCY, 20%										$310,166
TOTAL PROJECT COST										$1,860,999

MCARTHUR DRIVE LANDFILL, ST. JOSEPH, MO.
STREAM BANK STABILIZATION and CAPPING
SCS File 890014.13

EXHIBIT 3

ALTERNATIVE 3 - RIPRAP BLANKET/ASPHALT PAVING and SOIL CAP

ITEM DESCRIPTION	QUANTITY		MATERIAL COST		LABOR COST		EQUIPMENT COST		COMBINED COST	
		UNIT	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL
DIVISION 1 GENERAL										
MOBILIZATION/DEMOBILIZATION (2% OF TOTAL CONST. COST)	1	LS								$23,624
DIVISION 2 SITEWORK										
CLEAR AND GRUB LIGHT, TREES TO 6" DIAM., CUT & CHIP, GRUB STUMPS AND REMOVE (MEANS 021 100 104 0010 & 0150)	0.5	ACRE			$1,293.00	$647	$1,910.00	$955	$3,203.00	$1,602
STRIP 2" TOPSOIL, STOCKPILE FOR LATER USE (MEANS 021 140 144 0100)	230	CY			$0.25	$58	$0.74	$170	$0.99	$228
WASTE EXCAVATION (ONSITE WASTE DEPOSIT) (SCS)	4,300	CY			$12.00	$51,600	$3.00	$12,900	$15.00	$64,500
OFF SITE BORROW (SCS)	14,200	CY	$6.00	$85,200					$6.00	$85,200
EXCAVATION, BULK, SCRAPERS, (MEANS 022 200 246 0300)	13,500	CY			$0.56	$7,560	$1.55	$20,925	$2.11	$28,485
BACKFILL, BULK (SCS)	32,000	CY			$1.00	$32,000	$2.00	$64,000	$3.00	$96,000
24" INFILTRATION LAYER (SCS)	16,780	CY	$8.00	$134,240					$8.00	$134,240
SPREADING AND COMPACTION OF INFILTRATION LAYER (MEANS 022 200 226 5640)	16,780	CY			$0.22	$3,692	$0.42	$7,048	$0.64	$10,739
SPREADING OF INTERMEDIATE COVER (MEANS 022 200 226 5640)	8,390	CY			$0.22	$1,846	$0.42	$3,524	$0.64	$5,370
SPREADING OF 12 in TOPSOIL (MEANS 029 200 204 5200)	8,390	CY	$12.50	$104,875	$0.57	$4,782	$2.22	$18,626	$15.29	$128,283
HYDROSEEDING (SEED, FERTILIZER & WOOD MULCH) (MEANS 029 300 308 2400)	227	MSF	$22.50	$5,097	$6.60	$1,495	$7.20	$1,631	$36.30	$8,223
RIPRAP RANDOM, BROKEN STONE, MACHINE PLACED FOR SLOPE PROTECTION (MEANS 022 700 712 0100)	6,500	CY	$10.00	$65,000	$6.30	$40,950	$7.60	$49,400	$23.90	$155,350
PAVEMENT BASE, 6 in deep (MEANS 022 300 308 0100)	36,300	SY	$4.42	$160,446	$0.23	$8,349	$0.29	$10,527	$4.94	$179,322
ASPHALTIC CONCRETE PAVEMENT, 2 in Binder (MEANS 025 300 104 0200)	36,300	SY	$2.71	$98,373	$0.46	$16,698	$0.41	$14,883	$3.58	$129,954
ASPHALTIC CONCRETE PAVEMENT, 2 in Wearing (MEANS 025 300 104 0380)	36,300	SY	$2.98	$108,174	$0.33	$11,979	$0.30	$10,890	$3.61	$131,043
EXCAVATING, TRENCH, 6' to 10' (MEANS 022 200 254 0510)	1,000	CY			$0.97	$970	$1.38	$1,380	$2.35	$2,350
BEDDING, CRUSHED STONE, 3/4"-1/2" (MEANS 026 010 012 0100)	50	CY	$13.00	$650	$3.43	$172	$1.39	$70	$17.82	$891
BACKFILL, STRUCTURAL, no compaction (MEANS 022 200 208 2020)	1,000	CY			$0.29	$290	$0.29	$290	$0.58	$580
PIPING SUBDRAINAGE, 8 in Plastic (MEANS 027 100 111 0080)	700	LF	$2.25	$1,575	$0.45	$315			$2.70	$1,890
CATCH BASIN (MEANS 027 150 152 1120)	5	EA	$385.00	$1,925	$171.00	$855	$69.50	$348	$625.50	$3,128
SUBTOTAL (CONSTRUCTION COST)										$1,191,201

MCARTHUR DRIVE LANDFILL, ST. JOSEPH, MO.
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EXHIBIT 3 (CONTIUED)

ALTERNATIVE 3 - RIPRAP BLANKET/ASPHALT PAVING and SOIL CAP

ITEM DESCRIPTION	QUANTITY		MATERIAL COST		LABOR COST		EQUIPMENT COST		COMBINED COST	
		UNIT	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL
PERMITTING										
SURVEYING (AREA FOR WASTE REDEPOSIT)	1	LS				COMPLETED				$0
HEALTH & SAFETY PLAN	1	LS				$5,000				$5,000
LANDFILL GAS SURVEY	1	LS				$2,500				$2,500
PERMIT APPLICATIONS USACOE - INDIVIDUAL PERMIT WATER QUALITY CERTIFICATE WETLAND PERMIT	1	LS				$20,000				$20,000
WETLAND DELENEATION (FOR AREAS THAT WILL BE DISTURBED BY THE STABILIZATION ACTIVITY AND AREAS THAT HAVE BEEN SCOURED.)	1	LS				COMPLETED				$0
WASTE RELOCATION PLAN (FOR MDNR)	1	LS				COMPLETED				$0
CONSTRUCTION QA CERTIFICATION	1	LS				$30,000				$30,000
SUBTOTAL (CONSTRUCTION AND PERMITTING COSTS)										$1,248,701
ADMINISTRATIVE										
MATERIAL SUBTOTAL				$765,555						
LABOR SUBTOTAL						$241,756				
15% LABOR MARKUP						$36,263				
SUBTOTAL										$1,284,964
15% OVERHEAD AND PROFIT (MEANS 010 062 0400)										$192,745
SUBTOTAL (CONSTRUCTION, AND PERMITTING COSTS)										$1,477,709
SUBTOTAL										$1,284,964
1% PERFORMANCE BOND ON CONSTRUCTION COST										$12,950
SUBTOTAL										$1,490,559
3.5% ESCALATION										$52,170
SUBTOTAL										$1,542,729
CONTINGENCY, 20%										$308,545
TOTAL PROJECT COST										$1,851,273

APPENDIX B

MAINTENANCE COST

MCARTHUR DRIVE LANDFILL, ST. JOSEPH, MO.
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EXHIBIT 4

ANNUAL MANTENACE COSTS

ITEM DESCRIPTION	QUANTITY		MATERIAL COST		LABOR COST		EQUIPMENT COST		COMBINED COST	
		UNIT	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL	UNIT COST	SUB-TOTAL
ALTERNATIVE 1 - GRADING ENTIRE LANDFILL WITH A SOIL CAP										
MOWING LIGHT BRUSH, TRACTOR WITH ROTARY MOWER (MEANS 029 700 730 1660)	520	MSF			$9.35	$4,862	$9.60	$4,992	$18.95	$9,854
TOTAL ANNUAL MAINTENACE COST										$9,854
ALTERNATIVE 2 - GRADING ENTIRE LANDFILL WITH ASPHALT PAVIN										
SURFACING, SLURRY SEALING, 1 COAT (MEANS 025 450 458 2240)	62,000	SY	$0.57	$35,340	$0.09	$5,580	$0.08	$4,960	$0.74	$45,880
EXCAVATE AND HAUL SILT FROM BASINS (SCS)	2	LS							$1,000.00	$2,000
TOTAL ANNUAL MAINTENACE COST										$47,880
ALTERNATIVE 3 - GRADING LANDFILL WITH SOIL CAP AND ASPHALT										
MOWING LIGHT BRUSH, TRACTOR WITH ROTARY MOWER (MEANS 029 700 730 1660)	227	MSF			$9.35	$2,122	$9.60	$2,179	$18.95	$4,302
SURFACING, SLURRY SEALING, 1 COAT (MEANS 025 450 458 2240)	36,300	SY	$0.57	$20,691	$0.09	$3,267	$0.08	$2,904	$0.74	$26,862
EXCAVATE AND HAULT SILT FROM BASIN (SCS)	1	LS							$1,000.00	$1,000
TOTAL ANNUAL MAINTENACE COST										$32,164

APPENDIX C

NET PRESENT VALUE

MCARTHUR DRIVE LANDFILL, ST. JOSEPH, MO.
STREAM BANK STABILIZATION and CAPPING
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NET PRESENT VALUE ANALYSIS

EXHIBIT 5

ITEM DESCRIPTION	CAPITAL COSTS (1997$)	ANNUAL MAINT COSTS (1997$)	NET PRESENT VALUE		
			CAPITAL (1997$)	MAINT (1997$)	TOTAL COSTS (1997$)
ALTERNATIVE 1 - GRADING ENTIRE LANDFILL WITH A SOIL CAP					
	1,739,040	9,854	1,739,040	179,396	1,918,436
ALTERNATIVE 2 - GRADING ENTIRE LANDFILL WITH ASPHALT PAVING					
	1,860,999	47,880	1,860,999	871,673	2,732,672
ALTERNATIVE 3 - GRADING LANDFILL WITH SOIL CAP AND ASPHALT					
	1,851,273	32,164	1,851,273	585,557	2,436,830