REMOVAL ACTION WORK PLAN

FOR THE

FORMER RALSTON DISPOSAL SITE

Prepared for

ROCKWELL INTERNATIONAL CORPORATION
CEDAR RAPIDS, IOWA

Project No. 1166.0254

May 1994

Prepared by

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I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of Iowa.

Signature: _____

Name: Jeffrey L. Coon, P.E.

Date: 5-17-94 Reg. No.: 11975

My registration expires December 31, 1994

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INTRODUCTION

OBJECTIVES

This Removal Action Work Plan (RAWP) has been prepared by Montgomery Watson on behalf of Rockwell International Corporation (Rockwell) for the former Ralston disposal (Ralston) site in Cedar Rapids, Iowa. This RAWP is submitted as a requirement of the Administrative Order on Consent, Docket Number VII-93-F-004 (Consent Order), entered into on January 22, 1993, between Rockwell and the U.S. Environmental Protection Agency (EPA). The purpose of this RAWP is to present the selected removal actions, as identified by the Removal Action Decision document, and the strategy for activities associated with design and construction of the selected removal actions at the Ralston site. Specific objectives of the RAWP are:

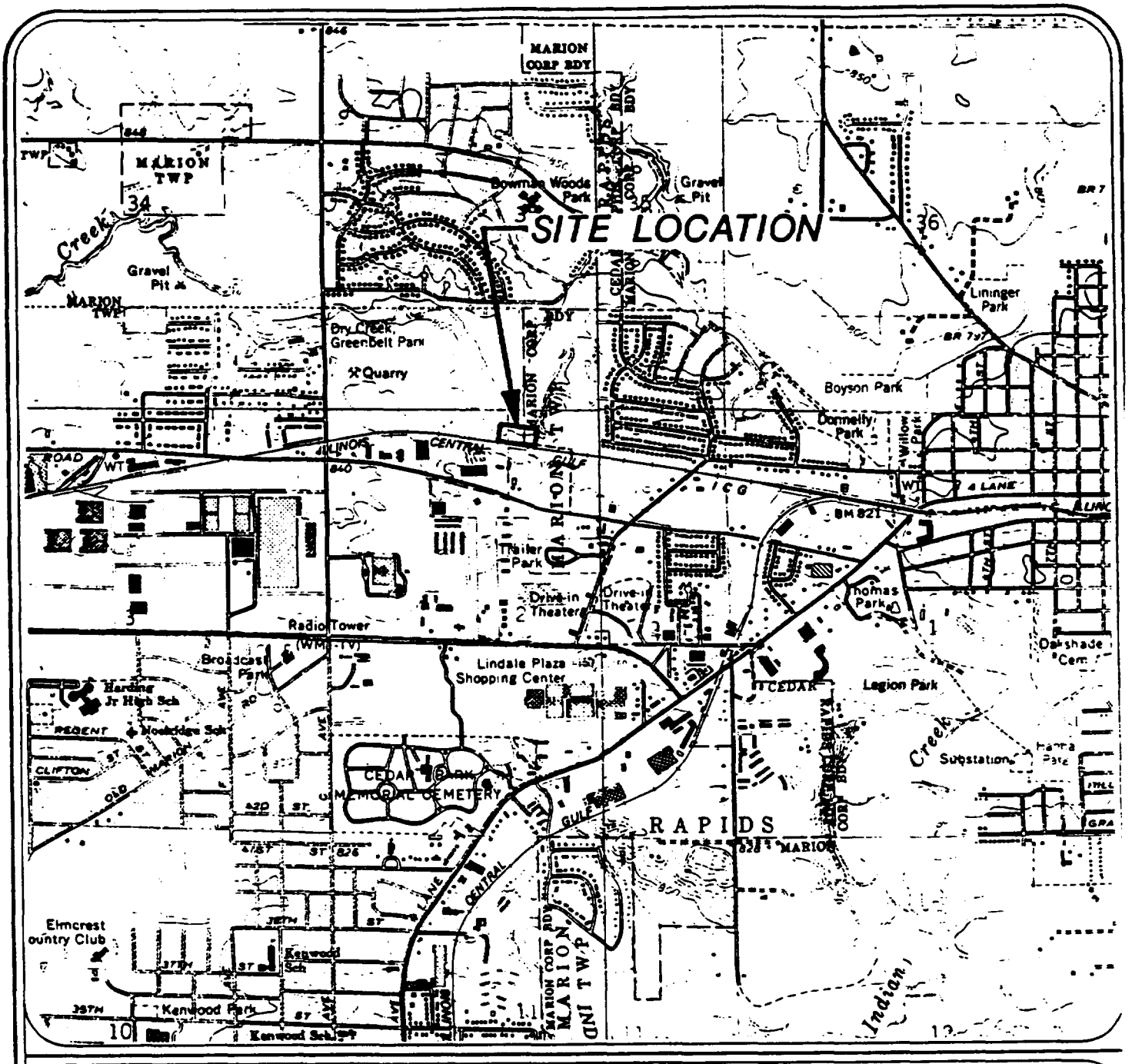
- Present the project organization for design and implementation of the removal actions.
- Identify and describe the selected removal actions.
- Identify applicable or relevant and appropriate requirements (ARARs) associated with the selected removal actions.
- List the anticipated design drawings and technical specifications for the selected removal actions.
- Present a tentative schedule for design and implementation of the selected removal actions.
- Present a Health and Safety Plan to be used during implementation of the selected removal actions.

It should be noted that information contained in the Engineering Evaluation/Cost Analysis (EE/CA) and the Removal Site Evaluation (RSE) has been used to complete this RAWP and is referenced herein.

SITE LOCATION

The Ralston site is located in the NE 1/4, NW 1/4, Section 2, T83N, R7W of Linn County, Iowa (Figure 1-1). The site is situated north of 228 Blairs Ferry Road in northern Cedar Rapids, Iowa. For the purpose of this document, the Ralston site will be defined as the fenced area shown on Figure 1-2.

The Ralston site consists of a former disposal area, a segment of Dry Run Creek, and a portion of the creek floodplain totaling approximately 1.5 acres. The steep banks of Dry Run Creek define most of the northern edge of the former disposal area, whereas the south is bounded by the Illinois Central Gulf Railroad. The Ralston site is accessed via a gravel road north from Blairs Ferry Road between the Bauer residence to the east and Joe's Auto Service to the west. A site layout map of the Ralston site is presented as Figure 1-2.



MAP SOURCE: - U.S.G.S. TOPOGRAPHIC QUADRANGLES CEDAR RAPIDS NORTH AND MARION, LINN COUNTY, IOWA.

SITE LOCATION: - SEC. 2, T.84N., R. 7W.

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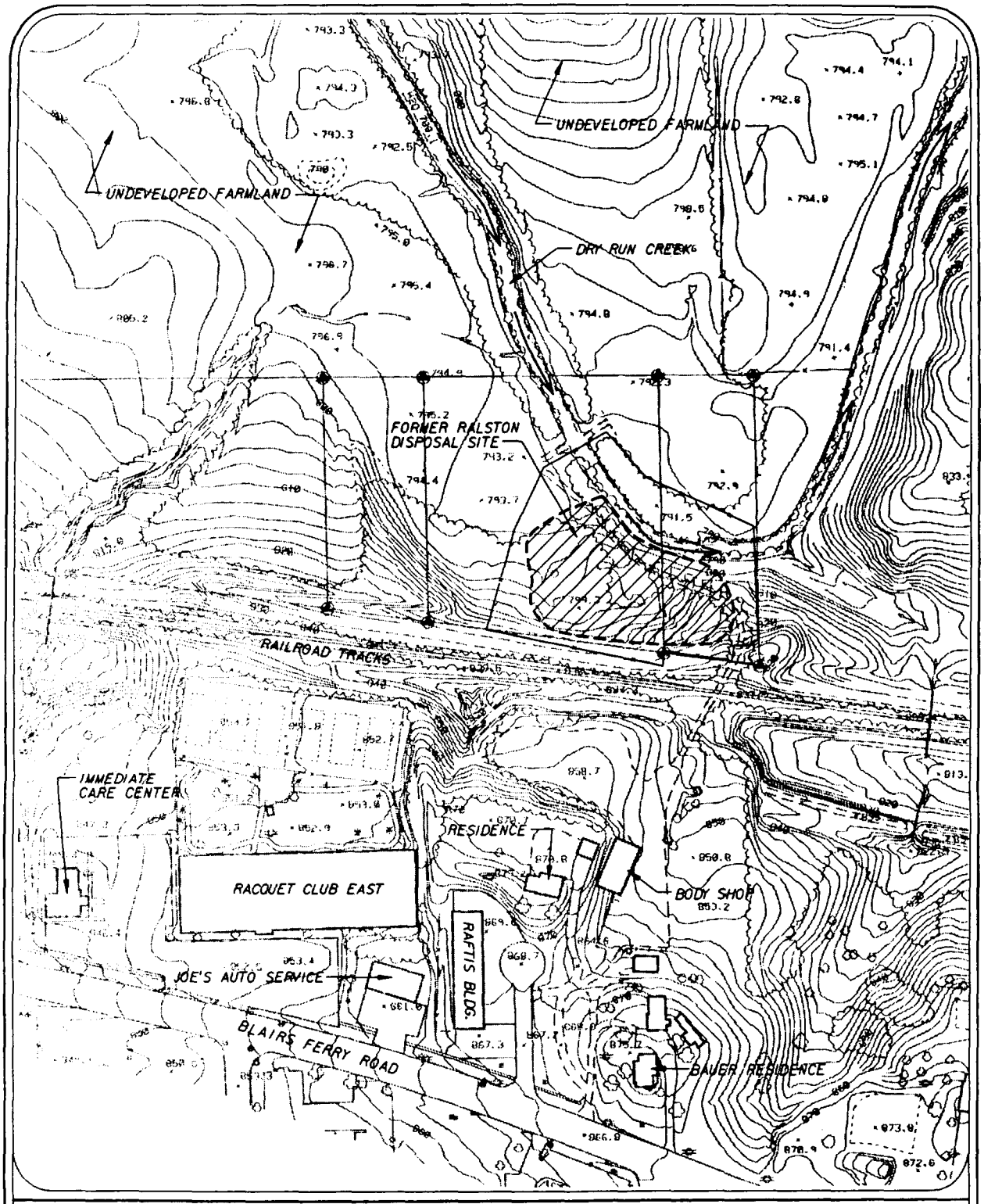
SITE LOCATION MAP

FIGURE 1-1



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FORMER RALSTON DISPOSAL SITE LAYOUT

FIGURE 1-2

SITE HISTORY

Background

Little information is known conclusively regarding specific time periods, amounts, types and methods of waste disposal at the Ralston site. From about 1956 to 1958, the Ralston site was used by Rockwell as a disposal area for industrial waste. An unknown amount of solid and liquid waste were disposed at the site. The wastes were typically burned and spread in layers as necessary to accommodate additional waste. The types of waste disposed at the site by Rockwell included solvents; paint sludge; and general industrial refuse, including scrap metal, office furniture, and construction and demolition materials. The Ralston site was not restricted to waste disposal solely for Rockwell purposes; and other local businesses or citizens likely disposed of other types of solid waste at the site.

In addition to the waste described above, the Ralston site was also used by Rockwell for disposal of cyanide waste (ferrocyanide salts) from a plating operation. The cyanide wastes were initially placed in 5-gallon containers. Two 5-gallon containers were then placed in a 55-gallon drum and encapsulated in concrete. An undetermined number of concrete-encapsulated cyanide containers were disposed at the Ralston site. In 1989, Rockwell removed and properly disposed of two drums of encapsulated cyanide and further site excavations have since revealed no other concrete-encapsulated cyanide drums.

Property Ownership

During the period of waste disposal at the site, the property was owned by Leonard Ralston. In 1975, the property was acquired by one of its current owners, James Raftis. Mr. Raftis owns the majority of the land that the Ralston site occupies. A strip of land on the east side of the Ralston site is owned by the Illinois Central Gulf Railroad. Rockwell currently maintains a property access agreement with Mr. Raftis and several other adjoining property owners for the purpose of conducting environmental investigations and remediation in the Ralston site vicinity. The known property boundaries are shown on Figure 1-2.

Regulatory History

In 1981, Rockwell notified the EPA of the disposal of hazardous substances at the Ralston site, in accordance with Section 103(c) of the Comprehensive Environmental Response, Compensation and Liabilities Act (CERCLA). Since 1985, several CERCLA-regulated activities have been conducted to determine the environmental impact of disposal of hazardous substances at the Ralston site. A summary of site CERCLA activities is shown in Table 1-1. In August 1992, Rockwell officially accepted an invitation by the EPA to utilize the Superfund Accelerated Cleanup Model (SACM) for the Ralston site. Acceptance of this SACM initiative mandated negotiation of the Consent Order.

SITE DESCRIPTION

Land Use

The northern half of the area immediately adjacent to the Ralston site is uncultivated cropland and wooded areas. Surrounding this undeveloped region, residential areas occupy the western,

TABLE 1-1

SUMMARY OF RALSTON SITE CERCLA ACTIVITIES

Date	CERCLA Activity	Activity Conducted By	Results/Implications
1981	CERCLA 103(c) Notification	Rockwell	Notifies the Environmental Protection Agency (EPA) of disposal of hazardous substances at the former Ralston disposal site.
May 1985	Preliminary Assessment	E&E/FIT	Indicates contamination may have resulted from disposal activities.
November 1988	Screening Site Inspection	E&E/FIT	Geophysical survey conducted; elevated levels of metals and volatile organic compounds (VOCs) were detected in soils. Water samples from nearby wells and springs did not detect contamination.
1989	Removal of Drums	Rockwell	Two drums of concrete-encapsulated cyanide were removed.
November 1990	Trenching, Installation of Soil Borings	E&E/FIT; Montgomery Watson	Six trenches were excavated at the site; soil borings were installed on 50-foot x 50-foot grid. Elevated levels of metals and VOCs were detected in soils.
November 1991	Private Well Sample	Rockwell	Water sample collected from Bauer well detected trichloroethylene above the Maximum Contaminant Level.
November 1991	Remedial Investigation/Feasibility Study (RI/FS) Consent Order	Rockwell, EPA	Consent Order required Rockwell to conduct a RI/FS at the former Ralston disposal site.
April 1992	RI/FS Work Plans	Montgomery Watson	RI/FS Work Plans were submitted to the EPA.
June 1992	Phase I RI/FS	Montgomery Watson	Phase I RI/FS activities were aimed at the nature and extent of contamination at the site. Elevated VOCs were detected in shallow and bedrock groundwater; VOCs and metals were detected in soils; low levels of VOCs were detected in surface water and sediment of creek.
October 1992	Field Sampling Plan (FSP) Addendum (Phase II RI/FS)	Montgomery Watson	Outlined additional RI/FS investigation activities.
November 1992	Implement FSP Addendum Activities (Phase II RI/FS)	Montgomery Watson	Additional wells and soil borings were installed to determine horizontal and vertical extent of VOC contamination in the former Ralston disposal site vicinity.

TABLE 1-1 (CONTINUED)

SUMMARY OF RALSTON SITE CERCLA ACTIVITIES

Date	CERCLA Activity	Activity Conducted By	Results/Implications
January 1993	Consent Order Superfund Accelerated Cleanup Model (SACM)	Rockwell, EPA	Consent Order required Rockwell to prepare Removal Site Evaluation (RSE) and Engineering Evaluation/Cost Analysis (EE/CA) Reports.
March 1993	RSE and EE/CA Reports	Montgomery Watson	Draft reports submitted to the EPA.
March 1993	FSP Phase III Addendum	Montgomery Watson	Outlined additional RI/FS Investigation Activities.
May 1993 - December 1993	Implement FSP Addendum Activities	Montgomery Watson	Additional wells installed to determine horizontal and vertical extent of VOCs in Silurian system.
December 1993	Final EE/CA and RSE	EPA	SACM documents approved by the EPA.
December 1993 - January 1994	Public Comment Period	EPA	Period for public review and comment on SACM activities and proposed EE/CA response actions.

northern and eastern boundaries. South of the railroad tracks, the land use is generally zoned commercial and light industrial with some isolated residences. Major commercial development generally begins south of Blairs Ferry Road.

Topography

The topography of the Ralston site is characterized by steeply sloping bluffs along Dry Run Creek to the north and a railroad embankment to the south. Approximately 10 to 30 feet of relief is associated with the steep southern banks of Dry Run Creek which form the northern boundary of the former disposal area. South of the former disposal area the steep slope of the railroad embankment quickly levels off to the north and forms a relatively flat area up to the south bank of Dry Run Creek. The access road into the site follows a more gently sloping path into the main portion of the site. Northwest of the former disposal area, the land surface gently grades into the floodplain. Northeast of the site, the floodplain of the creek is well defined by steeply sloping bluffs and is approximately 500 feet in width. A topographic map, illustrating the local topography in and around the site, is presented as Figure 1-3.

Geology

A detailed description of the regional and local geology for the Ralston site vicinity is presented in Section 2 of the Removal Site Evaluation (RSE) Report, March 1993. A brief description of the site geology is presented below.

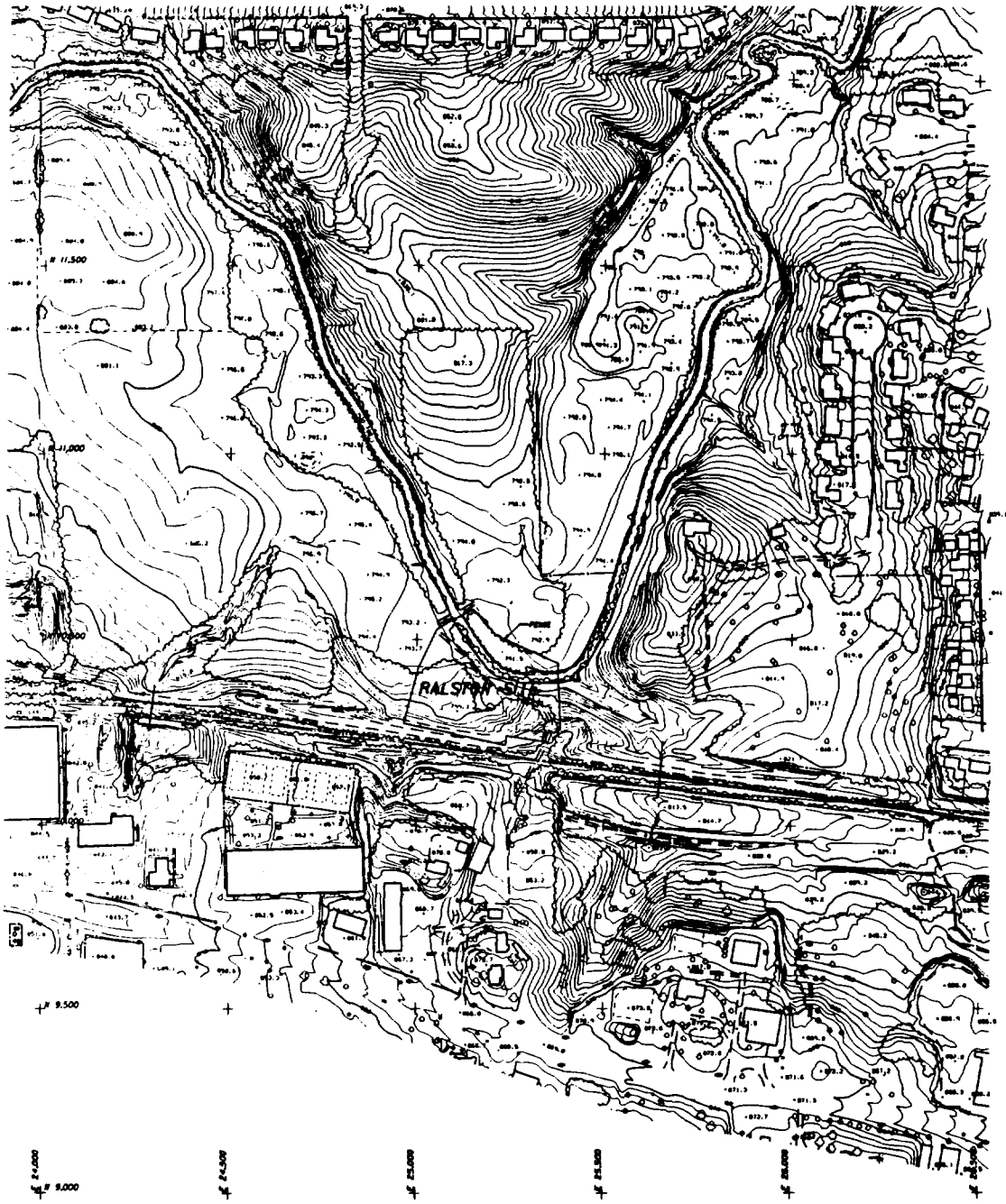
The geology of the Ralston site area generally consists of unconsolidated Quaternary alluvial deposits overlying Devonian and Silurian carbonate bedrock. The alluvial stratigraphy consists of silt overlying fine to medium sand to a depth of 12 feet. Approximately 0-2 feet of fine to medium gravel is typically found at the bedrock surface. The bedrock surface is extremely weathered and is composed of 1-2 feet of commingled dolomite fragments and clay. The uppermost bedrock units encountered at the site are 90 feet of dense and lithographic carbonates of the lower Devonian Otis and Bertram Formations. A zone of highly vugular dolomite is generally found at a depth of 40-50 feet throughout the site. Underlying the Devonian carbonates, Silurian dolomites are estimated to be 350 feet thick. The uppermost Silurian formation at the site is the undifferentiated Scotch Grove Formation, comprised of several dolomitic facies which range in texture from extremely porous to dense. The Scotch Grove Formation is approximately 200 feet thick at the site.

Hydrogeology

Detailed descriptions of the regional and site hydrogeology are presented in Section 2 of the RSE Report, March 1993. A brief description of the basic hydrogeology of the Ralston site is presented below.

The alluvium and Silurian carbonates form the two principal groundwater systems present at the Ralston site. These groundwater systems are separated by the weathered clayey bedrock surface and less conductive Devonian carbonates and are collectively underlain by a regional confining bed (Ordovician Maquoketa Shale) at a depth of about 450 feet.

The alluvial groundwater system is defined as groundwater located between the water table and the weathered bedrock surface. Alluvial groundwater flow is generally concentrated in the



NOTE: - CONTOUR INTERVAL = 2 FEET

N

0 300

SCALE IN FEET

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SITE TOPOGRAPHIC MAP

FIGURE 1-3

coarse sand and gravel immediately above the bedrock surface. The saturated thickness of the unit is approximately 5-10 feet across the site. The direction of alluvial groundwater flow from the Ralston site is generally to the north-northeast under the creekbed. North of the site, in the floodplain peninsula, alluvial groundwater flow is radially south, toward the creek channel. A generalized depiction of the alluvial groundwater flow system is presented in Figure 1-4.

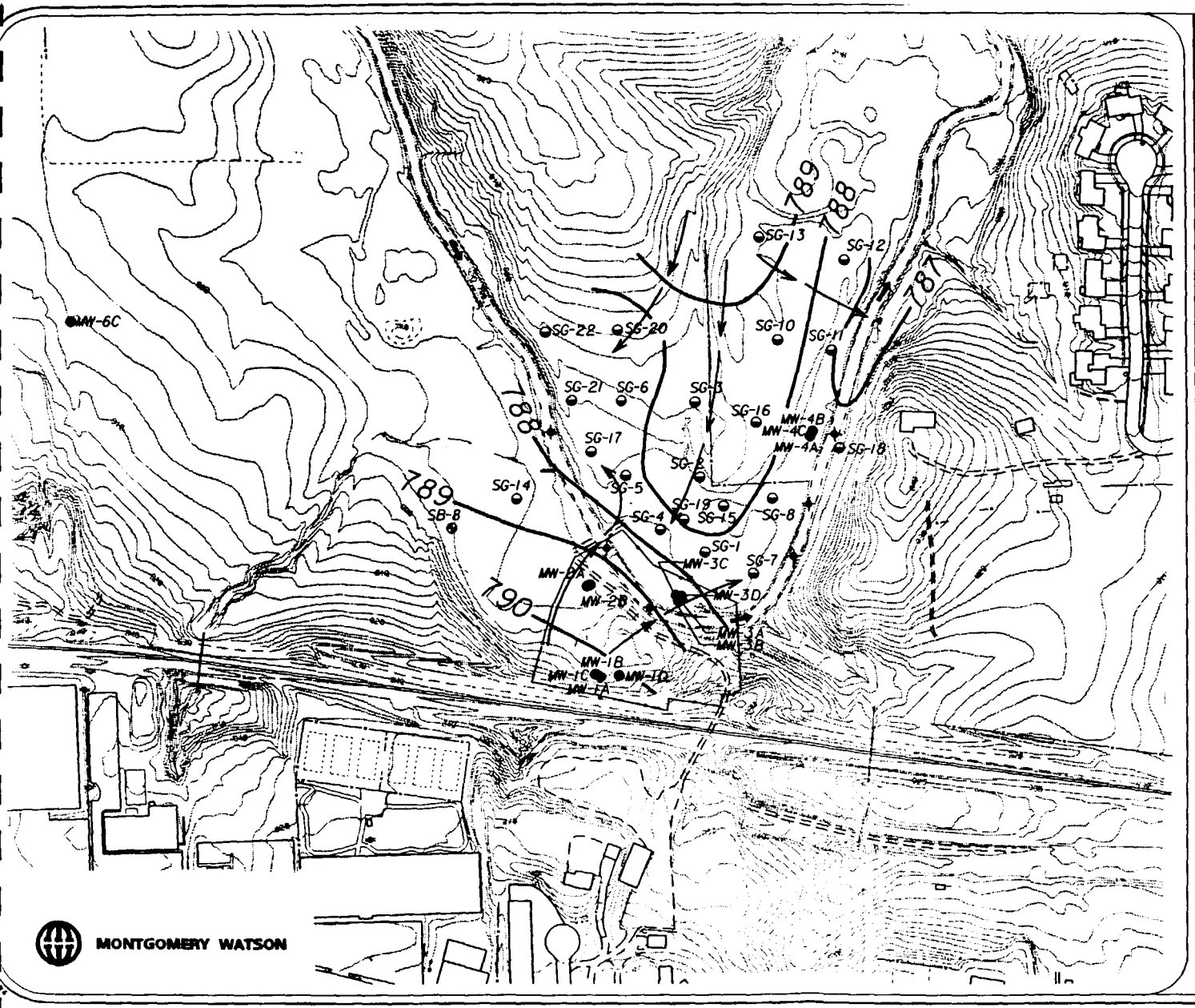
Below the alluvial groundwater system are 90 feet of less conductive Devonian carbonates. Although fractures and secondary porosity developed within these strata are capable of transmitting groundwater, this hydrologic unit is not as permeable as the alluvial sand and gravel above or the dolomites below.

Significant groundwater flow occurs in the highly porous Silurian dolomites underlying the Ralston site. The horizontal direction of groundwater flow within the dolomite strata is generally to the southeast. Yields from Silurian wells at the site reflect the geologic variability of facies, with permeabilities primarily derived from fractures, joints and interconnected vugular and fossil modic porosity. Vertical gradients at nested wells indicate predominantly downward groundwater flow from the alluvial system to the Silurian aquifer. Very little vertical gradient exists within the Silurian aquifer from the upper Scotch Grove (MW-3C) to middle Scotch Grove (MW-3D) wells. Regional discharge of the Silurian aquifer is to Indian Creek located approximately two miles southeast of the site.

Nature and Extent of Contamination

Detailed descriptions of the nature and extent of contamination at the Ralston site are presented in Section 3 of the RSE. Both soil and groundwater at the site have been affected by the disposal of hazardous materials. Soil samples have been collected during preliminary soil boring and excavation activities and during the Phase I Remedial Investigation (RI), at the site. Groundwater samples have been collected from the site during both Phase I and Phase II of the RI. Sampling locations, including locations of monitoring wells and soil borings, are shown on Figure 1-5. A brief description of the nature and extent of contamination detected in soil and groundwater is presented below.

Excavation Activities. Trenches were excavated at the Ralston site during preliminary investigations which indicated a variety of solid wastes present within the former disposal area. Ash appears to be the most ubiquitous component of the waste at the site, likely the result of extensive burning of wastes in layers by Rockwell personnel during their use of the site for disposal operations. Concrete rubble, bricks and other construction and demolition materials also appear to be present throughout much of the disposal area in significant quantities. Empty, crushed and parts of drums were found at nearly all trench locations. Several large pieces, including a car body, steel tanks, rotary kiln sections, and a large steel tank were also unearthed in the disposal area. These large pieces, and others like them, likely contribute a measurable portion of the total volume of solid waste in the former disposal area. Soil samples collected from one trench exhibited concentrations of trichloroethene (TCE) and tetrachloroethene (PCE) and cis-1,2-dichloroethene (DCE) as high as 56 mg/kg, 14 mg/kg and 1.1 mg/kg, respectively. Copper, lead and chromium were detected in a soil sample at concentrations of 62,000 mg/kg, 990 mg/kg and 880 mg/kg, respectively.



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0 200

SCALE IN FEET

NOTE: - CONTOUR INTERVAL = 2 FT.

LEGEND:

- MONITORING WELL
- SOIL BORING (PHASE I RI)
- TEMPORARY MONITORING POINTS (PHASE 2 RI)
- PIEZOMETER
- FLOW LINE
- 790 EQUIPOTENTIAL LINE
- DIRECTION OF CREEK FLOW

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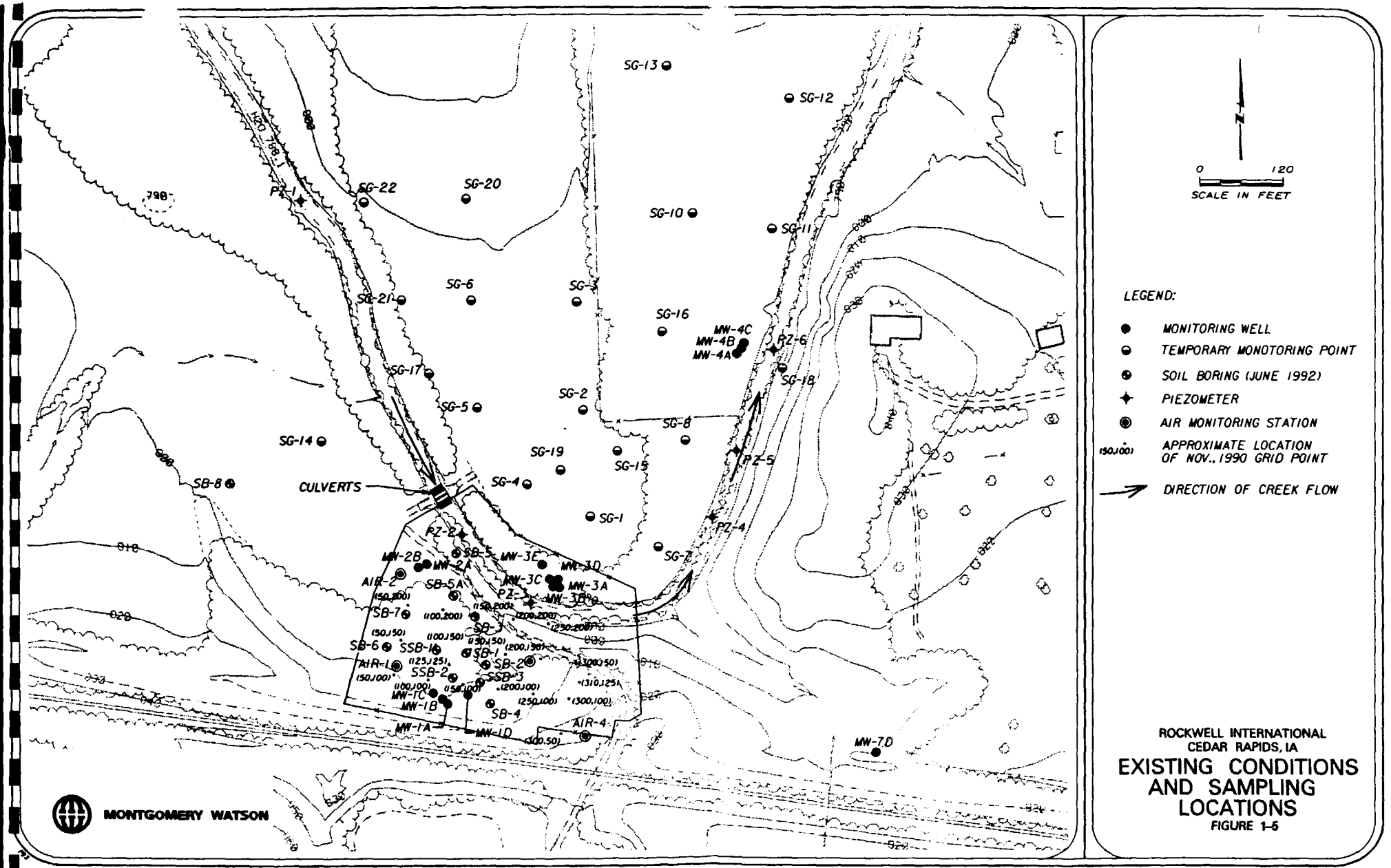
ALLUVIAL GROUNDWATER FLOW SYSTEM

FIGURE 1-4


SG-13
SG-12
SG-22
SG-20
PZ-1
SG-10
SG-11
SG-6
SG-21
SG-16
MW-4C
MW-4B
MW-4A
PZ-6
SG-17
SG-18
SG-5
SG-2
SG-8
SG-14
SG-19
SG-15
PZ-5
SB-8
CULVERTS
SG-4
SG-1
PZ-2
PZ-4
SG-7
MW-2B
MW-2A
SB-5
MW-3E
MW-3D
AIR-2
SB-5A
MW-3C
MW-3A
PZ-3
MW-3B
SB-7
SB-3
SB-6
SSB-1A
SB-1
AIR-1
SB-2
SSB-2
SSB-3
MW-1C
MW-1B
SB-4
AIR-4
MW-1A
MW-1D
MW-7D
0
120
SCALE IN FEET
LEGEND:
MONITORING WELL
TEMPORARY MONOTORING POINT
SOIL BORING (JUNE 1992)
PIEZOMETER
AIR MONITORING STATION
(50,100)
APPROXIMATE LOCATION OF NOV., 1990 GRID POINT
DIRECTION OF CREEK FLOW
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EXISTING CONDITIONS AND SAMPLING LOCATIONS
FIGURE 1-5

Soil Samples. Soil samples collected from borings at the Ralston site during Phase I of the RI indicated concentrations of TCE, PCE, DCE, toluene and xylenes as high as 17,000 mg/kg, 1,800 mg/kg, 20 mg/kg, 6,300 mg/kg and 700 mg/kg, respectively. Data from these soil borings indicate that soil contamination at the site extends vertically from the surface to a depth of at least 15 feet. The highest concentrations of volatile contamination at the site are generally found in the north-central portion of the former disposal area. The approximate extent of TCE concentrations in subsurface soils is presented in Figure 1-6.

Soil samples indicate that the eastern portion of the Ralston site exhibits metals concentrations that are significantly higher than background concentrations. Cadmium, chromium, copper and lead are the most widespread metals detected above background levels at the site. These metals were detected at concentrations as high as 300 mg/kg, 474 mg/kg, 50,000 mg/kg and 6,600 mg/kg, respectively. Most of the elevated metals concentrations found at the site are generally concentrated within the top 5 feet of soil, with the exception of the eastern portion of the site, which exhibited elevated metals concentrations to depths of 15 feet. Figure 1-7 illustrates the approximate extent of select metals at the site.

Concentrations of semivolatile organic compounds and polychlorobiphenyls (PCBs) in soil at the Ralston site were generally below quantitation limits. These samples indicate that semivolatile organic compounds and PCBs do not comprise a significant portion of the soil contamination present at the site.

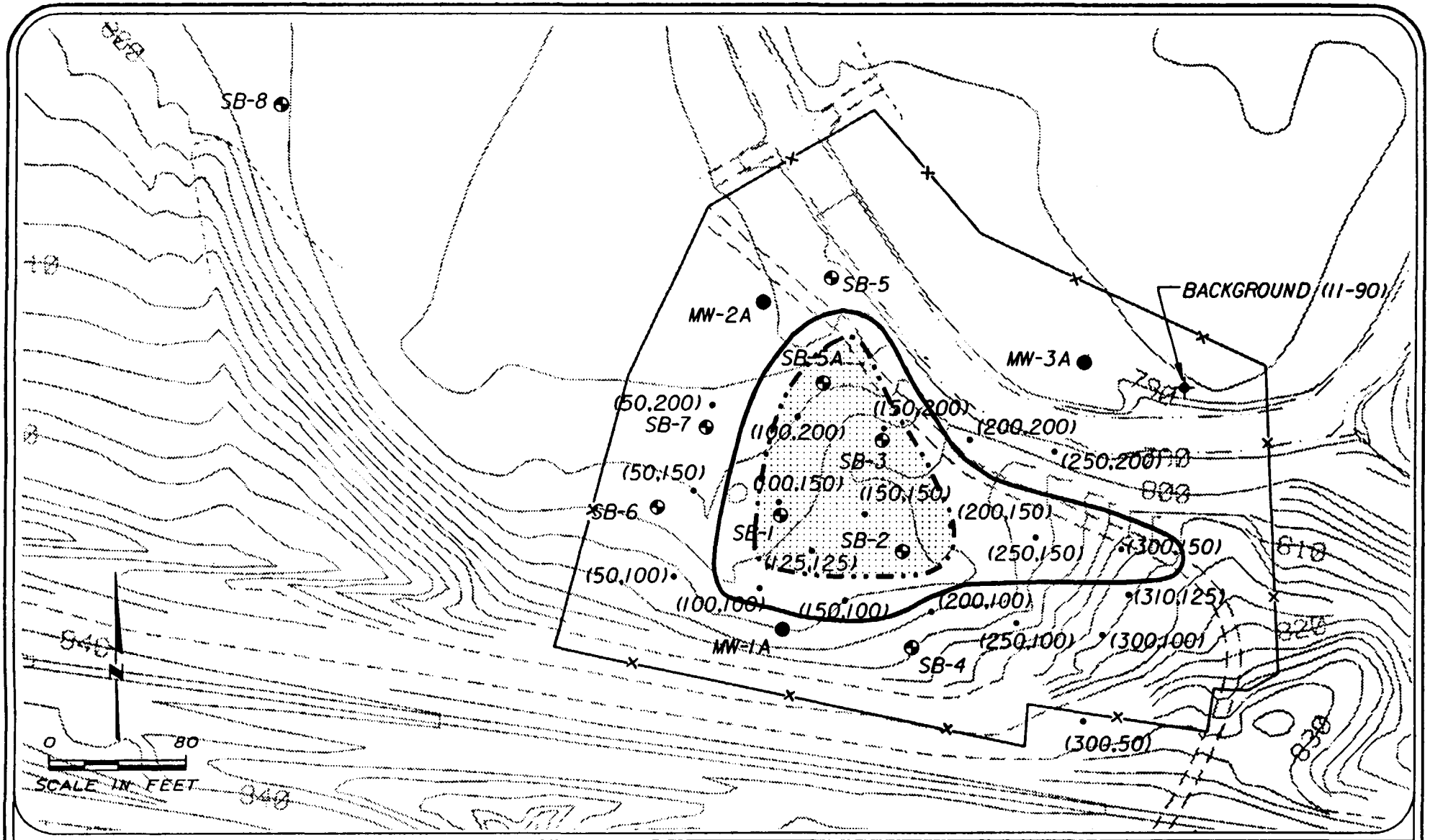
Groundwater Samples. Groundwater samples were collected from soil borings located in the former disposal area during the Phase I RI to determine the nature of groundwater contamination in the source area. Phase II of the RI included the collection of additional groundwater samples to delineate the extent of groundwater contamination in the alluvial aquifer.

Significant levels of volatile organic compound (VOC) concentrations were found in shallow groundwater within the limits of the disposal area. Soil boring groundwater samples exhibited concentrations of TCE, DCE and vinyl chloride as high as 980,000 µg/L, 180,000 µg/L and 29,000 µg/L, respectively. Other VOCs detected at elevated levels within the disposal area include methyl ethyl ketone (MEK) at 13,000 µg/L, toluene at 39,000 µg/L, acetone at 39,000 µg/L, PCE at 2,600 µg/L, 1,1,1-trichloroethane at 1,000 µg/L and xylenes at 3,600 µg/L. The highest concentrations of VOCs in groundwater at the Ralston site generally correspond to the area marked by TCE-contaminated subsurface soils above 20 mg/kg (Figure 1-6).

Beyond the limits of the former disposal area, TCE, DCE and vinyl chloride are the primary VOC contaminants of concern detected in the alluvial groundwater system. The approximate extent of VOC contamination in the alluvial groundwater system is depicted on Figure 1-8.

Concentrations of metals detected in alluvial groundwater samples were generally below applicable drinking water standards. Semivolatile organic compounds were detected in soil boring groundwater samples collected within the disposal area at concentrations significantly less than VOC levels. Semivolatile organic compounds have not been detected in the groundwater beyond the limits of the former disposal area.

The primary VOC contaminants of concern identified in the alluvial groundwater system are present at lower concentrations in the bedrock groundwater. TCE, DCE and vinyl chloride



LEGEND:

- TCE >20 (mg/kg)
- TCE >1.0 (mg/kg)
- SAMPLING LOCATION
- MONITORING WELL
- (50,100) APPROXIMATE LOCATION OF NOV., 1990 GRID POINT

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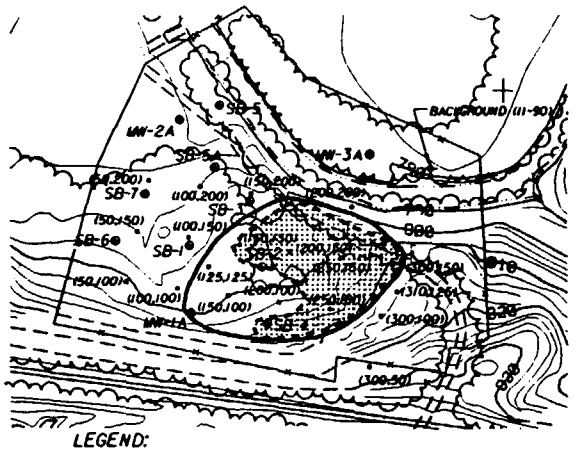
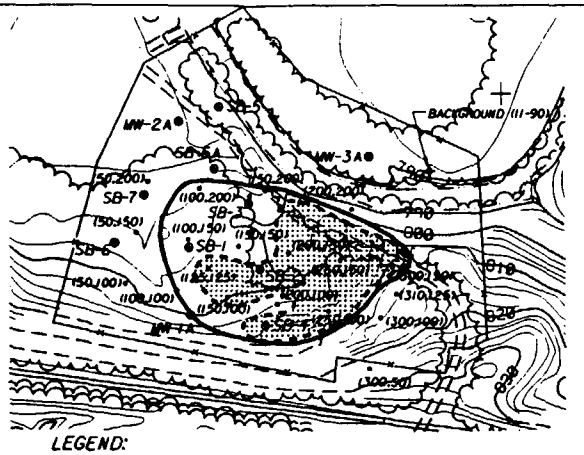
APPROXIMATE EXTENT OF TCE IN SUBSURFACE SOILS

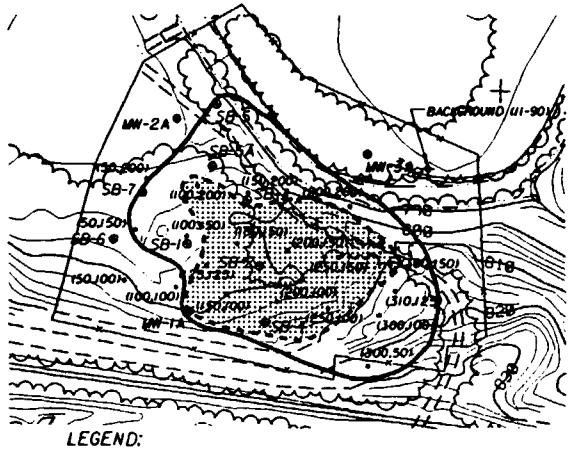
FIGURE 1-6



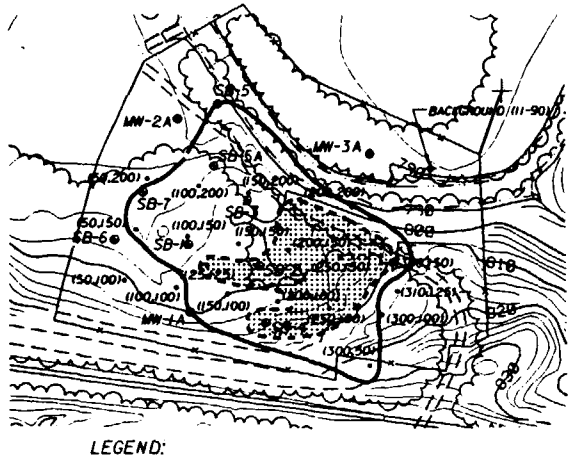
CADMIUM



CHROMIUM



COPPER



LEAD

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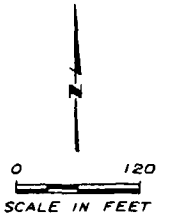

GENERAL LEGEND:

- SOIL BORING
- MONITORING WELL
- APPROXIMATE LOCATION OF NOV., 1990 GRID POINT

NOTE: STANDARD DEVIATION OF MEAN BACKGROUND DEFINED IN RSE REPORT.

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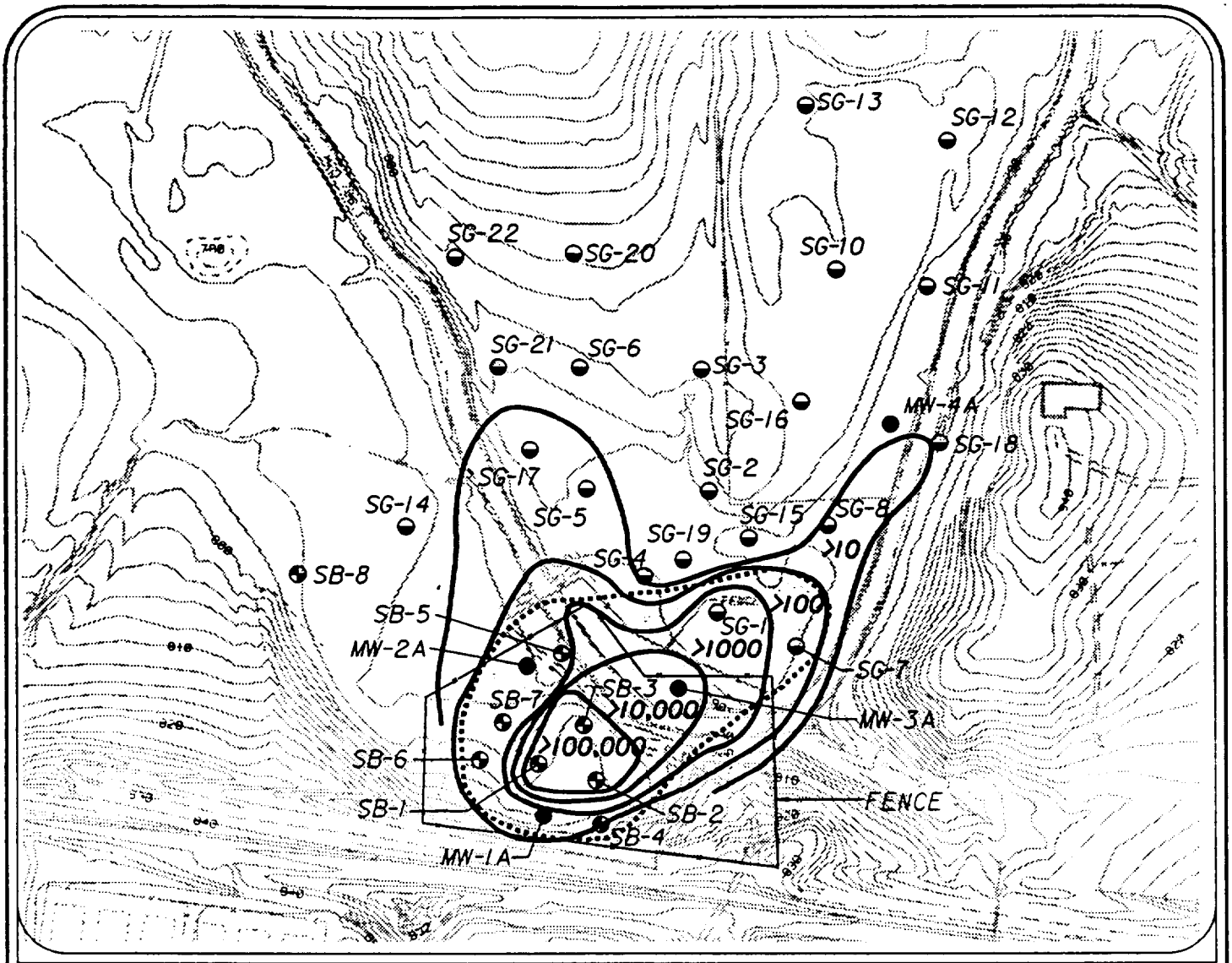
APPROXIMATE EXTENT OF SELECT METALS CONCENTRATIONS IN SUBSURFACE SOILS

FIGURE 1-7



LEGEND:

- SOIL BORING (PHASE 1 RI)
- MONITORING WELL
- TEMPORARY MONITORING POINT (PHASE 2 RI)
- CONCENTRATION RANGE OF TOTAL VOCs (µg/L)
- MINIMUM EXTENT OF ALLUVIAL GROUNDWATER CONTAMINATION TO BE ADDRESSED BASED ON TCE AND VINYL CHLORIDE CONCENTRATIONS.

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APPROXIMATE EXTENT OF VOC CONCENTRATIONS IN ALLUVIAL GROUNDWATER

FIGURE 1-8

generally comprise the majority of contaminants detected in the bedrock system. These contaminants are found at nearly all bedrock well locations. Other VOCs detected in bedrock wells include PCE, 1,1-DCE, trans-1,2-DCE, benzene, toluene, ethylbenzene and xylenes at levels significantly lower than the primary VOC contaminants of concern. The highest concentrations of bedrock groundwater contaminants at the site were found in Devonian well MW-3B, where concentrations of TCE, DCE and vinyl chloride have been detected up to 2,200 µg/L, 4,800 µg/L and 2,100 µg/L, respectively. The horizontal and vertical extents of VOC contamination in the Silurian aquifer are currently being investigated.

RISK ASSESSMENT

The EPA conducted a draft risk assessment (DRA) for the Ralston site using chemical data collected during the Phase I and Phase II of the RI. The background, results and conclusions of the DRA were presented briefly in the EE/CA. The results and conclusions of the DRA, as they pertain to the removal action objectives, are described below.

The DRA evaluated risks arising from potential exposure pathways for both current land users (off-site residents and casual visitors) and potential future land users (on-site residents and casual visitors). Risks associated with ingestion of noncarcinogenic-contaminated soil were above EPA-acceptable levels for current and future land use casual visitors. Risks associated with ingestion of noncarcinogenic-contaminated groundwater, soil, vapors and surface water were above EPA-acceptable levels for future land use on-site residents.

Therefore, the above risks can be reduced by minimizing the following:

- Dermal contact with or incidental ingestion of contaminated surface soils.
- Ingestion of contaminated groundwater.
- Dermal contact with or incidental ingestion of Dry Run Creek surface water.
- Inhalation of contaminated vapors.

Objectives of the selected removal actions will help accomplish these reductions in risk.

PROJECT ORGANIZATION

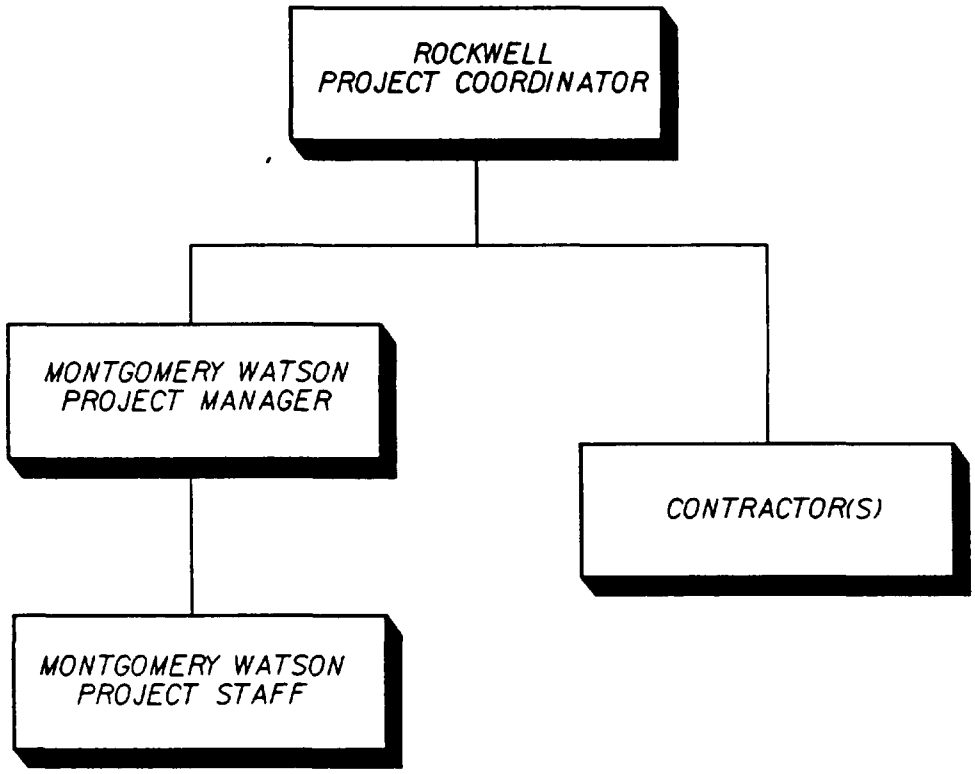
An organizational chart, showing the relationship of the parties involved with the removal actions at the Ralston site, is shown on Figure 1-9.

Rockwell Project Coordinator

The Rockwell Project Coordinator will administer the removal action for Rockwell and will be the primary contact with the regulatory agencies. The Rockwell Project Coordinator will oversee the entire project. All changes in the project scope of work, due to field change orders or other unforeseen circumstances, will be approved by the Rockwell Project Coordinator.

Montgomery Watson Project Manager

The Montgomery Watson Project Manager (PM) will be responsible for administration, technical content and quality assurance of all project deliverables. The PM will report directly to the Rockwell Project Coordinator and will initiate and coordinate all permit applications or



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PROJECT ORGANIZATION

FIGURE 1-9

regulatory notifications in accordance with the ARARs for the project. The PM will assign appropriate Montgomery Watson personnel to complete the necessary removal action tasks. Tracking the budget and schedule, scheduling the field activities and managing the contractor(s) will all be the responsibility of the PM.

Montgomery Watson Project Staff

The project staff includes the project engineer(s), the project hydrogeologist(s) and other field personnel required to complete the required removal action tasks. The staff will report directly to the PM and will be responsible for completing the majority of the design work, technical aspects of project deliverables and construction oversight. Project staff will be responsible for the quality assurance of the contractors and the implementation of the Health and Safety Plan (Appendix A) during site activities.

Removal Action Contractors

The contractors for the project are not yet known and will be directly retained by Rockwell. Qualifications of the contractors' will be submitted to the EPA as they are made available to Rockwell. The removal action contractors will be responsible for the removal action tasks for which they are retained. The contractors will report directly to the on-site Montgomery Watson Project Staff or the PM. The contractors will be responsible for compliance with the quality assurance and health and safety procedures for the removal action tasks.

Coordination with the Environmental Protection Agency

The Montgomery Watson PM and the Rockwell Project Coordinator will periodically update the EPA Region VII RPM on the status of the project through monthly progress reports and telephone conferences (frequency to be determined during various phases of the project). The RPM will also be notified of significant changes in project scope (i.e., cap extensions, discovery of buried material, etc.) and the changes coordinated and approved through consultation between the Rockwell Project Coordinator, the Montgomery Watson PM and the EPA Region VII RPM.

from Montgomery-Watson 8/8/94 letter

SECTION 2

SECTION 2

SELECTED REMOVAL ACTIONS

OBJECTIVES

The overall scope of the removal action at the Ralston site is to reduce the immediate threat of contaminant migration and potential human exposure posed by the site. General removal action objectives, based on information from the DRA and the RSE, for the Ralston site are:

- Reduce the potential for migration of contaminated surface soil from the site and reduce the potential for exposure to surface soil through incidental ingestion.
- Reduce the levels of VOCs in soil and groundwater at the source area, and areas immediately north of Dry Run Creek, in order to prevent the continuing release of VOCs to groundwater and reduce the threat of exposure to contaminated groundwater by future users.
- Reduce the exposure potential associated with potential contaminant migration to Dry Run Creek surface water and sediment.

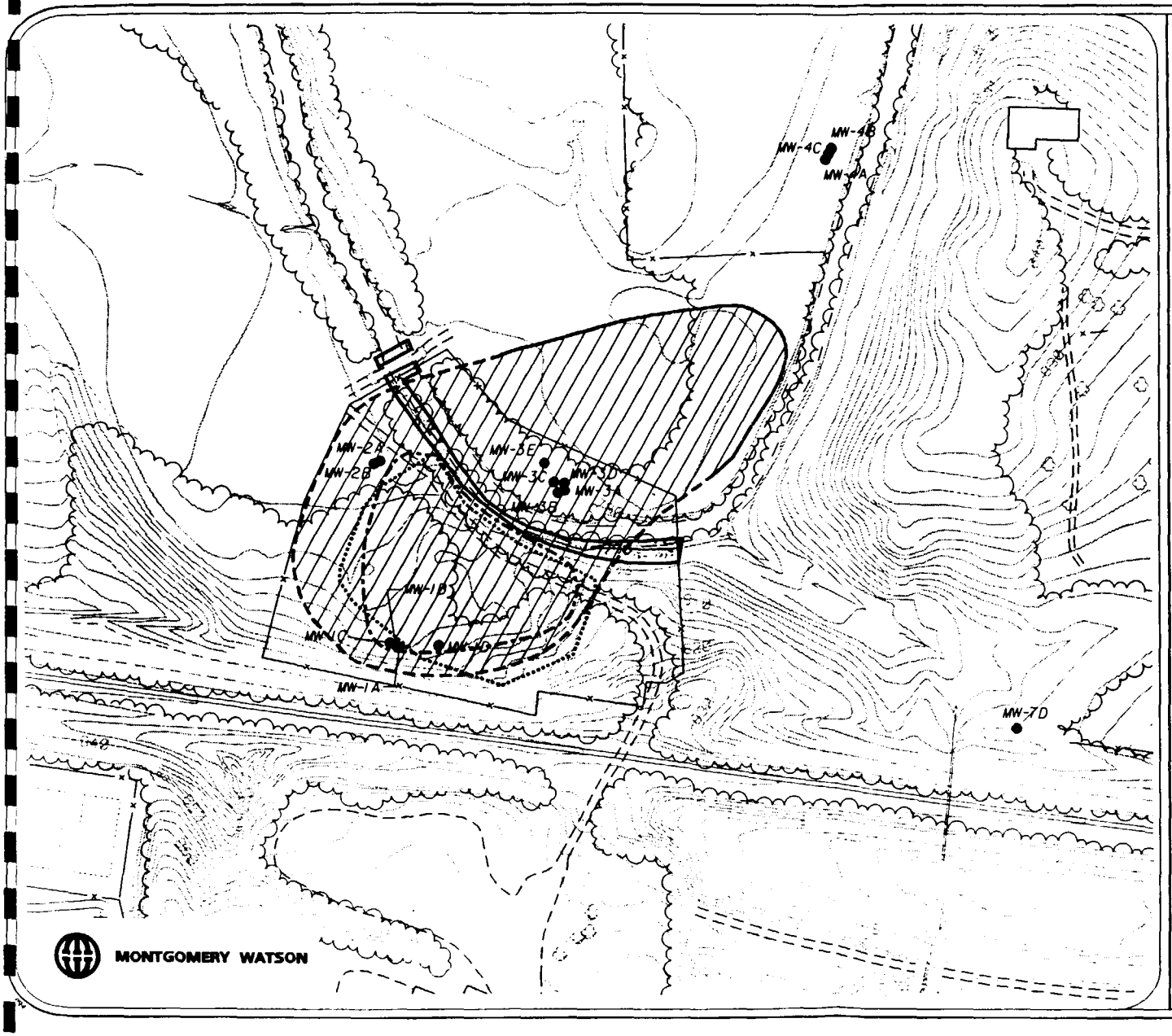
Meeting these overall removal action objectives will contribute to the performance of the projected long-term remedial strategy for the Ralston site. Individual objectives for the design of each of the removal actions are described in the following sections. Long-term remedial objectives for the deep groundwater will not be addressed during this removal action. Following completion of the RI/FS activities, remedial and monitoring alternatives will be proposed to the EPA.

DESCRIPTION OF SELECTED REMOVAL ACTIONS

Brief descriptions of the removal action alternatives for the Ralston site were presented in the EE/CA. Each alternative was evaluated in terms of effectiveness, implementability and cost. Four removal actions have been selected by the EPA to address contaminants in the surface and subsurface soil and alluvial groundwater at the Ralston site. These removal actions are:

1. Stabilization of the south bank of Dry Run Creek, adjacent to the Ralston site.
2. Capping of the former disposal area.
3. Installation of a dual purpose soil vapor extraction and groundwater pump and treat (SVE/GPT) system in the former disposal area.
4. Installation of a groundwater pump and treat system for alluvial groundwater north of the Ralston site.

Figure 2-1 illustrates the areas in which each of these removal actions will be implemented. Descriptions of each of these removal actions is given below.



MONTGOMERY WATSON

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SCALE IN FEET

LEGEND:

APPROXIMATE AREA OF SOIL CONTAMINATION TO BE ADDRESSED BY SOIL VAPOR EXTRACTION SYSTEM

EXTENT OF FORMER DISPOSAL AREA CAP

APPROXIMATE AREA OF GROUNDWATER CONTAMINATION TO BE ADDRESSED BY GROUNDWATER EXTRACTION

EXTENT OF CREEK BANK STABILIZATION

ROCKWELL INTERNATIONAL
CEDAR RAPIDS, IA

APPROXIMATE AREAS OF SELECTED REMOVAL ACTIONS

FIGURE 2-1

Creek Bank Stabilization

Objectives. The individual objectives of the creek bank stabilization removal action are:

- Stabilize the south bank slope of Dry Run Creek to the 100-year flood stage, where practical.
- Allow for integration of the creek bank stabilization with the former disposal area cap and SVE/GPT system.

General Description. To minimize erosion of the south bank of Dry Run Creek, cable-stayed concrete mats will be placed along the bank from the south edge of the creek bottom to the top of the bank slope or the 100-year flood water elevation, whichever is lower. A drainage layer and geomembrane liner will be placed on the bank slope underneath the cable-stayed concrete mats to allow the slope to drain freely and to inhibit groundwater/surface water interaction, respectively. A typical detail of the creek bank stabilization is included in Appendix B.

The area along the south creek bank will be cleared of trees and shrubs, and graded to allow the placement of the concrete mats. The concrete mats will be constructed of 15-inch by 15-inch concrete blocks joined by stainless steel cables to form 4-foot by 16-foot mats. The blocks will have a minimum height of 4.5 inches, based on a maximum creek velocity of 18 ft/s. Because the velocity of water flow in the creek is typically much less than 18 ft/s, the concrete blocks selected are conservative. The mats are flexible and will take the shape of the slope they are placed on. Therefore, disturbance of the subsurface, which could cause release of contaminants to Dry Run Creek, will be minimal. Large rubble or debris that is encountered in the south creek bank will be removed, to the extent practical, and placed within the former disposal area to be capped.

A drainage layer, consisting of a plastic mesh between two layers of geotextile fabric, will be placed directly on the creek bank subsurface. This drainage layer will allow groundwater to escape the subsurface following a flood or heavy rainfall, preventing saturated conditions that may cause slope instability.

A geomembrane liner will be placed on the south creek bank, between the cable-stayed concrete and the geotextile drainage layer, to minimize the interaction of the surface water flow in Dry Run Creek and the alluvial groundwater flow from the former disposal area. This geomembrane liner will extend from just below the creek bottom to several feet above the top of the bank slope, where it will be anchored in a trench. The top of the geomembrane liner will be integrated with the clay cap.

Capping of the Former Disposal Area

Objectives. A compacted clay cap installed over the former disposal area will serve to:

- Limit potential direct contact exposure of surface soils to the public.
- Prevent transport of contaminated surface soil off site.
- Minimize infiltration of surface water into the former disposal area.

- Provide a low permeability "seal" to enhance the SVE system.

- Redirect surface water runoff from the former disposal area.

General Description. The compacted clay cap will be installed over the former disposal area to cover the contaminated surface soil and prevent the potential migration of surface soil contamination off site. The cap will also minimize infiltration of rain and surface runoff water into the subsurface of the former disposal area. The cap will be installed such that surface water runoff from the cap is directed away from the former disposal area. Details of the capped area are included in Appendix B.

The cap will cover the former disposal area and will be integrally connected to the geomembrane liner that underlies the cabled concrete. This will effectively isolate the former disposal area from infiltration of surface water and the atmosphere. By minimizing the infiltration of atmospheric air to the subsurface, the SVE system will collect concentrated contaminated soil vapor, thereby increasing the efficiency of contaminant collection and treatment.

The cap will consist of 2 feet of compacted clay, with a typical maximum permeability of $1x10^{-7}$ cm/sec, which will be overlain by 2 feet of topsoil. The topsoil layer will be seeded so that erosion of the topsoil and clay layers is minimized. The estimated area to be capped is approximately 28,000 square feet. 0.64 Acre

A drainage ditch will be constructed around the perimeter of the capped area to direct surface water off and around the former disposal area. Terraces will be included in the cap construction to reduce the flow distance across the cap and to redirect runoff from the cap into the perimeter drainage ditch. A temporary access road will be built across the cap following placement of the compacted clay. It is anticipated that this road will be removed within two to three years, when access is provided to the northwest of the site. The access road area will then be topsoiled and seeded.

Dual Purpose Soil Vapor Extraction and Groundwater Pump and Treat System

Objectives. A dual purpose extraction system, designed to extract alluvial groundwater and soil vapor from the subsurface of the former disposal area, will be installed at the Ralston site. The specific objectives of this removal action are:

- Extract contaminated groundwater from the alluvial aquifer in and around the former disposal area.

- Extract contaminated soil vapor from the unsaturated and vadose zones in the former disposal area to remediate, to the extent possible, the contaminated soil at the site.

- Limit the further migration of contaminated alluvial groundwater off site.

- Lower the current groundwater table so that the SVE system can remediate the soil in the former disposal area more effectively.

- Treat the extracted groundwater and soil vapor to concentrations sufficient to meet discharge requirements.

General Description. The well screens for the dual purpose SVE/GPT system will be installed through the contaminated soil and into the contaminated alluvial groundwater aquifer. Dual purpose SVE/GPT vacuum extraction wells, installed to the bedrock surface, will be the primary component of the SVE/GPT system.

Groundwater and soil vapor will be extracted through the use of an applied vacuum to the subsurface. This vacuum will cause increased volatilization of contaminants in the subsurface and will draw contaminated vapors toward the vacuum extraction wells, where they will be withdrawn. Groundwater will also be extracted from the vacuum extraction wells. VOCs in the groundwater will be separated from the water with an air stripper. The off-gas from the air stripper and the extracted soil vapor will then be treated with a catalytic oxidizer or other air treatment device. Based on information in the EE/CA documents, it is estimated that approximately 20 dual purpose wells will be sufficient to capture site contamination. The number of wells may be different depending on the installation contractor recommendations.

The treated groundwater will most likely be discharged to the local publicly-owned treatment works (POTW). In the future, a National Pollutant Discharge Elimination System (NPDES) permit may be obtained to discharge the treated groundwater into Dry Run Creek near the Ralston site.

Alluvial Groundwater Extraction and Treatment North of Dry Run Creek

Objectives. The extraction and treatment of alluvial groundwater will be implemented north and northeast of the Ralston site. Groundwater samples collected during the RI indicated that elevated alluvial groundwater contamination extends to these areas and may act as a continuing source for release of VOCs to the bedrock groundwater system. Objectives of this removal action are:

- Extract the contaminated alluvial groundwater north of the former disposal area.
- Reduce migration of contaminated groundwater to currently unaffected areas.
- Treat the extracted groundwater to concentrations sufficient to meet discharge requirements.

General Description. The extraction of groundwater from the area north of the former disposal area will be conducted with a series of groundwater extraction wells. The wells will be installed to the top of the bedrock surface, and will be screened from the bedrock surface into the alluvium. A submersible well pump will be installed in each well and will be operated on level control using float-type level switches. The extracted groundwater will be conveyed via underground pipe to the treatment system and treated with the extracted groundwater from the SVE/GPT system.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The implementation and construction of the removal actions at the Ralston site will be conducted in accordance with all ARARs. Compliance with ARARs will ensure that cleanup of the site

provides the mandatory protection to human health and the environment. Tables 2-1, 2-2 and 2-3 list the contaminant-specific, action-specific and location-specific ARARs, respectively, for the removal actions at the Ralston site. Brief descriptions of ARARs associated with each of the removal actions are presented below.

Creek Bank Stabilization

The construction of the creek bank stabilization will require a joint construction permit from the Iowa Department of Natural Resources (IDNR) and the United States Army Corps of Engineers (COE) in accordance with Section 404 of the Clean Water Act (CWA) and Iowa Administrative Code (IAC), Chapter 567—70, 71 and 72. These permits are required whenever a stream or river bank is cut, filled or modified. A permit application has been submitted and approved by the IDNR and the COE.

Capping of the Former Disposal Area

The debris and wastes buried in the former disposal area may be considered hazardous wastes. Therefore, the Code of Federal Regulations, Chapter 40, Sections 260, 261 and 264 (40 CFR 260, 261 and 264) may be applicable if these wastes are excavated during construction of the compacted clay cap. These sections deal with the management, treatment, storage and disposal of hazardous wastes. IAC, Chapter 567—23 regulates emissions of fugitive dust during site activities. The emissions of fugitive dust will be controlled by water suppression or other means during construction if dust emissions create a nuisance during construction activities. A stormwater discharge permit for construction activities will be obtained from the IDNR, pursuant to Iowa Code Section 455B.174 and Subrule 567—64.4(2) of the IAC.

In addition, a separate joint construction permit from the IDNR and the COE will be required in accordance with Section 404 of the CWA and the IAC, for the earthwork associated with capping of the former disposal area in a portion of the 100-year floodplain. A permit application for the former disposal area capping has been submitted to the IDNR and the COE for approval.

Dual Purpose Soil Vapor Extraction and Groundwater Pump and Treat System

Regulations in 40 CFR 141 define the maximum contaminant levels (MCLs) for some of the contaminants present at the Ralston site, using health-based standards. These regulations may apply to the cleanup of groundwater at the Ralston site.

If, in the future, treated groundwater may be discharged into the surface waters in the Ralston site vicinity, an NPDES permit will be obtained. At this time, the treated groundwater is planned to be discharged to a POTW, which will require a pretreatment agreement, in accordance with the National Pretreatment Standards established in 40 CFR 403.

Off-gas from the air stripper unit and extracted soil vapor will be treated with a catalytic oxidizer unit or other appropriate air treatment device. The emissions from the air treatment device will be subject to the requirements of the Clean Air Act. Specifically, 40 CFR 50 and the Iowa Code, Chapters 567-24, 28, and 30 will apply to the construction, operation and emissions from the air treatment system. Linn County requires a construction permit and an operating permit for remedial treatment equipment that may emit hazardous air pollutants.

TABLE 2-1

CONTAMINANT-SPECIFIC ARARs

Standard, Requirement, Criteria or Limitation	Citation	Description	Comment
FEDERAL			
Safe Drinking Water Act	40 USC Section 300		
National Primary Drinking Water Standards	40 CFR Part 141	Establishes maximum contaminant levels (MCLs) which are health-based standards for public water systems.	The MCLs for organic and inorganic contaminants are relevant and appropriate to the groundwater contaminants.
Clean Water Act	33 USC Section 1251-1376		
Ambient Water Quality Criteria	40 CFR Part 131, Quality Criteria for Water, 1976, 1980, 1986	Requires the states to set ambient water quality criteria (AWQC) for water quality based on use classifications and the criteria developed under Section 304(a) of the Clean Water Act.	AWQC for some of the organic and inorganic contaminants in the groundwater at the site have been developed. May be relevant and appropriate if contaminated or treated groundwater is discharged to surface water during a removal action.
National Pollutant Discharge Elimination System Permit Regulations	33 USC Section 1251-1376 40 CFR Parts 122,125	Requires permits for the discharge of pollutants from any point source into waters of the United States (U.S.).	A permit is not required for on-site CERCLA response actions, but the substantive requirements would apply if an alternative developed would discharge into a creek or other surface water on the site. A permit would be required if the discharge is to a creek or surface water located off site.
National Pretreatment Standards	40 CFR Part 403	Sets standards to control pollutants which pass through or interfere with treatment processes in publicly-owned treatment works or which may contaminate sewage sludge.	If an alternative involves discharge to publicly-owned treatment works, these standards would be applicable.
Clean Air Act	42 USC Section 7401-7642		
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes standards for ambient air quality to protect public health and welfare.	Former Ralston disposal site is not considered to be a source of air pollution based on screening activities. This is applicable if contaminants are discharged to the air during a soil and groundwater treatment process.

TABLE 2-1 (CONTINUED)

CONTAMINANT-SPECIFIC ARARs

Standard, Requirement, Criteria or Limitation	Citation	Description	Comment
STATE			
Iowa Air Pollution Control Regulations	Chapter 567—28	Ambient Air Quality Standards (Adopts 40 CFR 40).	See National Primary and Secondary Ambient Air Quality Standards.
	Chapter 567—30	This chapter is not yet promulgated, but it will govern emissions from an on-site treatment process. Development of a permit will be on a case-by-case basis under the general authority of the IDNR to protect human health and the environment.	None
Iowa Water Pollution Control Regulation	Chapters 567—60 to 64	Chapter 60 provides general definitions applicable in this title and rules of practice. Chapter 61 contains the water quality standards of the State including classification of surface waters. Chapter 62 contains the standards relevant to the discharge of pollutants to the waters of the state. Chapters 63-64 identify monitoring, analytical and reporting requirements pertaining to specific permits for the operation of water disposal systems.	None
Iowa Responsible Parties Cleanup Regulations	Title X, Chapter 133	These rules establish the procedures and criteria the Department will use to determine the parties responsible and cleanup actions necessary to meet the goals of the State pertaining to the protection of groundwater. These rules pertain to the cleanup of groundwater, soils and surface waters where groundwater may be impacted. (See Table 1-3)	None

TABLE 2-2

ACTION-SPECIFIC ARARs

Standard, Requirement, Criteria or Limitation	Citation	Description	Comment
FEDERAL			
Solid Waste Disposal Act (SWDA)	42 USC Section 6901-6987		
Hazardous Waste Management Systems General	40 CFR Part 260	Establishes procedures and criteria for modification or revocation of any provision in 40 CFR Parts 260-165.	May be applicable if a substance at the site was to be excluded from the list of hazardous wastes.
Identification and Listing of Hazardous Wastes	40 CFR Part 261	Defines those solid wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 263-265 and Parts 124, 270 and 271.	Identifies those wastes considered to be hazardous wastes at the site. Any wastes considered as hazardous would be required to be handled as such.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store or dispose hazardous waste.	Subparts B through X may be applicable or relevant and appropriate to on-site and off-site remedial actions.
Occupational Safety and Health Act	20 USC Section 651-678	Regulates worker health and safety.	None
Clear Air Act	42 USC Section 7401-7642	Regulates air quality to protect human health and the environment.	None
National Ambient Air Quality Standards	40 CFR Part 50	Treatment technology standards for emissions to air: • incinerators • surface impoundments • waste piles • landfills • fugitive emissions	If an alternative developed would involve emissions governed by these standards, then the requirements are applicable.

TABLE 2-2 (CONTINUED)

ACTION-SPECIFIC ARARs

Standard, Requirement, Criteria or Limitation	Citation	Description	Comment
STATE			
Iowa Environmental Quality Act	Chapter 455B	Defines the jurisdiction of the department, defines powers and duties of the commission and the director, civil or criminal proceedings to be undertaken by the State Attorney General.	None
Iowa Air Pollution Control Regulations	Chapter 567—23	Governs the release of fugitive dust in quantities creating a nuisance during site activities and emissions from a treatment system.	None
	Chapter 567—24	Applies to emissions from a permitted emission point. Could be applied to excess emissions of fugitive dust.	None
	Chapter 567—25	State could require measurement of emissions from an air stripper.	None
	Chapter 567—28	Ambient Air Quality Standards (Adopts 40 CFR 50).	None
Iowa Water Pollution Control Regulations	Chapter 567—40	Water supply definitions. Defines MCLs which Chapter 133 refers to.	None
Iowa Responsible Parties Cleanup Regulations	Chapter 133	These rules establish the procedures and criteria the Department will use to determine the parties responsible and cleanup actions necessary to meet the goals of the State pertaining to the protection of groundwater. These rules pertain to the cleanup of groundwater itself and soils and surface water where groundwater may be impacted.	None

TAB' ?-3

POTENTIAL LOCATION-SPECIFIC ARARs

Standard, Requirement, Criteria or Limitation	Citation	Description	Comment
FEDERAL			
Clean Water Act	40 CFR 230 Section 404	Establishes a permit program administered by the U.S. Army Corps of Engineers to regulate the nonpoint source discharges of dredged or fill material into waters of the U.S.	Affects location and construction of removal alternatives within the floodplain of Dry Run Creek.
RCRA	40 CFR 270.14(b)(11) (iii) and (iv)	Establishes building criteria for TSD facilities located in floodplain.	Potentially affects location and construction of removal alternatives within the floodplain of Dry Run Creek.
STATE			
Clean Water Act	Section 401	State Section 401 water quality certification is mandatory for all projects requiring Federal Section 404 permit. Section 401 certification is State's concurrence that a project is consistent with state's water quality standards. Also establishes criteria for wetlands.	Affects location and construction of removal alternatives within the floodplain of Dry Run Creek.
Floodplain Development	Iowa Code Section 455B, Chapters 70-76	The State has authority to regulate construction on all floodplains and floodways in the State. Chapters 70-76 explain how and when a permit must be obtained for various types of development.	Potentially affects location and construction of removal alternatives within the floodplain of Dry Run Creek.
LOCAL			
City of Cedar Rapids	Local Ordinance	Variance/issuance of floodplain permits under Floodplain Management Ordinance for Federal Emergency Management Agency.	Affects location and construction of removal alternatives within the floodplain of Dry Run Creek.

A permit may be required from the State of Iowa for the extraction of groundwater from the subsurface at the Ralston site. A building permit will be obtained from the City of Cedar Rapids for construction of the treatment building.

Alluvial Groundwater Extraction North of Dry Run Creek

The groundwater extraction system north of Dry Run Creek will be subject to the same ARARs as the extraction and treatment of the groundwater from the former disposal area. Any applicable permits obtained for the remediation of groundwater in the former disposal area will include the extraction and treatment of the groundwater north of Dry Run Creek. Conveyance of groundwater through a buried pipe under the creek will require an additional joint construction permit (Section 404 of the CWA and IAC 567—70, 71 and 72) from the IDNR and the COE.

OPERATING GOALS

Operation of the combined removal actions will be detailed during design of the removal actions. However, it is anticipated that the system will be completely automatic, with periodic maintenance required. The system will be capable of remote access from off-site location(s). An automatic alarm will be integral to the treatment system in order to shut down operation of the system under alarm conditions.

Treatment of the groundwater will reduce the concentrations of contaminants to levels at, or below, the limits established in the pretreatment agreement with the POTW. Treatment of the off-gas from the air stripper and the extracted soil vapor will be treated to comply with the Linn County air emissions permit and other applicable standards identified above.

SECTION 3

SECTION 3

REMOVAL ACTION DESIGN DOCUMENTS

OBJECTIVES

This section describes the design documents to be prepared for the selected removal actions. Design drawings and technical specifications for the creek bank stabilization and former disposal area cap are presented in Appendices B and C. Design of the dual purpose SVE/GPT system and additional groundwater extraction system have not been completed at the time of this submittal; however, anticipated lists of the design drawings for each of these removal actions are presented. In addition, performance and quality assurance criteria to be followed during construction and system startup are included below.

DESIGN DRAWINGS AND TECHNICAL SPECIFICATIONS

Creek Bank Stabilization and Capping of the Former Disposal Area

As described in Section 2, stabilization of the south side of Dry Run Creek will consist of clearing and grubbing the area, minimal regrading of the bank surface, placing a geomembrane liner and installing cable-stayed concrete mats on the bank slope. In conjunction with construction of the creek bank stabilization the former disposal area will be capped with a compacted layer of clay. This clay cap will serve to isolate the former disposal area from stormwater infiltration and reduce the potential for continued alluvial groundwater contaminant migration. The cap will also inhibit the flow of "clean" atmospheric air through the subsurface, which will assist the SVE system. Table 3-1 presents a list of the design drawings, and Table 3-2 presents a list of the technical specifications for the creek bank stabilization and former disposal area cap. The design drawings for the creek bank stabilization and former disposal area cap are included in Appendix B. Appendix C includes technical specifications for the creek bank stabilization and former disposal area cap.

Soil Vapor Extraction and Groundwater Pump and Treat System

Once the former disposal area is sufficiently capped, installation of the dual purpose SVE/GPT system will be initiated. This removal action will include installation of the dual purpose extraction wells, all required conveyance piping, pumps, blowers, meters, valves, and appurtenant equipment. The design of the groundwater and soil vapor treatment system will also be included with this removal action. The treatment system will likely consist of influent and effluent equalization tanks, an air stripper, a catalytic oxidizer, and possible other chemical feed systems and/or filters. The system will be installed inside a pre-engineered building. Additional groundwater extraction wells will be added as necessary to achieve adequate capture of the alluvial groundwater. Preliminary lists of design drawings for the dual purpose SVE/GPT system are shown in Table 3-3.

Alluvial Groundwater Extraction North of Dry Run Creek

The design and construction of alluvial groundwater extraction wells in the area north of Dry Run Creek will be implemented concurrently with the design and construction of the SVE/GPT

TABLE 3-1

DESIGN DRAWINGS FOR CREEK BANK STABILIZATION AND FORMER DISPOSAL AREA CAP

Drawing	Title
G-01	Cover Sheet
G-02	Location Maps, Sheet Index and Detail Identification
C-01	Existing Conditions
C-02	Project Overview
C-03	Clearing and Grubbing
C-04	Disposal Area General Grading
C-05	Disposal Area Final Grading
C-05A	Borrow Area Final Grading
C-06	Erosion Control Plan
C-07	Details
C-08	Sections
C-09	Cross Section Locations
C-10	Cross Sections

TABLE 3-2

TECHNICAL SPECIFICATIONS FOR CREEK BANK STABILIZATION AND FORMER DISPOSAL AREA CAP

Section	Title
02100	Site Preparation
02120	Silt Fences
02200	Earthwork
02270	Erosion Control (Vegetative)
02276	Geotextile Fabrics
02300	Rock Surfacing
02625	Corrugated Metal Pipe
02781	Very Low Density Polyethylene (VLDPE) Geomembrane Liners
03401	Cable-Stayed Concrete Mat System

TABLE 3-3

DESIGN DRAWINGS FOR SOIL VAPOR EXTRACTION AND GROUNDWATER PUMP AND TREAT SYSTEM FORMER RALSTON DISPOSAL SITE

Drawing	Title
G-01	Cover Sheet
G-02	Site Location, Sheet Index, Legend
C-01	Existing Conditions
C-02	Dual Purpose Extraction Well Layout
C-03	Conveyance Piping Plan
C-04	Conveyance Piping Sections
C-05	Typical Dual Purpose Extraction Well
C-06	Conveyance Piping Trench Details
C-07	Miscellaneous Details
A-01	Site Plan - Building Area
A-02	Treatment Building Floor Plan
A-03	Treatment Building Elevations/Sections
A-04	Treatment Building Details
A-05 through A-07	Foundation Plan/Details
A-08	Office/Control/Restroom Details
A-09	Treatment Building HVAC Plan/Details
A-10	HVAC Mechanical Equipment Schedule
M-01	Process Flow Diagram
M-02	Process Hydraulic Profile
M-03	Equipment Arrangement Plan
M-04	Equipment Schedules
M-05	Treatment Process Piping - Sheet 1
M-06	Equipment Sections/Details - Sheet 1
M-07	Equipment Sections/Details - Sheet 2
M-08	Miscellaneous Details - Sheet 1

TABLE 3-3 (CONTINUED)

DESIGN DRAWINGS FOR SOIL VAPOR EXTRACTION AND GROUNDWATER PUMP AND TREAT SYSTEM FORMER RALSTON DISPOSAL SITE

Drawing	Title
E-01	Electrical Legend
E-02	One-Line Diagram
E-03	Dual Purpose Well Field Electrical Plan
E-04	Treatment Building Underground Electrical Plan
E-05	Treatment Building Power and Control
E-06	Treatment Building Lighting and Outlets
E-07	Treatment Building Electrical Details
E-08	Process Equipment Electrical Details
E-09	Panel Details - Treatment Building
E-10	Motor Control Schematics
E-11	Miscellaneous Details
E-12 through E-22	Electrical Logic Diagrams
I-01 through I-03	Well Field P & IDs
I-04 through I-08	Treatment Process P & IDs

system in the former disposal area. The extracted groundwater from this system will be conveyed via pipeline under Dry Run Creek to the treatment system. Design drawings and technical specifications anticipated for the design of the alluvial groundwater extraction north of Dry Run Creek are shown on Tables 3-3 and 3-4, respectively.

PERFORMANCE MONITORING

Once the removal actions have been constructed and are operational, the treatment system and select monitoring wells will be monitored to determine if the removal actions are meeting their initial objectives. This will be done by:

- Collecting and analyzing groundwater samples from monitoring wells and comparing the results with historical groundwater data.
- Collecting and analyzing treatment water samples from the treatment system before and after specific processes.
- Sampling and analyzing soil vapor from the treatment system before and after specific processes.
- Gauging and recording groundwater head measurements from nearby monitoring wells to determine hydraulic gradient control.
- Sampling and analyzing surface water and comparing the results with historical data.

These data, along with other possible qualitative or quantitative data, will help determine the overall effectiveness of the removal action. A section of the design document for the construction of the SVE/GPT system will contain a detailed description of the specific tasks involved with performance monitoring of the system.

QUALITY ASSURANCE

The construction of the creek bank stabilization, the former disposal area cap and the SVE/GPT systems must be conducted so that the performance of the combined removal actions are not compromised by poor quality assurance or quality control (QA/QC). Therefore, specific QA/QC procedures will be followed during the construction of these removal actions.

Creek Bank Stabilization and Former Disposal Area Capping

The stabilization of the creek bank and capping of the former disposal area will be constructed simultaneously, prior to construction of the SVE/GPT or alluvial groundwater extraction systems. The QA/QC procedures for the creek bank stabilization and former disposal area cap construction are presented below.

For the construction of the creek bank stabilization, a Montgomery Watson on-site representative will inspect the placement of the geomembrane liner and installation of the cable-stayed concrete mats. In addition, representatives from the cable-stayed concrete and geomembrane liner manufacturers will be on site to guide the installation of their respective creek bank stabilization

components. The Montgomery Watson on-site representative will be responsible for assuring the construction proceeds in accordance with the design drawings and technical specifications. Sound engineering practices will be used during construction, and all OSHA regulations and the Health and Safety Plan will be followed. Any anticipated deviations from the design drawings and/or the technical specifications due to unforeseen circumstances encountered in the field will be recorded by the on-site representative and reported to both the Rockwell Project Coordinator and the Montgomery Watson PM as soon as possible. If it then becomes necessary to change the design of the creek bank stabilization the PM, with approval of the Rockwell Project Coordinator, will issue a change order. In no instance will the contractor(s) change the design without prior approval of both the Rockwell Project Coordinator and the Montgomery Watson PM.

The construction of the former disposal area cap consists mainly of earthwork, compaction and installation of erosion control. A Montgomery Watson on-site representative will periodically inspect the site and the work completed to ensure that the project is proceeding in accordance with the design drawings. Laboratory tests of the compacted clay will be conducted to verify that the clay is compacted sufficiently to meet the permeability requirements. Manufacturers' certifications of materials will be required for all geotextile fabrics, geomembrane liner, seeding and fertilizer to be used for the construction of both the creek bank stabilization and the former disposal area cap to ensure adequate construction materials (that meet the appropriate specifications) are being utilized.

Surveys will be conducted following placement of the general fill, the final compacted clay and the topsoil layer to ensure adequate thickness of each of these layers. Placement of organic erosion control blankets will be inspected to ensure installation is completed in accordance with manufacturers specifications and recommendations.

Following completion of the former disposal area cap and creek bank stabilization, the area will be inspected periodically and maintained. The cap, terraces and associated drainageways will be inspected following heavy precipitation events to discover any erosion that may have occurred. Damaged areas will then be repaired by replacing any lost soil, compacting, reseeding and remulching or placing organic erosion control fabric on the affected area(s). The access road and cabled-concrete will be inspected periodically and repaired, as necessary, to restore them to their original condition. The surface vegetation will be controlled by mowing the area and reseeding any sparsely vegetated areas, as necessary.

Soil Vapor Extraction/Groundwater Pump and Treat Systems and Alluvial Groundwater Extraction North of Dry Run Creek

QA/QC for the construction and maintenance for the operation of the SVE/GPT and treatment systems at the Ralston site will be addressed in the design document for these removal actions. The QA/QC procedures will cover the following:

- Inspection of the installation and testing of dual purpose SVE/GPT extraction wells and associated mechanical, electrical and instrumentation equipment.

- Inspection of the installation and testing of alluvial groundwater extraction system north of Dry Run Creek.

- Inspection of the installation and testing of the treatment system and all associated mechanical, electrical and instrumentation equipment.

These QA/QC procedures will ensure that all installed removal actions are capable of performing their intended functions and that minimal operation and maintenance is required for each component of the combined remedial system. These procedures will also ensure operation of the combined remedial system as originally intended.

SECTION 4

SECTION 4

SCHEDULE OF REMOVAL ACTIONS

The proposed schedule for major components of the selected removal actions is shown in Table 4-1. The dates listed on this schedule are tentative but do give an indication of the relative progression of the removal actions at the Ralston site. Significant changes to this schedule are not anticipated, but could occur due to unforeseen delays in issuance of permits, weather, or other unforeseen circumstances. If significant modifications to this schedule are necessary, all parties involved with affected portions of the removal action schedule will be notified as part of the monthly progress reports to the EPA.

TABLE 4-1

SCHEDULE OF SELECTED REMOVAL ACTIONS

Start Date	Finish or Submittal Date	Component of Removal Action
	05-16-94	Removal Action Work Plan Submitted to the EPA
03-31-94	05-16-94	Design of Creek Bank Stabilization, Former Disposal Area Cap
05-16-94	06-24-94	Application and Receipt of Floodplain Construction Permit for Creek Bank Stabilization, Former Disposal Area Cap
05-27-94	06-17-94	Bid Phase for Stabilization and Cap Construction
06-24-94	08-19-94	Stabilization and Cap Construction
05-27-94	07-08-94	Design of SVE/GPT System and Alluvial Groundwater Extraction System North of Dry Run Creek (Submitted to the EPA 07-08-94)
06-03-94	07-29-94	Application and Receipt of Building Permit from City of Cedar Rapids
07-08-94	07-29-94	Bid Phase for SVE/GPT System and Alluvial Groundwater Extraction System Construction
08-01-94	10-31-94	Application and Receipt of Air Emissions Permit from Linn County, Iowa
08-01-94	10-31-94	Negotiation of Pretreatment Agreement with POTW
08-01-94	11-04-94	Construction of SVE/GPT System and Alluvial Groundwater Extraction System North of Dry Run Creek
11-07-94	12-02-94	Startup and Test-Out of Combined Remediation System
12-02-94	01-13-95	Preparation and Submittal of Removal Action Report to the EPA

APPENDIX A

SITE SAFETY PLAN

FOR

FORMER RALSTON DISPOSAL SITE

Prepared for

ROCKWELL INTERNATIONAL CORPORATION
CEDAR RAPIDS, IOWA

Project No. 1166.0250

January 1994

Prepared by

Montgomery Watson
11107 Aurora Avenue
Des Moines, Iowa 50322
515-253-0830

PREPARED BY: _____ **DATE:** _____

APPROVED BY: _____ **DATE:** _____
Health and Safety Coordinator

APPROVED BY: _____ **DATE:** _____
Project Manager

APPROVED BY: _____ **DATE:** _____
Program Director

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1.0 - INTRODUCTION

Montgomery Watson has developed this Site Safety Plan (SSP) to address health and safety procedures for the removal action activities to be conducted at the former Ralston disposal site (Ralston), Cedar Rapids, Iowa. The SSP establishes health and safety procedures for field activities that will minimize potential risk to personnel performing removal action activities associated with the source area and shallow alluvial groundwater.

The SSP applies to all Montgomery Watson employees who will potentially be exposed to safety and/or health hazards associated with the proposed construction activities. This SSP has been developed based on limited knowledge regarding the specific chemical hazards and potential physical hazards which would be associated with planned site activities. Site-specific work activities include: construction of treatment building, installation of soil vapor and groundwater extraction wells, construction of clay cap, construction of trench wall near Dry Run Creek, construction of groundwater interception trench north of Dry Run Creek, and creek bank stabilization.

The SSP has been prepared in compliance with requirements of the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operation and Emergency Response Standards (29 CFR 1910.120) and other applicable OSHA regulations. Actual working conditions may require modification of this SSP. Except in emergency situations, the Industrial/Hazardous Waste Group Health and Safety Manager (HSM), Health and Safety Coordinator (HSC), or Project Safety Officer (PSO) must approve any modifications before they can be implemented. Written documentation of the change must be attached as an addendum to this SSP. A "Field Change Request" form is included as Attachment A.

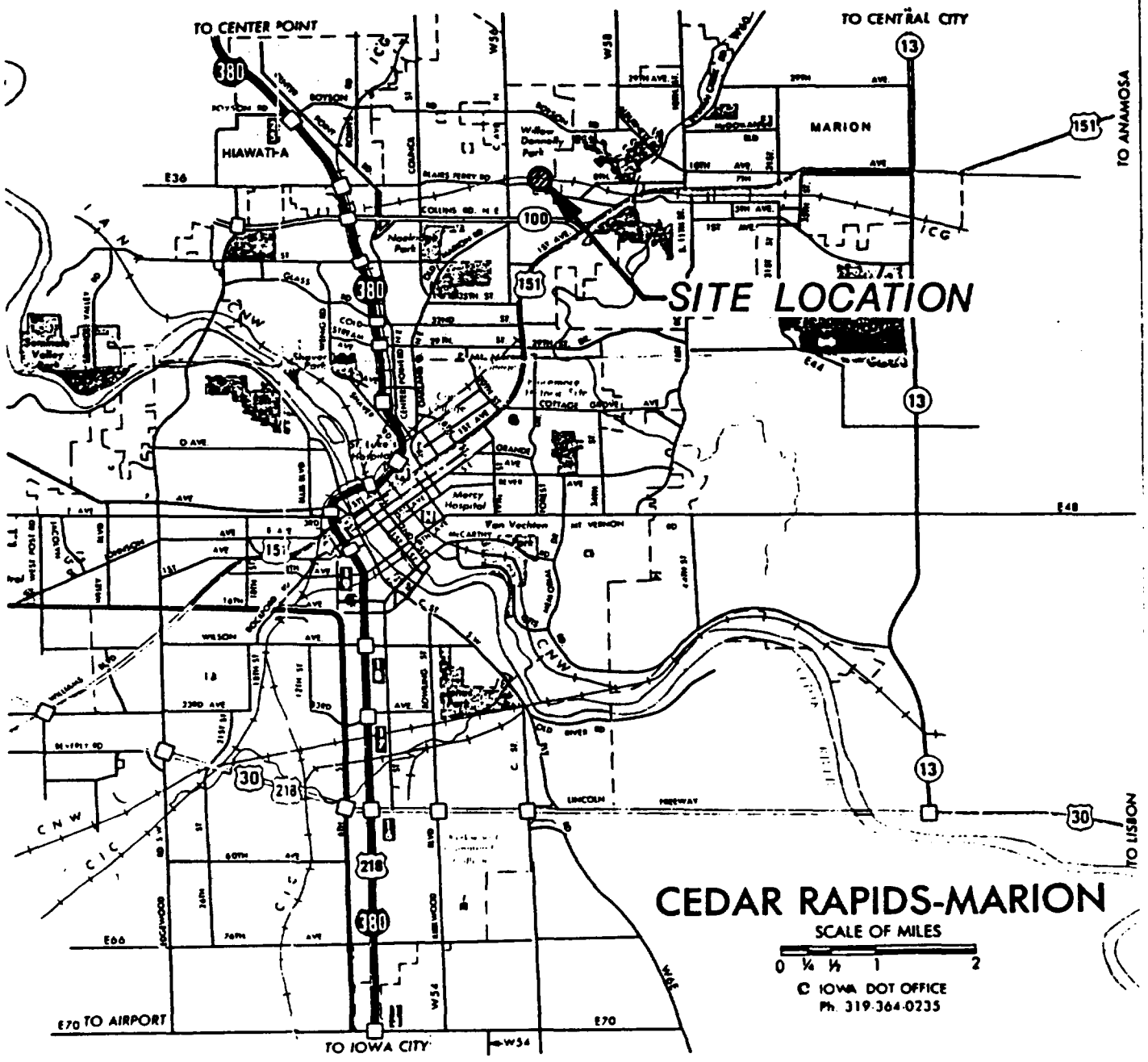
2.0 - SITE DESCRIPTION, HEALTH RISK AND ACCIDENT PREVENTION

2.1 - Site Description

The Ralston site is approximately 1-1/2 acres in size and located in the NE 1/4, NW 1/4, Section 2, T8N, R7W, Linn County, Iowa as shown on Figure 2-1. The Ralston site is located behind 228 Blairs Ferry Road in Cedar Rapids, Iowa. The 1-1/2 acre site is a part wooded/grassy lot bordered on the north by Dry Run Creek, on the south by railroad tracks, on the west by farmland and on the east by wooded lots. Several residences and light commercial businesses are located south of the site along Blairs Ferry Road.

The Ralston site was used by Rockwell International Corporation (Rockwell) from 1956 to 1958 as a disposal area for wastes generated from a pilot gold plating facility and other industrial sources. The wastes at the site were burned and spread out in layers as necessary to accommodate additional wastes. The types of wastes burned and buried included solvents, paint sludge and general refuse (scrap metal, office furniture and other industrial refuse). The Ralston site was also used to dispose of cyanide waste from the plating operation. Two 5-gallon containers of cyanide waste were placed in a 55-gallon drum and encapsulated in concrete.

Site reconnaissance in 1985 and a geophysical survey in 1988 noted the presence of drums and other areas of suspected waste disposal. In 1989, Rockwell removed two drums of encapsulated cyanide; further site excavations revealed no other cyanide encapsulated drums. Additional excavation and boring activities at the site in 1990 identified metals and several volatile organic compounds (VOCs) in surface and subsurface soil samples above background concentrations. Several site investigations have been completed using the approved Remedial Investigation



MAP SOURCE: - IOWA DEPARTMENT OF TRANSPORTATION
GENERAL HIGHWAY AND TRANSPORTATION
MAP

N

MONTGOMERY WATSON

ROCKWELL INTERNATIONAL CORPORATION

SITE LOCATION MAP

FIGURE 2-1

Work Plan. This data is available for review in the Des Moines office of Montgomery Watson or the Administrative Record on file at the Cedar Rapids Public Library, at request.

2.2 - Existing Areas of Investigation and Associated Chemical Hazards

Soil and groundwater sampling activities have previously been conducted at the facility. VOCs [primarily trichloroethylene (TCE), cis-1,2-dichloroethene (DCE), tetrachloroethylene (PCE) and vinyl chloride] were detected in disposal area surface and subsurface soil samples. Detectable concentrations of cadmium, chromium, copper and lead were also measured in surface and subsurface soil samples. Toluene, xylene, acetone, and methylene chloride were detected in subsurface soil samples.

Concentrations of TCE, DCE, vinyl chloride, methyl ethyl ketone (MEK), toluene, acetone, and xylenes were detected in alluvial groundwater samples. Semivolatile organic compounds were also detected in alluvial groundwater samples. Bedrock groundwater activities are not addressed in the removal action activities.

Concentrations of DCE, vinyl chloride and TCE were detected in Dry Run Creek surface water and sediment samples.

2.3 - Proposed Additional Investigation Activities

The proposed remediation activities planned for the Ralston site include:

- Construction of treatment building.
- Installation of soil vapor and groundwater extraction wells.
- Construction of clay cap.
- Construction of trench wall near Dry Run Creek.
- Construction of groundwater extraction wells north of Dry Run Creek.
- Creek bank stabilization.

2.4 - Safety and Health Risk Analysis

Chemical Toxicity Hazard. The potential toxic exposure hazard to site personnel associated with chemical contaminants present at the areas described in Section 2.2 can be expressed in Threshold Limit Values-Time Weighted Average (TLVs-TWAs) as established by the American Conference of Governmental Industrial Hygienists (ACGIH); Permissible Exposure Limits (PELs) as mandated by OSHA; Recommended Exposure Limits (RELs) as suggested by the National Institute for Occupational Safety and Health (NIOSH); and by Immediately Dangerous to Life or Health (IDLH) values established by NIOSH and OSHA.

TLV-TWA: The TWA airborne concentration of a substance for a normal 8-hour work day and 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effects.

PEL: The TWA airborne concentration of a substance for a normal 8-hour work day and a 40-hour work week, to which workers may be exposed, day after day. PELs are OSHA-promulgated exposure standards (29 CFR 1910.100).

from 8/8/94 letter

REL: The TWA airborne concentration of a substance up to a 10-hour exposure duration (unless otherwise noted). RELs are established by NIOSH to reduce or eliminate adverse occupational health effects.

IDLH: The maximum airborne concentration of a substance which one could escape within 30 minutes without escape-impairing symptoms or any irreversible effects.

Available information regarding site contamination occupational exposure limits for potential contaminants including TWA and IDLH values and ionization potentials are presented in Table 2-1. Table 2-2 summarizes odor thresholds, routes of exposure and symptoms. Table 2-3 presents the abbreviations used for symptoms.

Due to the nature of this field work, Montgomery Watson personnel cannot fully anticipate the types and concentrations of these potential hazards. Therefore, proper monitoring during removal action activities is a necessity. Specific monitoring and hazard assessment will be covered in Section 8 of this SSP.

Physical Hazards. Physical hazards anticipated during the Ralston field work include operation of heavy equipment, drill rig operation potential, noise, heat or cold stress, electrical hazards, vehicle travel hazards and slip, trip and fall hazards. To prevent the hazard of drilling into underground power cables or other utilities, all utilities will be marked prior to initiating drilling. Standard drilling procedures, which prohibit drilling within 5 feet of marked underground utilities or within 20 feet of overhead electrical hazards, will be followed.

Levels of Personal Protection. Work will commence in Level D personal protective equipment (PPE). However, due to the potential for adverse employee exposure, the contingency to upgrade to Level C protection is included in Section 8. The upgrade will occur in the event that dust and/or atmospheric monitoring during specific site activities meets or exceeds predetermined levels established for upgrading protective equipment based on toxic air contaminants. Further explanation and criteria for upgrading the level of protection are discussed in Section 8.

If monitoring indicates that an upgrade to Level C protection is warranted, it will be the responsibility of the Montgomery Watson on-site safety officer to stop field activities until air-purifying respirators equipped with appropriate cartridges are donned by Montgomery Watson personnel working in the exclusion zone.

2.5- Activity Hazard Analysis

Drilling and Trenching Activities. Hazards associated with removal action activities include equipment dangers; slip, trip and fall hazards; potential exposure to organic vapors, metals, heat/cold stress; and noise stress. Monitoring for dust conditions and the potential gases listed in Table 2-1 will be conducted to minimize exposure by early detection. If necessary, the site will be upgraded to Level C, or personnel will move away from the site until levels drop to acceptable working levels. Heat/cold stress will be monitored depending upon ambient conditions. During the advancement of each extraction well, drilling safety will be observed and maintained. Standard drilling safety procedures are included in Attachment B, "Drilling Safety Guide," prepared by the National Drilling Federation.

All field personnel will be required to wear steel-toed boots, hard hats, hearing protection and safety glasses when working near heavy equipment.

TABLE 2-1

TOXICITY INFORMATION AND OCCUPATIONAL HEALTH GUIDELINES

Chemical Compound	HighestContaminant Concentration in Soil/Alluvial Groundwater (ppm/ppb)	NIOSH-ACGIH TWA (for air) (ppm/mg/m^3)	OSHA IDLH (for air) (ppm/mg/m^3)	Ionization Potential
Metals				
Cadmium	74/-	-/0.05	-/9	NA
Chromium	880/-	-/0.5	NA	NA
Copper	62,000/-	-/1	NA	NA
Lead	6,600/-	-/0.05	-/700	NA
Volatile Compounds				
Acetone	-/49,000	250	20,000	9.69
cis-1,2-Dichloroethene (DCE)	-/20-230,000	200/-	4,000/-	9.65
Methyl ethyl ketone (MEK)	-/13,000	200/-	3,000/-	9.54
Methylene Chloride	-/16,000	500/-	5,000/-	11.32
Tetrachloroethylene (PCE)	1,800/2,600	25/-	500/-	9.32
Toluene	6,300/39,000	100/-	2,000/-	8.82
Trichloroethylene (TCE)	17,000/980,000	50/-	1,000/-	9.45
Vinyl Chloride	.66/29,000	C5/-	-/-	9.99
Xylene	700/3,600	100/-	1,000/-	8.56
Inorganics				
Cyanide	2.8/-	-/C5	-/50	NA

- Indicates no information available.
C = Ceiling limit.
NA = Not applicable.
ND = Not detected.
ppb - Parts per billion.
ppm = Parts per million.
mg/m^3 = Micrograms per cubic meter.

Abbreviations:

NIOSH - National Institute for Occupational Safety and Health
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
TWA - Time Weighted Average
IDLH - Immediately Dangerous to Life or Health

References and Sources of Information:

1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Limits Agents.
NIOSH Pocket Guide to Chemical Hazards.
PHOTOVAC Technical Bulletin No. 11.
Personnel Protection and Safety, EPA Course 165.2 (manual).
The Condensed Chemical Dictionary, 10th Ed., 1981.
Sax's Dangerous Properties of Industrial Materials, 8th Ed.

TABLE 2-2

ODOR AND EXPOSURE CHARACTERISTICS

Contaminant	Odor Threshold (ppm)	Description of Odor	Route of Exposure[a]	Symptomology[b]
Metals				
Cadmium	N.A.	Odorless	Inh, Ing	Resp sys, kidneys, prostate, blood
Chromium	N.A.	Odorless	Inh, Ing	Histologic fibrosis of lungs
Copper	N.A.	Odorless	Inh, Ing, Con	Irrit nasal muc memb, pharynx; nasal perforation; eye irrit; metallic taste; derm; in animals: lung, liver, kidney, damage; anemia
Lead	N.A.	Odorless	Inh, Ing, Con	Weak, lass, insom; facial pallor; pal eye, anor, low-wgt, malnut; constip, abdom pain, colic; anemia; gingival lead line; tremor; para wrist, ankles; encephalopathy; nephropathy; irrit eyes; hypotension
Volatile Compounds				
Acetone	33-653	Fragrant, mint-like	Inh, Ing, Con	Irrit eyes, nose, throat; head, dizz; derm
cis-1,2-Dichloroethene (DCE)	0.08-17	Slightly acrid, chloroform-like	Inh, Ing, Con	Irrit eyes, resp sys; covs, depres
Methyl ethyl ketone (MEK)	5.4-55	Moderately sharp, fragrant, mint- acetone-like	Inh, Ing, Con	Irrit eyes, nose, head; dizz; vomit
Methylene Chloride	1.2-440	Chloroform-like	Inh, Ing. Con	Ftg, weak, sleepiness, li-head; limbs numb, tingle; nau; irrit eyes, skin; [carc]
Tetrachloroethylene (PCE)	47	Mild, chloroform-like	Inh, Ing, Con	Irrit eyes, nose, throat; nau; flush face, neck; verti, dizz, inco; head, som; skin eryt; liver damage; [carc]

TABLE 2-2 (CONTINUED)

ODOR AND EXPOSURE CHARACTERISTICS

Contaminant	Odor Threshold (ppm)	Description of Odor	Route of Exposure[a]	Symptomology[b]
Volatile Compounds (Continued)				
Toluene	0.16-37	Sweet, pungent, benzene-like, sour, burnt	Ing, Abs, Ing, Con	Ftg, weak; conf, euph, dizz, head; dilated pupils, lac; ner, musc ftg, insom; pares; derm
Trichloroethylene (TCE)	82	Chloroform-like, ether, solventy	Inh, Ing, Con	Head, verti; vis dist, tremors, som, nau, vomit; irrit eyes; derm; card arrhy, pares; [carc]
Vinyl Chloride	10-20	Pleasant at high concentrations, sweet	Inh	Weak; abdom pain, GI bleeding; hepatomegaly; pallor or cyan of extremities; [carc]
Xylene	20	Sweet, aromatic	Inh, Abs, Ing, Con	Dizz, excitement, drow, inco, staggering gait; irrit eyes, nose, throat; corneal vacuolization; anor, nau, vomit, abdom pain; derm
Inorganics				
Cyanide	-	Almond-like	Inh, Abs, Ing, Con	Asphy and death can occur; weak, head, conf; nau, vomit; incr rate resp; slow gasping resp; irrit eyes, skin

ppm = Parts per million.
N.A. = Not applicable.
- Indicates no information available.

[a] Route of exposure key: Inh = Inhalation; Ing = Ingestion; Con = Skin and/or Eye Contact; Abs = Skin Absorption.

[b] Symptoms of exposure abbreviations key is presented in Table 2-3.

Reference and Sources of Information:

1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Limits Agents.
The Condensed Chemical Dictionary 10th Ed., 1981.
NIOSH Pocket Guide to Chemical Hazards.
Personnel Protection and Safety, EPA Course 165.2 (manual).
PHOTOVAC Technical Bulletin No. 11.
Sax's Dangerous Properties of Industrial Materials, 8th Ed.

TABLE 2-3

ABBREVIATIONS FOR SYMPTOMS OF EXPOSURE

Abbreviation	Symptom	Abbreviation	Symptom	Abbreviation	Symptom
abdom	abdominal	constric	constriction	fib	fibrosis
album	albuminuria	convuls	convulsions	fibrl	fibrillation
anem	anemia	cor	acute right heart strain or chronic right ventricular pulmonale, hypertrophy	func	function
anes	anesthesia			frost	frostbite
anor	anorexia			ftg	fatigue
anos	anosmia	corn	cornea	fvr	fever
ANS	automatic nervous system	CVS	cardiovascular system	gasp	gasping
apat	apathy	cyan	cyanosis	GI	gastrointestinal
appre	apprehension	defat	defatting	gidd	giddiness
arrhy	arrhythmias	deg	degeneration	glau	glaucoma
asphy	asphyxia	dent	dental	glu	glucose
asth	asthma	depres	depressant/depression	halu	hallucinations
atax	ataxia	derm	dermatitis	head	headache
biliru	bilirubinuria	diarr	diarrhea	hema	hematuria
blur	blurred	dil	dilated	hemat	hematoma
breath	breathing	dist	disturbance	hemato	hematopoietic
bron	bronchitis	dizz	dizziness	hemog	hemoglobinuria
bronspas	broncospasm	drow	drowsiness	hemorr	hemorrhage
BUN	blood urea nitrogen	dys	dysuria	hep	hepatic
ca	cancer	dysart	dysarthria	hyper	hyperemia
cachexia	severe generalized weakness, emaciation	dysp	dyspnea	hypox	hypoxemia
		ecz	eczema	ict	icterus
carc	carcinogenic/carcinogen	emphy	emphysema	inco	incoordination
card	cardiac	enl	enlargement	inflamm	inflammation
cere	cerebral	eosin	eosinophilia	inj	injury
chol	cholinesterase	epis	epistaxis	insom	insomnia
chor	chorea	epit	epithelium	intox	intoxication
cirr	cirrhosis	equi	equilibrium	irrit	irritation
CNS	central nervous system	ery chol	erhthrocyte cholinesterase	irrity	irritability
coll	collapse	eryt	erythemia	jaun	jaundice
conf	confusion	euph	euphoria	kera	keratitis
conj	conjunctivitis	extrem	extremities	kid	kidney
constip	constipation	fasc	fasiculation	lab	labored

TABLE 2-3 (CONTINUED)

ABBREVIATIONS FOR SYMPTOMS OF EXPOSURE

Abbreviation	Symptom	Abbreviation	Symptom	Abbreviation	Symptom
lac	lacrimation	para	paralysis	rhin	rhinorrhea
lar	laryngeal	paresis	incomplete loss of muscular power; weakness of a limb	salv	salivation
lass	lassitude			scotoma	an area of absent or depressed vision in the visual field
leucyt	leukocytoses	parox	paroxysmal		
leuk	leukemia	perf	perforation	sens	sensitization
leupen	leukopenia	peri neur	peripheral neuropathy	sez	seizure
li-head	lightheadedness	perineurit	peripheral neuritis	sleep	sleepiness
liv	liver	periorb	periorbital	sneez	sneezing
lo-ap	appetite loss	photo	photophobia	som	somnolence
low-wgt	weight loss	pig	pigmentation	spas	spasm
lymp	lymphocytosis	plas	plasma	strabismus	abnormality of the eyes in which the visual axes do not meet at the desired point
mal	malaise	pleur	pleurisy		
malnut	malnutrition	pneu	pneumonia		
monocy	monocytosis	pneutis	pneumonitis	subs	substernal
muc memb	mucous membrane	PNS	peripheral nervous system	sweat	sweating
musc	muscle	polyneur	polyneuropathy	swell	swelling
myo	myotonia	pros	prostration	sys	system
narc	narcotic	prot	proteinuria	tacar	tachycardia
narco	narcosis	psypec	psychialopecia	tend	tenderness
nas	nose/nasal	pulm	pulmonary	trachbronc	tracheobronchitis
nau	nausea	pulsus altenans	a pulse pattern in which beats occur at regular intervals, but with alternating weak and strong beats	vasconst	vasoconstriction
nec	necrosis			venfib	ventricular fibrillation
neph	nephritis			verti	vertigo
ner	neurologic			vesic	vesiculation
neur	nervousness	pup	pupil	vis dist	visual disturbance
numb	numbness	RBC	red blood cell	vomit	vomiting
opac	opacity	resp	respiratory	weak	weakness
pal	pallor	respar	respiratory arrest	wheez	wheezing
palp	palpitations	retster	retosternal		

Reference: U.S. Department of Health and Human Services, June 1990. NIOSH Pocket Guide to Chemical Hazards, DHHS (NIOSH), Publication No. 90-117.

3.0 - ASSIGNMENT OF RESPONSIBILITIES

Assignment of responsibilities for development, coordination and implementation of the SSP is essential for proper administration of the plan's requirements. Implementation of the SSP will be accomplished through an integrated effort of the following personnel:

Team Member	Work Assignment	Safety Training
Michael D. Geringer	Health and Safety Coordinator (HSC)	40-Hr. Health and Safety 8-Hr First Aid, CPR 8-Hr Supervisory Training
Elizabeth A. Hicks	Project Safety Officer (PSO)	40-Hr. Health and Safety 8-Hr First Aid, CPR 8-Hr Supervisory Training
Jeffrey L. Coon, P.E.	Project Manager (PM)	40-Hr Health and Safety 8-Hr First Aid, CPR 8-Hr Supervisory Training
B. Aaron Bailey	On-Site Safety Officer (OSO)	40-Hr Health and Safety 8-Hr First Aid, CPR 8-Hr Supervisory Training
Thomas A. Blair	On-Site Safety Officer (OSO)	40-Hr Health and Safety 8-Hr First Aid, CPR 8-Hr Supervisory Training
Keith E. Schilling	On-Site Safety Officer (OSO)	40-Hr Health and Safety 8-Hr First Aid, CPR 8-Hr Supervisory Training

3.1 - Project Manager (PM)

The PM is primarily responsible for safety performance of the project and is the central point of contact with Rockwell personnel. Should a health and safety issue develop in the performance of the field activities, the PM will contact Rockwell personnel assigned to the project and the Montgomery Watson PSO.

3.2 - Project Safety Officer (PSO)

The PSO or her designee is responsible for preparation of the site-specific SSP under supervision of the HSC. The PSO will ensure that the SSP complies with OSHA standards and site-specific health and safety requirements based on known or anticipated health and safety concerns. If necessary, the PSO can modify the site-specific SSP to accommodate on-site changes that may affect safety. The OSO will confer with the PSO on all modifications to the SSP. The PSO will be available for consultation when required. The HSC or PSO may visit the site during field activities to perform a site safety audit but will not remain throughout the site investigation. A copy of the Site Safety Checklist is included as Attachment C.

3.3 - On-Site Safety Officer (OSO)

The OSO is responsible for the implementation of the SSP. The OSO has the responsibility and authority to halt or modify any work condition or remove personnel from the site if he considers conditions to be unsafe. The OSO will be the main contact in any on-site emergency situation and will direct all field activities. The OSO will ensure that all on-site Montgomery Watson personnel understand and comply with site safety requirements. If the OSO observes Montgomery Watson or subcontractor personnel deviating from standard health and safety practices, an "Incident Report" form (Attachment D) will be completed. A copy of the report will be submitted to the HSC and, if applicable, the subcontractor company. Except for minor changes or emergencies, the OSO can modify the SSP requirements only after consultation with and agreement by the HSC or PSO. The OSO or an assigned designee will be on site at all times during field activities.

3.4 - Field Staff

All Montgomery Watson field staff are responsible for understanding and complying with all requirements of the SSP. Every morning before the start of field activities, a tailgate safety meeting will be conducted to instruct field staff on SSP requirements. During this meeting site safety concerns and questions can be directed to the OSO by field staff.

3.5 - Notification Requirements

Unanticipated field conditions will occasionally require modifications to the SSP. Notification and/or approval procedures will be dependent on actual field conditions. Conditions which require an upgrade of one level in PPE should be reported to the HSC, PSO or PM and recorded on the "Tailgate Safety Meeting" form (Attachment E). Minor changes not affecting the degree of protection can be implemented by the OSO. These changes will be documented and sufficiently justified in the field log book.

The OSO will stop all field activities and contact the HSC, PSO or PM under the following conditions:

1. Any activity requiring an upgrade to Level B protection.

2. Any IDLH activity, as defined by NIOSH.

3. Any proposed entry by Montgomery Watson personnel into a confined space.

4. Any physical hazard where an exposure under reasonable circumstances could lead to possible death or permanent injury.

4.0 - PERSONNEL TRAINING

All Montgomery Watson personnel working on the Ralston site shall meet the training requirements specified in 29 CFR 1910.120. To ensure all site personnel understand the hazards associated with site activities, the SSP will be discussed and the OSO shall maintain documentation that each site worker has been instructed on the contents of the SSP. Each worker must sign and date a "Personal Acknowledgement" form (Attachment F) stating that he/she understands the contents of the SSP.

The following general outline is to be used by the OSO for informing personnel who will work on site:

General Field Safety Techniques

- Responsibilities
  - Overview of the SSP
- Medical Program
  - Reasons for health surveillance
- Site Work Zones
- Vehicles (cars, trucks, etc.)
  - Operation
- Site Air Monitoring
- Potential Hazardous Contaminants Present
  - Chemical hazards at the specific site (toxicity, symptomology)
- Contingency and Response
- Use of Field Equipment and Supplies
  - Work tools
  - Sampling equipment
  - Monitoring equipment
- Site Control and Security
- Buddy System
  - Hand signals
- Work Limitations
  - Weather
  - Fatigue
  - Heat/cold stress
  - Hours of work

Personal Protective Equipment and Clothing

- General
- Availability
- Hearing Protective Devices
- Respiratory Protection (selection, fit test, donning and use)
- Personal Protective Clothing (selection, inspection, don/doff)
- Personal Protection for Level D
- Personal Protection for Level C
- Limitations of Clothing and Equipment
- Decontamination of Clothing and Equipment
- Disposal of Contaminated Clothing and Equipment

Site Review

- Site Maps
- Pertinent Site History Information
- Safety Information

Emergency Assistance

- Transportation
- Cardiopulmonary Resuscitation/First Aid

- Availability of Emergency Services
- Emergency Assistance On Site

Sampling Techniques

- Hazards of Sampling
- Personal Protective Clothing Required
- Decontamination of Sampling Equipment

5.0 - MEDICAL SURVEILLANCE AND TRAINING

Establishment of a medical surveillance program is essential for protection of site personnel. The program has three main purposes:

- To establish a baseline measure of health against which future changes can be compared.
- To identify any underlying illnesses or conditions that might be aggravated by chemical exposures or job activities (i.e., use of respiratory protective equipment).
- To allow recognition of any abnormalities at the earliest opportunity, so that corrective measures can be implemented.

5.1 - Medical Screening and Health Surveillance

All on-site Montgomery Watson personnel will have an initial baseline medical examination, as described in Attachment G, prior to mobilization. If one year has elapsed since an initial exam, an updated medical history and examination will be required.

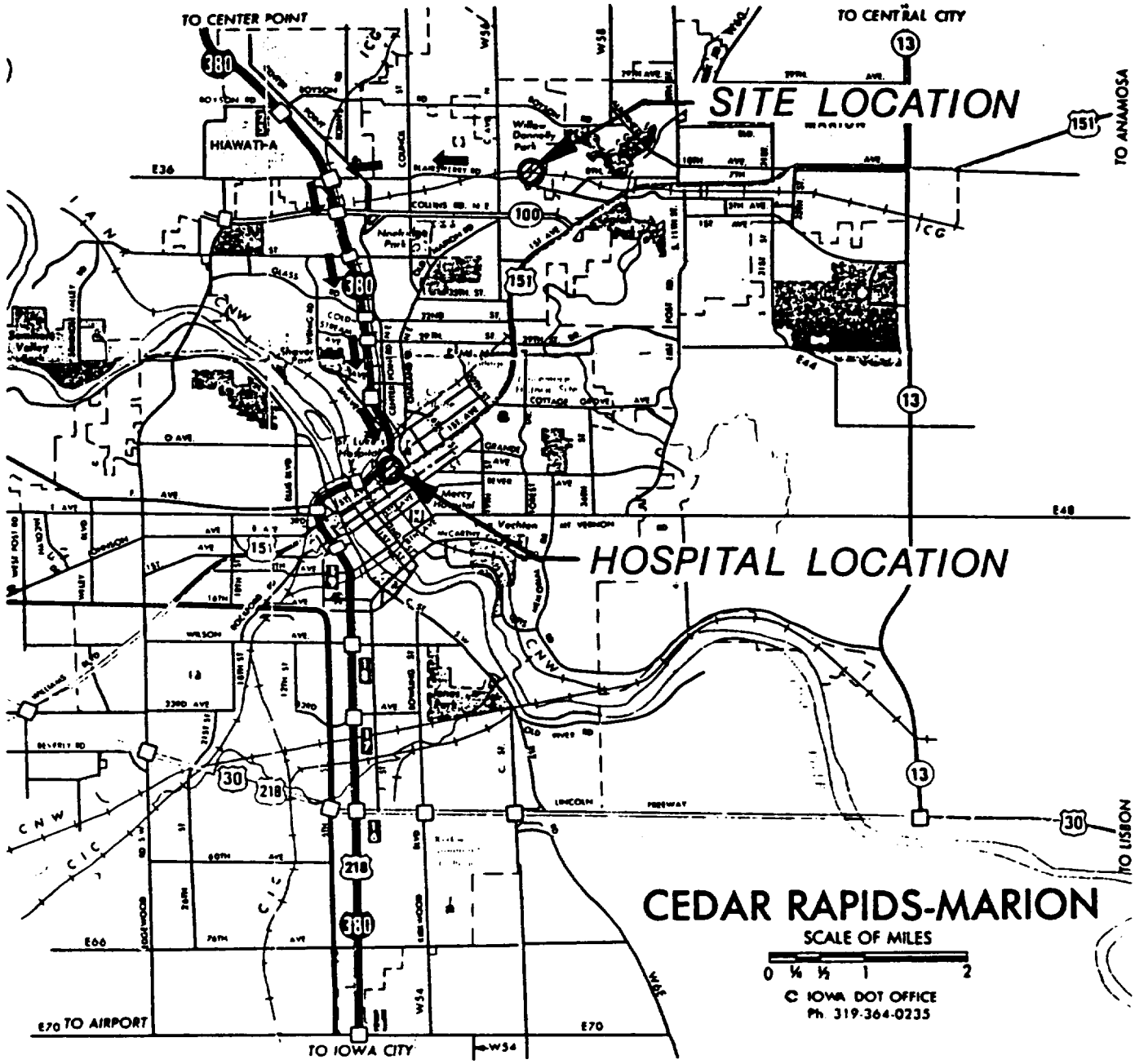
5.2 - Injury and Illness Prevention Program (IIPP)

Montgomery Watson has developed a formalized IIPP. All Montgomery Watson field staff are required to read and to be familiar with this document. A copy of the document is included as Attachment H.

5.3 - Emergency Medical Assistance and First-Aid Equipment

Prior to work startup, the OSO will discuss the emergency medical assistance network which has been established for the Ralston site. Locations of phones, fire extinguishers, first-aid kits, emergency telephone numbers, etc. will be identified (see Attachment I). A map showing directions to the nearest hospital will be provided to all field personnel. A map to the hospital is included as Figure 5-1. Attachment I and the emergency route map will be clearly posted at each work site. A designated safety vehicle will be on site and available at all times for a medical or safety emergency. The OSO, or personnel designated by the OSO, will be responsible for the availability and use of the safety vehicle.

The OSO will be certified to render first aid and cardiopulmonary resuscitation (CPR) prior to the initiation of field activities. A first-aid kit will be available at the site for use by trained personnel. An adequate supply of fresh water or a portable emergency eye wash will be available at each work site.



MAP SOURCE: - IOWA DEPARTMENT OF TRANSPORTATION
GENERAL HIGHWAY AND TRANSPORTATION
MAP

N

MONTGOMERY WATSON

ROCKWELL INTERNATIONAL CORPORATION

EMERGENCY ROUTE TO HOSPITAL

FIGURE 5-1

6.0 - SITE CONTROL

Site control requires the establishment of a regulated area, designated work zones, evacuation protocol and site security. Access to the site is restricted by a chain-link fence and locked gates. Signs have been posted to limit trespassing. Currently, site access is limited to access by a dirt road leading to the property. Vehicle access is confined to the road.

6.1 - Regulated Areas

To minimize the transfer of potentially hazardous substances from the site, contamination control procedures are needed. Two general methods will be used: (1) establishing site work zones (i.e., Exclusion, Contamination Reduction-Level C Only, and Support Zones) and (2) implementing procedures for personnel/equipment decontamination. Site access must be controlled to reduce the possibility of contaminant exposure and transport by personnel or equipment from the site. The possibility of contaminant exposure and transport will be reduced or eliminated in a number of ways, including:

- Minimizing the number of personnel on site, consistent with effective operations.
- Establishing physical barriers to prevent extra personnel from entering the site.
- Establishing control points to regulate access to work zones.
- Establishing work zones around each sampling location.
- Implementing appropriate decontamination procedures.

Safety procedures for preventing or reducing the migration of contamination requires the delineation of zones on the site where prescribed operations will occur. Movement of personnel and equipment between zones and onto the site itself will be limited by access control points. After confirming the appropriate level of personal protection for site entry and determining the general wind direction, site work zones will be established. In the event site conditions mandate use of Level C protection, the site will be modified to include the appropriate work zones. Two contiguous zones are required for Level D and three for Level C (Sections 6.2 and 6.3). Pylons or stakes and caution tape will be used to define the work areas.

6.2 - Level D Work Zones

The following zones will be established for sites where Level D activities are to be conducted:

- Zone 1: Exclusion Zone
- Zone 2: Support Zone

Zone 1 - Exclusion Zone. The exclusion zone, or work zone, is the zone where contamination is most likely to occur. All personnel entering the exclusion zone must wear, at a minimum, the Level D protection prescribed in Section 7.1. The outer boundary of the exclusion zone will be established by visually surveying the site and determining (1) the distances needed to prevent fire or an explosion from affecting personnel outside the zone, (2) the physical area necessary to conduct site operations and (3) the potential for contaminants to be wind blown from the area. The exclusion zone area will be of sufficient size to include on-site vehicles and equipment. Once the boundary has been determined, it shall be defined with pylons or stakes and caution tape. Any entry and exit control point must be established at the periphery of the exclusion zone to regulate the flow of personnel and equipment into and out of the zone. During subsequent site operations, the boundary may be modified and adjusted by the OSO as more information becomes available.

Zone 2 - Support Zone. The support zone, the outermost area of the site, is considered the contamination-free zone where support equipment (command post, safety vehicle, etc.) is located. Normal work clothes are appropriate within this zone. Only personnel who have been trained and who don the prescribed Level D protection will be permitted to enter the exclusion zone from the support zone.

A figure illustrating Level D work zones is included as Attachment J.

6.3 - Level C Work Zones

The following zones will be established for sites where Level C activities are to be conducted:

- Zone 1: Exclusion Zone
- Zone 2: Contamination Reduction Zone
- Zone 3: Support Zone

Zone 1 - Exclusion Zone. The exclusion zone, the innermost of the three designated areas, is the zone where contamination is most likely to occur. It is anticipated that this area will encompass the area immediately surrounding the heavy equipment or the sampling point. All personnel entering the exclusion zone must wear, at a minimum, the Level C protection presented in Section 7.2.

The outer boundary of the exclusion zone, the "hotline," will be established by visually surveying the site and determining (1) the distances needed to prevent fire or an explosion from affecting personnel outside the zone, (2) the physical area necessary to conduct site operations and (3) the potential for contaminants to be windblown from the area. Once the boundary has been determined, it shall be defined with pylons or stakes and caution tape. An entry and exit control point must be established at the periphery of the exclusion zone to regulate the flow of personnel and equipment into and out of the zone. During subsequent site operations, the boundary may be modified and adjusted by the OSO as more information becomes available.

Zone 2 - Contamination Reduction Zone. Between the exclusion zone and the support zone, a contamination reduction zone will be established. A "contamination control line" separating the contamination reduction zone and the support zone will de designated with pylons or stakes and caution tape. This zone provides a transition between contaminated and clean zones. This zone serves as a buffer to further reduce the possibility of introducing contamination to the clean zone. Decontamination procedures and spatial distance will provide additional measures to prevent contaminant transfer by site personnel and equipment.

Initially, the contamination reduction zone will be considered a clean area. At the boundary between the exclusion and contamination reduction zones, decontamination stations will be established for personnel and heavy equipment. Exit from the exclusion zone will be through a designated decontamination corridor.

As operations proceed, the area around the decontamination station may become contaminated. Due to spatial distance and decontamination procedures, the amount of contaminants should decrease from the "hotline" to the support zone used.

A figure illustrating Level C work zones is included as Attachment J. Detailed Level C decontamination procedures are provided in Section 9 and in Attachment K.

Zone 3 - Support Zone. The support zone, the outermost part of the site, will be considered a contamination-free zone where support equipment (command post, safety vehicle, etc.) is located. Because normal work clothes are appropriate within this zone, potentially contaminated clothing, equipment and samples are not permitted. Only personnel who have been trained and who don the prescribed Level C protection will be permitted to enter the exclusion zone from the support zone.

The location of the command post and other support facilities in the support zone at each site depends on a number of factors, including:

- Accessibility: Topography, available open space, road location or other limitations.
- Wind Direction: The support facilities should be located upwind of the exclusion zone. Shifts in wind direction and other conditions may be such that an ideal location based on wind direction alone does not exist.
- Resources: Water.

Access to the contamination reduction zone from the support zone will be through a controlled access point. Personnel entering the contamination reduction zone to assist in decontamination must wear the prescribed PPE. Reentry into the support zone requires removal of any PPE worn in the contamination reduction zone.

6.4 - Site Security

Only authorized personnel shall enter the regulated areas. The OSO will establish the bounds of the regulated areas. The following measures will be taken to ensure site security:

- All persons entering the regulated areas are subject, at a minimum, to the provisions specified within this SSP. The OSO shall have the responsibility and authority to assure that this is enforced.
- All persons entering the contamination reduction zone or the exclusion zone shall have the appropriate training or personal protective clothing and, if needed, respiratory equipment and have completed an established medical surveillance program.

7.0 - PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE will be required during the course of the removal action activities at the Ralston site. PPE selection will be based primarily on hazard assessment data and work task requirements. Prior to entry, each work area will be monitored for potentially hazardous contaminants using a Photoionization Detector (PID) equipped with an 11.7 eV lamp or equivalent, or a Flame Ionization Detector (FID), and an Exotox #50 Four Gas Detector or equivalent to identify any areas of concern.

The Exotox #50 will detect oxygen, carbon monoxide and hydrogen sulfide concentrations and provide LEL percentages. The PID/FID and Exotox #50 will be calibrated in the field at the beginning of each work day according to manufacturer instructions. Following calibration, a reading will be recorded using upwind background measurements. At the end of each work day,

a reading will be taken using upwind background measurements to determine calibration variations. An "Equipment Calibration" form is included as Attachment L.

The breathing zone and the opening of borings, wells and trench excavations will be monitored with the PID/FID and Exotox #50. Dust conditions will also be visually monitored by Montgomery Watson personnel.

Based upon the site history, the initial level of protection for all field activities will be Level D. Provisions are made in Section 8.2 for upgrading the level of protection to Level C or evacuating the site based upon oxygen deficiency, flammability, dust conditions, or high levels of organic vapors.

7.1 - Level D PPE

Personnel working in the exclusion zone, as defined in Section 6.2, shall wear, at a minimum:

- Tyvek™ or cloth coveralls will be worn for all field activities. Poly-coated Tyvek™ or Saranex™ coveralls will be worn where the potential for contact with contaminated liquids exists.
- Gloves (outer): chemical resistant, 4-mil, nitrile. When contact with liquid is anticipated, chemical-resistant, 22-mil, nitrile gloves will be worn.
- Gloves (inner): chemical-resistant, 4-mil, nitrile.
- Boots: leather or chemical-resistant; steel-toed when near heavy equipment.
- Overboots: chemical-resistant, if leather under boots are worn and if contact with contaminants is suspected.
- Hip boots or waders, if necessary, (when conducting removal action activities in Dry Run Creek).
- Hard hat and hearing protection when near heavy equipment.
- Safety glasses or goggles.

7.2 - Level C PPE

When air monitoring information, dust conditions or previously obtained site information dictates that a particular site be upgraded to a Level C protection area, personnel shall wear, as a minimum:

- Full-face or half-face air-purifying respirator with dust filters, organic vapor (OV) and highly toxic particulates (HEPA) cartridges (MSHA/NIOSH approved). Safety glasses or goggles must be used when a half-face respirator is worn.
- Tyvek™ or cloth coveralls will be worn for all field activities. Poly-coated Tyvek™ or Saranex™ coveralls will be worn where the potential for contact with contaminated liquids exists.
- Gloves (outer): chemical resistant, 4-mil, nitrile. When contact with liquid is anticipated, chemical-resistant, 22-mil, nitrile gloves will be worn.

- Gloves (inner): chemical-resistant, 4-mil, nitrile.
- Boots: leather or chemical-resistant; steel-toed when near heavy equipment.
- Overboots: chemical-resistant, if leather under boots are worn and if contact with contaminants is suspected.
- Hip boots or waders, if necessary, (when conducting removal action activities in Dry Run Creek).
- Hard hat and hearing protection when near heavy equipment.
- Safety glasses or goggles.

7.3 - Respirator Selection and Fit Test

Prior to working in Level C protection at the Ralston site, personnel assigned to work on site must submit verification of respirator fit-testing to the OSO or PSO. Montgomery Watson air-purifying respirator fit test protocol is presented in Attachment M. A record documenting the date, size, brand and model number of the air-purifying respirator for each site worker will be maintained by the OSO or PSO. Contact lenses will not be worn when using a full-face respirator in the exclusion zone. Site workers who require corrective lenses and are working in Level C PPE in the exclusion zone will be supplied with spectacles specially designed for respirators.

8.0 - HAZARD ASSESSMENT

Hazard assessment is essential in determining the hazard control measures that need to be implemented during site activity. Hazard assessment is an ongoing process and involves characterization of the chemical, physical, biological and other safety hazards at the site.

8.1 - Site Survey

Prior to initiation of work activities, the OSO shall conduct a site survey to identify safety hazards and to determine appropriate control measures. Hazards may include ground traffic, and current weather conditions such as excessive hot conditions, lightning, etc.

8.2 - Air Monitoring

The main objective of atmospheric monitoring is to assess the inhalation and explosion hazards presented to site personnel. During site activities, air monitoring will be conducted using PID/FID equipment and the Exotox #50 or equivalent.

PID/FID. Each work site shall be continually monitored for organic vapors with a PID equipped with an 11.7 eV lamp or equivalent, or a FID, as described in Section 7.0. The PID/FID will be checked daily and operated in the 0-20 parts per million (ppm) range. Organic vapor levels will be measured upwind of the work area to determine a background reading. Readings within the work area in the breathing zone of site workers (two to five feet above the ground) will be taken every 15 minutes in the unsaturated zone and every 30 minutes in the saturated zone during drilling and trenching activities. All monitoring readings will be recorded in a field log book by the OSO or designated personnel.

Exotox #50. Each trenching or excavation work site shall be continually monitored for potential gases (specifically hydrogen sulfide, oxygen and LEL) with an Exotox #50, as described in

Section 7.0. Vapor levels will be measured upwind of the drill site to determine a background reading. Readings within the work area in the breathing zone of site workers (two to five feet above the ground) will be taken every 15 minutes in the unsaturated zone and every 30 minutes in the saturated zone. All Exotox #50 readings will be recorded in the field log book by the OSO or his designee. Exotox #50 monitoring of the trenching and excavation sites will be conducted as long as personnel are within the defined boundaries of the work area.

Dust conditions will by visually inspected by Montgomery Watson personnel continually.

Action Levels for Upgrade to Level C. The decision to cease operations or upgrade the level of protection will be based on elevated readings of organic vapors and dust conditions. Situations dictating selection of these upgrade levels and the corresponding action to be taken are as follows:

- When the PID/FID indicates sustained (15 minutes) breathing zone organic vapor concentrations in excess of 5 meter units, the OSO will require the use of respirators equipped with OV cartridges until readings in the work area drop and maintain a level below 5 meter units.

- Should dusty conditions that are irritating to the eyes, nose or throat prevail during field activities, respirators equipped with dust filters or HEPA cartridges will be donned.

Action Levels for Ceasing Operations. The decision to cease operations will be based on levels of flammables and organic vapors reaching IDLH values. Situations dictating selection of these upgrade levels and the corresponding action to be taken are as follows:

- When PID/FID indicates sustained (15 minutes) breathing zone organic vapors exceeding 25 meter units, the designated work area (exclusion zone) shall be evacuated until the vapor levels have subsided.

- When the Exotox #50 indicates sustained (15 minutes) breathing zone percent LEL of flammables in excess of 25 percent or more, operations will cease and the work area will be evacuated.

- If the oxygen concentration, as measured by the Exotox #50, falls below 19.5 percent, operations will cease and the work area will be evacuated until oxygen concentrations return to a minimum 19.5 percent.

- If the TWA of a contaminant exceeds the maximum use concentration (MUC) of the air-purifying respirator cartridge, operations will cease and the work area will be evacuated. The MUC for OV cartridges is 1,000 ppm.

- If no air-purifying respirator cartridge is available or protection greater than air-purifying respirator is recommended by the respirator manufacturer or recognized publications or authority, operations will cease.

- If contaminant levels as measured by the PID/FID or Exotox #50 reach their corresponding IDLH values, operations will cease and the work area will be evacuated.

The HSC, PSO or PM will be notified of any upgrade in PPE in accordance with Section 3.

8.3 - Contaminant Exposure

Exposure to chemicals can be divided into two categories:

- Injuries from direct contact, such as acid burns or inhalation of toxic chemicals.
- Potential injury due to gross contamination on clothing or equipment.

For inhalation exposure cases, treatment can only be performed by a qualified physician. If the contaminant is on the skin or in the eye, immediate measures can be taken on site to counteract the substance's effect. First-aid treatment consists of flooding the affected area with copious amounts of water. The OSO must assure that an adequate supply of running water or a portable emergency eye wash is available on site.

8.4 - Thermal Stress

Cold Stress. If the ambient temperature or wind chill equivalent falls to below 25°F, site personnel who must remain outdoors will wear insulated protective garments. These shall consist of the following (or their equivalents): one-piece coveralls with quilted lining or fill, insulated work boots, helmet liners or hooded jacket, and cloth or polypropylene glove liners. If necessary, work breaks and rotation of tasks will be planned to reduce cold stress.

The extreme case of cold stress is hypothermia. Some of the symptoms which indicate hypothermia are:

- Shivering
- Drowsiness
- Mumbling
- Trouble Making Decisions
- Difficulty Performing Tasks
- Weakness
- Poor Coordination

If these conditions are noted, the following procedures should be performed:

- Remove wet clothing and replace with dry.
- Shelter victim from the wind.
- Monitor and support the victim's vital signs and keep him/her from moving.
- Contact designated medical facility.

Heat Stress. If ambient temperatures exceed 75°F, and site personnel are wearing Saranex™ protective clothing or equivalent, they will monitor their heart rate as an indicator of heat strain by the following method: three heart rate pulses should be taken during the last half of each of the first, second and third minutes of any rest period (the pulse should be checked by using the fore and middle fingers and applying light pressure to the pulse in the wrist or neck). Record these numbers. If the difference between the first and third pulses is more than 10 beats per minute, the worker must reduce his/her workload.

In addition, at temperatures above 75°F, provisions must be made for workers to have access to liquids, including potable water. If necessary, work breaks and rotation of tasks must be planned to reduce heat strain.

Personnel shall also be trained to recognize the symptoms of heat stress and the appropriate action to take upon recognition. Although physiological monitoring is not always necessary, it is

essential that personnel understand the significance of heat stress. Some of the symptoms which indicate heat exhaustion are:

- Clammy Skin
- Light Headedness
- Slurred Speech
- Rapid Pulse
- Weakness, Fatigue
- Confusion
- Fainting
- Nausea (vomiting)

If these conditions are noted, the following steps should be performed:

- Remove the victim to a cool and uncontaminated area.
- Remove protective clothing.
- Cool the victim with cold packs and/or fanning.
- Give water to drink, if conscious.
- Keep victim lying down.
- Elevate legs 8-12 inches above head.
- Allow victim to rest.

Symptoms that indicate heat stroke include:

- Staggering Gait
- Hot, Dry Skin; Temperature Rise (yet may feel chilled)
- Incoherence, Delirium
- Mental Confusion
- Convulsions
- Unconsciousness

If heat stroke conditions are noted, immediately perform the following steps:

- Remove victim to a cool, uncontaminated area.
- Remove protective clothing.
- Cool the victim (whole body) with water, compresses, and/or rapid fanning.
- Keep victim lying down.
- Elevate legs 8-12 inches above head.
- Allow victim to rest.
- Transport the victim immediately to a medical facility for further cooling and monitoring of body functions. HEAT STROKE IS A MEDICAL EMERGENCY!

When protective clothing is grossly contaminated, contaminants can possibly be transferred to treatment personnel and cause an exposure. Unless severe medical problems have occurred simultaneously with personnel contamination, such as spinal or head injuries which mandate as little movement of the patient as possible, the protective clothing should be carefully removed.

9.0 - DECONTAMINATION PROCEDURES

Establishment of decontamination procedures for personnel and equipment is necessary to control contaminant movement from the exclusion zone and to protect field personnel from contaminant exposure.

9.1 - Level D Decontamination

Level D protection does not require personnel and equipment to be decontaminated upon leaving the exclusion zone unless the OSO identifies a need for decontamination based upon vapors generated at a particular work area, dusty conditions or gross visual contamination of protective clothing and/or equipment. When decontamination is necessary, it will consist of the following:

- A decontamination station will be located at the "hotline" where personnel routinely enter/exit the exclusion zone. When exiting the exclusion zone, personnel will remove overboots, coveralls and outer gloves only at the specified decontamination station.

- Personnel shall be instructed on the proper PPE decontamination techniques. This will consist of the removal of protective clothing in an "inside-out" manner in a specified sequence. Removal of contaminants from clothing or equipment by blowing, shaking or any other means that may disperse material into the air is prohibited.

- Personnel will not be permitted to exit the regulated work area until contaminated PPE has been removed. All PPE that has been removed shall remain at the decontamination station until worn again or disposed. At the conclusion of site activities and prior to disposal or transfer off site, all PPE must be placed in sealed plastic bags.

- All employees will wash their hands (face-optional) with soap and water or a disinfectant towelette before entering the support zone, eating, drinking, smoking or applying cosmetics. These activities will be restricted to the designated rest area(s) in the support zone.

9.2 - Level C Decontamination

When site work is being conducted in Level C, personnel participating in the site investigation may become contaminated by:

- Exposure to vapors, gases, mists or particulates in the air.
- Contact by materials while collecting water samples or handling soil samples.

Specific Level C decontamination procedures are found in Attachment K. The decontamination procedures can be modified by the OSO with the approval of the PSO, eliminating unnecessary stations or otherwise adapting it to site conditions.

An area within the contamination reduction zone will be designated as the contamination reduction corridor (CRC). The CRC controls access into and out of the exclusion zone and confines personnel decontamination activities to a limited area. Personnel exiting the exclusion zone must go through the CRC. The size of the CRC will depend on the number of decontamination stations, work control zone dimensions and the amount of available space. Zone boundaries will be clearly marked, with entry and exit restricted. A separate CRC will be required for the entrance and exit of heavy equipment needing decontamination. The CRC will be dedicated to equipment decontamination activities only.

Nondisposable personal protective clothing and respirators, monitoring equipment, sampling supplies, etc. will be stored adjacent to the CRC. Personnel must don their PPE and enter the exclusion zone through a separate point at the hotline.

9.3 - Decontamination Chemical Materials

If solvents, such as methanol, are used in addition to distilled water to decontaminate PPE and field equipment, the OSO will be responsible for ensuring the proper storage and disposal of these materials. As required by OSHA, material safety data sheets (MSDSs) for the chemical materials used in decontamination procedures will be maintained on site and available to field personnel. The OSO or PSO will be available to discuss related health and safety concerns with field personnel.

9.4 - Equipment Decontamination and Disposal of Contaminated Materials

Monitoring devices, sampling equipment and certain PPE may need to be decontaminated. Monitoring devices, sampling equipment and PPE shall be decontaminated using either a high-pressure, high-temperature sprayer or a detergent wash and distilled water rinse. To the extent possible, monitoring devices should be protected against contamination by placing disposable, plastic covers around electronic components. All materials and equipment used for decontamination purposes must be properly disposed. Disposable clothing, tools, buckets, brushes and other contaminated equipment will be disposed of in an on-site dumpster. Clothing that may be reused will be secured in sealed plastic bags before removal.

9.5 - Decontamination During Medical Emergencies

If prompt life-saving first-aid and/or medical treatment is required, decontamination procedures will be bypassed. First Responders will be notified of the potential of contamination en route so that appropriate measures can be taken to protect the First Responders and the integrity of the emergency vehicle while transporting injured personnel. On-site personnel will accompany contaminated injured personnel to the nearest medical facility to inform hospital personnel of decontamination procedures.

Outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Chemical-resistant clothing can be cut away. If the outer contaminated garments cannot be safely removed, the individual shall be wrapped in plastic, rubber or blankets to help prevent the contamination of ambulances and/or medical personnel. Outer garments will then be removed at the medical facility. No attempt will be made to wash or rinse the victim unless it is known the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or loss of life. For minor medical problems or injuries, normal decontamination procedures will be followed.

In the case of heat-related illnesses, protective clothing must be removed immediately and further decontamination procedures should be omitted or minimized.

10.0 - SITE HEALTH AND SAFETY PROGRAM DOCUMENTATION

Field activities shall be documented, at a minimum, by the following means:

Site Safety Plan. All work shall be performed in accordance with the provisions stated in this SSP. Instances of noncompliance will be documented in a field log book by the OSO.

On-Site Safety Officer's Field Log. The OSO or his designee shall maintain a daily log that includes on-site observations related to health and safety and changes in implementation of the SSP (and their justification).

Personnel Training Documentation. The OSO shall maintain documentation for health and safety training of all on-site personnel.

Tailgate Safety Meeting Documentation. The OSO shall conduct tailgate safety meetings at least once daily. These meetings must be documented on a "Tailgate Safety Meeting" form (Attachment E), which will be signed by the attendees at each meeting and available at the site. A file of "Tailgate Safety Meeting" forms shall be kept by the OSO.

OSHA Mandated Recordkeeping. Employee medical surveillance records, employee exposure records and illness/injury records will be maintained by Montgomery Watson for 30 years, in accordance with 29 CFR 1910.120.

OSHA Job Safety and Health Protection Poster. The OSO will ensure that this document is present on site at all times. The poster (Attachment N) will be available to all field personnel.

11.0 - GENERAL SITE SAFETY REQUIREMENTS

The following practices are expressly forbidden during on-site investigations:

- Smoking, eating, drinking, or chewing tobacco while in the exclusion (work) zone or any potentially contaminated area.
- Ignition of Flammable Materials in the Work Zone: Equipment shall be bonded and grounded, spark-proof and explosion-resistant, as appropriate.
- Contact with Potentially Contaminated Substances: Walking through puddles or pools of liquid; kneeling on the ground or leaning; and sitting or placing equipment on the contaminated soil should be avoided.
- When performing tasks in the exclusion zone in Level C or higher PPE, personnel shall work using the "buddy system" at all times. OSHA regulation defines the "buddy system" as:

> "A system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the "buddy system" is to provide rapid assistance to employees in the event of an emergency."

Field personnel should keep the following guidelines in mind when conducting on-site activities:

- Hazard assessment is a continual process; personnel must be aware of their surroundings and constantly be aware of the chemical/physical/biological hazards that are present.
- The minimal number of persons necessary to perform work tasks in a safe and efficient manner will be allowed in the exclusion zone.

- Field team members will be familiar with the physical characteristics of each investigation site, including: wind direction, site access and locations of communication devices and safety equipment.

- Prior to field activities, the location of underground utilities must be established.

Team members will be familiar with the following emergency hand signals:

Hand Signal	Interpretation
• Hand gripping throat.	Respirator problems, cannot breathe.
• Grip team member's wrist or place both hands around waist.	Leave site immediately, no debate!
• Thumbs up.	OK, I am alright, I understand.
• Thumbs down.	No, negative.

TABLE 2-3

ABBREVIATIONS FOR SYMPTOMS OF EXPOSURE

Abbreviation	Symptom	Abbreviation	Symptom	Abbreviation	Symptom
abdom	abdominal	constric	constriction	fib	fibrosis
album	albuminuria	convuls	convulsions	fibrl	fibrillation
anem	anemia	cor	acute right heart strain or	func	function
anes	anesthesia		chronic right ventricular	frost	frostbite
anor	anorexia		pulmonale, hypertrophy	ftg	fatigue
anos	anosmia	corn	cornea	fvr	fever
ANS	automatic nervous system	CVS	cardiovascular system	gasp	gasping
apat	apathy	cyan	cyanosis	GI	gastrointestinal
appre	apprehension	defat	defatting	gidd	giddiness
arrhy	arrhythmias	deg	degeneration	glau	glaucoma
asphy	asphyxia	dent	dental	glu	glucose
asth	asthma	depres	depressant/depression	halu	hallucinations
atax	ataxia	derm	dermatitis	head	headache
biliru	bilirubinuria	diarr	diarrhea	hema	hematuria
blur	blurred	dil	dilated	hemat	hematoma
breath	breathing	dist	disturbance	hemato	hematopoietic
bron	bronchitis	dizz	dizziness	hemog	hemoglobinuria
bronspas	broncospasm	drow	drowsiness	hemorr	hemorrhage
BUN	blood urea nitrogen	dys	dysuria	hep	hepatic
ca	cancer	dysart	dysarthria	hyper	hyperemia
cachexia	severe generalized	dysp	dyspnea	hypox	hypoxemia
	weakness, emaciation	ecz	eczema	ict	icterus
carc	carcinogenic/carcinogen	emphy	emphysema	inco	incoordination
card	cardiac	enl	enlargement	inflamm	inflammation
cere	cerebral	eosin	eosinophilia	inj	injury
chol	cholinesterase	epis	epistaxis	insom	insomnia
chor	chorea	epit	epithelium	intox	intoxication
cirr	cirrhosis	equi	equilibrium	irrit	irritation
CNS	central nervous system	ery chol	erhthrocyte cholinesterase	irrity	irritability
coll	collapse	eryt	erythemia	jaun	jaundice
conf	confusion	euph	euphoria	kera	keratitis
conj	conjunctivitis	extrem	extremities	kid	kidney
constip	constipation	fasc	fasiculation	lab	labored

TABLE 2-3 (CONTINUED)

ABBREVIATIONS FOR SYMPTOMS OF EXPOSURE

Abbreviation	Symptom	Abbreviation	Symptom	Abbreviation	Symptom
lac	lacrimation	para	paralysis	rhin	rhinorrhea
lar	laryngeal	paresis	incomplete loss of muscular power; weakness of a limb	salv	salivation
lass	lassitude			scotoma	an area of absent or depressed vision in the visual field
leucyt	leukocytoses	parox	paroxysmal		
leuk	leukemia	perf	perforation	sens	sensitization
leupen	leukopenia	peri neur	peripheral neuropathy	sez	seizure
li-head	lightheadedness	perineurit	peripheral neuritis	sleep	sleepiness
liv	liver	periorb	periorbital	sneez	sneezing
lo-ap	appetite loss	photo	photophobia	som	somnolence
low-wgt	weight loss	pig	pigmentation	spas	spasm
lymp	lymphocytosis	plas	plasma	strabismus	abnormality of the eyes in which the visual axes do not meet at the desired point
mal	malaise	pleur	pleurisy		
malnut	malnutrition	pneu	pneumonia		
monocy	monocytosis	pneutis	pneumonitis	subs	substernal
muc memb	mucous membrane	PNS	peripheral nervous system	sweat	sweating
musc	muscle	polyneur	polyneuropathy	swell	swelling
myo	myotonia	pros	prostration	sys	system
narc	narcotic	prot	proteinuria	tacar	tachycardia
narco	narcosis	psypec	psychialopecia	tend	tenderness
nas	nose/nasal	pulm	pulmonary	trachbronc	trachcobronchitis
nau	nausea	pulsus altenans	a pulse pattern in which beats occur at regular intervals, but with alternating weak and strong beats	vasconst	vasoconstriction
nec	necrosis			venfib	ventricular fibrillation
neph	nephritis			verti	vertigo
ner	neurologic			vesic	vesiculation
neur	nervousness	pup	pupil	vis dist	visual disturbance
numb	numbness	RBC	red blood cell	vomit	vomiting
opac	opacity	resp	respiratory	weak	weakness
pal	pallor	respar	respiratory arrest	wheez	wheezing
palp	palpitations	retster	retosternal		

Reference: U.S. Department of Health and Human Services, June 1990. NIOSH Pocket Guide to Chemical Hazards, DHHS (NIOSH), Publication No. 90-117.

ATTACHMENT A

FIELD CHANGE REQUEST

MONTGOMERY WATSON

Client: _____ Date: _____

Job Location: _____ Number: _____

Project: _____ Job/File No.: _____

Prepared By: _____ Title: _____

Contract Requirements:

Proposed Change:

Reason for Change:

Anticipated Impacts:

Field Team Leader	Health & Safety Officer	Project Manager

ATTACHMENT B

Drilling Safety Guide

NATIONAL DRILLING FEDERATION

DCDMA
Diamond Core Drill Manufacturers Association

NDCA
National Drilling Contractors Association

DRILLING SAFETY GUIDE

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DRILLING SAFETY GUIDE

I. An Introduction To Drilling Safety

The organization where you work is interested in your safety, not only when you are working on or around a drill rig, but also when you are traveling to and from a drilling site, moving the drill rig and tools from location to location on a site or providing maintenance on a drill rig or drilling tools. This safety guide is for your benefit.

Every drill crew should have a designated safety supervisor. The safety supervisor should have the authority to enforce safety on the drilling site. A rig worker's first safety responsibility is to listen to the safety directions of the safety supervisor.

2. Governmental Regulations

All local, state and federal regulations or restrictions, currently in effect or effected in the future, take precedence over the recommendations and suggestions which follow. Government regulations will vary from country to country and from state to state.

3. The Safety Supervisor

The safety supervisor for the drill crew will in most cases be the drill rig operator.

- The safety supervisor should consider the "responsibility" for safety and the "authority" to enforce safety to be a matter of first importance.
- The safety supervisor should be the leader in using proper personal safety gear and set an example in following the rules that are being enforced on others.
- The safety supervisor should enforce the use of proper personal protective safety equipment and take appropriate corrective action when proper personal protective safety equipment is not being used.
- The safety supervisor should understand that proper maintenance of tools and equipment and general "housekeeping" on the drill rig will provide the environment to promote and enforce safety.
- Before drilling is started with a particular drill, the safety supervisor must be assured that the operator (who may be the safety supervisor) has had adequate training and is thoroughly familiar with the drill rig, its controls and its capabilities.
- The safety supervisor should inspect the drill rig at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged hoses and/or damaged pressure gauges and pressure relief valves.
- The safety supervisor should check and test all safety devices such as emergency shut-down switches at least daily and preferably at the start of a drilling shift. Drilling should not be permitted until all emergency shut-down and warning systems are working correctly. Do not wire around, bypass or remove an emergency device.
- The safety supervisor should check that all gauges, warning lights and control levers are functioning properly and listen for unusual sounds on each starting of an engine.
- The safety supervisor should assure that all new drill rig workers are informed of safe operating practices on and around the drill rig and should provide each new drill rig worker with a copy of the organization's drilling operations safety manual, and when appropriate the drill rig manufacturer's operations and maintenance manual. The safety supervisor should assure that each new employee reads and understands the safety manual.

- The safety supervisor should carefully instruct a new worker in drilling safety and observe the new worker's progress towards understanding safe operating practices.
- The safety supervisor should observe the mental, emotional and physical capability of each worker to perform the assigned work in a proper and safe manner. The safety supervisor should dismiss any worker from the drill site whose mental and physical capabilities might cause injury to the worker or coworkers.

• A safety supervisor should assure that there is a first-aid kit on each drill rig and a fire extinguisher on each drill rig and on each additional vehicle and assure that they are properly maintained.

• The safety supervisor (and as many crew members as possible) should be well trained and capable of using first-aid kits, fire extinguishers and all other safety devices and equipment.

• The safety supervisor should maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police, hospitals, etc.) and inform other members of the drill crew of the existance and location of the list.

4. Individual Protective Equipment

For most geotechnical, mineral and/or groundwater drilling projects, individual protective equipment should include a safety hat, safety shoes, safety glasses and close fitting gloves and clothing. The clothing of the individual drill rig worker is not generally considered protective equipment; however, your clothing should be close fitting but comfortable, without loose ends, straps, draw strings or belts or otherwise unfastened parts that might catch on some rotating or translating component of the drill rig. Rings and jewelry should not be worn during a work shift.

• Safety Head Gear. Safety hats (hard hats) should be worn by everyone working or visiting at or near a drilling site. All safety hats should meet the requirements of ANSI Z89.1. All safety hats should be kept clean and in good repair with the headband and crown straps properly adjusted for the individual drill rig worker or visitor.

• Safety Shoes or Boots. Safety shoes or boots should be worn by all drilling personnel and all visitors to the drill site that observe drilling operations within close proximity of the drill rig. All safety shoes or boots should meet the requirements of ANSI Z41.1

• Gloves. All drilling personnel should wear gloves for protection against cuts and abrasion which could occur while handling wire rope or cable and from contact with sharp edges and burrs on drill rods and other drilling or sampling tools. All gloves should be close fitting and not have large cuffs or loose ties which can catch on rotating or translating components of the drill rig.

• Safety Glasses. All drilling personnel should wear safety glasses. All safety glasses should meet the requirements of ANSI Z87.1.

• Other Protective Equipment. For some drilling operations, the environment or regulations may dictate that other protective equipment be used. The requirement for such equipment must be determined jointly by the management of the drilling organization and the safety supervisor. Such equipment might include face or ear protection or reflective clothing. Each drill rig worker should wear noise reducing ear protectors when appropriate. When drilling is performed in chemically or radiologically contaminated ground, special protective equipment and clothing may and probably will be required. The design and composition of the protective equipment and clothing should be determined as a joint effort of management and the client who requests the drilling services.

5. Housekeeping On And Around The Drill Rig

The first requirement for safe field operations is that the safety supervisor understands and fulfills the responsibility for maintenance and "housekeeping" on and around the drill rig.

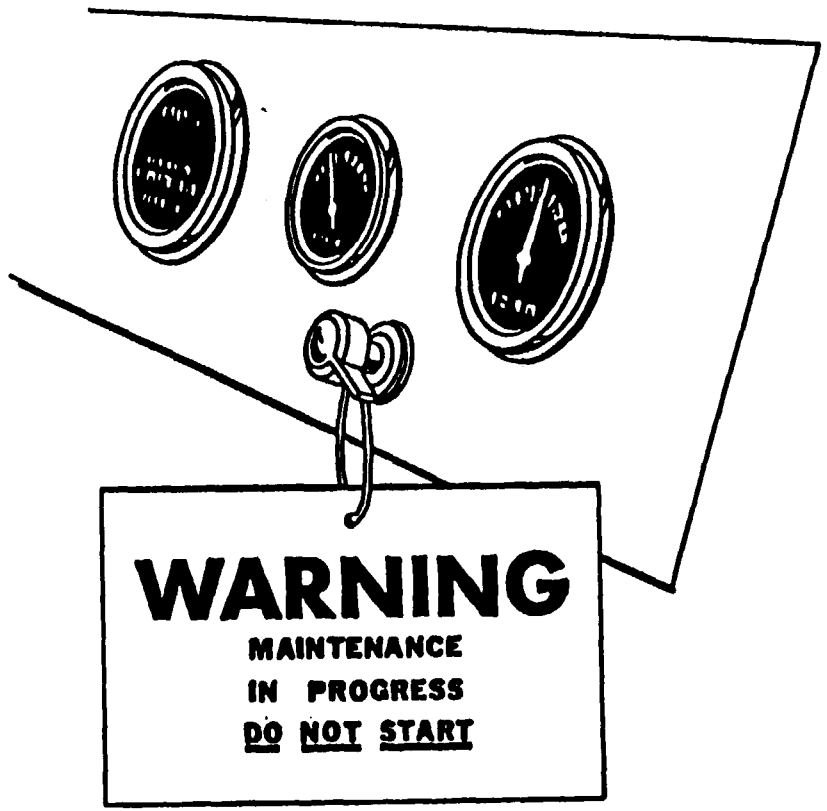
- Suitable storage locations should be provided for all tools, materials and supplies so that tools, materials and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor.
- Avoid storing or transporting tools, materials or supplies within or on the mast (derrick) of the drill rig.
- Pipe, drill rods, casing, augers and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling or sliding.
- Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.
- Work areas, platforms, walkways, scaffolding and other accessways should be kept free of materials, debris and obstructions and substances such as ice, grease or oil that could cause a surface to become slick or otherwise hazardous.
- Keep all controls, control linkages, warning and operation lights and lenses free of oil, grease and/or ice.
- Do not store gasoline in any portable container other than a non-sparking, red container with a flame arrester in the fill spout and having the word "gasoline" easily visible.

6. Maintenance Safety

Good maintenance will make drilling operations safer. Also, maintenance should be performed safely.

- Wear safety glasses when performing maintenance on a drill rig or on drilling tools.
- Shut down the drill rig engine to make repairs or adjustments to a drill rig or to lubricate fittings (except repairs or adjustments that can only be made with the engine running). Take precautions to prevent accidental starting of an engine during maintenance by removing or tagging the ignition key.

- Always block the wheels or lower the leveling jacks or [illegible] and set hand brakes before working under a drill rig.
- When possible and appropriate, release all pressure on the hydraulic systems, the drilling fluid system and the air pressure systems of the drill rig prior to performing maintenance. In other words, reduce the drill rig and operating systems to a "zero energy state" before performing maintenance. Use extreme caution when opening drain plugs and radiator caps and other pressurized plugs and caps.
- Do not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have had adequate time to cool.



- Never weld or cut on or near a fuel tank.
- Do not use gasoline or other volatile or flammable liquids as a cleaning agent on or around a drill rig.
- Follow the manufacturer's recommendations for applying the proper quantity and quality of lubricants, hydraulic oils and/or coolants.

• Re[illegible]e all caps, filler plugs, protective guards or panels and high pressure hose clamps and chains or cables that have been removed for maintenance before returning the drill rig to service.

7. Safe Use Of Hand Tools

There are almost an infinite number of hand tools that can be used on or around a drill rig and in repair shops and more than an equal number of instructions for proper use. "Use the tool for its intended purpose" is the most important rule. The following are a few specific and some general suggestions which apply to safe use of several hand tools that are often used on and around drill rigs.

• When a tool becomes damaged, either repair it before using it again or get rid of it.

• When using a hammer, any kind of hammer for any purpose, wear safety glasses and require all others around you to wear safety glasses.

• When using a chisel, any kind of chisel, for any purpose, wear safety glasses and require all others around you to wear safety glasses.

• Keep all tools cleaned and orderly stored when not in use.

• Use wrenches on nuts – don't use pliers on nuts.

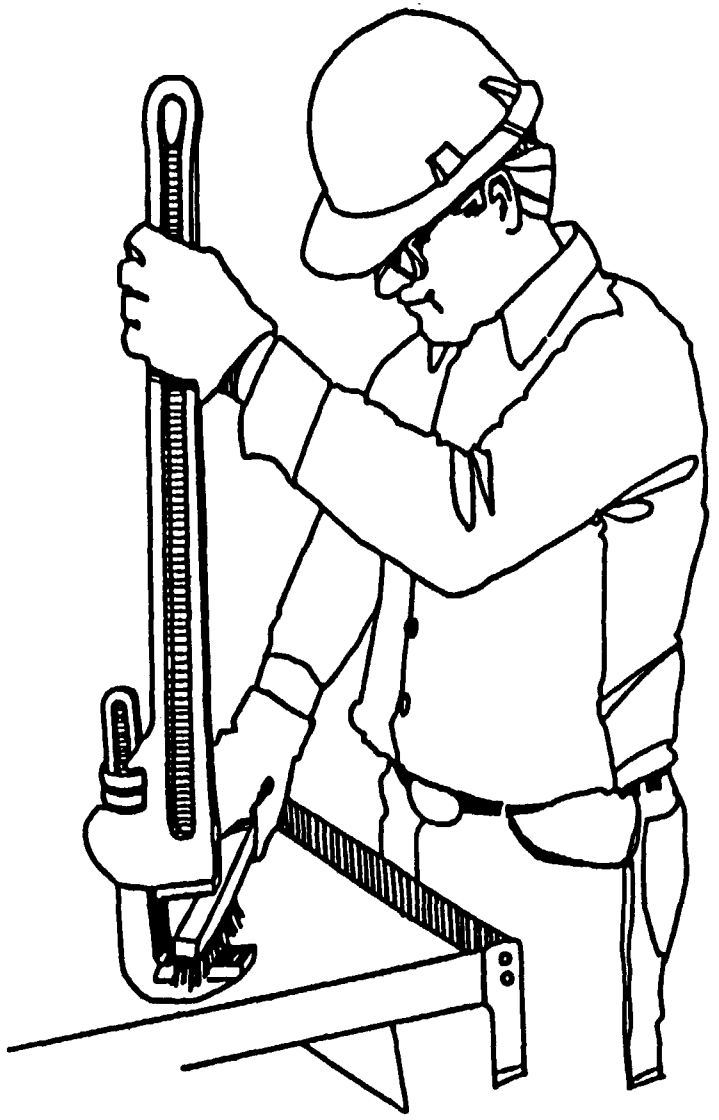
• Use screwdrivers with blades that fit the screw slot.

• When using a wrench on a tight nut – first use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands when possible and with both feet firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing – check the place where you may fall for sharp objects.

• Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease which would otherwise build up and cause wrenches to slip.

• Never use pipe wrenches in place of a rod holding device.

• Replace hook and heel jaws when they become visibly worn.



• When breaking tool joints on the ground or on a drilling platform, position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform, should the wrench slip or the joint suddenly let go.

8. Clearing The Work Area

Prior to drilling, adequate site clearing and leveling should be performed to accommodate the drill rig and supplies and provide a

sc vorking area. Drilling should not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

9. Start Up

- All drill rig personnel and visitors should be instructed to "stand clear" of the drill rig immediately prior to and during starting of an engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the correct nonactuating positions and the cathead rope is not on the cathead before starting a drill rig engine.
- Start all engines according to the manufacturer's manual.

10. Safety During Drilling Operations

Safety requires the attention and cooperation of every worker and site visitor.

- Do not drive the drill rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick) look up to check for overhead obstructions. (Refer to Section 11 on Overhead and Buried Utilities.)
- Before raising the mast (derrick), all drill rig personnel (with exception of the operator) and visitors should be cleared from the areas immediately to the rear and the sides of the mast. All drill rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig must be first leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after initial set up. Lower the mast (derrick) only when the leveling jacks are down and do not raise the leveling jack pads until the mast (derrick) is lowered completely.
- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.

- The operator of a drill rig should only operate a d rig from the position of the controls. If the operator of the drill rig must leave the area of the controls, the operator should shift the transmission controlling the rotary drive into neutral and place the feed control lever in neutral. The operator should shut down the drill engine before leaving the vicinity of the drill.
- Throwing or dropping tools should not be permitted. All tools should be carefully passed by hand between personnel or a hoist line should be used.
- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a drill rig or while on the job.
- If it is necessary to drill within an enclosed area, make certain that exhaust fumes are conducted out of the area. Exhaust fumes can be toxic and some cannot be detected by smell.
- Clean mud and grease from your boots before mounting a drill platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the drill rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- All air and water lines and pumps should be drained when not in use if freezing weather is expected.
- All unattended boreholes must be adequately covered or otherwise protected to prevent drill rig personnel, site visitors or animals from stepping or falling into the hole. All open boreholes should be covered, protected or backfilled adequately and according to local or state regulations on completion of the drilling project.
- "Horsing around" within the vicinity of the drill rig and tool and supply storage areas should never be allowed, even when the drill rig is shut down.
- When using a ladder on a drill rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool "bucket" or a safety hook to raise or lower hand tools.

An elevated derrick platform should be used with the following precautions:

• n working on a derrick platform, use a safety belt and a lifeline. The safety belt should be at least 4 in. (100 mm) wide and should fit snugly but comfortably. The lifeline, when attached to the derrick, should be less than 6 ft. (2 m) long. The safety belt and lifeline should be strong enough to withstand the dynamic force of a 250 lb. (115 kg) weight (contained within the belt) falling 6 ft. (2 m).

• When climbing to a derrick platform that is higher than 20 ft. (6 m), a safety climbing device should be used.

• When a rig worker is on a derrick platform, the lifeline should be fastened to the derrick just above the derrick platform and to a structural member that is not attached to the platform or to other lines or cables supporting the platform.

• When a rig worker first arrives at a derrick platform, the platform should immediately be inspected for broken members, loose connections and loose tools or other loose materials.

• Tools should be securely attached to the platform with safety lines. Do not attach a tool to a line attached to your wrist or any other part of your body.

• When you are working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.

• Loose tools and similar items should not be left on the derrick platform or on structural members of the derrick.

• A derrick platform over 4 ft. (1.2 m) above ground surface should have toe boards and safety railing that are in good condition.

• Workers on the ground or the drilling floor should avoid being under rig workers on elevated platforms, whenever possible.

Be careful when lifting heavy objects:

• Before lifting any object without using a hoist, make sure that the load is within your personal lifting capacity. If it is too heavy, ask for assistance.

• Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and unarched while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and unarched. In other words, perform the lifting with the muscles in your legs, not with the muscles in your lower back.

• If a heavy object must be moved some distance wi t the aid of machinery, keep your back straight and unarched. Change directions by moving your feet, not by twisting your body.

• Move heavy objects with the aid of hand carts whenever possible.

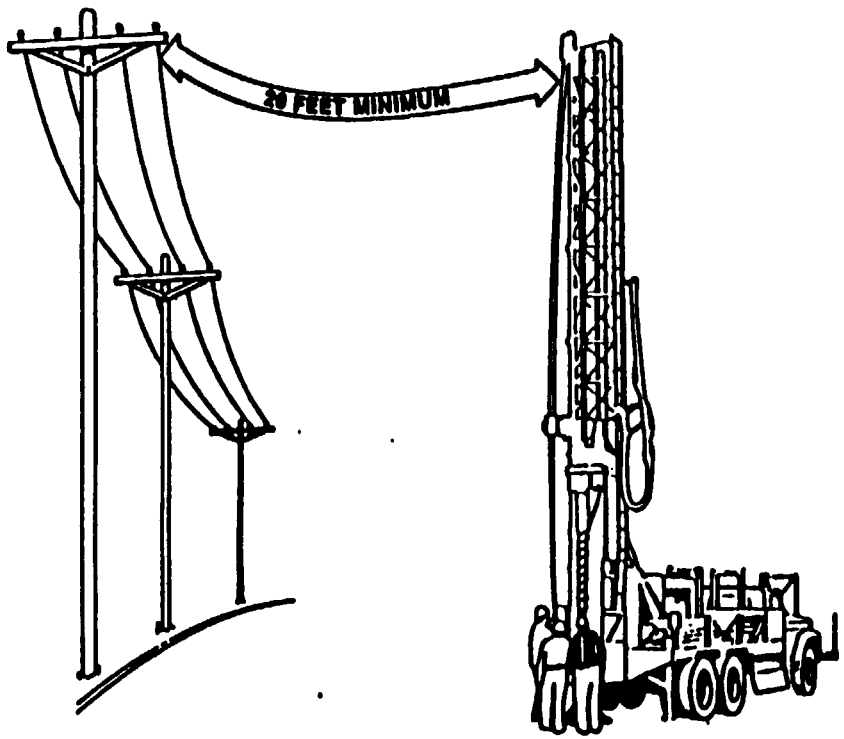
Drilling operations should be terminated during an electrical storm and the complete crew should move away from the drill rig.

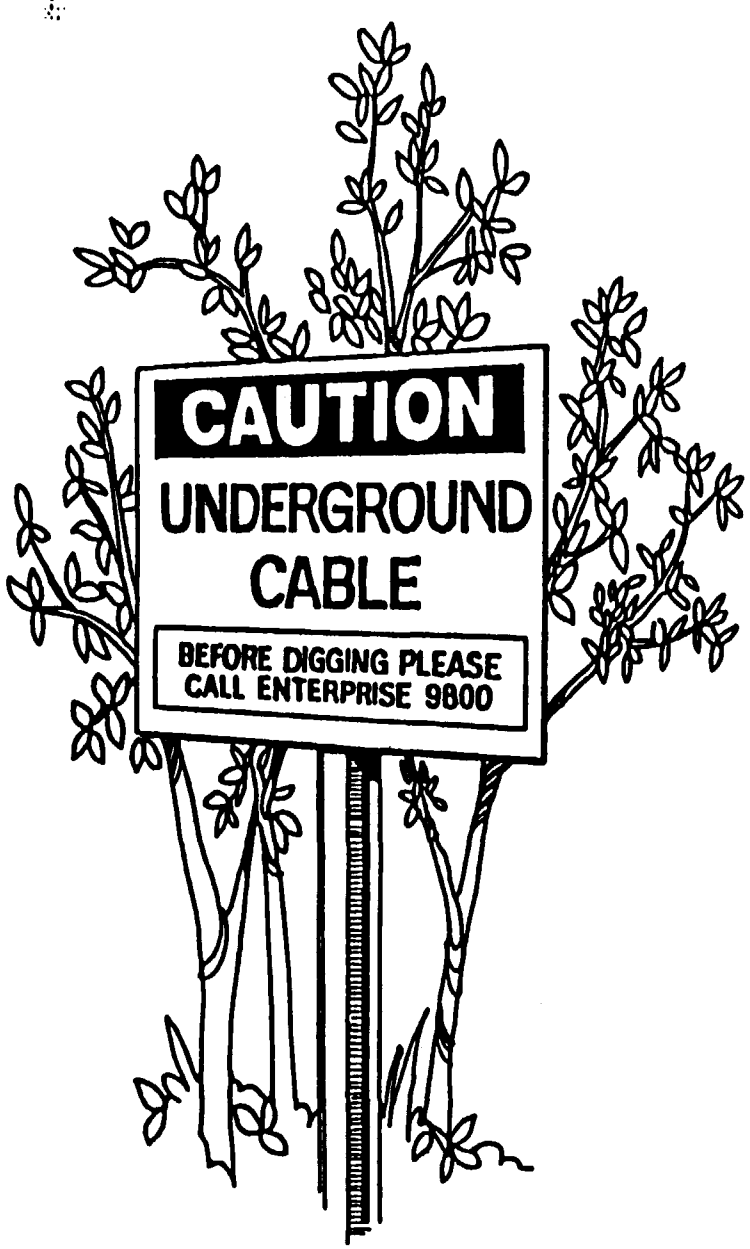
11. Overhead And Buried Utilities

The use of a drill rig on a site or project within the vicinity of electrical power lines and other utilities requires that special precautions be taken by both supervisors and members of the exploration crew. Electricity can shock, it can burn and it can cause death.

• Overhead and buried utilities should be located, noted and emphasized on all boring location plans and boring assignment sheets.

• When overhead electrical power lines exist at or near a drilling site or project, consider all wires to be alive and dangerous.





• Watch for sagging power lines before entering a site. Do not lift power lines to gain entrance. Call the utility and ask them to lift or raise the lines or deenergize (turn off) the power.

• Before raising the drill rig mast (derrick) on a site in the vicinity of power lines, walk completely around the drill rig. Determine what the minimum distance from any point on the drill rig to the nearest power line will be when the mast is raised and/or beir ɹised. Do not raise the mast or operate the drill rig if this distance is less than 20 ft. (6 m), or if known, the minimum clearance stipulated by federal, state and local regulations.

• Keep in mind that both hoist lines and overhead power lines can be moved toward each other by the wind.

• In order to avoid contact with power lines, only move the drill rig with the mast (derrick) down.

• If there are any questions whatever concerning the safety of drilling on sites in the vicinity of overhead power lines, call the power company. The power company will provide expert advice at the drilling site as a public service and at no cost.

Underground electricity is as dangerous as overhead electricity. Be aware and always suspect the existance of underground utilities such as electrical power, gas, petroleum, telephone, sewer and water. Ask for assistance:

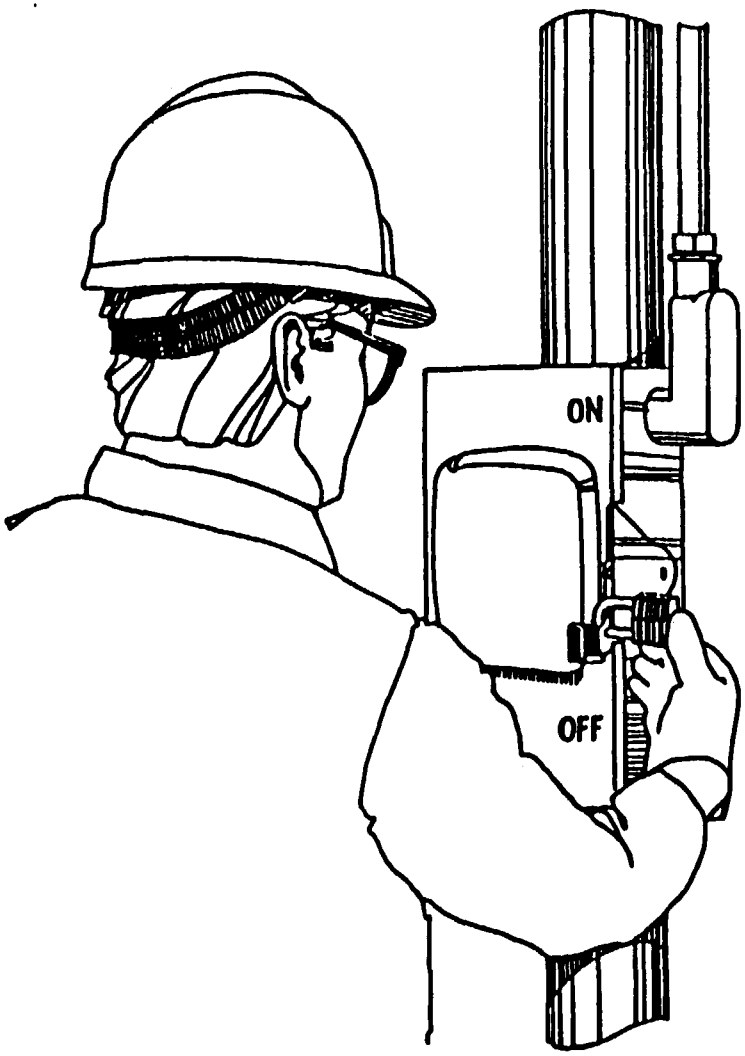
• If a sign warning of underground utilities is located on a site boundary, do not assume that underground utilities are located on or near the boundary or property line under the sign: call the utility and check it out. The underground utilities may be a considerable distance away from the warning sign.

• Always contact the owners of utility lines or the nearest underground utility location service before drilling. Determine jointly with utility personnel the precise location of underground utility lines, mark and flag the locations and determine jointly with utility personnel what specific precautions must be taken to assure safety.

12. Safe Use Of Electricity

Drilling projects sometimes require around-the-clock operations and, therefore, require temporary electrical lighting. In general, all wiring and fixtures used to provide electricity for drilling operations should be installed by qualified personnel in accordance with the National Electrical Code (NFPA70–1984) with consideration of the American Petroleum Institute's recommended practices for electrical installations for production facilities (API–RP–500B). Lights should be installed and positioned to assure that the work area and operating

...ns are well lit without shadows or blind spots. The following specific recommendations emphasize the safe use of electricity during land-based drilling operations:



- Before working on an electrical power or lighting system, lock-out the main panel box with your own lock and keep the key on your person at all times.
- All wiring should be installed using high quality connections, fixtures and wire, insulated and protected with consideration of the drilling environment. Makeshift wiring and equipme... should not be permitted.
- All lights positioned directly above working areas should be enclosed in cages or similar enclosures to prevent loose or detached lamps or vaportight enclosures from falling on workers.
- Lights should be installed to produce the least possible glare or "blind spots" on tools, ladders, walkways, platforms and the complete working area.
- Electrical cables should be guarded and located to prevent damage by drilling operations or by the movement of personnel, tools or supplies.
- All plug receptacles should be the three-prong, U-blade, grounded type and have adequate current carrying capacity for the electrical tools that may be used.
- All electric tools should have three-prong, U-blade, ground wire plugs and cords.
- Do not use electrical tools with lock-on devices.
- All electrical welders, generators, control panels and similar devices should be adequately grounded.
- Control panels, fuse boxes, transformers and similar equipment should have a secure, protective enclosure.
- Avoid attaching electrical lighting cables to the derrick or other components of the drill rig. If this must be done, use only approved fasteners. Do not "string" wire through the derrick.
- Poles used to hold wiring and lights should not be used for any other purpose.
- Power should be turned off before changing fuses or light bulbs.
- When a drilling area is illuminated with electrical lighting, all workers should wear safety head gear that protects the worker's head, not only against falling or flying objects, but also against limited electrical shock and burn according to ANSI Z89.1 and Z89.2.
- Electrical equipment should only be operated by trained, designated personnel.
- If you are not qualified to work on electrical devices or on electric lines, do not go near them.

React To Contact With Electricity

If a drill rig makes contact with electrical wires, it may or may not be insulated from the ground by the tires of the carrier. Under either circumstance the human body, if it simultaneously comes in contact with the drill rig and the ground, will provide a conductor of the electricity to the ground. Death or serious injury can be the result. If a drill rig or a drill rig carrier makes contact with overhead or underground electrical lines:

- Under most circumstances, the operator and other personnel on the seat of the vehicle should remain seated and not leave the vehicle. Do not move or touch any part, particularly a metallic part, of the vehicle or the drill rig.
- If it is determined that the drill rig should be vacated, then all personnel should jump clear and as far as possible from the drill. Do not step off – jump off, and do not hang on to the vehicle or any part of the drill when jumping clear.
- If you are on the ground, stay away from the vehicle and the drill rig, do not let others get near the vehicle and the drill rig and seek assistance from local emergency personnel such as the police or a fire department.
- When an individual is injured and in contact with the drill rig or with power lines, attempt rescue with extreme caution. If a rescue is attempted, use a long, dry, unpainted piece of wood or a long, dry, clean rope. Keep as far away from the victim as possible and do not touch the victim until the victim is completely clear of the drill rig or electrical lines.
- When the victim is completely clear of the electrical source and is unconscious and a heart beat (pulse) cannot be detected, begin cardiopulmonary resuscitation (CPR) immediately.

14. Safe Use Of Wire Line Hoists, Wire Rope And Hoisting Hardware

The use of wire line hoists, wire rope and hoisting hardware should be as stipulated by the American Iron and Steel Institute Wire Rope Users Manual.

- All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for: abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reeving, jamming, crushing, bird caging, kinking, core protrusion and damage to lifting hardware. Wire ropes should be replaced when inspection indicates excessive damage according to the Wire Rope Users Manual. All wire ropes which have not been used for a period of a month or more should be thoroughly inspected before being returned to service.
- End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer's instructions and loaded according to the manufacturer's specifications.
- If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to assure that the swivel freely rotates under load.
- If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, do not hoist more than 1 ft. (0.3 m) of the drill rod column above the top of the mast (derrick), do not hoist a rod column with loose tool joints and do not make up, tighten or loosen tool joints while the rod column is being supported by a rod slipping device. If drill rods should slip back into the borehole, do not attempt to brake the fall of the rods with your hands or by tensioning the slipping device.
- Most sheaves on exploration drill rigs are stationary with a single part line. The number of parts of line should not ever be increased without first consulting with the manufacturer of the drill rig.
- Wire ropes must be properly matched with each sheave – if the rope is too large, the sheave will pinch the wire rope – if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger sized wire ropes.

The following procedures and precautions must be understood and implemented for safe use of wire ropes and rigging hardware.

- Use tool handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool handling hoists to pull on objects away from the drill rig; however, drills may be moved using the main hoist if the wire rope is spooled through proper

ves according to the manufacturer's recommendations.

- When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.
- When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far as possible away from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.
- Minimize shock loading of a wire rope – apply loads smoothly and steadily.
- Avoid sudden loading in cold weather.
- Never use frozen ropes.
- Protect wire rope from sharp corners or edges.
- Replace faulty guides and rollers.
- Replace worn sheaves or worn sheave bearings.
- Replace damaged safety latches on safety hooks before using.
- Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- Clutches and brakes of hoists should be periodically inspected and tested.
- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles and other lifting aids.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope on hoist drums with your hands.
- Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.
- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public or property are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up and when the load is being hoisted.
- Never hoist the load over the head, body or feet of any personnel.

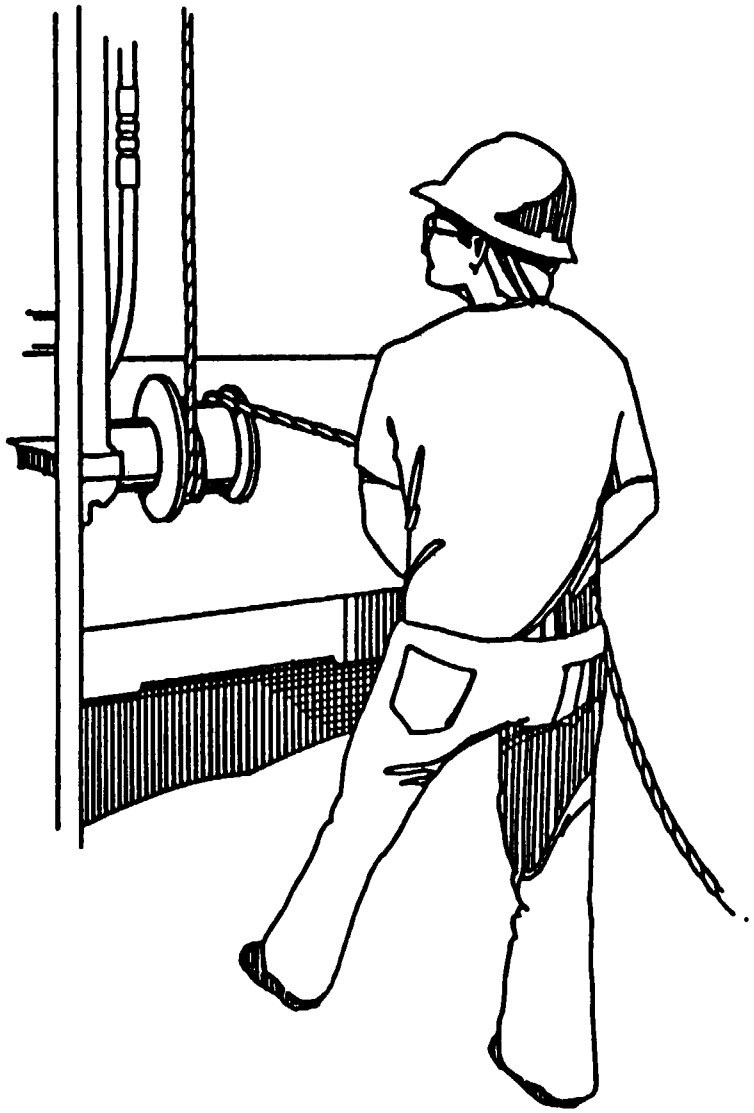
- Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replacement wire ropes should conform to the drill rig manufacturer's specifications.

15. Safe Use Of Cathead And Rope Hoists

The following safety procedures should be employed when using a cathead hoist.

- Keep the cathead clean and free of rust and oil and/or grease. The cathead should be cleaned with a wire brush if it becomes rusty.
- Check the cathead periodically, when the engine is not running, for rope wear grooves. If a rope groove forms to a depth greater than 1/8 in. (3 mm), the cathead should be replaced.
- Always use a clean, dry, sound rope. A wet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.
- Should the rope "grab" the cathead or otherwise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator should also back away and stay clear. If the rope "grabs" the cathead, and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator should keep careful watch on the suspended tools and should quickly back away after turning off the engine.
- The rope should always be protected from contact with all chemicals. Chemicals can cause deterioration of the rope that may not be visibly detectable.
- Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg or any other part of your body.
- Always maintain a minimum of 18 inches of clearance between the operating hand and the cathead drum when driving samplers, casing or other tools with the cathead and rope method. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground.

Never operate a cathead (or perform any other task around a drill rig) with loose unbuttoned or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or lacings.



- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.

- Do not use more rope wraps than are required to hoist a load.
- Do not leave a cathead unattended with the rope wrapped on the drum.
- Position all other hoist lines to prevent contact with the operating cathead rope.
- When using the cathead and rope for driving or back-driving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.
- The cathead operator must be able to operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

16. Safe Use Of Augers

The following general procedures should be used when starting a boring with continuous flight or hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear and the engine running at low RPM.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below ground surface.
- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control and repeat the hole starting process.
- An auger guide can facilitate the starting of a straight hole through hard ground or a pavement.

The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnecting auger sections, and inserting and removing the auger fork. The operator must assure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.

Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench or any other tools during rotation.

- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatever.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

17. Safety During Rotary And Core Drilling

Rotary drilling tools should be safety checked prior to drilling:

- Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.
- Drill rod chuck jaws should be checked periodically and replaced when necessary.
- The capacities of hoists and sheaves should be checked against the anticipated weight to the drill rod string plus other expected hoisting loads.

Special precautions that should be taken for safe rotary or core drilling involve chucking, joint break, hoisting and lowering of drill rods:

- Only the operator of the drill rig should brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.
- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws.

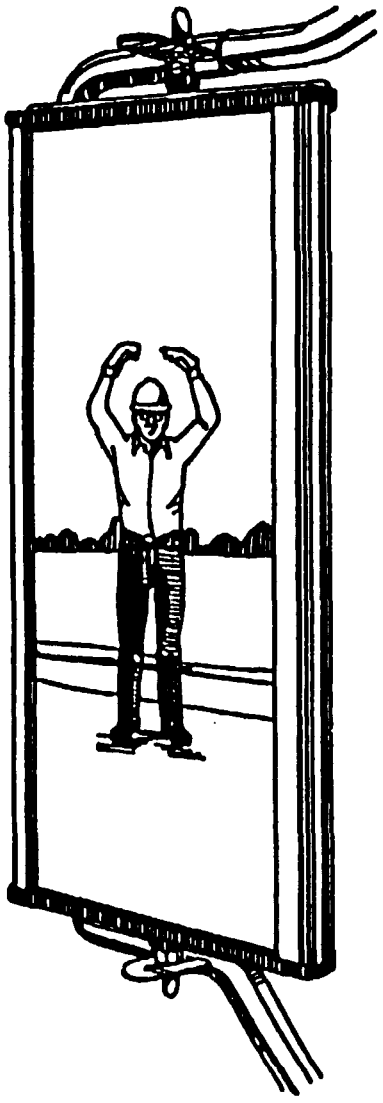
- Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.
- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.
- If work must progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

18. Safety During Travel

The individual who transports a drill rig on and off a drilling site should:

- Be properly licensed and should only operate the vehicle according to federal, state and local regulations.
- Know the traveling height (overhead clearance), width, length and weight of the drill rig with carrier and know highway and bridge load, width and overhead limits, making sure these limits are not exceeded with an adequate margin.
- Never move a drill rig unless the vehicle brakes are in sound working order.
- Allow for mast overhang when cornering or approaching other vehicles or structures.
- Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.

watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels or other commercial sites.



- Never travel on a street, road or highway with the mast (derrick) of the drill rig in the raised or partially raised position.
- Remove all ignition keys when a drill rig is left unattended.

19. Loading And Unloading

When loading or unloading a drill rig on a trailer or a truck:

- Use ramps of adequate design that are solid and substantial enough to bear the weight of the drill rig with carrier – including tooling.
- Load and unload on level ground.
- Use the assistance of someone on the ground as a guide.
- Check the brakes on the drill rig carrier before approaching loading ramps.
- Distribute the weight of the drill rig, carrier and tools on the trailer so that the center of weight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the hitch of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.
- The drill rig and tools should be secured to the hauling vehicle with ties, chains and/or load binders of adequate capacity.

20. Off-Road Movement

The following safety suggestions relate to off-road movement:

- Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gulleys, ruts and similar obstacles.
- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven or hilly ground.
- Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts and mountings.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4 x 4, 6 x 6, etc. vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
- Attempt to cross obstacles such as small logs and small erosion

...nels or ditches squarely, not at an angle.

- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.
- After the drill has been moved to a new drilling site, set all brakes and/or locks. When grades are steep, block the wheels.
- Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.

21. Tires, Batteries And Fuel

Tires on the drill rig must be checked daily for safety and during extended travel for loss of air and they must be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be reinflated to normal pressures before movement on firm or hilly ground or on streets, roads and highways. Under inflated tires are not as stable on firm ground as properly inflated tires. Air pressures should be maintained for travel on streets, roads and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:

- Missing or loose wheel lugs.
- Objects wedged between duals or embedded in the tire casing.
- Damaged or poorly fitting rims or rim flanges.
- Abnormal or uneven wear and cuts, breaks or tears in the casing.

The repair of truck and off-highway tires should only be made with required special tools and following the recommendations of a tire manufacturer's repair manual.

Batteries contain strong acid. Use extreme caution when servicing batteries.

- Batteries should only be serviced in a ventilated area while wearing safety glasses.
- When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.
- When installing a battery, connect the battery ground clamp last.
- When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger leads to the battery posts. Cell caps should be loosened

prior to charging to permit the escape of gas.

- Spilled battery acid can burn your skin and damage your eyes. Spilled battery acid should be immediately flushed off of your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a medical physician at once.
- To avoid battery explosions, keep the cells filled with electrolyte, use a flashlight (not an open flame) to check electrolyte levels and avoid creating sparks around the battery by shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.

Special precautions must be taken for handling fuel and refueling the drill rig or carrier.

- Only use the type and quality of fuel recommended by the engine manufacturer.
- Refuel in a well-ventilated area.
- Do not fill fuel tanks while the engine is running. Turn off all electrical switches.
- Do not spill fuel on hot surfaces. Clean any spillage before starting an engine.
- Wipe up spilled fuel with cotton rags or cloths – do not use wool or metallic cloth.
- Keep open lights, lighted smoking materials and flames or sparking equipment well away from the fueling area.
- Turn off heaters in carrier cabs when refueling the carrier or the drill rig.
- Do not fill portable fuel containers completely full to allow expansion of the fuel during temperature changes.
- Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Do not transport portable fuel containers in the vehicle or carrier cab with personnel.
- Fuel containers and hoses should remain in contact with a metal surface during travel to prevent the buildup of static charge.

2' First Aid

At least one member of the drill crew, and if only one, preferably the drilling and safety supervisor, should be trained to perform first aid. First aid is taught on a person-to-person basis, not by providing or reading a manual. Manuals should only provide continuing reminders and be used for reference. It is suggested that courses provided or sponsored by the American Red Cross or a similar organization would best satisfy the requirements of first aid training for drill crews.

For drilling operations it is particularly important that the individual responsible for first aid should be able to recognize the symptoms and be able to provide first aid for electrical shock, heart attack, stroke, broken bones, eye injury, snake bite and cuts or abrasions to the skin. Again, first aid for these situations is best taught to drill crew members by instructors qualified by an agency such as the American Red Cross.

A first aid kit should be available and well maintained on each drill site.

23. Drill Rig Utilization

Do not attempt to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc. Only use the drill rig and tools for the purposes which they are intended and designed.

24. Drill Rig Alterations

Alterations to a drill rig or drilling tools should only be made by qualified personnel and only after consultation with the manufacturer.

ATTACHMENT C

ATTACHMENT C

SITE SAFETY CHECKLIST

Date _____ **Time** _____

Montgomery Watson Personnel:

Other Persons on Site:

Field Activities:

Safety Inspector _____

	Yes	No
Training		
1) Personal acknowledgment forms signed by Montgomery Watson personnel.		
2) All Montgomery Watson personnel 40-Hour OSHA safety trained.		
3) At least one Montgomery Watson personnel First Aid/CPR trained.		
4) All Montgomery Watson personnel meet annual physical requirements.		
Site Control		
1) Exclusion, contamination reduction and support zones established.		
2) No excess people in work area.		
3) Proper decontamination stations established and procedures followed.		
Drilling Safety		
1) Overhead utilities (20-foot separation distance).		
2) Underground utilities (5-foot separation distance).		
3) Proper drilling safety procedures followed.		
4) Slip/trip/fall hazards identified and communicated.		
5) No eating, drinking or smoking in work area.		
6) Safety harness worn while climbing rig tower.		

Equipment	Yes	No
1) Fire extinguisher in Montgomery Watson vehicle.		
2) First aid kit in Montgomery Watson vehicle.		
3) Eye wash kit in Montgomery Watson vehicle.		
4) Blood borne pathogen kit in Montgomery Watson vehicle.		
5) Emergency vehicle available.		
6) Copy of SSP on hand.		
7) Route to Hospital Map and Emergency Information Sheet posted at work area.		
8) OSHA Job Health and Safety Poster at work area (SSP).		
9) Tailgate Safety Meeting Form completed and signed.		
10) Contractor SSP on site or letter indicating adoption of Montgomery Watson's SSP.		
11) Subcontractor's understanding of site-specific health and safety issues (protective clothing, key chemical symptoms, monitoring, levels for upgrade, etc.).		
Monitoring		
1) PID/FID equipment on site, if applicable; correct lamp for contaminants of concern.		
2) Exotox #50 on site, if applicable.		
3) Dräger™ pump and tubes on site, if applicable.		
4) Field equipment calibrated correctly and recorded.		
5) PID/FID, Exotox #50 or Dräger™ readings taken every interval of drilling/consistent time intervals.		
6) PID/FID, Exotox #50 and/or Dräger™ readings recorded in field log book.		
6) Respirators and appropriate cartridges on site.		
7) Montgomery Watson personnel properly fit-tested for respirator use.		
8) Protective safety level upgraded according to air monitoring equipment being used.		
Protective Clothing		
Drilling and Soil Sampling Activities:		
1) Tyvek™, Poly-coated Tyvek™ or Saranex™ aprons or suits worn if contact with contaminated liquids is anticipated. Others as specified in plan.		
2) Inner nitrile gloves (4 milliliter (mil)). Outer nitrile gloves (15 mil) worn if contact with contaminated liquids is anticipated. Others as specified in plan.		

Protective Clothing (Continued)	Yes	No
3) Hard hats worn.		
4) Hearing protection worn (near drill rig).		
5) Safety glasses or goggles worn.		
6) Steel-toed foot wear worn/chemically resistant covers.		
7) If Level C PPE required, respirator with correct cartridges worn.		
Groundwater Sampling Activities:		
1) Poly-coated Tyvek™ or Saranex™ aprons or suits worn. Others as specified in plan.		
2) Chemical-resistant boots worn if chemical contact is expected.		
3) Inner and outer nitrile gloves (4 mil and 15 mil, respectively) worn. Others as specified in plan.		
4) Safety glasses or goggles worn.		
5) If Level C PPE required, respirator with correct cartridges worn.		
Stream and Sediment Sampling:		
1) Poly-coated Tyvek™ or Saranex™ aprons or suits worn. Others as specified in plan.		
2) Chemical-resistant boots worn.		
3) Inner and outer nitrile gloves (4 mil and 15 mil, respectively) worn. Others as specified in plan.		
4) Safety glasses or goggles worn.		
5) If Level C PPE required, respirator with correct cartridges worn.		
Developing/Slug Testing:		
1) Poly-coated Tyvek™ or Saranex™ aprons or suits worn. Others as specified in plan.		
2) Chemical-resistant boots worn if chemical contact expected.		
3) Inner and outer nitrile gloves (4 mil and 15 mil, respectively) worn. Others as specified in plan.		
4) Safety glasses or goggles worn.		
5) If Level C PPE required, respirator with correct cartridges worn.		

ATTACHMENT D

INCIDENT REPORT

MONTGOMERY WATSON

Date: _____ **Time (Occurence/Discovery):** _____

Project No.: _____

Site/Location: _____

Reported By: _____

Incident: _____

_____

_____

_____

_____

_____

Corrective Action: _____

_____

_____

_____

_____

Response: _____

_____

_____

_____

_____

Notification: ☐ HSC ☐ PSO ☐ PM ☐ BOM ☐ Subcontractor

cc: Mike Geringer, Montgomery Watson HSC
Subcontractor Company
Project File

ATTACHMENT E

TAILGATE SAFETY MEETING FORM

Date: _____ **Time:** _____ **Job Number:** 1166.0250

Client: Rockwell International Corporation **Address:** Cedar Rapids, Iowa

Site Location: Former Ralston Disposal Site

Scope of Work: Advance soil borings; conduct trenching; install monitoring wells; collect soil, groundwater and surface water samples.

SAFETY TOPICS PRESENTED

Chemical Hazards:

1. Chemicals of Concern: Acetone, cadmium, chromium, copper, cyanide, cis-1,2-dichloroethene, lead, methyl ethyl ketone, methylene chloride, tetrachloroethylene, toluene, trichloroethylene, vinyl chloride and xylene.

2. Warning properties (Table 2-2 of SSP)

3. PPE Needed:

   Drilling, Trenching and Soil Sampling: Steel-toed boots, hard hats, hearing and eye protection, and nitrile gloves.

   Groundwater and surface water sampling: Eye protection, 4-mil nitrile inner and 22-mil nitrile outer gloves, Saranex™ protective clothing.

Physical Hazards:

1. Equipment dangers
2. Utility lines
3. Heat/cold stress
4. Vehicle traffic hazards
5. Trip, slip and fall hazards
6. Work limitations (temperature, weather conditions, light): Work will take place during daylight unless artificial light is provided; work may be postponed due to adverse weather conditions such as lightning, extreme hot or cold temperatures; a sufficient number of breaks will be allowed.

Monitoring:

1. Equipment needed/used: PID/FID equipment and the Exotox #50 will be used for organic vapor, oxygen and other gas monitoring; dust conditions will be visually monitored.

2. Chemicals being monitored for: Organic vapors, oxygen, carbon monoxide, hydrogen sulfide and dust.

3. Levels for upgrading:

   If PID/FID indicates sustained reading of 5 meter units or if the Exotox #50 indicates sustained reading of 10 ppm, upgrade to Level C.

Should irritating, dusty conditions exist, upgrade to Level C with dust or HEPA cartridges.

If PID/FID indicates sustained reading of 25 meter units, evacuate site until levels subside.

When the Exotox #50 indicates sustained LEL reading in excess of 25% or more, operations will cease, and the site will be evacuated.

4. Frequency of readings and logging in field book

Special Equipment:

Decontamination of Clothing/Equipment:

1. Cleaning solvents used: Alconox, distilled water.

2. Disposal of clothing/equipment: In sealed plastic bags and on-site dumpster.

Site Control:

1. Location of working zones
2. PPE needed in various zones:
   Level D or C in exclusion zone
   Level D or work clothes in support zone

Other:

No smoking, eating or drinking in work areas.

Emergency Procedures:

1. Location of emergency equipment:
   First aid kit, eye wash kit and fire extinguisher located in each field vehicle; extra safety supplies located in field vehicle.
2. Designated safety vehicle
3. Posted emergency information, route to hospital map, chemical symptoms table

ATTENDEES

Name Printed	Signature

Meeting Conducted By: _____ _____
Name Printed Signature

ATTACHMENT F

ATTACHMENT F

PERSONAL ACKNOWLEDGEMENT

As a component of the Site Safety Plan (SSP) designed to provide personnel safety during the site investigation activities at the Ralston site, Cedar Rapids, Iowa, you are required to read and understand the SSP. When you have fulfilled this requirement, please sign and date this "Personal Acknowledgement." Also provide the requested information pertaining to use of Level C respiratory protection.

Model/Type of Respirator: _____

Date Fit Tested: _____

_____
Signature

_____
Name (Printed)

_____
Date

ATTACHMENT G

ATTACHMENT G

MEDICAL SURVEILLANCE PROGRAM

The medical surveillance program will include the following components:

Occupational History

A description of previous employment, work responsibilities, and off-the-job hobbies or activities that have involved potential exposure(s) to chemical, biological, physical, or ergonomic stressors. Additional information pertaining to specific incidents regarding known exposures to workplace or off-the-job exposures that resulted in an injury or illness must be provided.

Medical History

A compilation of information regarding height, weight, blood pressure, past illnesses (physical or mental), physical injuries (broken bones, surgeries), smoking history, respiratory illness (lung disorders, asthma, bronchitis, pulmonary restrictions), alcohol consumption, exercise rate, vaccinations, allergies (skin or lung disorders), and family medical history.

Physical Examination

Routine physical examination designed to screen for gross abnormalities.

Blood Tests

On-site personnel shall receive a basic panel of blood counts and chemistries to evaluate metabolic, kidney, liver, endocrine and blood-forming functions. The following blood tests are the desired minimum:

- White blood cell count, differential cell count and platelet estimate
- Hemoglobin and/or hematocrit
- Albumin, globulin and total protein
- Total bilirubin
- Serum glutamic oxalacetic transaminase (SGOT)
- Lactic dehydrogenase
- Inorganic phosphate
- Alkaline phosphatase
- Calcium
- Phosphorus
- Uric acid
- Creatinine
- Urea nitrogen
- Cholesterol
- Glucose

Urine Tests

On-site personnel shall have a routine urinalysis that includes:

- Specific gravity
- Microscopic examination
- Acetone
- Albumin
- pH
- Protein
- Glucose

Pulmonary Function Tests

Pulmonary function testing is a requirement of the baseline medical examination. At a minimum, the tests shall include lung ventilation evaluations of forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC).

X-Ray

X-ray examinations should be obtained only when clinically indicated by other testing procedures (i.e., pulmonary function testing). A chest X-ray, when required, should be a standard 14 x 17-inch P-A (posterior-anterior) exposure. However, no chest X-ray shall be obtained if the employee has had one within the past three years or is pregnant. Records should be requested from the former examining physician, radiologist or hospital. All films shall be read or reviewed by a board-certified "B" reader physician or other competent medical specialist.

Vision and Hearing Testing

Vision testing that measures refraction, depth perception and color vision should be administered by a qualified technician or physician.

Audiometric testing performed at 500, 1,000, 2,000, 3,000, 4,000 and 8,000 hertz pure tone should be conducted in an approved booth (29 CFR, Part 1910.95, Appendix D) by a qualified technician and the results read by a certified audiologist or a physician familiar with audiometric evaluation.

At the completion of the examination, the employee will receive a written opinion concerning their medical or physical status. The PSO will notify the employee's supervisor of the results. Should any restrictions be found during the physical examination, it will be conveyed to the employee and the information included in their personnel file.

As discussed in Sections 3.4 and 3.5, the PE/OSO must conduct a tailgate safety meeting at the beginning of each shift, whenever new personnel arrive at the site, as site conditions change, or as needed.

ATTACHMENT H

ATTACHMENT H

SUBJECT: MONTGOMERY WATSON INJURY AND ILLNESS PREVENTION PROGRAM (IIPP)

I. PURPOSE

Montgomery Watson is absolutely committed to the establishment, implementation and maintenance of an effective Injury and Illness Prevention Program (IIPP). This program is intended to conform with requirements of the California Labor Code section 6401.7 and implementing regulations, commonly known as California SB198. THIS PROGRAM IS NOT ONLY MANDATORY IN CALIFORNIA (TITLE 8, No. 1509 AND No. 3203), IT IS ALSO MANDATORY, BY ADOPTION AS COMPANY POLICY, IN ALL OTHER MONTGOMERY WATSON OFFICES. It is the intent of this program to ensure that each and every employee has a safe and healthful work environment and the knowledge to properly and safely perform his/her work.

Besides company employees, this IIPP covers all other workers (temporary, part time, contractor) that Montgomery Watson controls, directs or supervises on the job, to the extent these workers are exposed to work site and job assignment specific hazards.

II. RESPONSIBILITIES

In order to accomplish the objectives of this program a "team" effort on the part of all Montgomery Watson employees is needed. It is essential that all personnel take an interest and participate actively in all phases of the IIPP. Every employee must accept responsibility for his/her own actions and conduct, follow safety and health procedures, and recognize and report hazards in his/her work area.

The responsibility for overseeing and maintaining the IIPP has been designated to the Corporate Health and Safety Manager. The role of the Technology Division is to provide corporate guidance and direction to facilitate the development and implementation of effective programs in the function/operating groups. Each of the function/operating groups has the responsibility to develop any specific procedures and specialized applications that improve the effectiveness of the IIPP.

Each Cost/Profit Center Supervisor, or senior Montgomery Watson Management representative on a field job-site, has the responsibility to implement the Montgomery Watson IIPP at their location. As further discussed in this procedure, it is this individual's responsibility to identify and evaluate location-specific workplace hazards, conduct inspections, correct unsafe conditions, conduct accident investigations, communicate the requirements of the IIPP to employees, train employees and perform the necessary record keeping tasks.

For each location, the name of the person responsible to implement the IIPP, and his or her authority, must be provided in writing as an attachment to this Bulletin.

III. IDENTIFYING AND EVALUATING WORKPLACE HAZARDS

A. General

The identification and control of hazards is essential in order to maintain a safe and healthful workplace. Our system for identifying and evaluating hazards includes three general components: (1) an operational review when the Environmental/

Occupational Health and Safety Program is first established or when a new substance, process, procedure or operation is introduced to the workplace, (2) the determination of Cal-OSHA/OSHA standards applicability, (3) the utilization of work site inspections.

B. Hazard Control System

The Montgomery Watson system for identifying and evaluating workplace hazards to prevent occupational health and safety injuries and illnesses includes the following:

- Hazard assessment survey of Montgomery Watson operations and facilities during the development of the SB 198 Program.
- Review of OSHA General Industry Safety Orders (GISO) and other Safety Orders that apply to Montgomery Watson.
- Review of industry and general information (including Material Safety Data Sheets for chemicals used) on potential occupational health and safety hazards.
- Review and utilization of information and resources of insurance carrier loss control services, other health and safety consultants, and OSHA consultation.
- Identification and development of job safety classes applicable to Montgomery Watson that utilize common work conditions and hazard potential to group employees into general categories.
- Periodic and scheduled inspections of general work areas and specific work sites, including formal follow-up procedures for corrective actions.
- Investigation of all occupational accidents, injuries, and illnesses to determine cause and eliminate repeat occurrences.
- Encouraging employees to inform management of hazards in the workplace without fear of reprisal.

IV. INSPECTIONS

A. General

At Montgomery Watson, inspections are an integral component of our comprehensive health and safety program. Inspections perform two roles in injury and illness prevention: first, they are a means of identifying potential hazards not previously recognized; second, they are used to verify ongoing compliance with controls and safe practices designed to prevent previously identified occupational hazards.

In terms of the Montgomery Watson IIPP, inspections are formal, regularly scheduled, involve careful observation to detect new hazards, properly documented, and utilize written checklists to identify unsafe conditions and work practices.

- Cost/Profit Center Supervisors have the responsibility to ensure that proper inspections are scheduled, conducted, documented, and discrepancies corrected.
- Health and Safety Coordinators have general program oversight, through regular review audits, to insure compliance.

B. Frequency

As a part of our IIPP, all Montgomery Watson Cost/Profit Center Supervisors will perform, either personally or through directive, periodic scheduled inspections of their work areas. In general, inspections are based on hazard potential and severity. The frequency of these inspections depends on the operations involved, the magnitude of the hazards, the proficiency of employees, changes in equipment or work processes, and the history of workplace injuries and illnesses.

The following guidelines may serve as a general approach in determining the appropriate frequency of inspections for each Montgomery Watson Cost/Profit Center:

Quarterly: Shop, chemicals, lab, construction sites
Annually: Office areas.

In addition to scheduled periodic inspections based on the hazard potential of a work area, there are other situations where an inspection is required. These situations include:

- When the IIPP is first established.
- Whenever new substances, processes, procedures, or equipment are introduced that present new occupational health and safety hazards.
- Whenever Montgomery Watson is made aware of a new or previously unrecognized hazard.
- When investigating an occupational injury or illness.
- Special inspections required by an OSHA/Cal-OSHA standard or other regulatory agency on a prescribed timetable.

V. CORRECTING UNSAFE CONDITIONS

All hazards discovered during an inspection or coming to the attention of Montgomery Watson must be corrected in a timely manner consistent with the seriousness of the hazard. All reasonable efforts should be made to abate recognized hazards as soon as possible and to advise employees of any uncorrected hazards. However, if there is an imminent danger of serious harm, an immediate corrective action, such as taking the piece of equipment or work station out of service, is required. If an imminent hazard exists which cannot be immediately abated without endangering people/property, then all potentially exposed personnel will be removed from the area except those necessary to correct the hazardous condition. Employees correcting the hazardous condition shall be provided with the necessary safeguards.

In regard to the correcting of unsafe conditions, Montgomery Watson Cost/Profit Center Supervisors shall ensure the health and safety of their employees/guests by:

- Promptly correcting unsafe or unhealthy conditions.
- Setting a target date for correcting any hazard that cannot be immediately corrected, and following-up to confirm the hazard abatement.

- Utilizing the area inspection checklist to track and document identified hazards and corrective measures.
- Providing interim protection to employees while the correction of hazards is proceeding.
- Informing area personnel of the status of the hazardous condition.
- Immediately removing/supporting the removal of any personnel exposed or potentially exposed to an imminent hazard.
- Securing the resources (maintenance personnel, health and safety specialists, consultants) necessary to assess the hazard severity and recommend corrective action/abate the hazard.

VI. ACCIDENT INVESTIGATION

The Montgomery Watson IIPP requires that all occupational injury and illness cases be thoroughly investigated to determine the cause and to prevent reoccurrence. Any accident, injury or other exposure to hazardous substances will trigger an investigative inspection of the subject work area, in accordance with the guidelines outlined in the attached Accident Investigation Procedure (See Montgomery Watson Environmental/Occupational Health and Safety Bulletin VI–1).

VII. COMMUNICATIONS

A. General

All Montgomery Watson employees will be provided and are encouraged to seek/request information regarding occupational health and safety. Montgomery Watson's system for communicating with employees on occupational health and safety matters includes:

- Written communications (memos, paycheck inserts, booklets)
- Electronic mail messages
- Postings (posters, general bulletins)
- Meetings (safety, staff)
- Training programs
- Montgomery Watson Health and Safety Working Group
- Health and Safety Videos (Contact the Health and Safety Coordinator or the Corporate Health and Safety Manager for the latest listing of videos.)

In addition, all employees are encouraged and should inform their Cost/Profit Center Supervisor about any workplace hazards they are aware of. No Montgomery Watson employee will incur any form of reprisal or discrimination if they disclose a safety hazard. If they so choose, employees may report the potential hazard anonymously to either the Health and Safety Coordinator or the Corporate Health and Safety Manager.

B. Ensuring Employee Compliance

In order to have an effective IIPP, all Montgomery Watson employees must contribute by complying with the safety-related requirements of their jobs. The majority of all accidents are a result of unsafe acts and most of these can be prevented by following safe work practices. The Montgomery Watson system for ensuring employee compliance with safe and healthy work practices includes:

- Providing relevant information to employees on health and safety issues.
- Training and retraining personnel on the specific safe work practices associated with each job assignment.
- A communications system that encourages the reporting of occupational hazards by employees and a company commitment to correct all hazardous conditions.
- An inspection program that identifies violations of safe work practices.
- Ensuring that management understands and enforces safety rules and policies.
- Human Resources Administration procedures on disciplinary action including violation of Montgomery Watson environmental/occupational health and safety standards.
- Recognizing employees who follow safe and healthful work practices.

VIII. EMPLOYEE TRAINING

A. General

Training of employees is considered one of the most effective means of achieving an injury-and illness-free workplace. Employees who understand the hazards of their work environment and safe work practices have a lower injury frequency and are able to identify and report problems before an injury or illness results.

The IIPP serves as the umbrella for Montgomery Watson environmental/occupational health and safety training efforts. Other previous employee health and safety training designed to meet the requirements of a specific standard must continue, but the IIPP incorporates additional employer responsibilities. Under the IIPP, employees must be instructed in general safe and healthy work practices and specifically on the hazards of each employee's job assignment. All employees must be advised of:

- Potential occupational hazards identified in their workplace generally and those specifically related to their job assignment.
- Means of minimizing potential hazards, including work conditions, safe work practices, and personal protective equipment.
- Any new hazards introduced by a change in equipment, processes, raw materials, etc.

B. Frequency

The frequency of IIPP health and safety training is dependent on the potential severity of the hazards associated with an assignment/area. To maximize time and efficiency,

IIPP training should be incorporated with any other required training efforts such as Hazard Communication, Emergency Preparedness, Respiratory Protection, etc.

In addition to ongoing efforts, training must also be provided as follows:

- When the IIPP is first established.
- To all new employees.
- To all employees given new job assignments for which training has not been previously received.
- Whenever new substances, processes, procedures or equipment are introduced to the workplace and represent a new hazard.
- Whenever Montgomery Watson is made aware of a new or previously unrecognized hazard.
- For Profit Center Supervisors to familiarize them with the health and safety hazards to which employees under their immediate direction and control may be exposed.

IX. RECORD KEEPING

Every Montgomery Watson Cost/Profit Center Supervisor has the responsibility to maintain the records associated with the development, implementation and maintenance of the IIPP for his/her Cost/Profit Center. All records must be maintained for a minimum of three (3) years, but other specific regulatory standards may impose longer time requirements. Individual employee training, chemical exposure, and disciplinary action documentation should be placed in the respective employee's department and corporate personnel folders.

The following documents/actions are required to be maintained as part of each Cost/Profit Center Supervisor's record keeping program:

- Records of scheduled and periodic inspections including persons conducting the inspection, any identified unsafe condition or work practice, and all corrective action taken.
- Documentation of health and safety training for each employee including employee name, employee number, training dates, type(s) of training and training providers.
- Descriptions of the content of the training that details what the employees were trained on.
- Complete and thorough accident investigations including records of inspection and corrective action.
- Records of safety meetings and classes (include topics covered), individual training, employee communications, field training, safety meetings, etc.
- Records of employee exposure to hazardous materials.
- Records of employee disciplinary action taken as a result of non-compliance with a company safety/health policy.

Records must be maintained by each Cost/Profit Center Supervisor.

The following records must be forwarded immediately by the Cost/Profit Center Supervisor to the Corporate Health and Safety Manager:

1. Disciplinary Action
2. Injury/Illness Investigation Reports
3. Open Items (previously identified, serious discrepancies)

X. OBLIGATIONS AND RESPONSIBILITIES CONCERNING NON-MONTGOMERY WATSON EMPLOYEES

A. It is not uncommon for Montgomery Watson personnel to interface with client, contractor, or subcontractor personnel on a daily basis. This is an integral and necessary part of the company's business activities.

There exist other considerations, however, when dealing with workplace health and safety issues. These may include OSHA regulations, various Labor Codes, and contractual provisions.

B. Unless clearly stated and authorized in a contract, the Cost/Profit Center Supervisor must insure that Montgomery Watson employees observe the following when dealing with client, contractor, or subcontractor personnel on health and safety issues:

1. Montgomery Watson employees must not train or certify non-employees on any health and safety issue. This is a legal responsibility of each employer. However, voluntary attendance without any obligation of non-employees in Montgomery Watson Health and Safety training courses is acceptable.

2. Montgomery Watson employees must not issue personal protective equipment to non-employees. Again, the providing of this type equipment is the responsibility of each employer.

3. Montgomery Watson employees must not direct non-employees in carrying out specific, "step-by-step" elements of a work task. The general work product or expected end result must, of course, be conveyed to a non-employee. However, the incremental completion of the task and the methodologies used must be left to the non-employee who should receive appropriate training from his/her employer.

4. If a Montgomery Watson employee observes any unsafe act which could jeopardize his/her personal safety, or the personal safety of others, including the contract employee, the Montgomery Watson employee must take steps to resolve the issue.

   This is formal procedure and is described in Bulletin No. X-1.

C. Please contact the Corporate Health and Safety Manager if there are any questions.

XI. COMPLIANCE SUMMARY

After reviewing this Bulletin, complete Attachment A ("Injury and Illness Prevention Program") which summarizes major compliance provisions. Review completed attachment with employees.

APPENDIX A

COMPLIANCE SUMMARY
INJURY AND ILLNESS PREVENTION PROGRAM

I. List Resident Responsible Person: _____

Corporate Health and Safety Manager: Paul T. Shiroma, PAS-3/12b, 818/568-6678

II. Identify Workplace Hazards/Conditions. Some Examples:

- ☐ Chemical Exposure (potential)
- ☐ Compressed Air
- ☐ Confined Spaces
- ☐ Cranes & Hoists
- ☐ Electrical
- ☐ Elevated Work Surfaces
- ☐ Ergonomics
- ☐ Explosives
- ☐ Flammable Liquids, Gases, Vapors
- ☐ Gas Cylinders
- ☐ Hazardous Chemicals
- ☐ Industrial Vehicles/Forklifts
- ☐ Ladders
- ☐ Lockout/Tagout
- ☐ Machinery
- ☐ Noise
- ☐ Office
- ☐ Protective Equipment
- ☐ Radiation
- ☐ Sampling Equipment, i.e., "Smeals," Boats
- ☐ Thermal Stress (Heat & Cold)
- ☐ Tools, Hand/Powered
- ☐ Trenching/Excavation
- ☐ Vehicle (Auto)
- ☐ Welding/Cutting/Brazing
- ☐ Other _____

III. Inspection

- ☐ For hazards identified above, generate an inspection checklist. (Utilize the manufacturer's operations manual, consult industry references, or contact the Corporate Health and Safety Manager for sample checklists.)
- ☐ Conduct inspection on a regular basis. Recommended frequencies*:

Office Areas:	Annually
Field Sites:	Quarterly

*Dependent on exposures and severity of conditions

IV. Correction of Inspection Findings

- ☐ Assign responsibility for correction.
- ☐ Track and close/elevate discrepancies on ongoing basis.

V. Accident Investigation (Refer to Health and Safety Manual Bulletin VI-1)

- ☐ Complete Employee Injury Report Form for every workplace injury/illness.
- ☐ Send copy to Corporate Health and Safety Manager.

VI. Training (Assigned, transferred, and new employees)

- ☐ Train employees to general program requirements
  - Hazardous Communication (HAZCOM)
  - Emergency Procedures
  - Fire Prevention
- ☐ Train employees to specific workplace hazards identified in II above.
- ☐ Conduct refresher training classes as appropriate.

VII. Disciplinary Action

- ☐ Document all disciplinary action (coordinate with Human Resources).

VIII. Employee Communications

- ☐ Distribute regular bulletins issued from Corporate Health and Safety Manager.
- ☐ Raise issues through Health and Safety Coordinators or Health/Safety Working Group.
- ☐ Raise issues directly to Corporate Health and Safety Manager.

IX. Documentation

- ☐ Retain records (inspections, correction, training, investigation) for 3 years.
- ☐ Make available for Internal Audits/Regulatory Inspections.

APPENDIX B

OCCUPATIONAL INJURY/ILLNESS REPORT FORM

I. IDENTIFICATION

A. EMPLOYEE (EE)

Name: _____	Age: _____
Title: _____	Sex: _____
EE Number: _____	Seniority Date: _____
Cost Center: _____	

B. INCIDENT

Date: _____	Location: _____
Time: _____	_____
Date Reported (If different from incident date): _____	Names of Any Witnesses: _____ _____

II. DESCRIPTION

DESCRIBE WHAT HAPPENED

Who: _____

What: _____

_____

How: _____

_____

Other: _____

Sketch layout on back of form. Attach any witness statements, photographs, or other relative documents.

III. CORRECTIVE ACTION/RECOMMENDATIONS

Be specific _____

_____

	YES	If yes, give date	NO
Did this corrective action address separate, yet similar, conditions?	_____	_____	_____
Was this corrective action shared with the injured employee?			
Was this corrective action shared with all affected employees?			

IV. CERTIFICATION			
Form completed by:	_____	Date:	_____
Cost Center Manager approval:	_____	Date:	_____

V. SPACE FOR SKETCH, OR ADDITIONAL NARRATIVE

cc: Health and Safety Coordinator
Corporate Health & Safety Office (FAX to 818/568-6619 within 24 hours of incident)
Corporate Human Resources (Susie Day)
Group Manager

ATTACHMENT I

ATTACHMENT I

EMERGENCY ASSISTANCE INFORMATION

Jeffrey L. Coon (Project Manager), Montgomery Watson: (515) 253-0830 (8:00 - 5:00)
(515) 224-4719 (after hours)

Michael D. Geringer (Health and Safety Coordinator)
Montgomery Watson: (515) 253-0830 (8:00 - 5:00)
(515) 224-6380 (after hours)

Terry Noteboom, Rockwell International Corporation: (319) 395-5710

Location of Nearest Working Telephone: Montgomery Watson Field Vehicle

Location of Fire Extinguishers: Drill Rig or Heavy Equipment and
Montgomery Watson Field Vehicle

Location of Emergency Eye Lavages: Montgomery Watson Field Vehicle

Location of First-Aid Kit: Montgomery Watson Field Vehicle

Ambulance, Fire, Police, Sheriff: Telephone 911

State Highway Patrol: (800) 525-5555

Poison Control: Iowa Methodist, (800) 277-6377

Hospital: St. Lukes Hospital, 1026 A Avenue, Cedar Rapids, IA (319) 369-7211

Emergency Route: Blairs Ferry Road west to I-380 south; to 7th Street exit; left on A street to St. Lukes Hospital. (Figure 5-1)

Iowa Department of Natural Resources: (515) 281-8694

EPA Spill Response: (913) 236-3778

Power Company: Iowa Electric, Underground Location, (319) 398-4531
After 5:00 p.m., (319) 398-4411

Natural Gas Company: Iowa Illinois Gas and Electric Company, Location of Underground Gas, (800) 292-8989; Emergency Gas, (319) 364-5101

Telephone Company: U.S. West, (800) 292-8989
(515) 224-3905

ATTACHMENT J

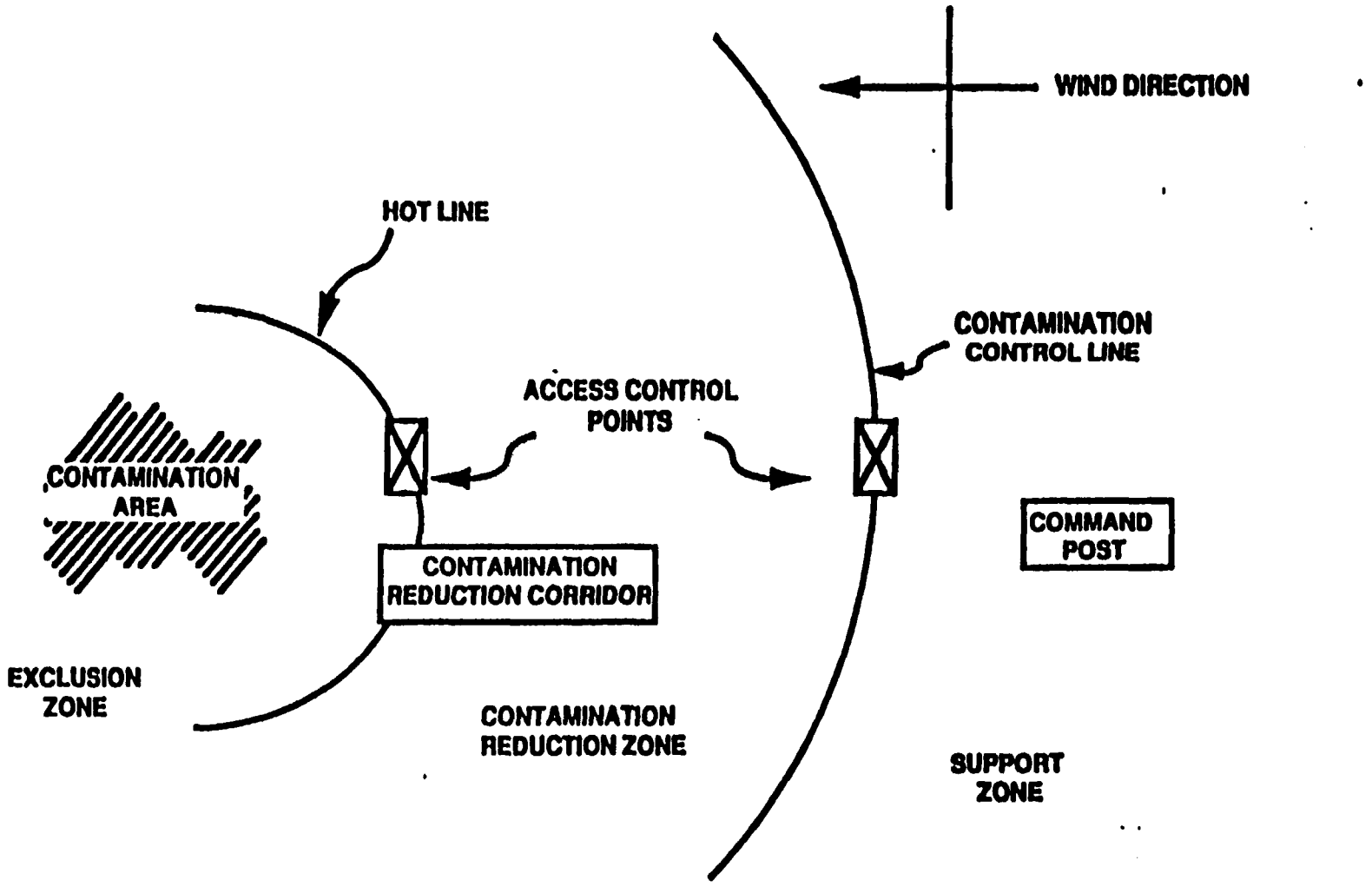


DIAGRAM OF SITE ZONES

ATTACHMENT K

ATTACHMENT K

LEVEL C DECONTAMINATION PROCEDURE

A. Equipment Worn

The decontamination procedure outlined is for field personnel wearing Level C protection consisting of:

- One-piece chemical-resistant suit.
- Air-purifying respirator.
- Hard hat with face shield.
- Chemical-resistant boots, steel toe.
- Boot covers (optional).
- Inner and outer gloves.

B. Procedure For Decontamination

All decontamination procedures will take place in the Contamination Reduction Zone (CRZ).

- Station 1: Equipment Drop

  Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, clipboards, etc.) in different containers with plastic liners. Segregation at the drop point reduces the probability of cross-contamination.

  Equipment: various sized containers
  plastic liners

- Station 2: Boot Cover or Chemical-Resistant Boots Removal

  Remove boot covers (if used) and dispose of in a plastic-lined container or save for next use.

  Equipment: container (30-55 gallons)
  plastic liners
  bench or stool

- Station 3: Outer Glove Removal

  Remove outer gloves and dispose in containers with plastic liner or save for next use.

  Equipment: container (20-30 gallons)
  plastic liners

- Station 4: Chemical-Resistant Disposable Suit Removal

  Remove suit. Deposit in 55-gallon drum for disposal.

  Equipment: container (55-gallon drum)
  bench or stool

- Station 5: Hard Hat with Eye Protection Removal

  Remove hard hat. Avoid touching face with gloves. Save for next use.

- Station 6: Air-Purifying Respirator Removal

  Remove air-purifying respirator and place in a designated location. Facepieces will be disassembled, cleaned, dried, inspected and maintained prior to the next use.

- Station 7: Inner Glove Removal

  Remove the inner gloves last and dispose of in a designated 55-gallon drum.

  Equipment: container (55-gallon drum)

ATTACHMENT L

MONTGOMERY WATSON

EQUIPMENT CALIBRATION FORM

Project: _____ **Project Number:** _____

Personnel: _____ **Date:** _____

Weather: Clear _____ **Rain** _____ **Snow** _____ **Temperature** _____ **Humidity** _____

INSTRUMENTATION: PID _____ **FID** _____ **Explosimeter** _____

CALIBRATION:

Date	Time	Calibration Standard	Calibration Standard Concentration (ppm)	Meter Reading	Comments

CALIBRATION CHECK:

Date	Time	Calibration Standard	Calibration Standard Concentration (ppm)	Meter Reading	Comments

MAINTENANCE AND/OR REPAIR:

Date	Problem	Return to Mfg. for Repair	In-House Repair	Type of Maintenance or Repair*	Effective	Comments

* *Does not include charging batteries.*

Note: *If you run out of space in the maintenance and repair section please write on back. Comments should include whether or not it was a warranty repair, date equipment was repaired or was received from the manufacturer, and any other information you feel would be useful.*

ATTACHMENT M

- Personnel will be instructed to keep their eyes tightly closed when being fit tested for half-face air-purifying respirators.

- The tester will direct a stream of irritant smoke towards the face seal area of the test subject. Start at least 12 inches from the facepiece and gradually move to within one inch, moving around the whole perimeter of the mask.

- The test subject will move his/her head around, count out loud slowly from one to ten, and take deep breaths while the respirator face seal is being challenged by the irritant smoke.

- If the irritant smoke produces an involuntary reaction (cough) by the test subject, the test will be stopped and the respirator rejected. If the test subject feels comfortable with the face seal achieved, the brand, model and size will be noted on the Montgomery Watson Respiratory Training Completion Form and submitted to the OSO.

ATTACHMENT M

MONTGOMERY WATSON AIR-PURIFYING RESPIRATOR FIT TESTING PROTOCOL

When Level C protection is required, all personnel will be fit tested with air-purifying respirators prior to initiation of site work. Fit testing will be qualitative using the oxystannic chloride testing method. Personnel will be allowed to select a respirator with which they can achieve a proper face seal. A written record of the results of the fit tests and the equipment issued is necessary. The PE/OSO is responsible to ensure that a Montgomery Watson Respiratory Training Completion Form (attached) is completed prior to use of respiratory protective equipment by any Montgomery Watson site worker.

Personnel will be instructed in the uses and limitations of air-purifying respirators. It will be stressed that any breakthrough (odor, taste or irritation) or an increased resistance is cause to immediately leave the exclusion zone. Upon return to the support zone, the respirator must be thoroughly inspected. Cartridges will be replaced as appropriate.

Nondisposable respirators will be cleaned with a mild detergent, air dried and inspected after each use. Each respirator will be stored in a plastic bag prior to the next use.

The following will be the standard operating protocol for Respirator Fit Testing Using Oxystannous Chloride Irritant Smoke:

Qualitative fit testing involves two distinct steps: performance of positive/negative pressure checks and then fit testing using oxystannous chloride (smoke tubes) or isoamyl acetate (banana oil). Testing with isoamyl acetate is less satisfactory for three reasons: people have varying odor thresholds for the substance, there is a possibility of olfactory fatigue, and personnel may not acknowledge breakthrough even when they are aware it is occurring. Oxystannous chloride is an irritant smoke that will elicit an involuntary cough upon breakthrough.

Before conducting the negative and positive pressure checks, the wearer will be told to "seat" his/her mask by rapidly moving the head side-to-side and up and down, taking a few deep breaths. The pressure checks will be conducted as follows:

- Negative pressure check: the wearer closes off the respirator inhalation valve and inhales. A vacuum and partial inward collapse of the mask should result. If a vacuum can not be maintained for at least 10 seconds, readjust the facepiece and try again.

- Positive pressure check: the wearer closes off the respirator exhalation valve and breathes out gently. Air should escape through any gaps in the seal.

- After the pressure checks are completed the wearer will be questioned regarding the comfort of the respirator. If it has become uncomfortable, another size or model of respirator must be tried. When the respirator has passed the pressure checks, the wearer is ready to proceed with the qualitative fit test using oxystannic chloride smoke tubes.

- Facepieces equipped with high efficiency dust mist filters will be used for the qualitative fit test.

- A large transparent plastic bag may be used as the fit test chamber by hanging it from a door frame.

ATTACHMENT N

SAFETY AND HEALTH PROTECTION ON THE JOB

STATE OF IOWA

Chapter 88-Code of Iowa provides job safety and health protection for workers throughout the State of Iowa.

The Iowa Division of Labor Services has the responsibility for administering this Chapter. The Division of Labor adopts Federal occupational safety and health standards as State of Iowa standards. Employers and employees are required to comply with these standards.

SAFETY ON THE JOB IS EVERYBODY'S RESPONSIBILITY!

EMPLOYERS: Chapter 88 requires that all employers must furnish to employees employment and a place of employment free from recognized hazards which cause or are likely to cause death or serious physical harm to employees and comply with occupational safety and health standards adopted under this Chapter.

EMPLOYEES: Chapter 88 requires that each employee comply with occupational safety and health standards and all rules, regulations and orders issued pursuant to this Chapter which are applicable to the employee's own actions and conduct.

COMPLIANCE WITH SAFETY AND HEALTH REQUIREMENTS

To ensure compliance with safety and health requirements, the Iowa Division of Labor conducts periodic inspections of places of employment. Inspections are conducted by trained compliance safety and health officers. Chapter 88 requires that an authorized representative of the employer and a representative authorized by the employees be given an opportunity to accompany the inspector for the purpose of aiding the inspection. Where there is no authorized employee representative, the compliance safety and health officers will consult with a reasonable number of employees concerning safety and health conditions in the workplace. Employees or their representatives have the right to notify the Division and request an inspection if they believe that unsafe and unhealthful conditions exist at their workplace. In addition, employees have the right to bring unsafe conditions to the attention of the compliance safety and health officer making the inspection. Complainant's names will be kept anonymous upon request.

Employees may not be discharged or discriminated against in any way for filing safety and health complaints or otherwise exercising their rights under Chapter 88. Employees who believe they have been discriminated against may file a complaint with the Division or the U. S. Department of Labor within 30 days of the alleged discrimination. Discrimination complaints of this nature by State or local governmental employees must be submitted to the Division of Labor Services.

If upon inspection the Division of Labor believes that Chapter 88 has been violated, a citation of alleged violations and proposed penalties will be issued promptly to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

Citations of violation issued by the Iowa Division of Labor must be prominently displayed at or near the place of violation.

Chapter 88 provides for mandatory penalties of up to $7,000 for each serious violation and optional penalties of up to $7,000 for each non-serious violation. Penalties of up to $7,000 are required for each day during which an employer fails to correct a violation within the period set in the citation. Any employer who willfully or repeatedly violates Chapter 88 is to be assessed civil penalties of not more than $70,000 for each violation. Willful violations carry a $5,000 minimum penalty.

Criminal penalties are also provided for in Chapter 88. A willful violation resulting in the death of an employee, upon conviction, is punishable by a fine of not more than $70,000 or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

For assistance and information, including copies of Chapter 88 and of specific safety and health standards, contact:

Iowa Division of Labor
1000 East Grand Avenue
Des Moines, Iowa 50319-0209
Telephone (515) 281-3606

COMPLAINTS ABOUT STATE PROGRAM ADMINISTRATION

Any interested person or representative of such person or group of persons may submit a complaint to the Federal government concerning the operation or administration of any aspect of the Iowa Division of Labor's occupational safety and health activities pursuant to Chapter 88-Code of Iowa.

Complaints may be submitted orally or in writing to:

Assistant Regional Administrator
U. S. Department of Labor
Occupational Safety & Health Administration
911 Walnut, Room 406
Kansas City, Missouri 64106
Phone: (816) 426-5861

Any such complaint should describe the grounds for the complaint and specify the aspect or aspects of the administration or operation of Iowa's program which is believed to be inadequate.

If upon receipt of the complaint, the Assistant Regional Administrator (ARA) determines that reasonable grounds exist to believe that an investigation should be made, the ARA shall cause such investigation, including any workplace inspection, to be made as soon as practicable.

If the Assistant Regional Administrator determines there are no reasonable grounds for an investigation of a complaint the ARA shall notify the complaining party in writing of such determination.

The Assistant Regional Administrator shall advise the complainant of the findings of any investigation conducted and any corrective action that may result.

The complainant's name and the names of other complainants shall not appear in any record published, released, or made available. The complainant's name will be deleted from any copy of the complaint which might be released or made available.

ISSUES NOT COVERED:

The Iowa Division of Labor will not inspect any maritime operations, including bridge construction over border rivers. These operations will be under the jurisdiction of the Federal Occupational Safety and Health Administration. All complaints regarding maritime operations should be referred to the Federal Office listed above, except those involving State or local governmental employees which continue to be covered by the Iowa Division of Labor Services.

RIGHT-TO-KNOW

The Iowa Hazardous Chemicals Risk Right-to-Know Law gives employees a right to information regarding hazardous chemicals in the workplace. Employers are to provide this information upon request.

Allen J. Meier, Commissioner
Iowa Division of Labor Services

IMPORTANT!

This poster must be displayed in a prominent place in the establishment to which the employees normally report to work.

APPENDIX B

ROCKWELL INTERNATIONAL CORPORATION
CEDAR RAPIDS, IOWA

APPENDIX B

CONSTRUCTION DRAWINGS FOR DISPOSAL AREA CAP AND CREEK STABILIZATION

FORMER RALSTON DISPOSAL SITE CEDAR RAPIDS, IOWA

MAY, 1994

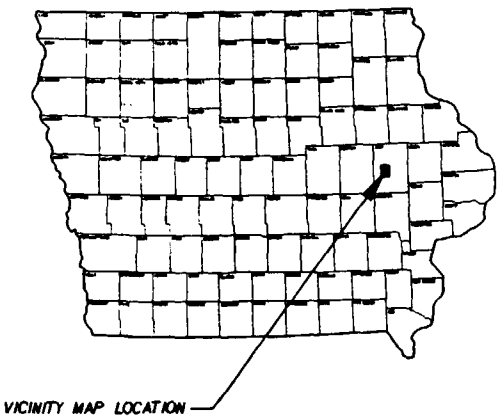
MONTGOMERY WATSON

Des Moines, Iowa

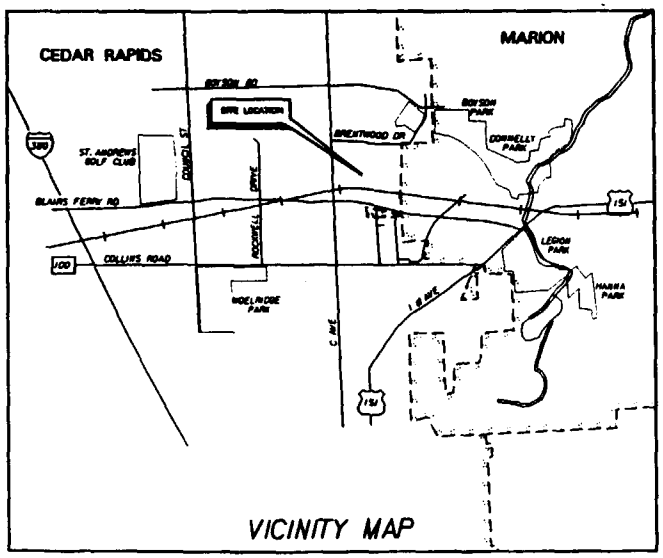
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

JEFFREY L. COON, P.E. — 11975 REG. NO. — 5-17-94 DATE

MY REGISTRATION EXPIRES DECEMBER 31, 1994



PROJECT LOCATION MAP



VICINITY MAP

SHEET INDEX

SHEET		DESCRIPTION
GENERAL	G-01	COVER SHEET
	G-02	LOCATION MAPS, SHEET INDEX AND DETAIL IDENTIFICATION
CIVIL	C-01	EXISTING CONDITIONS
	C-02	PROJECT OVERVIEW
	C-03	CLEARING AND GRUBBING
	C-04	DISPOSAL AREA GENERAL GRADING
	C-05	DISPOSAL AREA FINAL GRADING
	C-05A	BORROW AREA FINAL GRADING
	C-06	EROSION CONTROL
	C-07	DETAILS
	C-08	SECTIONS
	C-09	CROSS SECTION LOCATIONS
	C-10	CROSS SECTION

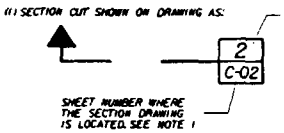
GENERAL LEGEND

- EXISTING MONITORING WELL
- BENCHMARK
- SLOPE INDICATOR

SECTION AND DETAIL IDENTIFICATION

SECTION IDENTIFICATION

(1) SECTION CUT SHOWN ON DRAWING AS:



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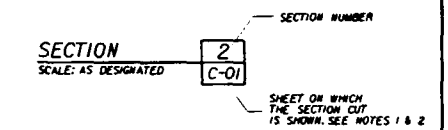

DETAIL IDENTIFICATION

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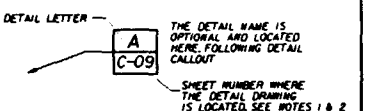

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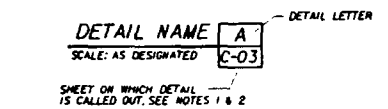
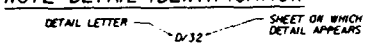


NOTE DETAIL IDENTIFICATION



NOTES:

(1) IF PLAN AND SECTION OR DETAIL CALL-OUT AND DETAIL ARE SHOWN ON SAME SHEET, THE SHEET NUMBER IS REPLACED BY A HORIZ. LINE.

(2) IF DETAIL OR SECTION IS CALLED OUT ON NUMEROUS SHEETS THE DRAWING NUMBER IS REPLACED BY "VAR".

REV	DATE	BY	DESCRIPTION

SCALE: NONE

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

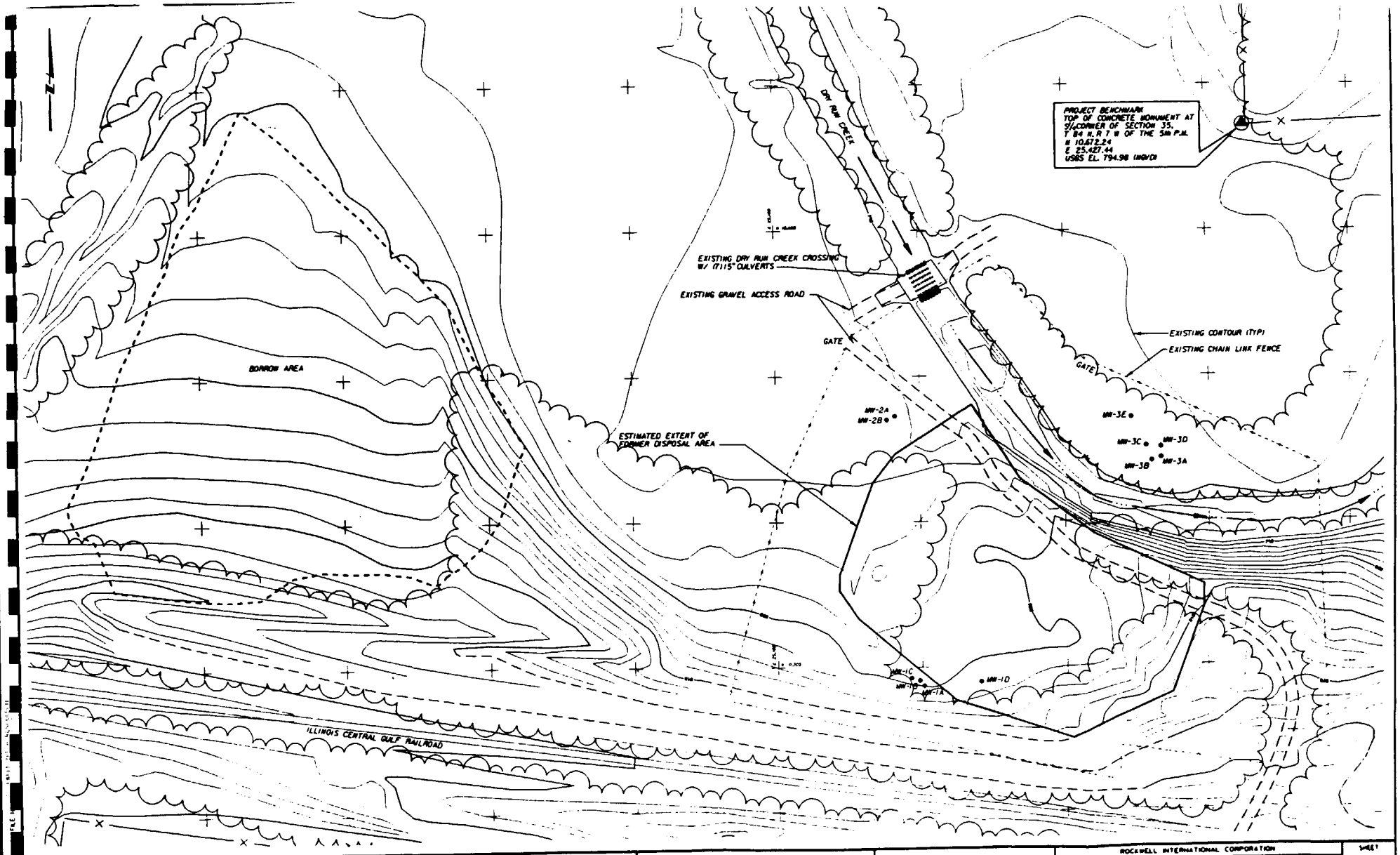
DESIGNED
DRAWN
CHECKED

SUBMITTED
PROJECT ENGINEER — REG. NO. — DATE
MONTGOMERY WATSON — REG. NO. — DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION
LOCATION MAPS, SHEET INDEX AND DETAIL IDENTIFICATION

SHEET G-02

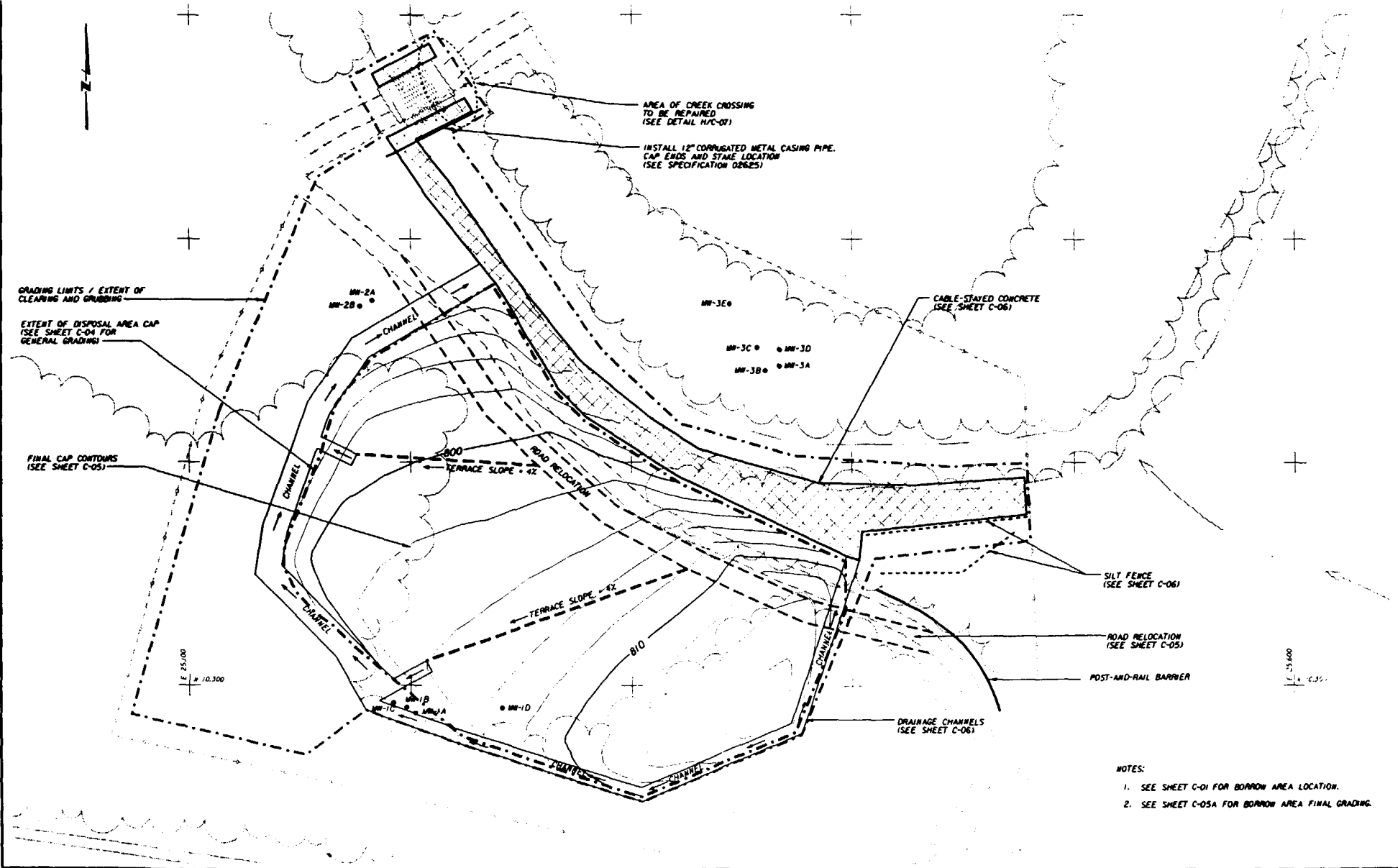


REV	DATE	BY	DESCRIPTION	SCALE: 1" = 30'	WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.	DESIGNED TAB DRAWN TNL / JFD CHECKED JLC	SUBMITTED PROJECT ENGINEER DATE MONTGOMERY WATSON REG. NO. DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION
EXISTING CONDITIONS

SHEET C-01



NOTES:

1. SEE SHEET C-01 FOR BORROW AREA LOCATION.
2. SEE SHEET C-05A FOR BORROW AREA FINAL GRADING.

REV	DATE	BY	DESCRIPTION

SCALE: 1" = 20'

WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

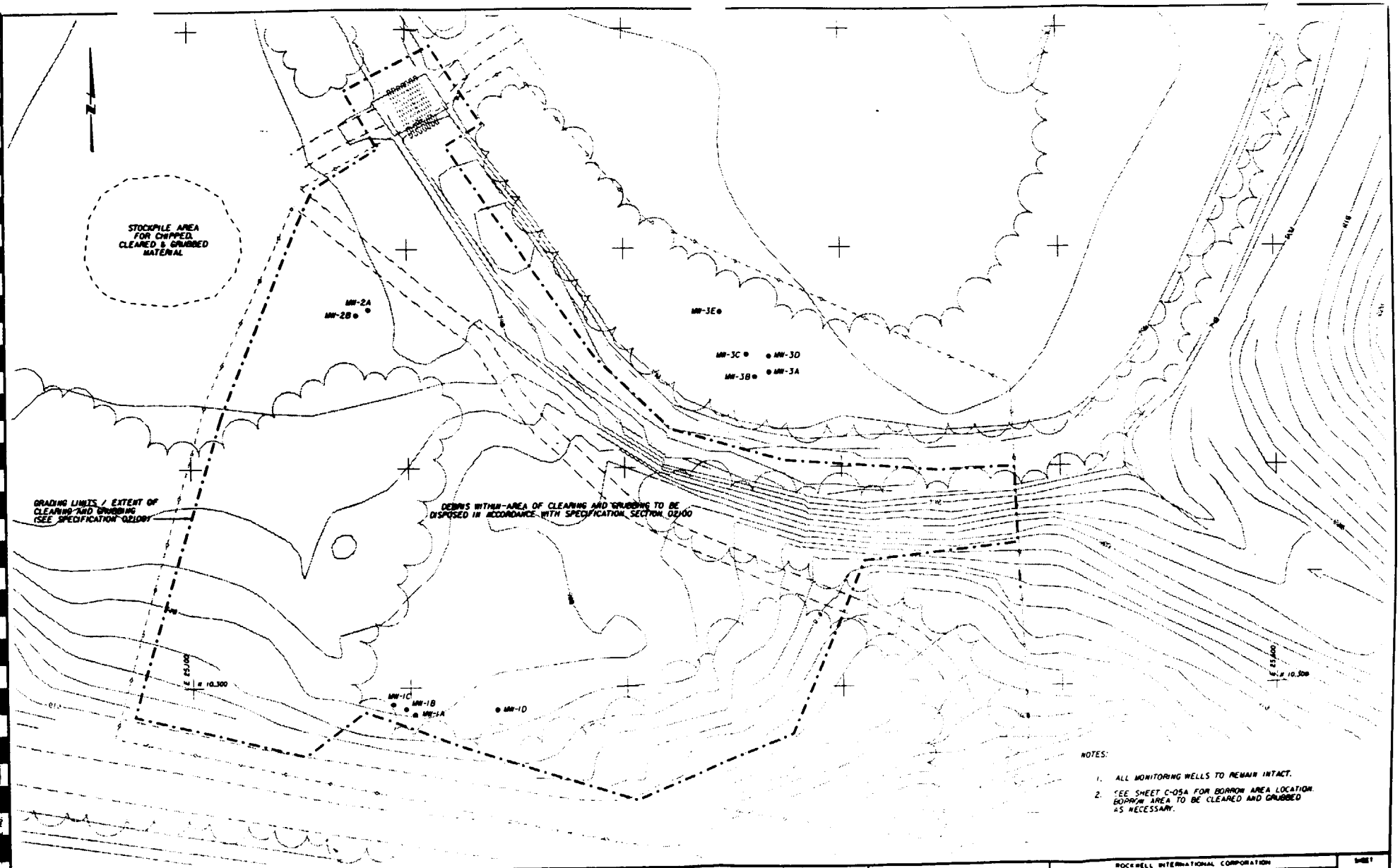
DESIGNED TAB
DRAWN THL/JFD
CHECKED JLC

SUBMITTED
PROJECT ENGINEER REG. NO. DATE
MONTGOMERY WATSON REG. NO. DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION
PROJECT OVERVIEW

SHEET C-02



NOTES:

1. ALL MONITORING WELLS TO REMAIN INTACT.
2. SEE SHEET C-05A FOR BORROW AREA LOCATION. BORROW AREA TO BE CLEARED AND GRUBBED AS NECESSARY.

REV	DATE	BY	DESCRIPTION

SCALE: 1" = 20'

WARNING: 0 1/2" — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED TAB
DRAWN THL/JFD
CHECKED ALC

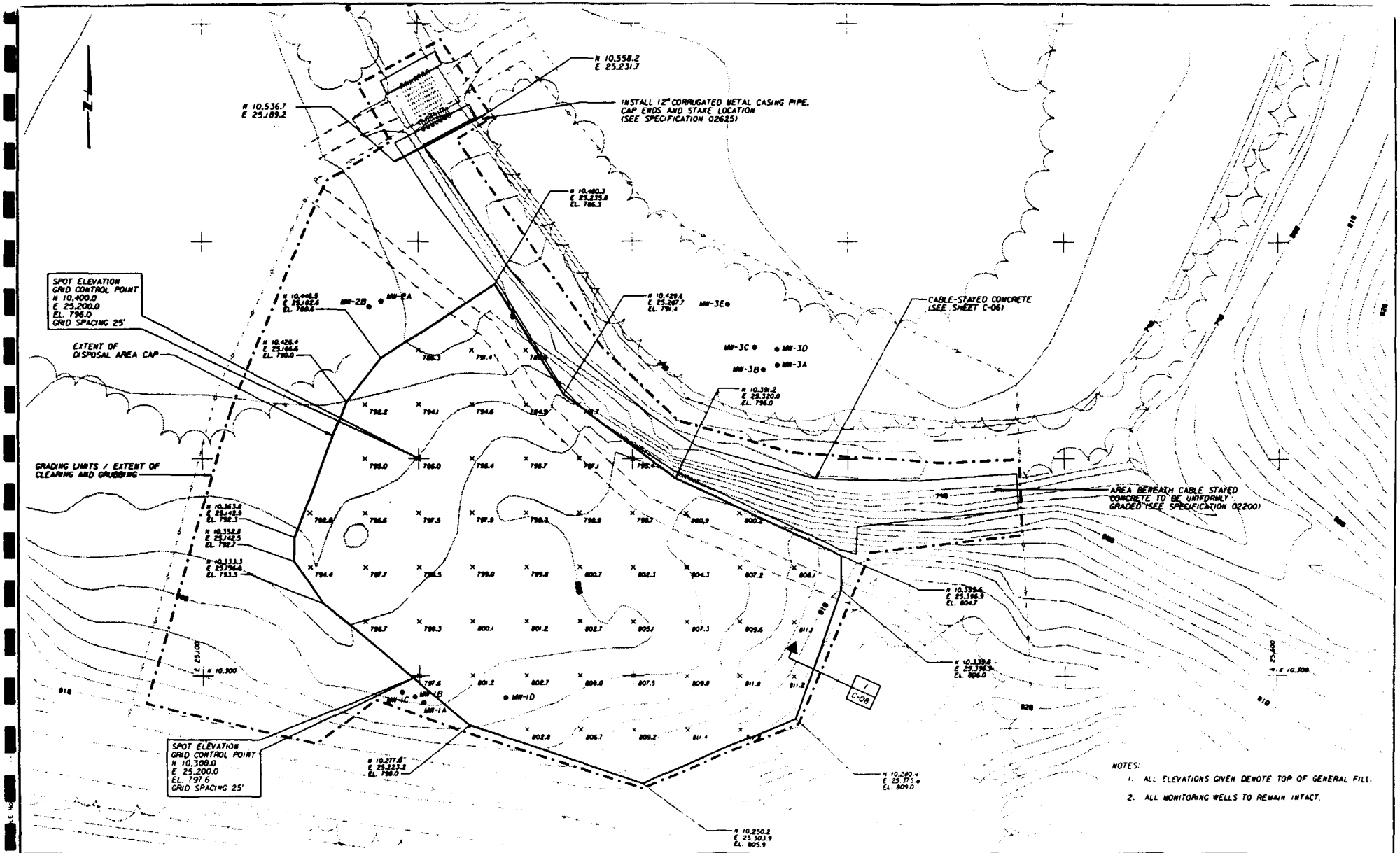
SUBMITTED
PROJECT ENGINEER — REG. NO. — DATE
MONTGOMERY WATSON — REG. NO. — DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION

CLEARING AND GRUBBING

SHEET C-03



REV	DATE	BY	DESCRIPTION

SCALE: 1" = 20'

BARMING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

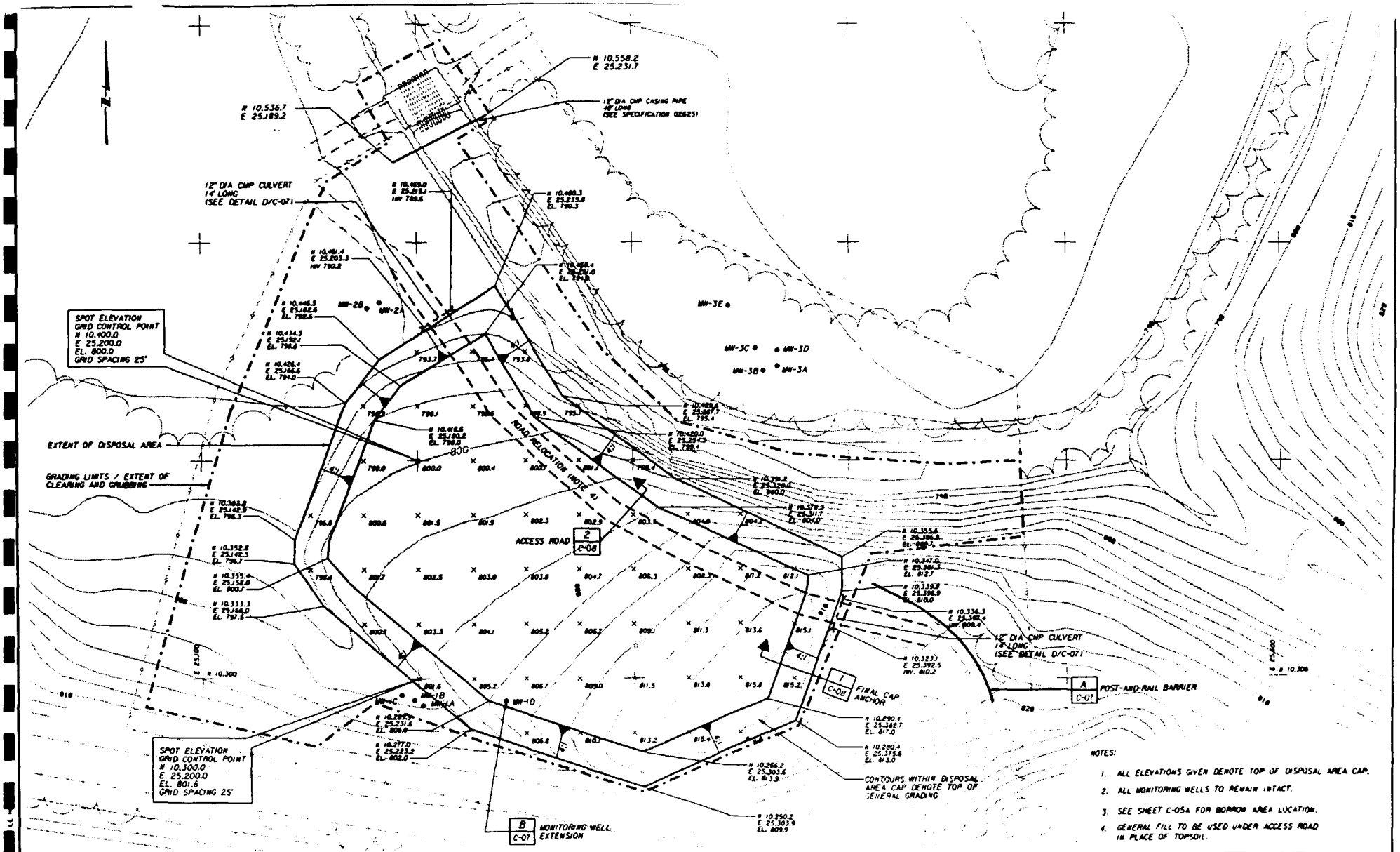
DESIGNED
DRAWN
CHECKED

SUBMITTED
PROJECT ENGINEER REG. NO. DATE
MONTGOMERY WATSON REG. NO. DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION
DISPOSAL AREA GENERAL GRADING

SHEET C-04



REV	DATE	BY	DESCRIPTION

SCALE: 1" = 20'

WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

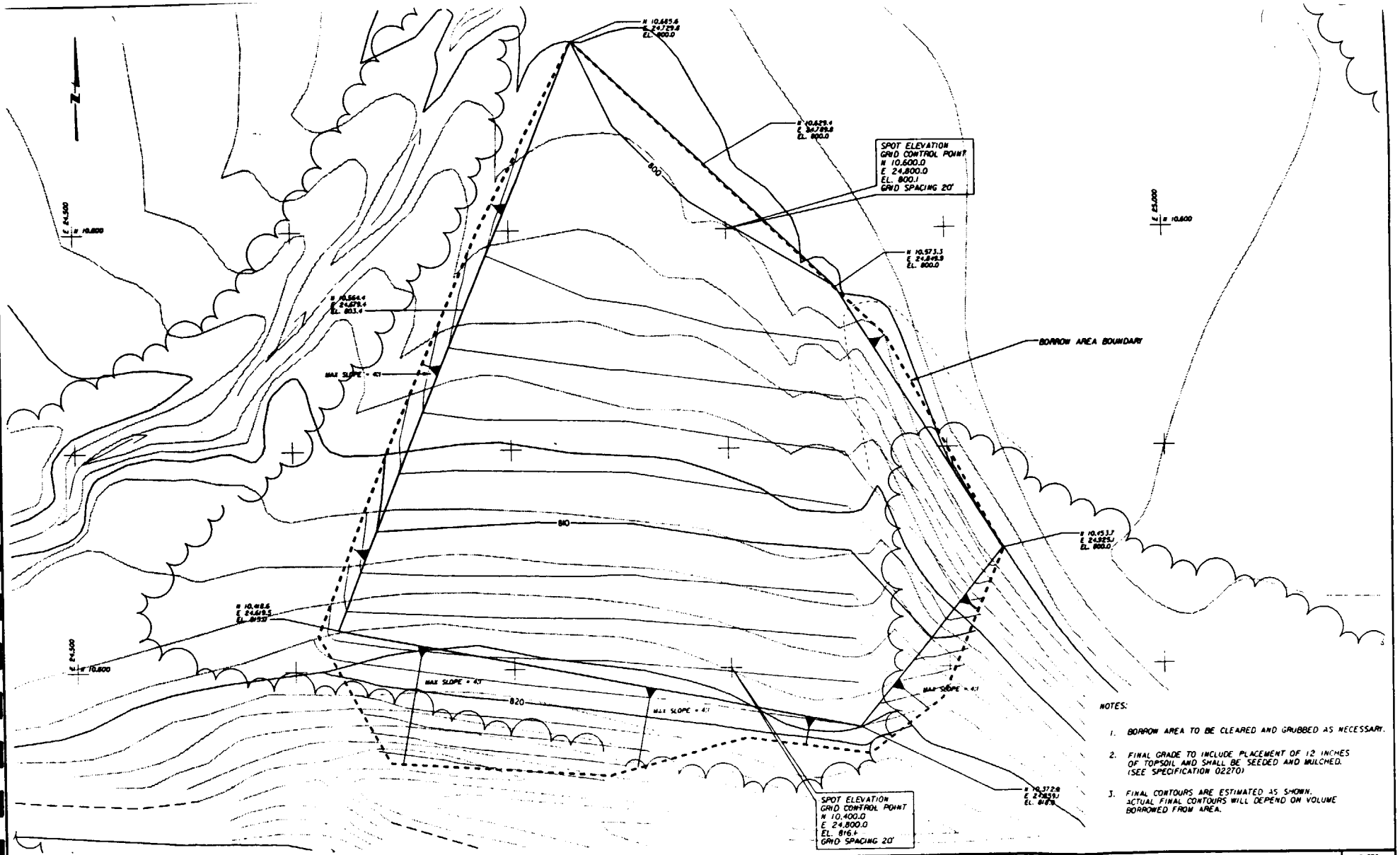
DESIGNED TAB
DRAWN THL/JFD
CHECKED JLC

SUBMITTED
PROJECT ENGINEER REG. NO. DATE
MONTGOMERY WATSON REG. NO. DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION
DISPOSAL AREA FINAL GRADING

SHEET
C-05



NOTES:

1. BORROW AREA TO BE CLEARED AND GRUBBED AS NECESSARY.
2. FINAL GRADE TO INCLUDE PLACEMENT OF 12 INCHES OF TOPSOIL AND SHALL BE SEEDED AND MULCHED. (SEE SPECIFICATION 02270)
3. FINAL CONTOURS ARE ESTIMATED AS SHOWN. ACTUAL FINAL CONTOURS WILL DEPEND ON VOLUME BORROWED FROM AREA.

REV	DATE	BY	DESCRIPTION

SCALE: 1" = 20'

WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE. (0, ½, 1)

DESIGNED TAB
DRAWN JFD/THL
CHECKED JLC

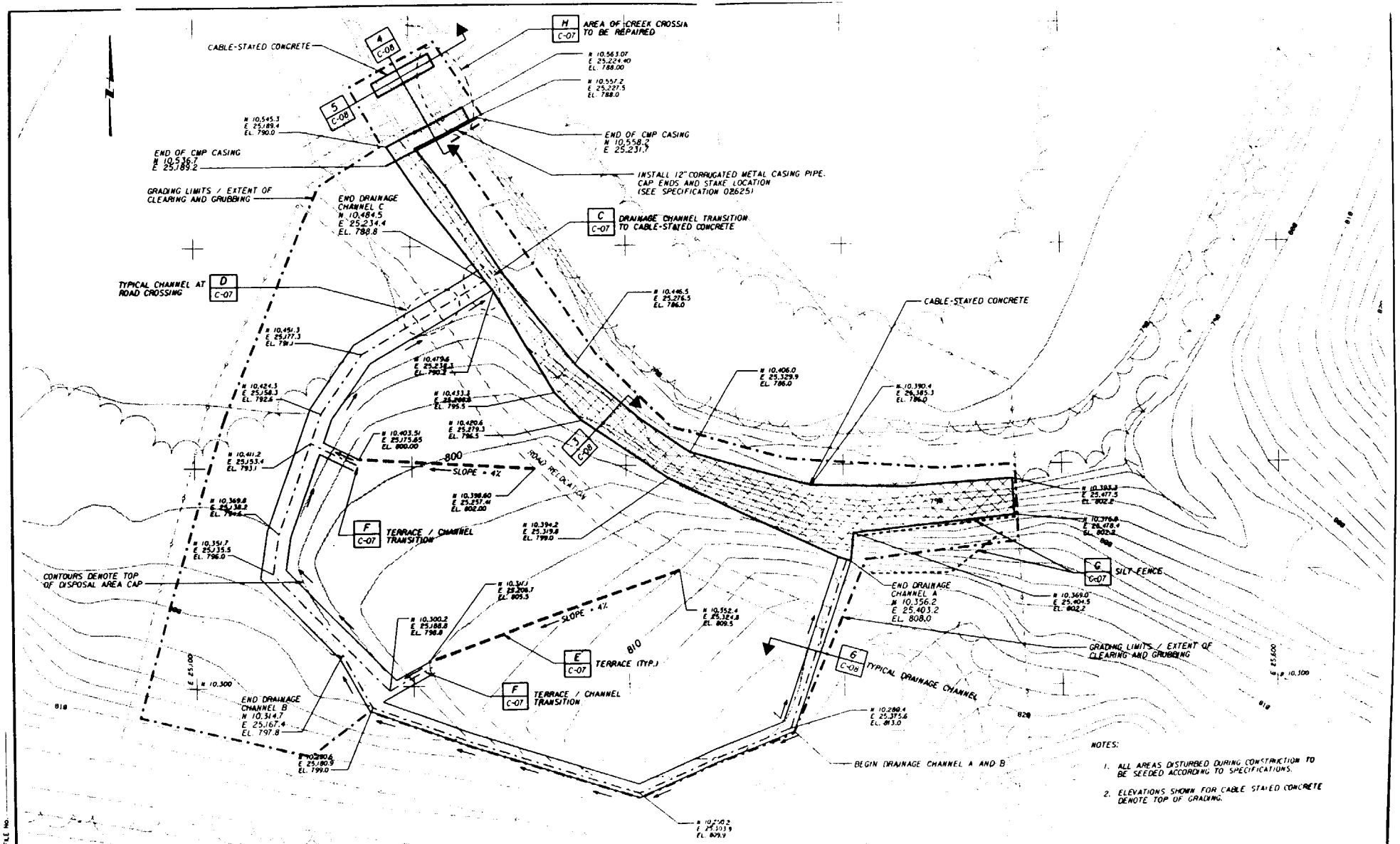
SUBMITTED
PROJECT ENGINEER REG. NO. DATE
MONTGOMERY WATSON REG. NO. DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION

BORROW AREA FINAL GRADING

SHEET C-05A



REV	DATE	BY	DESCRIPTION

JOB NO. FILE NO.

SCALE: 1" = 20'

WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

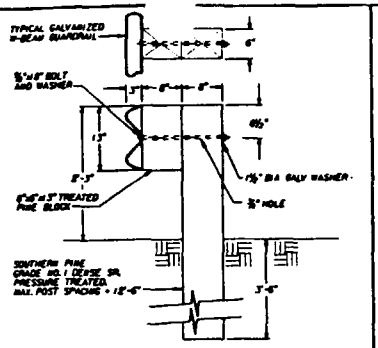
DESIGNED TAB
DRAWN
CHECKED

SUBMITTED
PROJECT ENGINEER REG. NO. DATE
MONTGOMERY WATSON REG. NO. DATE

MONTGOMERY WATSON
Des Moines Iowa

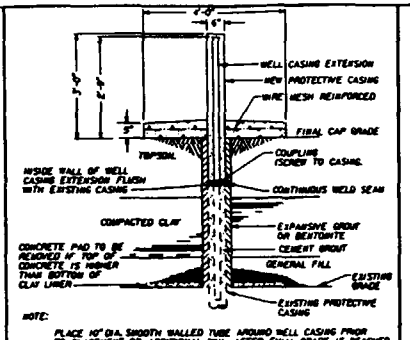
ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION
EROSION CONTROL

SHEET C-06



POST-AND-RAIL BARRIER — A

NOT TO SCALE — C-05

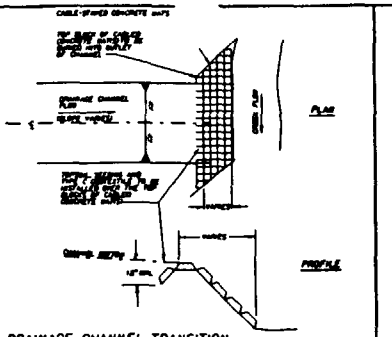


NOTE:

PLACE 10" DIA. SMOOTH WALLED TUBE AROUND WELL CASING PRIOR TO PLACEMENT OF ADDITIONAL SOIL. AFTER FINAL GRADE IS REACHED, REMOVE TUBE AND BACKFILL WITH EXPANSIVE GROUT OR BENTONITE.

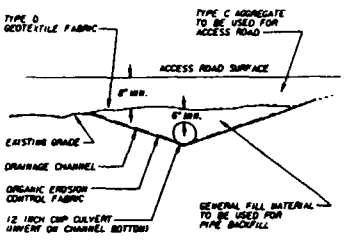
MONITORING WELL EXTENSION — B

NOT TO SCALE — C-05



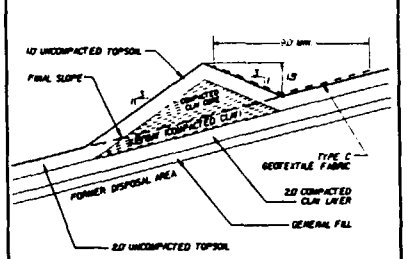
DRAINAGE CHANNEL TRANSITION TO CABLE-STAYED CONCRETE — C

NOT TO SCALE — C-06



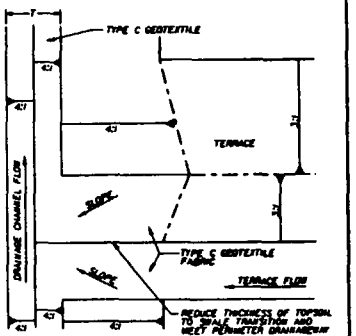
TYPICAL CHANNEL AT ROAD CROSSING — D

NOT TO SCALE — C-06



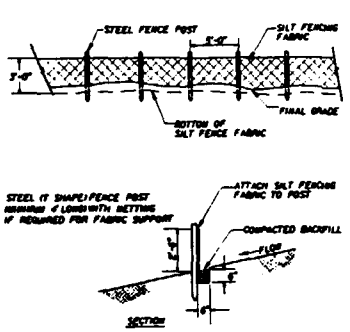
TYPICAL TERRACE — E

NOT TO SCALE — C-06



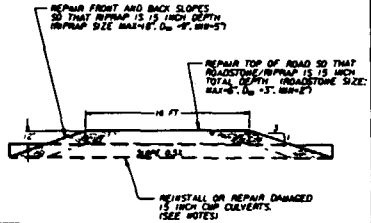
TERRACE / CHANNEL TRANSITION — F

NOT TO SCALE — C-06



SILT FENCE — G

NOT TO SCALE — C-06



NOTES:

1. CULVERTS SHALL BE PLACED ON THE CREEK BOTTOM WITH MIN. CULVERT SPACING =2'.
2. MAX SIZE OF GRAVEL BACKFILL =3".
3. FOLLOWING REPAIR, SURFACE OF AGGREGATE IS TO BE GROUTED WITH NON-SHRINK CEMENT GROUT.

AREA OF CREEK CROSSING TO BE REPAIRED — H

NOT TO SCALE — C-06

REV	DATE	BY	DESCRIPTION

SCALE: AS SHOWN

WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED TAB
DRAWN JFD/TWL
CHECKED AC

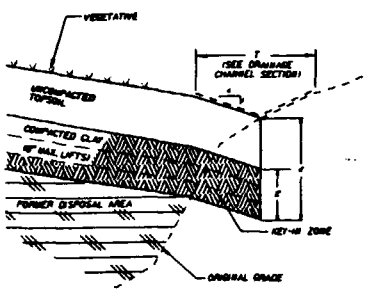
SUBMITTED
PROJECT ENGINEER REG. NO. DATE
MONTGOMERY WATSON REG. NO. DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION

DETAILS

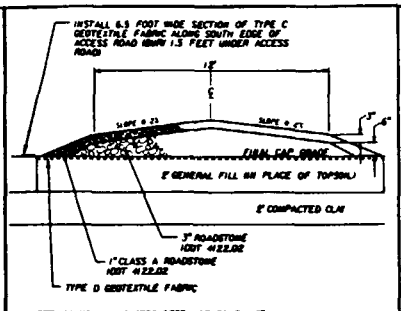
C-07



LANDFILL FINAL CAP ANCHOR TO ORIGINAL GRADE

NOT TO SCALE

1	1
C-04	C-05

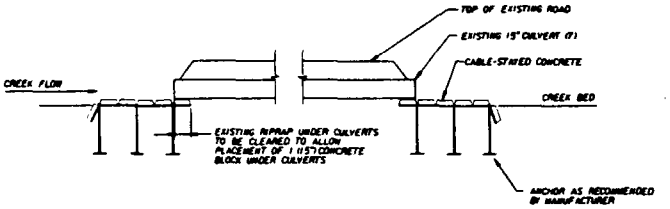


NOTE: MINIMUM COMPACTED DEPTH OF ROAD = 8"

ACCESS ROAD SECTION (TYP)

NOT TO SCALE

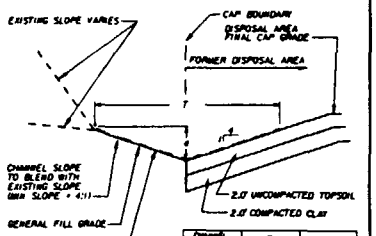
2
C-05



SECTION

NOT TO SCALE

4
C-06

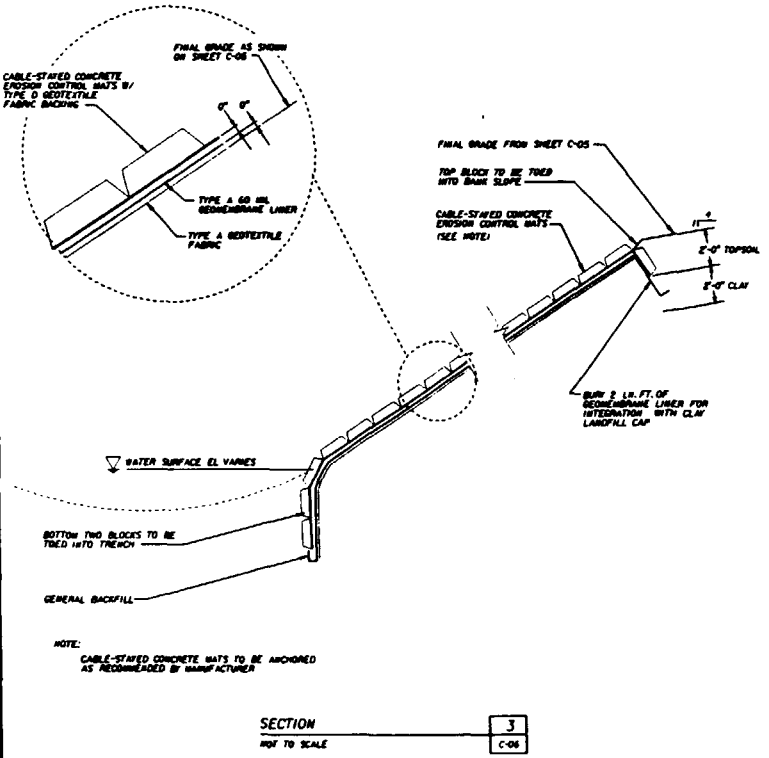


Channel Section	T	d
A	8.0	1.0
B	8.0	1.0
C	H.E. MIN.	1.4

TYPICAL DRAINAGE CHANNEL

NOT TO SCALE

6
C-06

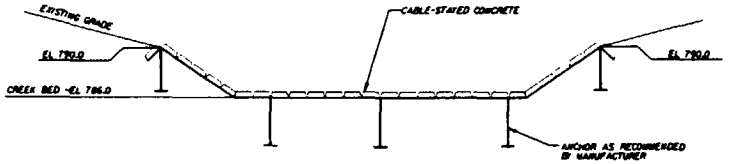


NOTE:
CABLE-STAYED CONCRETE MATS TO BE ANCHORED AS RECOMMENDED BY MANUFACTURER

SECTION

NOT TO SCALE

3
C-06



SECTION

NOT TO SCALE

5
C-06

REV	DATE	BY	DESCRIPTION

SCALE: AS SHOWN

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

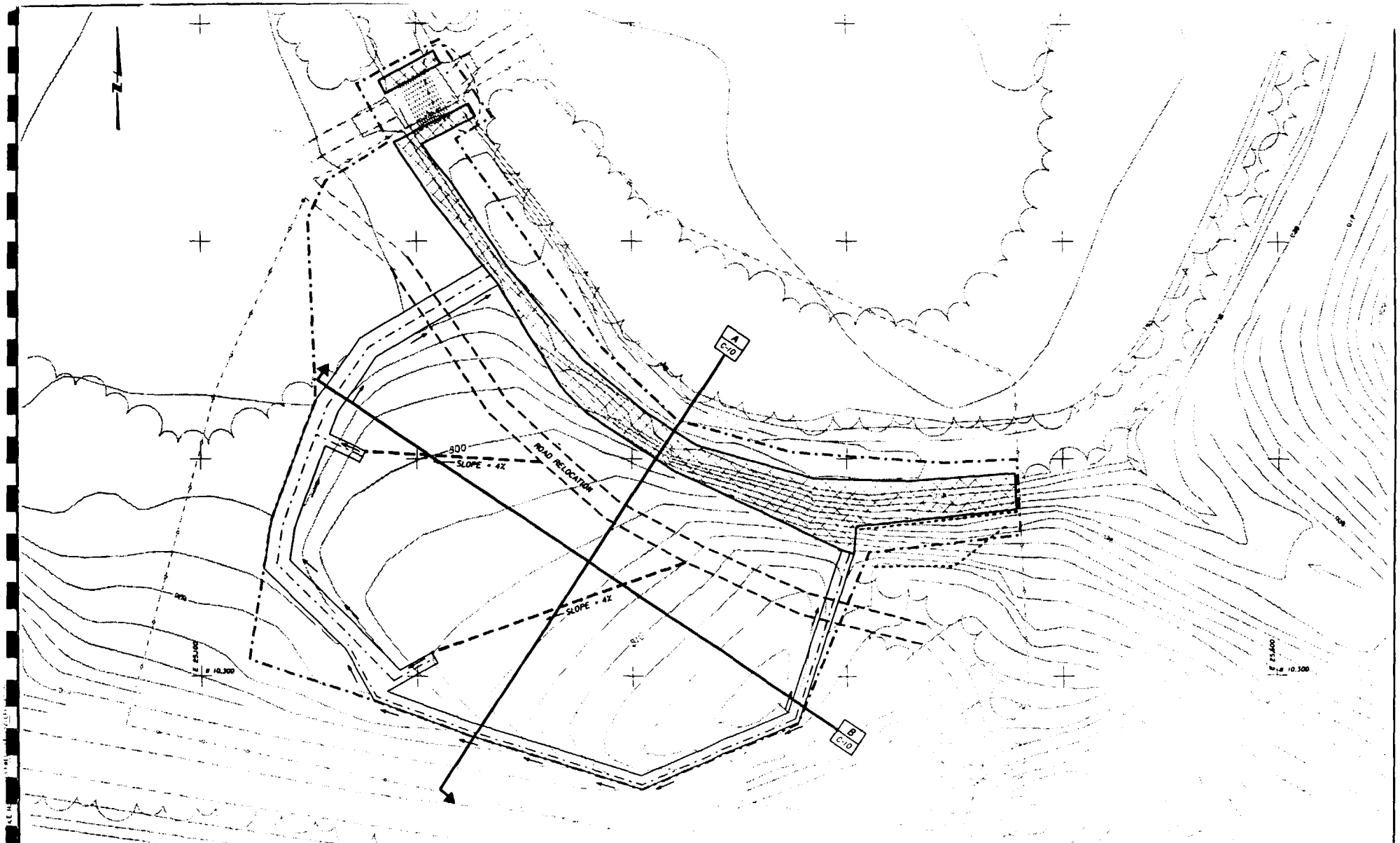
DESIGNED TAB
DRAWN JFD/TAL
CHECKED ALC

SUBMITTED
PROJECT ENGINEER — REG. NO. — DATE
MONTGOMERY WATSON — REG. NO. — DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION
SECTIONS

SHEET C-08



REV DATE BY DESCRIPTION

SCALE: 1" = 20'

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

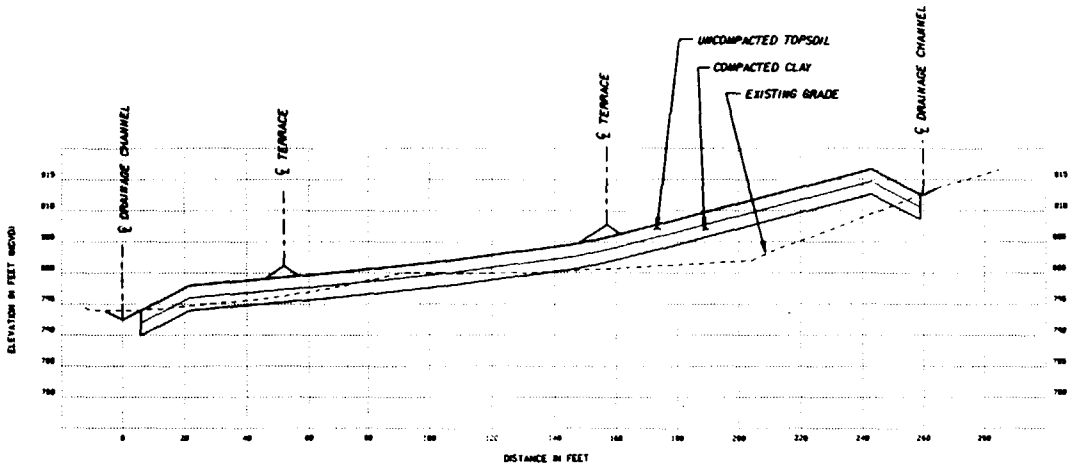
DESIGNED TAB
DRAWN JFD/TNL
CHECKED AC

SUBMITTED
PROJECT ENGINEER REG. NO. DATE
MONTGOMERY WATSON REG. NO. DATE

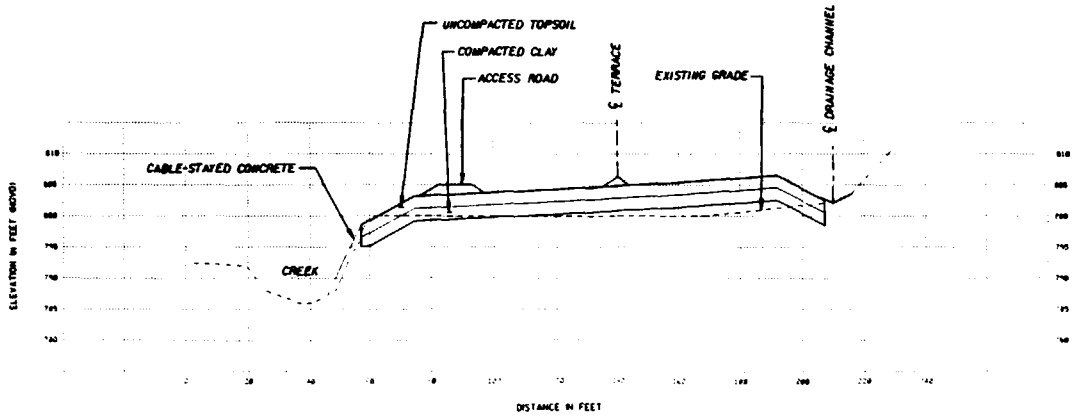
MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION
CROSS SECTION LOCATIONS

SHEET
C-09



CROSS SECTION B / C-09



CROSS SECTION A / C-09

REV	DATE	BY	DESCRIPTION

SCALE: HORIZ. 1" = 20' VERT. 1" = 10' V.E. = 2x

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED TAB
DRAWN JFD/TNL
CHECKED JAS

SUBMITTED
PROJECT ENGINEER REG. NO. DATE
MONTGOMERY WATSON REG. NO. DATE

MONTGOMERY WATSON
Des Moines, Iowa

ROCKWELL INTERNATIONAL CORPORATION
DISPOSAL AREA CAP & CREEK STABILIZATION
CROSS SECTIONS A AND B

SHEET C-10

APPENDIX C

TECHNICAL SPECIFICATIONS

DRY RUN CREEK STABILIZATION AND CAPPING ACTIVITIES

AT THE

FORMER RALSTON DISPOSAL SITE

Prepared for

ROCKWELL INTERNATIONAL CORPORATION
CEDAR RAPIDS, IOWA

Project No. 1166.0254

May 1994

Prepared by

Montgomery Watson
11107 Aurora Avenue
Des Moines, Iowa 50322
515-253-0830

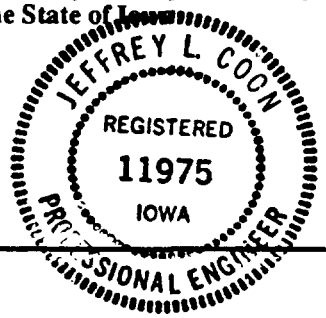
I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of Iowa.

Signature: _____

Name: Jeffrey L. Coon, P.E.

Date: 5-17-94 Reg. No.: 11975

My registration expires December 31, 1994



TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

SECTION 00300 - BID SCHEDULE

BID COMPILATION SCHEDULE

for Creek Stabilization and Capping Activities at the Former Ralston Disposal Site
According to the Contract Documents

Bid Item	Description	Estimated Quantity	Unit	Unit Price	Total Price
1.	Mobilization	1	Lump Sum		
2.	Site Preparation	1	Lump Sum		
3.	General Grading (General Excavation, Hauling and Grading)	1	Lump Sum		
4.	Final Grading (Compacted Clay)	1	Lump Sum		
5.	Topsoil Placement	1	Lump Sum		
6.	Type A Geotextile Fabric(Geocomposite Drainage)	7,500	S.F.		
7.	Type C Geotextile Fabric (Organic Erosion Control)	10,100	S.F.		
8.	Type D Geotextile Fabric (Geosynthetic Under Road)	3,500	S.F.		
9.	Type A Geomembrane Liner	7,500	S.F.		
10.	Type C Aggregate (Road Stone)	130	Ton		
11.	Cable-Stayed Concrete Mat Sysyem	8,400	S.F.		
12.	Corrugated Metal Pipe Unit Price	1	Lump Sum		
13.	Silt Fences	250	L.F.		
14.	Type A Permanent Seeding Unit Price	1	Lump Sum		
	TOTAL BID (Items 1-14)				

SECTION 00800 - SUPPLEMENTARY GENERAL CONDITIONS

PART 1 -- GENERAL

A. These Supplementary General Conditions (SGC) make additions, deletions, or revisions to Rockwell International Corporation's General Conditions (Form 107-B, Revision 02-90). All provisions of said Form 107-B (02-90) which are not so added, deleted, or revised remain in full force and effect.

SGC-1 - Definitions

A. ENGINEER - The ENGINEER is the firm of Montgomery Watson located at 11107 Aurora Avenue, Des Moines, Iowa 50322, (515) 253-0830, FAX (515) 253-9592.

B. OWNER / ROCKWELL - The terms OWNER / ROCKWELL will be used interchangeably when referring to Rockwell International Corporation located at 400 Collins Road, Cedar Rapids, Iowa 52498, (319) 395-5716, (319) 395-3437.

C. CONTRACTOR / BUILDER - The terms CONTRACTOR / BUILDER will be used interchangeably when referring to the general contractor with which Rockwell International Corporation enters an Agreement for performance of the scope of services outlined in these Construction Specifications.

SGC-2 - Site Safety

A. The CONTRACTOR shall submit to the OWNER and ENGINEER one copy each of the CONTRACTOR's Site Health and Safety Plan (SHSP) prior to mobilization to the site to conduct WORK associated with these Contract Documents. The CONTRACTOR shall not begin any work at the site prior to written approval of the CONTRACTOR's SHSP by the OWNER and ENGINEER.

B. All CONTRACTOR employees or representatives to be on site during the completion of the WORK shall have certification for 40-hour hazardous waste site work training in accordance with 29 CFR 1910.120.

C. The CONTRACTOR shall minimize, to the extent possible, the generation and transport of dust and runoff of surface water from the site during completion of the WORK. The implementation of dust suppression and runoff reduction methods, as directed by the ENGINEER, shall be the responsibility of the CONTRACTOR.

SGC-3 - Site Walk-Through

A. The OWNER and ENGINEER shall schedule a site walk-through which the OWNER, ENGINEER, and CONTRACTOR shall attend prior to the CONTRACTOR's mobilization on site. The CONTRACTOR shall be notified by either the OWNER or ENGINEER at least 7 days in advance of the site walk-through.

-- END OF SECTION --

SECTION 01025 - MEASUREMENT AND PAYMENT

PART 1 -- GENERAL

1.1 Scope

A. Payment for the various items listed in Section 00300 - "Bid Schedule," as further specified herein, shall include all compensation to be received by the CONTRACTOR for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, and incidentals appurtenant to the items of work being described, as necessary to complete the various items of the WORK all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). No separate payment will be made for any item that is not specifically set forth in the Bid Schedule, and all costs therefore shall be included in the prices named in the Bid Schedule for the various appurtenant items of work. Any quantities specified herein associated with lump sum bid items are estimates only and should be used as such. The CONTRACTOR is responsible for verifying all quantity estimates and should bid the job accordingly.

1.2 Mobilization (Bid Item No. 1)

A. Measurement for payment for Mobilization includes obtaining required permits, moving necessary equipment on site, arranging construction scheduling, providing a Site Safety Plan, and preparing for work activities, as required in the Contract Documents. The total Mobilization costs shall be limited to less than 5 percent of the Bid.

B. Payment for Mobilization activities will be made as a lump sum price in the Bid Schedule(s) under Bid Item No. 1. Payment shall be authorized only when all the conditions specified in Section 01505 - "Mobilization" have been satisfactorily completed.

1.3 Site Preparation (Bid Item No. 2)

A. Measurement for payment for Site Preparation shall be based upon a lump sum quantity, complete, all in accordance with the requirements of the Contract Documents.

B. Payment for Site Preparation activities will be made at the lump sum quantity indicated in the Bid Schedule under Bid Item No. 2. The price shall constitute full compensation for completion of all work associated with Site Preparation activities, including clearing and grubbing of approximately 2.7 acres in the former disposal area and designated borrow area. Also included in site preparation will be the removal and disposal of all debris, temporary installation of required silt fences, removal and disposal of existing silt fences, repair of existing creek crossing, extension of indicated monitoring well(s), and placement of post-and-rail barriers, as specified.

1.4 General Grading (Bid Item No. 3)

A. Measurement for payment for General Grading activities shall be based upon a lump sum quantity, complete, all in accordance with the requirements of the Contract Documents.

B. Payment for General Grading activities will be made at the lump sum quantity indicated in the Bid Schedule(s) under Bid Item No. 3. The price shall constitute full compensation for completion of all General Grading activities at the site, including minor grading on the creek bank, subsurface grading in the capped area, grading for the surface drainage ditches and all grading and excavation associated with the borrow area. The estimated volume of general fill placement at the site is 1,400 cubic yards.

1.5 Final Grading (Bid Item No. 4)

A. Measurement for payment for Final Grading activities shall be based upon a lump sum quantity, complete, all in accordance with the requirements of the Contract Documents.

B. Payment for the Final Grading activities will be made at the lump sum quantity indicated in the Bid Schedule(s) under Bid Item No. 4. The price shall constitute full compensation for completion of all Final Grading activities, including excavation, hauling, placement and compaction of approximately 2,700 cubic yards (measured in-place) of compacted clay on the cap, as specified.

1.6 Topsoil Placement (Bid Item No. 5)

A. Measurement for payment for the Topsoil Placement shall be based upon a lump sum quantity, complete, all in accordance with the requirements of the Contract Documents.

B. Payment for the Topsoil Placement will be made at the lump sum quantity indicated in the Bid Schedule(s) under Bid Item No. 5. The price shall constitute full compensation for completion of all Topsoil Placement activities, including excavation, haul and placement of topsoil on top of the clay cap and drainage ditches, as specified, and replacement of topsoil in the borrow area. The estimated volume of in-place topsoil in the capped area and borrow area is 3,900 cubic yards.

1.7 TYPE A Geotextile Fabric (Bid Item No. 6)

A. Measurement for payment for **TYPE A Geotextile Fabric** shall be based upon the number of planar square feet actually covered, as determined by field measurement, in accordance with the requirements of the Contract Documents. Overlap, waste, slope-factor correction, and trench anchoring material are considered incidental to the cost of this item.

B. Payment for **TYPE A Geotextile Fabric** shall be made at the unit price named in the Bid Schedule(s) under Bid Item No. 6 which price shall constitute full compensation for placement of approximately 7,500 in-place square feet of **TYPE A Geotextile Fabric**.

1.8 TYPE C Geotextile Fabric (Bid Item No. 7)

A. Measurement for payment for **TYPE C Geotextile Fabric** shall be based upon the number of planar square feet actually covered, as determined by field measurement, in accordance with the requirements of the Contract Documents. Overlap, waste, slope-factor correction, and trench anchoring material are considered incidental to the cost of this item.

B. Payment for **TYPE C Geotextile Fabric** shall be made at the unit price named in the Bid Schedule(s) under Bid Item No. 7 which price shall constitute full compensation for placement of approximately 10,100 in-place square feet of **TYPE C Geotextile Fabric**.

1.9 TYPE D Geotextile Fabric (Bid Item No. 8)

A. Measurement for payment for **TYPE D Geotextile Fabric** shall be based upon the number of planar square feet actually covered, as determined during field measurement by the ENGINEER, in accordance with the requirements of the Contract Documents. Overlap, waste, slope-factor correction, and trench anchoring material are considered incidental to the cost of this item.

B. Payment for **TYPE D Geotextile Fabric** shall be made at the unit price named in the Bid Schedule(s) under Bid Item No. 8 which price shall constitute full compensation for placement of approximately 3,500 square feet of **TYPE D Geotextile Fabric**.

1.10 TYPE A Geomembrane Liner (Bid Item No. 9)

A. Measurement for payment for **TYPE A Geomembrane Liner** shall be based upon the number of planar square feet actually covered, as determined during field measurement by the ENGINEER, in accordance with the requirements of the Contract Documents. Overlap, waste, slope-factor correction, and trench anchoring material are considered incidental to the cost of this item.

B. Payment for **TYPE A Geomembrane Liner** shall be made at the unit price named in the Bid Schedule(s) under Bid Item No. 9 which price shall constitute full compensation for placement of approximately 7,500 square feet of **TYPE A Geomembrane Liner**.

1.11 TYPE C Aggregate (Bid Item No. 10)

A. Measurement for payment for placement of **TYPE C Aggregate** on the access road shall be based upon the total weight of the **TYPE C Aggregate** used, based on load weight tickets obtained from a certified scale.

B. Payment for **TYPE C Aggregate** shall be made at the unit price named in the Bid Schedule under Bid Item No. 10, which price shall constitute full compensation for placement of approximately 130 tons of **TYPE C Aggregate**, as specified in the Contract Documents.

1.12 Cable-Stayed Concrete Mat System (Bid Item No. 11)

A. Measurement for payment for the Cable-Stayed Concrete Mat System shall be based upon the number of square feet of material actually placed, as determined by the number of mats used to stabilize the creek bank as shown on the Contract Documents. **TYPE D Geotextile Fabric** attached to the mat system and necessary anchors are considered incidental to the cost of this item. Overlap, waste, slope correction and trench anchoring material are considered incidental to the cost of this item.

B. Payment for the Cable-Stayed Concrete Mat System shall be made at the unit price named in the Bid Schedule(s) under Bid Item No. 11, which price shall constitute full compensation for placement of an estimated 8,400 square feet of Cable-Stayed Concrete Mats.

1.13 Corrugated Metal Pipe (Bid Item No. 12)

A. Measurement for payment for installation of Corrugated Metal Pipe shall be based upon the number of linear feet actually placed, as determined by field measurement, in accordance with the requirements of the Contract Documents.

B. Payment for the installed Corrugated Metal Pipe shall be made at the unit price named on the Bid Schedule under Bid Item No. 12, which prices shall constitute full compensation for installation of approximately 30 linear feet of Corrugated Metal Pipe, including necessary backfill, in accordance with the Contract Documents.

1.14 Silt Fences (Bid Item No. 13)

A. Measurement for payment for installation of Silt Fences (approximately 250 linear feet) along the south bank of Dry Run Creek shall be based upon the number of linear feet of Silt Fence actually placed, complete, as determined by field measurement, all in accordance with the requirements of the Contract Documents.

B. Payment for such Silt Fences shall be made at the unit price named in the Bid Schedule(s) under Bid Item No. 13, which price will constitute full compensation for installation including fence fabric, fence posts, and all appurtenant work as required, in accordance with the Contract Documents.

1.15 TYPE A Permanent Seeding (Bid Item No. 14)

A. Measurement for payment for **TYPE A Permanent Seeding** shall be based upon the number of acres actually seeded at the recommended application rate, complete. all in accordance with the requirements of the Contract Documents.

B. Payment for **TYPE A Permanent Seeding** shall be made at the unit price named in the Bid Schédule(s) under Bid Item No. 14, which price shall constitute full compensation for application of the recommended seed, complete, including seedbed preparation, fertilizer, agricultural lime, and mulch on approximately 3 acres of land area.

-- END OF SECTION --

SECTION 01505 - MOBILIZATION

PART 1 -- GENERAL

1.1 The Requirement

A. Mobilization shall include the obtaining of all permits; moving onto the site all equipment; all as required for the proper performance and completion of the WORK. Mobilization shall include, but not be limited to, the following principal items:

1. Moving onto the site of all CONTRACTOR's equipment required for initiating construction activities.

2. Completing a Site Safety Plan for construction activities.

3. Providing proof of OSHA 40-hour training certification for all employees.

4. Obtaining all required permits.

5. Posting all OSHA-required notices and establishing required safety programs.

1.2 Safety and Protection

A. In accordance with generally accepted construction practices and Applicable Law, CONTRACTOR shall be solely and fully responsible for conditions, including the health and safety of all persons permitted on the site by CONTRACTOR and all persons under CONTRACTOR's direct control, including any of CONTRACTOR's subcontractors on the site and in the vicinity of any operations of CONTRACTOR on or off the site during the Project, with the exception that CONTRACTOR shall not be responsible for the health or safety of ENGINEER or ENGINEER's employees or agents or any EPA representatives, to the extent that any injuries of EPA representatives are caused by their own acts or omissions. In addition, CONTRACTOR shall not be responsible for any injuries, caused by EPA representatives, ENGINEER or its employees or agents. CONTRACTOR shall have complete control over access to the site during performance of the Project.

B. The services of ENGINEER in conducting inspections of the performance of CONTRACTOR are not intended to include review of the adequacy of the work methods, equipment, bracing or scaffolding, or other safety measures of CONTRACTOR on or off the site, or to obviate the need for any inspections by CONTRACTOR.

C. The CONTRACTOR shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the WORK. The CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. All employees on the WORK and other persons and organizations who may be affected thereby;

2. All the WORK and materials and equipment to be incorporated therein, whether in storage on or off the site; and

3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

D. The CONTRACTOR shall comply with all applicable laws and regulations (whether referred to herein or not) of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss and shall erect and maintain all necessary safeguards for such safety and protection. The CONTRACTOR shall notify owners of adjacent property and utilities when prosecution of the WORK may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

E. The CONTRACTOR shall designate a responsible representative at the site whose duty shall be the prevention of accidents. This person shall be the CONTRACTOR's superintendent unless otherwise designated in writing by the CONTRACTOR to the OWNER.

F. The CONTRACTOR shall provide all equipment, labor and materials to maintain dust and surface water runoff control from the site during completion of the WORK.

1.3 Contract Time

A. The WORK associated with these Contract Documents shall be completed within 45 days of the Notice to Proceed but not later than August 19, 1994.

-- END OF SECTION --

SECTION 02100 - SITE PREPARATION

PART 1 -- GENERAL

1.1 The Requirement

A. The work of this section includes clearing and grubbing in designated areas, removal and disposal of debris, repair of the existing creek crossing, placement of safety barriers in designated areas, modification of designated monitoring well(s), installation of required temporary silt fences and removal and disposal of existing silt fences.

1.2 Site Inspection

A. Prior to moving onto the project site, the CONTRACTOR shall visit and inspect the site conditions and review maps of the existing site.

PART 2 -- PRODUCTS

2.1 Safety Barriers

A. The CONTRACTOR shall be responsible for placement of Post-and-Rail type highway safety barriers along the east (outside) edge of the site access road as shown in the Drawings. CONTRACTOR may submit alternative safety barriers for review and approval by the ENGINEER following award of the contract by the OWNER.

PART 3 -- EXECUTION

3.1 Silt Fence Removal

A. The CONTRACTOR shall be responsible for removal and disposal of silt fences existing along the south edge of Dry Run Creek. Disposal of the silt fence materials shall be at an off-site location approved by the ENGINEER.

3.2 Silt Fence Placement

A. The CONTRACTOR shall be responsible for the installation of silt fences on the south creek bank slope, as shown on the Drawings, and any other temporary silt fences necessary to control sediment runoff from the site during implementation of the work.

3.3 Clearing

A. The CONTRACTOR shall be responsible for clearing the existing vegetation from the designated construction and borrow areas. The estimated area of clearing and grubbing is approximately 2.7 acres. Clearing will be concentrated in the former disposal area, the south creek bank, and the designated borrow area as designated in the Drawings. Clearing shall include but not be limited to, the removal of material such as any existing trees, branches, sticks, sod, grass, weeds, and decayed vegetative matter from the surface of the ground without removing more earth than is necessary.

3.4 Grubbing

A. Stumps and roots within the limits of vegetative disturbance shall be grubbed to a depth of no less than 24 inches below subgrade or embankment slopes. Stump holes shall be

backfilled with general fill material and compacted to the approximate density of the adjacent area.

3.5 Debris Removal

A. Any debris existing inside the former disposal area or the designated borrow area or along the creek embankments and the creek bottom shall be removed to achieve a smooth grade in these areas and disposed in accordance with subsection 3.7 of this section.

3.6 Stockpiling of Cleared and Grubbed Material

A. Cleared and grubbed materials shall be chipped and stockpiled in an area west of the construction area or other areas as designated by the ENGINEER. The area for the cleared and grubbed material is shown in the Drawings.

3.7 Disposal of Debris

A. Any debris, not including cleared and grubbed materials, removed during site preparation shall be disposed at a local solid waste management facility approved by the ENGINEER.

3.8 Repair of Existing Creek Crossing

A. The CONTRACTOR shall repair the existing creek crossing at the north edge of the site using materials similar to those originally used. This repair shall include, as necessary, the replacement and/or regrading of existing aggregate and the replacement and/or realignment of existing corrugated metal pipe culverts. The replaced aggregate will then be grouted in place with a nonshrinking cement grout, approved by the ENGINEER.

3.9 Extension of Existing Monitoring Well

A. Monitoring well MW-1D, shall be modified as shown on the Drawings. The existing steel well cover shall be removed and reused, if possible. All materials used shall be similar to those currently in place, or as directed by the ENGINEER.

3.10 Installation of Post-and-Rail Barrier

A. The post-and-rail barrier shall be installed as shown on the Drawings. Alternative safety barriers may be accepted by the OWNER or ENGINEER following submittal of the alternative barrier as an equal by the CONTRACTOR.

3.11 Protection of Existing Features

A. Items specifically pointed out by the OWNER such as monitoring wells and survey monuments shall not be disturbed. Any damage caused by the CONTRACTOR to these items shall be repaired or the damaged item(s) replaced to the satisfaction of the OWNER and at the CONTRACTOR's expense. Items and equipment existing at the site such as polyethylene storage tanks, storage shed and other miscellaneous equipment shall be removed, at the direction of the ENGINEER, and placed in a temporary storage area designated by the ENGINEER.

-- END OF SECTION --

SECTION 02120 - SILT FENCES

PART 1 -- GENERAL

1.1 The Requirement

A. The WORK of this section includes the installation of all silt fence as shown in the Drawings and as specified herein.

PART 2 -- PRODUCTS

2.1 Silt Fence Fabric

A. The silt fence fabric shall be nonwoven polyester material having a minimum width of 42 inches. The fabric shall have a strength of 35 pounds at 10 percent elongation and 55 pounds at 20 percent elongation.

2.2 Silt Fence Posts

A. The silt fence posts shall be steel with a minimum 1.3 pound/foot T-section lugs equipped with steel anchor plates. The steel anchor plates shall have a minimum area of 12 square inches.

B. The silt fence posts shall be coated with one prime and one finish coat of aluminum paint or one coat of self-priming aluminum paint.

C. Each silt fence post shall have a minimum length of 4 feet.

PART 3 -- EXECUTION

3.1 General

A. Silt fences shall be constructed as shown on the Drawings to control sediment transport above the cable-stayed concrete mat system. Temporary silt fences necessary to control sediment runoff from the site during completion of the WORK shall also be installed, as necessary, by the CONTRACTOR.

-- END OF SECTION --

SECTION 02200 - EARTHWORK

PART 1 -- GENERAL

1.1 The Requirement

A. This section includes all site preparatory earthwork required for construction of the project. Such earthwork shall include, but not be limited to, the loosening, removing, loading, transporting, depositing, and compacting, in its final location, of all materials wet and dry, as required for the purposes of completing the project specified in the Contract Documents. This earthwork will include, but not be limited to, the furnishing, placing, and removing of sheeting and bracing necessary to safely support the sides of all excavations; all pumping, ditching, draining, and other required measures for the removal or exclusion of water from the excavation; the supporting of structures above and below the ground; all backfilling around structures and all backfilling of trenches and pits; the disposal of excess excavated materials; borrow of materials to make up deficiencies for fills; and all other incidental earthwork, all to be in accordance with the requirements of the Contract Documents.

1.2 Contractor Submittals

A. The CONTRACTOR's attention is directed to the provisions of Subpart P, Section 1926.652 of the OSHA Safety and Health Standards for Construction, which require that all banks and trenches over 5 feet high shall be shored in accordance with Section 1926.652 requirements.

B. **Soil Test Results:** The following tests shall be performed on soil to be used by the CONTRACTOR for the compacted clay cap and the initial results of the tests submitted to the ENGINEER prior to placement of any low permeability clay. All samples shall be representative of the material to be placed.

1. Determination of maximum density and optimum moisture in accordance with the requirements of ASTM D 698. An optimum moisture-density curve shall be obtained for each 2,500 cubic yards of borrow material to be used.

2. Atterburg Limits, grain size determination and specific gravity tests shall be conducted in conjunction with the density-moisture relationship test.

3. Compacted moisture-density and permeability relationships shall be determined for the low permeability clay material to be used in accordance with ASTM D 2434. At least five specimens shall be compacted and tested for permeability for each 2,500 cubic yards of low permeability clay borrow material to be used. The moisture contents shall range from 0 to plus 5 percentage points of optimum moisture content, and the corresponding dry densities of approximately 80, 85, 90, 95, and 100 percent of the ASTM D 698 maximum standard proctor density. Test results shall be presented on a single plot of permeability versus dry density (minimum of 5 points).

C. The OWNER shall retain an independent soil testing firm to perform soil compaction testing at the OWNER's expense. The minimum frequency of soil compaction tests shall be one test per lift per 20,000 square feet. The CONTRACTOR shall notify the OWNER or ENGINEER of the completion of a lift and shall allow the OWNER-retained soil testing firm to conduct the necessary in-place density tests prior to placing the next lift.

PART 2 -- PRODUCTS

2.1 Suitable Fill and Backfill Material Requirements

A. **General:** Fill, backfill, and embankment materials shall be suitably selected or processed clean, fine earth, rock, or sand, free from grass, roots, brush, or other vegetation.

B. Fill and backfill materials to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.

C. **Suitable Materials:** Soils not classified as unsuitable pursuant to Paragraph 2.2 herein, are defined as suitable materials and may be used in fills, backfilling, and embankment construction subject to the specified limitations. In addition, when acceptable to the ENGINEER, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form an acceptable composite.

D. The following types of suitable materials are designated and defined as follows:

1. **General Fill Soil:** Soils existing on site and approved by the ENGINEER for the specified intended use. The material shall be free from grass, roots, brush, or other organic materials. These soils will be available from excavation(s) described in the Contract Documents and the designated borrow area shown on the Drawings. When acceptable to the ENGINEER, some unsuitable materials may be used for General Fill Soil, when thoroughly mixed with suitable soils as described herein.

2. Deposited waste, debris, or contaminated soil may only be used for general fill in the former disposal area to be capped during construction provided the maximum dimension of any piece of deposited waste, debris or contaminated soil is not greater than 6 inches, in accordance with guidelines set forth by the ENGINEER and/or OWNER. All such material to be used for general fill shall be placed in the former disposal area.

3. **Low Permeability Clay:** Material existing in the designated borrow area source consisting of predominantly clay materials. The material shall have no rocks, roots, debris or organic materials greater than 1-inch diameter. The OWNER or ENGINEER shall approve the use of all soil to be used for the compacted clay layer prior to placement by the CONTRACTOR. The material shall have a permeability of 1×10^{-7} cm/sec or less at a standard proctor density of 95 percent or less of maximum, when tested in accordance with ASTM D 698 and ASTM D 2434. Material shall be placed at 0 to 5 percentage points above optimum moisture content.

4. **Topsoil:** Material available in the designated borrow area source or other off-site borrow source that, based on texture and organic matter quantity, shall be capable of supporting vegetative growth. Material shall not contain any rocks, debris, roots or unbroken clumps larger than 3 inches in diameter. Material shall be free of contamination and shall be borrowed from a contaminant-free source.

2.2 Unsuitable Material

A. Any soil which cannot be compacted sufficiently to achieve the percentage of maximum density or performance requirement specified for the intended use shall be classed as

unsuitable material. Unsuitable material shall not be considered as deposited waste, debris, or contaminated soil.

B. Deposited waste, debris, or contaminated soil shall not be used for grading or General Fill Soils on the creek embankment or in drainage ditches around the capped area during construction and shall be handled and disposed of in accordance with guidelines set forth by the ENGINEER and/or OWNER.

2.3 Use of Fill, Backfill, and Embankment Material Types

A. The CONTRACTOR shall use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.

B. Where these Specifications conflict with the requirements of any local agency having jurisdiction, or with the requirements of a material manufacturer, the ENGINEER shall be immediately notified. In case of conflict therewith, the CONTRACTOR shall use the most stringent requirement, as determined by the ENGINEER.

C. Fill and backfill types shall be used in accordance with the following provisions:

1. General fills and grading shall be constructed of General Fill Soils, as defined herein.

2. The former disposal area cap shall be constructed of the following materials constructed to the thicknesses shown on the Drawings and to the compaction and permeability requirements described herein.

a. The compacted clay layer shall be constructed of Low Permeability Clay, as defined herein.

b. The Topsoil layer shall be constructed using Topsoil, as defined herein.

PART 3 -- EXECUTION

3.1 Excavation - General

A. If during general excavation activities, the CONTRACTOR encounters any visibly contaminated soil, environmental media, buried drums, large buried debris etc., WORK must cease immediately and the ENGINEER shall be notified. Only upon written approval from the ENGINEER shall the CONTRACTOR resume construction activities.

B. Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the WORK. The removal of said materials shall conform to the lines and grades shown or ordered. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill according to Section 02100 - "Site Preparation."

1. **Shoring:** The CONTRACTOR shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations and all pumping, ditching, or other measures for the removal or exclusion of water, including taking care of storm water, groundwater, and wastewater reaching the site of the WORK from any source so as to prevent damage to the WORK or adjoining property. Excavations shall be sloped or otherwise supported in a safe manner in accordance

with applicable state safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926) or as specified in the Contract Documents.

2. **Temporary Erosion and Sediment Control:** The CONTRACTOR shall be responsible for maintaining any temporary erosion and sediment control structures as necessary throughout the successful completion of the WORK. Use of temporary earthen embankments, terraces, sedimentation areas, silt fences and vegetative cover shall be required, as directed by the ENGINEER, throughout completion of the WORK. Costs for establishing such temporary erosion and sediment control measures shall be considered incidental to work items included in this section.

3. **Notification of ENGINEER:** The CONTRACTOR shall notify the ENGINEER at least three days in advance of completion of any surface or subsurface grading or excavation and shall allow the ENGINEER a review period of at least one day before the exposed surface or subsurface is scarified and compacted or is covered with backfill or with any construction materials.

4. Actual excavation elevations and quantities are subject to field changes by the ENGINEER if such soil conditions exist to merit such change. Deviations from contracted quantities shall be handled in accordance with Section 01025 - "Measurement and Payment."

3.2 Grading Beneath Cabled-Stayed Concrete

A. Grading shall be carried to the grade as shown on the Drawings and graded to provide a reasonably smooth surface. Placement of the Type A Geotextile Fabric will then be initiated upon the smoothed surface.

B. Inappropriate subgrade soil, including sands, unstable soil or organic pockets shall be over-excavated and backfilled with general fill prior to initiation of Type A Geotextile Fabric placement.

3.3 General Grading in the Former Disposal Area

A. General grading in the area to be capped shall be conducted to establish grade for the subsurface of the compacted clay cap as shown on the Drawings. All excavation, fill and grading activities associated with the former disposal area shall be conducted so as to minimize the production of dust from the soil in the area.

B. Grading of general fill in the area to be capped shall utilize general fill materials excavated from the site whenever possible. Additional fill material, if needed, shall be excavated and hauled from the designated borrow area shown on the Drawings.

C. All grading of general fill shall produce a reasonably smooth, compacted surface free from irregular surface changes. All areas shall be uniformly smooth-graded so that the final graded surfaces are not more than 0.05 feet from the proposed grade shown on the Drawings, unless otherwise approved by the ENGINEER.

D. Over-excavation of buried debris or large boulders in the area to be capped shall be conducted, if necessary and at the direction of the ENGINEER to grade the surface or subsurface to the elevations shown on the Drawings. Any over-excavation shall be backfilled to the required grade with general fill and compacted to the approximate density of the adjacent soils.

3.4 Backfill - General

A. Backfill shall not be dropped directly upon any existing monitoring wells. Backfill around existing monitoring wells shall be conducted with care, by hand if necessary, to ensure no damage to the existing monitoring wells occurs.

3.5 Placing and Spreading of Backfill Materials

A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that when compacted each layer shall not exceed the thickness specified below:

1. Final backfill shall be placed in 6- to 8-inch lifts.

2. The former disposal area cap Low Permeability Clay layer shall be placed in 6- to 8-inch lifts. The clay shall be placed a 0-5 percent above optimum moisture content.

3. The former disposal area cap Topsoil layer shall be placed in 6- to 12-inch lifts.

B. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the pipe so that when compacted, the pipe zone backfill will provide uniform bearing and side support.

C. Where the backfill material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.

D. Where the backfill material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

E. Service and maintenance of any machinery will not be allowed within the backfill area. Any accidental spills of petroleum products or emissions caused by machinery service within the backfill area shall require immediate removal. All contaminated soil introduced within the backfill area shall be reloaded and discarded at an area approved by the ENGINEER. Appropriate backfill soil must then be replaced in the area of contaminated soil over-excavation with mechanical compaction required; additional density testing may be performed at the discretion for the ENGINEER. All additional costs resulting from contaminant discharge by the CONTRACTOR within the backfill area shall be borne by the CONTRACTOR.

3.6 Compaction of Fill, Backfill, and Embankment Materials

A. Each layer backfill as defined herein shall be mechanically compacted. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.

B. **Compaction Requirements:**

1. General Fill Soils shall be compacted to approximately 90 percent of maximum density in accordance with ASTM D698. Compaction tests shall be performed every 500 cubic yards.

2. Low Permeability Clay shall be compacted to a minimum of 95 percent of the maximum standard proctor density in accordance with ASTM D 698. At least one compaction test shall be performed per lift, every 10,000 square feet.

3. Topsoil shall only be compacted as necessary to achieve proper placement and grade elevation.

4. In areas where vegetative cover is to be established, the top 12 inches of backfill soils shall be placed and graded loosely and mechanical compaction is not required.

3.7 Earthwork in Designated Borrow Area

A. The designated borrow area, as shown on the Drawings, shall be used as the source of additional general fill, if necessary, and as the source of Low Permeability Clay and Topsoil to be used for the former disposal area cap.

B. The designated borrow area shall be cleared and grubbed prior to excavating general fill, clay or topsoil from the area. Care shall be taken not to disturb the area adjacent to the designated borrow area.

C. Maximum slopes at any time for surfaces in the designated borrow area shall be 25 percent, unless otherwise directed by the ENGINEER or OWNER.

D. Following completion of the use of the borrow area, the area shall be graded as shown on the Drawings, seeded and mulched as specified in Section 02270 - "Erosion Control (Vegetative)." Final grading shall be performed so that ponded water conditions do not exist.

3.8 Grade Completion

A. Final grade completion for the creek bank, drainage ditches, and capped area shall be as detailed on the Drawings or as specified by the ENGINEER based on deviations from the Contract Documents. Any uncharacteristic depressions or mounds on these final graded layers shall be subject to regrading to establish appropriate final surfaces. Any debris, including, but not limited to, roots, organic material, machinery parts, and ordinary trash, shall be removed from the completed final graded layer.

B. The respective representatives of the earthwork contractor and the geomembrane liner installation contractor shall coordinate their efforts to produce an acceptable support surface for the creek bank on which to install the geomembrane liner system. An authorized representative of the liner installation contractor shall approve, in writing submitted to the ENGINEER, the surface on which the lining is to be placed before installation of the liner shall commence. Once approved, it shall be the responsibility of the liner installation contractor to keep the support surface in the accepted condition, until complete installation of the liner is accomplished.

-- END OF SECTION --

SECTION 02270 - EROSION CONTROL (VEGETATIVE)

PART 1 -- GENERAL

1.1 The Requirement

A. The CONTRACTOR shall furnish and install all materials and work as needed to establish vegetative erosion control cover on designated disturbed areas of the site, including, but not limited to, seedbed preparation; applying fertilizers or seeds; and mulch.

1.2 Reference Specifications, Codes, and Standards

A. **Manufacturer's Standards:** Applying and planting of vegetative erosion control cover shall be in accordance with the manufacturer's published, written, and verbal recommendations and specifications for all materials required.

B. **Governmental Standards:** United States Department of Agriculture (USDA) Rules and Regulations under the Federal Seed Act.

1.3 Product Delivery, Storage, and Handling

A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken, packages, containers, or bundles bearing the name of the manufacturer.

B. **Storage and Handling:** All materials shall be carefully stored and handled in accordance with all manufacturer's recommendations and specifications. Storage and handling shall be in a manner that will prevent the damaging of the materials.

1.4 Quality Control

A. The ENGINEER shall have the right to reject and/or require the replacement of all defective and/or substandard materials delivered to the site and all defective and/or substandard work at the expense of the CONTRACTOR.

B. **Seed:** All seed shall meet or exceed requirements contained in this specifications of this section and Federal, State and County Laws Requiring inspection for plant disease and insect control and shall be labeled and certified in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act and Iowa State laws. All seed must be dated for test and be from the last season prior to date of delivery.

C. **Fertilizer:** Fertilizer shall meet standards for grade and quality as per the requirements of the Iowa Department of Agriculture.

D. **Mulch:** Mulch shall not contain any noxious weeds.

PART 2 -- PRODUCTS

2.1 Fertilizers

A. Fertilizer shall be a commercial grade inorganic, balanced fertilizer, uniform in composition, liquid or dry, and free flowing. Fertilizer may be delivered in bulk from the

supplier or in its original unopened containers. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.

B. A minimum of 100 lb/acre of fertilizer shall be applied to the areas to be seeded. The fertilizer shall have the following analysis ratio, unless otherwise directed or approved by the ENGINEER:

Nitrogen (N)	40 lbs
Phosphate (P_2O_5)	150 lbs
Potash (K_2O)	75 lbs

2.2 TYPE A Seed

A. **TYPE A** seed shall consist of the following combinations of cool season grasses, warm season grasses and legumes at the specified application rate in pounds pure live seed (PLS) per acre:

Smooth Bromegrass	40 lbs/acre
Oats	2 Bu/acre

B. **Seeding Rate:**

1. Pounds PLS per acre shall be calculated as: % purity x % germination = % PLS.

2. The actual seeding rate shall be calculated as: (pounds PLS per acre) / (% PLS).

C. Seed delivered to the site shall be labeled according to the U.S. Department of Agriculture Federal Seed Act and shall be furnished in containers with tags showing seed mixture, purity, germination, weed content, name of seller, and date on which seed was tested. Moldy seed or seed that has been damaged in storage shall not be used. Previous season seed crop shall be used only.

2.3 Mulch

A. Mulch shall consist of oats, rye, hay, grass cut from native grasses or other plants approved in writing by the ENGINEER. Mulch shall be of air dry straw that has been properly cured and harvested. Straw harvested after a killing frost or during dormant periods will not be acceptable. Straw shall not be rotted, brittle, moldy, caked or otherwise degraded. Mulch shall be free of noxious weeds and other weeds deemed undesirable by the ENGINEER, such as foxtail, etc. The chipped trees and weeds, etc., generated by clearing and grubbing may be mixed with the mulch used to cover the capped area or line the drainageways, at the discretion of the ENGINEER.

B. Each load of mulch shall be subject to inspection and acceptance by the ENGINEER prior to unloading. At least 50 percent of the herbage weight of each bale shall contain straw with a length of 10 inches or greater. This requirement shall be applied to all straw mulch intended for crimping into the seedbed.

PART 3 -- EXECUTION

3.1 General

A. The preparation and application of all elements of the permanent vegetative cover shall conform to all applicable codes and the manufacturer's published, written, and verbal

recommendations and specifications. Work shall be coordinated with related work specified in other sections of the Contract Documents. Vegetative cover work shall begin as soon as installation and construction work in isolated areas is completed. It should be noted the permanent vegetation shall be planted between August 15 and September 15, 1994.

3.2 Required Areas

A. Areas requiring vegetative erosion control cover include all designated areas disturbed during installation and construction of the various elements of the contract including, but not limited to, the capped area and associated drainage ditches and terraces, embankments above the cable-stayed concrete mats, and any disturbed areas in the designated borrow area.

3.3 Seedbed Preparation

A. Areas where permanent vegetative erosion control cover is to be established shall have no plant growth, rocks of diameter 4 inches or larger, or other obstructions following clearing and grubbing that will interfere with tilling, seeding, or maintenance operations.

B. The seedbed shall be thoroughly loosened and pulverized by tilling to a minimum depth of 6 inches and a maximum depth of 10 inches. The CONTRACTOR shall recognize that certain areas will require additional work to loosen the soil to a depth of 6 inches.

C. The integrity of seedbed areas shall be maintained throughout seeding and mulching activities so that no rills or severely eroded areas exist. All areas to be seeded shall be cultipacked or compacted by other means approved by the ENGINEER following incorporation of fertilizers and immediately prior to seed application. Cultipacking shall continue until such time as a finely pulverized and firmly compacted seedbed is obtained and approved by the ENGINEER.

D. Seedbed preparation shall not be performed when ground conditions are unsuitable due to excessive moisture, lack of moisture, and snow or frost.

3.4 Fertilizing

A. Fertilizer shall be applied no more than one week prior to seeding activities in areas scheduled for establishment of vegetative cover. Fertilizer application rates shall be as specified herein. Fertilizer shall be thoroughly incorporated throughout the upper 6 inches by discing, harrowing, or other approved means.

3.5 Seeding

A. Unless otherwise specified, vegetative cover shall be planted during the construction period.

B. **Weather Conditions:** Fertilizing, seeding, or mulching operations will not be permitted when wind velocities exceed 15 miles per hour or when the ground is frozen, unduly wet, or otherwise not in a tillable condition.

C. Use of temporary cover crops during construction activities may be considered by the CONTRACTOR to provide erosion control in completed areas prior to final vegetative

cover seeding. Costs for such temporary cover plantings shall be borne by the CONTRACTOR.

D. Seed shall be planted along the contours using a grassland-type drill, which places the seed no less than 1/4 inch and no greater than 1/2 inch into the seedbed. Drill spacing shall not exceed 6 inches apart. Successive planting strips shall overlap to provide uniform coverage over the area. Upon a show of green, bare areas skipped or killed will be replanted at no expense to the OWNER.

E. Plantings shall be made on a firm dry seedbed. No work shall be completed during periods of excessive field moisture conditions. Temporary cover plantings must be mowed, baled and removed from the job site prior to seedbed preparation for permanent vegetative cover.

3.6 Mulching

A. Straw mulch shall be applied immediately to areas seeded with permanent vegetative erosion control. Areas where organic erosion control blankets will be used, specifically on terraces and in drainage ditches, will not require straw mulch. Straw mulch shall be uniformly applied at the rate of 4,000 pounds per acre. The mulch may be spread either by hand or by mechanical spreader. When spread by hand, it shall be torn from the bale, "fluffed up" and spread uniformly over the area. When spread by a mechanical spreader, the machine shall be adjusted to prevent cutting the straw into pieces shorter than 6 inches and to provide uniform distribution of the straw over the area.

B. After application, the straw mulch shall be anchored into the soil by crimping into the soil with a mulch tiller to a minimum depth of 2 inches. Anchoring shall be accomplished by using a mulch tiller with a rolling coulter type disk which shall be sufficiently dull on the cutting edge to prevent cutting of the straw mulch. The disk must be of sufficient diameter to prevent the frame of the mulch tiller from dragging the straw mulch. The number of passes over the mulch shall not exceed two.

C. All straw mulching operations shall be done on the contour. The straw mulch shall not be covered with excessive amounts of soil. The rows or furrows made by the mulch tiller shall be spaced no more than 9 inches apart.

3.7 Maintenance and Repairs

A. Maintenance and repairs to the vegetative cover shall be completed in areas of rill erosion with a depth of greater than 3 inches and width greater than 4 inches. Repairs shall be completed on individual bare areas greater than 1 square yard or total bare areas exceeding 2 percent of the entire vegetative area. Costs of maintenance and repairs shall be at no expense to the OWNER.

-- END OF SECTION --

SECTION 02276 - GEOTEXTILE FABRICS

PART 1 -- GENERAL

1.1 The Requirement

A. The CONTRACTOR shall furnish and install all geotextile fabric, for drainage filters and separation of construction materials, all in accordance with the requirements of the Contract Documents.

1.2 Reference Specifications, Codes, and Standards

A. **Commercial Standards:**

ASTM D 276	Method for Identification of Fibers of Textiles.
ASTM D 1777	Method for Determination of Geotextile Thickness.
ASTM D 3776	Method for Determination of Geotextile Weight.
ASTM D 3786	Method for Determination of Geotextile Mullen Burst Strength.
ASTM D 4354	Practice for Sampling of Geotextiles for Testing.
ASTM D 4491	Test Methods for Water Permeability of Geotextiles by the Permittivity Method.
ASTM D 4533	Test Method for Trapezoidal Tear Strength of Geotextiles.
ASTM D 4632	Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).
ASTM D 4716	Test Method for Constant Head Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.
ASTM D 4751	Apparent Opening Size (AOS) of a Geotextile, Determining.
ASTM D 4873	Practice for Identification and Storage and Handling of Geotextiles.
ASTM D 4833	Test Method for Puncture Strength of Geotextiles.

1.3 Contractor Submittals

A. **Samples:** The CONTRACTOR shall submit samples of all geotextile materials proposed to be used on the WORK. The samples shall be clearly marked to show the manufacturer's

name and product identification and shall be submitted along with the manufacturer's technical data and installation instructions.

B. **Certificates:** The CONTRACTOR shall provide a certificate from the geotextile manufacturer stating conformance with the specification requirements.

1.4 Delivery, Storage, and Moving Material

A. The **TYPE A Geotextile Fabric** and **TYPE C Geotextile Fabric** shall be delivered to the site by the CONTRACTOR in rolls wrapped with protective covering to protect the fabric from mud, dirt, dust, debris, ultraviolet radiation, and abrasion due to shipping and handling. The **TYPE D Geotextile Fabric** to be used under the road base shall also be delivered to the site by the CONTRACTOR in rolls. The fabric shall be free of defects or flaws which significantly affect its physical properties. Each roll of fabric in the shipment shall be labeled in accordance with ASTM D 4873.

B. Care shall be taken while unloading and moving geotextile fabrics at the site prior to installation. Any material found to be damaged by the ENGINEER shall be removed from the site by the CONTRACTOR. All geotextile fabrics shall be handled and placed in accordance with the manufacturer's recommendations or as specified within the Contract Documents.

C. **TYPE D Geotextile Fabric** to be used under the cable-stayed concrete mat system shall be delivered to the site attached to the cable-stayed concrete in accordance with Section 03401 - "Cable-Stayed Concrete Mat System."

PART 2 -- PRODUCTS

2.1 TYPE A Geotextile Fabric - Geocomposite Drainage

A. **TYPE A Geotextile Fabric,** as specified in the Contract Documents, shall be classified as separation and/or drainage, nonwoven (may be needlepunch), polypropylene filter fabric encasing a HDPE Geonet conforming to the following performance criteria:

1. Filter Fabric

Property	Requirement	Test
Mass, oz./sq. yd	6.0*	ASTM D 3776
Apparent Opening Size (AOS)	70	ASTM D 4751
Permittivity, Sec^{-1}	1.1*	ASTM D 4491
Puncture Strength, lbs.	80*	ASTM D 4833

2. Geonet

Property	Requirement	Test
Tensile Strength (lb/in)	44*	D-1682
Transmissivity (m^2/sec)	1×10^{-3}	D-4716-87

B. **Note:** All numerical values shown above with an "*" represent minimum average roll values. Test results from any sampled roll in a lot shall meet or exceed the minimum values shown. Lot sampled shall be in accordance with ASTM D 4354.

C. Approved or equal manufacturers of **TYPE A Geotextile Fabric** are:

1. Fluid Systems
2. SLT North America
3. Gundle Lining Systems
4. National Seal Company

2.2 TYPE C Geotextile Fabric - Organic Erosion Control

A. **TYPE C Geotextile Fabric,** as specified in the Contract Documents, shall be classified as straw erosion control blanket with 100 percent straw matrix sewn between two photodegradable nets. Straw shall not be rotted, brittle, moldy, caked or otherwise degraded.

B. Straw erosion control blanket shall contain a minimum of 0.5 lb/sq yd of straw and be bound with cotton thread.

C. Approved or equal manufacturers of straw erosion control blankets are:

1. North American Green, Inc.
2. American Excelsior Company

2.3 TYPE D Geotextile Fabric

A. **TYPE D Geotextile Fabric,** as specified in the Contract Documents, shall be classified as a separation and/or filtration, nonwoven, polypropylene or polyester fabric conforming to the following performance criteria:

Property	Requirement	Test
Mass, oz./sq. yd	6.0*	ASTM D 3776
Apparent Opening Size (AOS)	70	ASTM D 4751
Puncture Strength, lbs.	80*	ASTM D 3787

B. **Note:** All numerical values shown above with an "*" represent minimum average roll values. Test results from any sampled roll in a lot shall meet or exceed the minimum values shown. Lot sampled shall be in accordance with ASTM D 4354.

C. Approved or equal manufacturers of **TYPE D Geotextile Fabric** are:

1. American Engineering Fabrics, Inc.
2. Amoco Fabrics and Fibers.
3. Exxon Chemical Company.
4. Hoechst Celanese.
5. Phillips Petroleum Company.

PART 3 -- EXECUTION

3.1 General

A. The **TYPE A Geotextile Fabric** shall be installed as shown on the Drawings.

B. The **TYPE C Geotextile Fabric** shall be installed as shown on the Drawings.

C. The **TYPE D Geotextile Fabric** shall be installed as shown on the Drawings.

D. The geotextile fabric shall be installed according to all manufacturer specifications and recommendations and as shown on the Drawings.

-- END OF SECTION --

SECTION 02300 - ROCK SURFACING

PART 1 -- GENERAL

1.1 The Requirement

A. The CONTRACTOR shall provide all labor, materials, and equipment necessary to construct the rock access road in accordance with the requirements of the Contract Documents.

PART 2 -- PRODUCTS

2.1 Access Road Base Material

A. Base rock shall be 3-inch roadstone. The 3-inch roadstone shall comply with Iowa Department of Transportation (IDOT) Specification 4122.02.

2.2 Access Road Surface Material

A. Surface material shall be 1-inch Class A roadstone. This material shall comply with IDOT Specification 4120.04.

2.3 TYPE D Geotextile Fabric

A. **TYPE D Geotextile Fabric** shall be used under the access road base material and shall conform to the requirements of Section 02276 - "Geotextile Fabrics."

PART 3 -- EXECUTION

3.1 Preparatory Work

A. Prior to placing any base material on the subgrade the area shall be uniformly graded without significant ruts or mounds and without abrupt changes in slope or grade. **TYPE D Geotextile Fabric** or rock base shall not be placed until such action is approved by the ENGINEER.

3.2 Placement of TYPE D Geotextile Fabric

A. **TYPE D Geotextile Fabric** shall be placed on the surface of the general fill in the area of the access road, following placement of the former disposal area cap, as a separation layer between the access road base material and the capped area.

B. **TYPE D Geotextile Fabric** shall be installed as specified and recommended by the manufacturer.

3.3 Rock Surfacing

A. On the prepared subgrade spread on one 6-inch thick layer of 3-inch roadstone and one 3-inch thick layer of 1-inch Class A roadstone. The 3-inch material shall comply with IDOT Specification 4122.02. The 1-inch Class A roadstone shall comply with IDOT Specification 4120.04.

B. Promptly roll each layer with a rubber tire and vibratory roller.

C. The crushed stone base shall be at least six inches thick after compaction and shall present a uniform surface that substantially conforms to the required grade and is free of loose material.

-- END OF SECTION --

SECTION 02625 - CORRUGATED METAL PIPE

PART 1 -- GENERAL

1.1 The Requirement

A. The CONTRACTOR shall furnish and install corrugated metal pipe and appurtenant work, complete in place at the locations shown on the Drawings, in accordance with the requirements of the Contract Documents.

B. Corrugated metal pipe shall include coated corrugated steel round pipe and related accessories.

1.2 Reference Specifications, Codes, and Standards

A. **Commercial Standards:**

AASHTO M36	Specification for Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains.
AASHTO M190	Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
AASHTO M196	Specification for Corrugated Aluminum Alloy Culverts and Underdrains.
AASHTO M243	Specification for Field-Applied Coating of Corrugated Plate for Pipe, Pipe Arches, and Arches.
AASHTO M246	Specification for Precoated Galvanized Steel Sheet for Culverts and Underdrains.

1.3 Contractor Submittals

A. The CONTRACTOR shall submit Shop Drawings and catalog data submittals for corrugated metal pipe to be installed.

B. A manufacturer's or fabricator's Certificate of Compliance shall be furnished stating that the corrugated metal pipe meets the specification requirements.

PART 2 -- PRODUCTS

2.1 Corrugated Steel Pipe

A. Corrugated steel pipe and coupling bands and fittings for each type, shall conform to the requirements of AASHTO M36, and shall be fabricated from either zinc-coated steel sheet or aluminum-coated steel sheet.

2.2 Requirements

A. Corrugated metal pipe shall meet the following requirements:

1.	Type of Pipe:	Circular
2.	Pipe Material:	Steel
3.	Size:	12 inches
4.	Wall Thickness:	.064 inches (16 gauge)

PART 3 -- EXECUTION

3.1 Installation

A. Pipe bedding shall consist of General Fill, free from any rocks, debris or unbroken clumps greater than 3 inches in maximum dimension and shall have a thickness of 8 inches under the pipe, unless otherwise shown.

B. The top of the creek crossing casing pipe shall be buried a minimum of 36 inches from the bottom of the creek.

C. All pipe shall be transported, stored, and handled with care. It shall not be rolled or dragged over gravel or rock, and during placement, shall be prevented from striking rock or other hard objects. Special care shall be taken in handling and placing coated pipe to avoid damaging the coating.

D. Pipe laying shall begin at the downstream end of the line and proceed upstream. Pipe shall be laid carefully and true to line and grade. Pipe shall be placed with longitudinal seams at the sides and with outside laps of circumferential joints upgrade.

E. Pipe sections shall be laid in the trench with a maximum spacing between sections of 1-1/2 inches. Connecting bands shall be placed with clamping angles and bolts at top of the pipe. The pipe coupling corrugations or projections shall properly engage the pipe sections before bolts are tightened. Care shall be taken to ensure that dirt or other particles do not get between the outside of the pipe and the coupling. For watertight joints, the band and gasket material shall be placed in accordance with the manufacturer's recommendations.

F. Pipe backfill shall consist of General Fill, free from any rocks, debris or unbroken clumps greater than 3 inches in maximum dimension and shall be not less than 6 inches in depth. Particular care shall be taken to assure that specified compaction is attained under the haunches of the pipe.

G. For the access road culverts, 8 inches of additional **TYPE C Aggregate** backfill shall be provided as the minimum cover.

H. For the casing pipe to be installed under the stream, a minimum of 24 inches of additional backfill shall be provided, using General Fill Soils.

I. The casing pipe installed under the stream shall be allowed to fill with water to prevent uplift prior to capping the ends of the pipe. End caps shall be steel or wood and shall be placed to prevent backfill material from entering the pipe.

J. Following installation, the ends of the casing pipe shall be staked at the ground surface so that the pipe can be located in the future. These stakes shall be surveyed so that they can be replaced or relocated if, during construction, they are destroyed or disturbed.

-- END OF SECTION --

SECTION 02781 - VERY LOW DENSITY POLYETHYLENE (VLDPE) GEOMEMBRANE LINERS

PART 1 -- GENERAL

1.1 The Requirement

A. The WORK of this section includes the installation of a geomembrane liner system as shown on the Drawings and as specified herein.

1.2 Contractors Submittals

A. The liner installation shall be completed by either a manufacturer-approved installer or an approved manufacturer/installer of liner systems as specified herein and as shown on the Drawings.

B. **Field Quality Control Manual:** The CONTRACTOR shall obtain and submit to the ENGINEER for approval a "Field Quality Control Manual" from a manufacturer-approved installer or an approved manufacturer/installed prior to the start of construction. The manual shall, at a minimum, provide detailed installation procedures, including equipment and methodology, and quality control testing protocol, including materials and seam testing. The ENGINEER shall have the right to approve or require changes in the manufacturer authorized geomembrane liner installer's "Field Quality Control Manual."

C. **Subcontractor:** All Subcontractor submittals shall be provided to the ENGINEER.

D. **Raw Materials:** The CONTRACTOR shall obtain and submit to the ENGINEER the following information from the geomembrane liner manufacturer:

1. The origin (resin supplier's name and resin production plant), identification (brand name and number) and production date of the resin.

2. A copy of the quality control certificates issued by the resin supplier noting results of density and melt index.

3. Reports on the tests conducted by the manufacturer to verify the quality (specific gravity, melt index, etc.) of the resin used to manufacture the geomembrane liner rolls assigned to this project.

E. **Quality Control Certificates:** A Quality Control Certificate for every roll of geomembrane liner shall be provided. The quality control certificate shall be signed by a responsible party. The quality control certificate shall include the following:

1. Roll numbers and identification.

2. **Results of Quality Control Tests.** At a minimum, results shall be given for thickness (ASTM D 751), tensile strength (ASTM D 638), and tear resistance (ASTM D 1004).

1.3 Reference Specifications, Codes and Standards

A. Without limiting the generality of other requirements of these Specifications all work specified herein shall conform to or exceed the applicable requirements of the following

documents to the extent that the provisions of such documents are not in conflict with the requirements of this section.

1. **Commercial Standards:**

ASTM F 88-68 (1973)	Test Methods for Seal Strength of Flexible Barrier Materials.
ASTM D 570	Test Method for Water Absorption of Plastics.
ASTM D 638-84	Test Method for Tensile Properties of Plastics.
ASTM D 696-79	Test Method for Coefficient of Linear Thermal Expansion of Plastics.
ASTM D 746-79	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
ASTM D 751	Test Methods for Thickness of Plastics.
ASTM D 792, Method A	Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
ASTM D 1004-66 (1981)	Test method for Initial Tear Resistance of Plastic Film and Sheeting.
ASTM D 1204-84	Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature .
ASTM 1238	Condition E Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
ASTM D 1505-68 (1979)	Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D 1603	Test Method for Carbon Black in Olefin Plastics.
ASTM D 1693-70 (1980)	Test Method for Environmental Stress-Cracking of Ethylene Plastics.
ASTM D 3015	Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.

1.4 Product Delivery, Storage, and Handling

A. **Delivery of Materials:** Manufactured materials shall be delivered in original, unbroken, packages; containers; or bundles bearing the name of the manufacturer.

B. **Storage and Handling:** All materials shall be carefully stored and handled in accordance with all manufacturer's recommendations and specifications. Storage and handling shall be in a manner that will prevent the damaging of the materials.

1.5 Quality Assurance

A. **Installation Experience:** The manufacturer-approved liner installer or approved manufacturer/installer (hereafter termed liner installer) shall have demonstrated its ability to perform this WORK by having previously successfully installed in hydraulic structures, such as lagoons, containment ponds or canal channels, a minimum of five million square feet of similar type flexible geomembrane linings. The selected installer shall have fabricated and supervised the installation of not less than 10 million square feet of VLDPE or other polyethylene type liners. The liner superintendent shall have a minimum of 5 million square feet of similar installation experience.

B. **Shop Drawings:** Prior to ordering the geomembrane material, the CONTRACTOR shall submit, for the ENGINEER's approval, Shop Drawings showing lining sheet layout with proposed size, number, position, and sequence of placing of all sheets and indicating the location and the direction of all field joints. Shop Drawings shall also show complete details and/or methods for anchoring the lining at top of slope, making field joints, seals at structures, etc. In addition, prior to manufacturing, an 8-inch x 10-inch sample of the material proposed for the lining shall be submitted to the ENGINEER for approval.

C. The liner installer and OWNER or OWNER's representative shall inspect each individual roll of geomembrane lining material prior to installation. Any roll of material with any defects or surface blemishes shall be rejected and removed from the site at no cost to the OWNER. The OWNER or OWNER's representative shall be the sole judge of what shall constitute a defect or blemish.

D. **Field Testing/Quality Control:** The liner installer shall employ on-site physical non-destructive testing on all welds to ensure water-tight homogeneous seams, as specified herein. Linear placement will not be permitted if the installer fails to provide proper testing equipment. The CONTRACTOR shall be responsible for any cost derived from improper test equipment.

E. **Warranty:** The liner installer, either as a manufacturer-approved installer or as an approved manufacturer/installer, shall warrant to the OWNER the entire lining installed under the Contract to be free of defects in materials and workmanship for a period of 15 years following the date of acceptance of the WORK by the OWNER. The liner manufacturer shall warrant the materials against defect or failure due to contact with groundwater or due to exposure to weather. This warranty shall be submitted with the CONTRACTOR's bid for approval, and shall state all conditions and exclusions.

PART 2 -- PRODUCTS

2.1 TYPE A Geomembrane Liner

A. **TYPE A Geomembrane Liner** shall be manufactured of very low density polyethylene (VLDPE) and shall be new, first quality product designed and manufactured specifically for the purposes of this WORK and shall have satisfactorily demonstrated by prior use to be

suitable and durable for such purposes. This material shall meet or exceeds the following specifications (all values are minimum unless otherwise specified):

Property	Requirement	Standard	Conditions
Thickness (Nominal)	60 mil	ASTM D 751	
Density (Min)	0.915 g/cc	ASTM D 1505	
Melt Flow Index (Max.)	0.5 g/10 min	ASTM D 1238	Condition E
Carbon Black Content	2-3%	ASTM D 1603	
Carbon Black Dispersion	A1 or A2 rating	ASTM D 3015	
Tensile Properties:		ASTM D 638 Type IV	Dumb-bell at 2 ipm
Tensile Strength at Break (Min)	3,800 psi 228 ppi		
Tensile Strength at Yield (Min)	2,200 psi 132 ppi		
Elongation at Break (Min)	600%		
Elongation at Yield (Min)	13%		
Tear Resistance (Min)	550 ppi 33 lbs	ASTM D 1004	Die C
Puncture Resistance (Min)	1,500 ppi 90 lbs	FTMS 101	Method 2065
Brittleness Temperature	-75° C	ASTM D 746	Procedure B
Environmental Stress Crack (Min)	1,500 hours	ASTM D 1693	10% Igepal, 50C
Dimensional Stability (Max.)	3%	ASTM D 1204	212° F 1-hour

B. Raw material for manufacture of the geomembrane liner shall be first quality VLDPE resin containing no more than 2 percent clean recycled polymer by weight. Specific gravity of the resin shall be greater than 0.935 as determined by ASTM D 792 Method A or ASTM D 1505. The melt index shall be 0.05 -0.3 g/10 min. as determined by ASTM D 1238 Condition 190/2.16.

C. The geomembrane liner shall meet or exceed the manufacturer's published specification and property requirements according to the specification sheet for the type and size of geomembrane liner required. The geomembrane liner shall be so produced as to be free of

holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. There shall be no factory seams.

D. The geomembrane liner shall be manufactured by the extrusion process and shall be uniform in color, thickness, size, and surface texture. The geomembrane liner shall be a flexible, durable, watertight product free of holes, blisters, undispersed raw materials and contaminants. Any defects shall be repaired using the extrusion fusion welding techniques in accordance with the manufacturer recommendations.

E. The geomembrane liner material shall be manufactured as a continuous sheet with no factory seams and in rolls with a minimum width of 15 feet. The roll length shall be maximized to provide the largest manageable sheet for the fewest field seams. Labels on the roll shall identify the thickness, length, width, and manufacturer's mark number. Packaged factory sheets of the geomembrane liner material which have been delivered to the project site shall be stored in accordance with the manufacturers recommendations.

F. **Extrusion Resin:** Resin used for extrusion welding with extrudate of lining sheets and for repairs shall be VLDPE produced from and the same as the sheet resin. Physical properties shall be same as the lining sheets.

G. **Anchor Bolts, Nuts and Washers:** Anchor bolts and nuts shall be 3/8-inch size, Type 18-8 stainless steel, as shown on the Plans or approved equal. Washers shall be Type 303 or 304 stainless steel.

H. **Caulk and Primer:** Caulk shall be neoprene Gacoflex N-1004 and primer shall be Gacoflex E-5320 as manufactured by Gaco Western, Inc., Seattle, Washington, or types recommended by the manufacturer for use with its material. Both shall be delivered in original sealed containers with the brand and name of the manufacturer clearly identified on each.

I. **Sponge Rubber Pad:** Sponge rubber pad shall be 1/4 inch thick neoprene, closed cell medium, Rubatex No. R-451-N, (ASTM D 1056-SCE-45), 25-35-durometer hardness, as manufactured by Rubatex Division, Bedford, VA or Great American Industries, or approved equal.

J. **Rubber Adhesive:** Rubber adhesive shall be neoprene, Python No. 1062, contact type, or of a type recommended by the lining manufacturer.

K. **Butyl Tape:** Butyl tape shall be SST as manufactured by Tremco, Cleveland, Ohio, for use in a submerged condition or approved equal.

L. **Texture:** The VLDPE shall be the textured-type sufficient to be installed on a 1:1 slope.

2.2 Manufacturers, or Equal

A. Approved or equal manufacturers of **TYPE A Geomembrane Liner**:

1. Gundle Lining Systems, Inc.
2. National Seal Company
3. SLT North America, Inc.
4. Poly-Flex

PART 3 -- EXECUTION

3.1 Geomembrane Liner Installation

A. **General:** The surface of the liner subgrade surface shall be prepared in accordance with the provisions of Section 02200 - "Earthwork" prior to the installation of the geomembrane liner. The geomembrane liner installer shall submit a certification of subgrade acceptance to the ENGINEER prior to performing any work. The subgrade materials shall be considered adequate for purposes of preparing for liner installation such that no special protective layers are required. Any additional subgrade preparation required for successful completion of the WORK, as specified in the Contract Documents, shall not be considered for purposes of this item.

B. **Installation:**

1. The geomembrane liner system shall be installed in accordance with these Specifications and as shown in the Drawings. The lining installation shall be coordinated with installation of the **TYPE A Geotextile Fabric** to minimize exposure time of the geomembrane liner system.

2. The geomembrane sheets shall be of such lengths and widths and shall be placed in such a manner as to reduce field jointing to a minimum. Horizontal field seams on the slopes shall not be permitted.

3. Under no circumstances shall the geomembrane liner be subjected to materials, sandbags, equipment, or other items being dragged across its surface, nor shall workmen and others slide down slopes atop the lining. All scuffed surfaces resulting from abuse of any kind during performance of the WORK shall be patched at the ENGINEER's direction. All parties walking or working upon the lining material shall wear smooth-sole shoes. Shoes with patterns in relief that pick up rocks and trash will not be permitted. No vehicular traffic shall be allowed on the geomembrane liner. Smoking will not be allowed on the liner.

4. Individual sheets of liner material shall be laid out and overlapped by a minimum of 2 inches prior to welding. Extreme care shall be taken by the installer in the preparation of the areas to be welded. The area to be welded shall be cleaned and prepared according to the procedures provided by the material manufacturer. All sheeting shall be welded together by means of hot wedge fusion welding or extrusion welding. The composition of the extrudate shall be identical to the lining material. No geomembrane material shall be placed when air temperature at a point 6 inches above the sheet being installed is less than 20 or greater than 105 degrees F, or when relative humidity is more than 80 percent, or when it is raining, snowing, hailing, or when there is frost on the ground.

5. The thermal welding equipment used shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the lining material so as to ensure changes in environmental conditions will not affect the integrity of the weld.

6. No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped, and an overlap extrusion weld shall be applied. All welds on completion of the WORK shall be tightly bonded. Any geomembrane

area showing injury due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of geomembrane material.

C. **Storage:** Material shall be stored on a smooth clean surface which will prevent damage to the geomembrane lining during unloading and loading operations.

D. **Liner Restraint During Installation:** Sandbags shall be used as required to hold the geomembrane liner in position during installation. Sandbags shall be sufficiently close-knit to preclude fines from working through the bag material or seams of the bags. Bags shall contain not less than 40 nor more than 60 pounds of sand having 100 percent passing a number 8 screen and shall be tied closed after filling. Bags that are split, torn, or otherwise losing their contents shall be immediately removed from the construction area and any spills immediately cleaned up.

E. **Geomembrane Anchors/Seals to Concrete Structures:**

1. Anchor bolts, neoprene adhesive, neoprene pads, butyl tape, Type 18-8 stainless steel battens, and caulking and primer shall be used to connect the geomembrane liner sheets to the concrete structures in accordance with the details shown on the Drawings. The contact surfaces of the geomembrane liner and concrete shall be free of all dirt, dust, free moisture, oil or other foreign materials.

2. Anchor bolts shall be set into the concrete per directions of the anchor bolt manufacturer. Embedment length into the concrete shall be per directions of the anchor bolt manufacturer. Anchor bolts shall be given adequate curing time per manufacturer's recommendations prior to applying any pull-out or lateral forces to the anchor bolts, and before making the VLDPE anchor/seal to the anchor bolts.

3. Neoprene adhesive shall be applied to both contact surfaces of the materials to which it separates. Application of neoprene adhesive shall be in conformance to the adhesive manufacturer's recommendations. Materials separated by the adhesive shall be joined within the time recommended by the manufacturer.

4. Butyl tape, caulking and primer shall be applied in accordance with the product manufacturer's recommendations. Butyl tape shall be applied to both contact surfaces of the materials to which it separates.

5. Nuts shall be tightened on the anchor bolts sufficiently to deform the neoprene pad uniformly along its length to obtain a watertight connection from the liner to the concrete structure. No wrinkles shall exist in the liner at the location of the battens prior to placement of the battens or under the battens after tightening the nuts on the anchor bolts.

F. **Repair of Damages to Liner During Installation:** All punctures, cuts, tears, severe abrasions and similar damage or abuse suffered by the geomembrane liner shall be repaired by patching, using the manufacturers recommended procedures and equipment for field welding, and to the satisfaction of the ENGINEER.

1. **Patches.** Patches shall be cut from flat, unwrinkled scraps of material being patched, and shall be free of defects, and seams of any type. The patches shall be of sufficient size to extend a minimum of 8 inches in all directions beyond the limits of any puncture, cut, tear, abrasion, etc. The minimum sized patch shall be 16 inches.

Patches shall be neat in appearance with corners rounded to a minimum 1-inch radius. The contact surfaces shall be prepared and the patch seamed in accordance with the specifications herein.

2. **Application.** Patches shall be applied as specified above for lap joints. The parent material shall be held flat in the area to be patched so as to provide an acceptable surface to receive the patch.

3. **Plugs.** Penetrations created during cable-stayed concrete mat system anchor installation shall be plugged with a 90/10 percent Portland cement/bentonite slurry.

G. **Field Seams:** Lap joints as shown on the Drawings shall be used to seam geomembrane liner sheets together in the field. The lap joints shall be formed by lapping the edges of liner sheets a minimum of 2 inches. The contact surfaces of the sheets shall be wiped clean to remove dirt, dust, moisture, and other foreign materials. All field seams shall have a bonded seam strength of 75 percent of specified value of tensile strength at yield. Field seams which join geomembrane sheets shall be made using the liner manufacturer's hot wedge fusion welding system, equipment, and techniques.

H. **Workmanship:** All seams and seals of the liner linings on completion of the WORK shall be tightly bonded. Any lining surface showing injury due to scuffing or penetration by foreign objects or distress shall be replaced or repaired as directed by the ENGINEER.

I. **Cleanup:** Cleanup within the WORK area shall be an on-going responsibility of the CONTRACTOR throughout the course of the WORK. Particular care shall be taken to insure that no trash, tools, and other unwanted materials are trapped beneath the geomembrane liner or on the liner installation. The ENGINEER may, at his discretion, halt work until such unwanted materials are removed from the installation in accordance with the Construction Specifications. Care shall be taken to insure that all scraps of lining material and drainage net are removed from the WORK area prior to completion of the installation.

3.2 Geomembrane Liner Testing

A. **General:** Geomembrane liner testing shall be conducted at the minimum intervals specified below. All samples shall be tested within 48 hours of the date of the sample and copies of the results shall be made available to the OWNER within 48 hours of the date of completion of the testing.

B. **Destructive Seam Testing:**

1. Two test welds, three feet long from each welding machine, shall be run twice daily at approximately four hour intervals for each eight hours of operation with the first set prior to liner welding and under the same climatic and physical conditions as for the liner welding. These test welds shall be marked with the date, ambient temperature, thickness, welding machine number and operators full name. Of the two samples, one shall be delivered to the OWNER, or OWNER's representative, immediately upon completion of the weld. The other sample shall be retained by the installer. These seam samples shall be tested in both shear and peel using tensile tests approved by ENGINEER with the applicable ASTM standards. The CONTRACTOR shall provide and operate a field tensiometer for these tests.

a. For the shear test, the two separate pieces of the geomembrane shall be pulled apart, placing the joined or seamed portion in between shear.

   Passing shear test will fail outside of the weld area at a value not less than 80 percent of the sheet's specified tensile strength at yield.

b. For the peel test, one end and the closest end of the adjacent piece shall be gripped, placing the seamed portion between them in a tensile mode.

   Passing peel test will fail outside of the weld area at a value not less than 70 percent of the sheet's specified tensile strength at yield.

2. In addition to the above trial seams, field seam samples shall be collected at 1,000-foot intervals for subsequent laboratory destructive testing. One set of samples for both the trial and field seam testing shall be sent to an independent laboratory selected by the OWNER and not affiliated with any installer, with their tests governing in the event of a dispute between the OWNER and the installer or CONTRACTOR.

3. During the field seaming operation, the ENGINEER may elect to have test samples removed from the field seams by the CONTRACTOR at locations selected by the ENGINEER.

C. **Nondestructive Air Pressure Testing:** Air pressure testing shall be utilized on all liner seams completed using hot wedge fusion welding. The sealed channel created by the fusion process shall be sealed at both ends prior to testing. The pressure induction device shall then be inserted into the test seam. The test seam shall then be pressurized for 5 minutes to 30 psi, with an observed pressure loss during the test of less than 3 psi.

   Any noted exceptions to the testing procedure shall require definition of any leakage areas by additional air pressure testing or vacuum testing. Following completion of testing, all test areas shall be patched according to these Construction Specifications.

D. **Nondestructive Vacuum Seam Testing:** Vacuum testing of field seams shall be performed by the installer continuously along all factory and field seams. Testing shall be performed under the direct observation of the ENGINEER. Vacuum testing shall be conducted using a glass faced suction box approximately 3 feet long and wide enough to adequately cover the weld. A smaller dimension box (4 inch x 12 inch) may be requested if a vacuum cannot be developed under the larger box in corner areas. Minimum vacuum during testing shall be -5 psig over a minimum period of 20 seconds. The test section shall have been wetted with a soap solution prior to conducting the test. Suction shall then be applied to the seam and any leaks are demonstrated by the formation of bubbles. Vacuum tests shall overlap a minimum of 6 inches. All free edges shall be removed using a method approved by the ENGINEER prior to testing. Leaks found shall be marked and repaired.

E. **Nondestructive Visual Inspection:** A quality-control technician shall visually inspect each lining sheet, seam, anchor and seal. Any area showing a defect shall be marked and repaired in accordance with the manufacturers repair procedures. Defects shall be marked and repaired.

F. **Records:**

1. Complete records shall be kept by the ENGINEER of all damaged areas, repairs and tests conducted and repairs and test which have passed. No cover material will be

allowed on the geomembrane liner until authorized by the ENGINEER following a final walk-through of the area to be covered.

2. The installer shall also keep detailed Record Drawings showing the location, size, type, and frequency of all tests and repairs made during the installation of the geomembrane liner system. These Record Drawings shall be updated by the installer on a daily basis and submitted to the OWNER upon completion of the project. Inspection of these Shop Drawings shall be made available to the ENGINEER or the OWNER for verification and review at any time during the construction period.

3.3 Anchoring Liner in Trench

A. **General:** The geomembrane liner shall be anchored at the top and bottom in an anchor trench, constructed as shown in the Drawings.

3.4 Placement of Cover Material Above Liner

A. **General:** Following satisfactory installation of the geomembrane liner along the creek embankment, the geomembrane shall be covered with cable-stayed concrete as shown on the Drawings and defined in Section 03401 - "Cable-Stayed Concrete Mat System." No operational traffic will be allowed on the geomembrane liner until the cable-stayed concrete cover has been installed. The exact procedure for placing the cable-stayed concrete upon the geomembrane liner, and the precautions planned for protecting the lining against damage during the placement of the cover material shall have the approval of the ENGINEER prior to commencement of this WORK. Placement of the cover material by the CONTRACTOR over the geomembrane lining shall be accomplished under the continuous observance and inspection of the ENGINEER, and no such WORK shall be permitted in his/her absence.

-- END OF SECTION --

SECTION 03401 - CABLE-STAYED CONCRETE MAT SYSTEM

PART 1 -- GENERAL

1.1 The Requirement

A. The CONTRACTOR shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to complete the cable construction and installation of the cable-stayed concrete mat system in work in accordance with the Contract Documents.

B. This Section covers the design, fabrication, delivery and installation of all cable-stayed concrete mats as manufactured by Royal Concrete Products or applied equal, including connections, complete, in place, as shown and specified.

1.2 Codes and Standards

A. **Commercial Standards:**

ANSI/ACI 315	Concrete Reinforcement
ANSI/ACI 318	Concrete Construction
ANSI/AWS A5.4	Welding Rods and Electrodes
AWS B2.1	
ANSI/AWS D1.1	Welding and Cutting
ANSI/AWS D1.4	Welding and Cutting
ASTM A 193	Specification for Allow-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 580	Specification for Stainless and Heat-Resisting Steel Wire
ASTM A 666	Specification of Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
ASTM C 33	Specification for Concrete Aggregates
ASTM C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	Test Method for Specific Gravity and Absorption of Fine Aggregate

ASTM C 150	Specification for Portland Cement
ASTM C 173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 204	Test Method for Fineness of Portland Cement by Air Permeability Apparatus
ASTM C 231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete
ASTM C 311	Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
ASTM E8	Stainless Steel Cable

1.3 Contractor Submittals

A. **Shop Drawing:** The CONTRACTOR shall furnish complete shop drawings for cable-stayed concrete mix design; mat system layout showing proposed size, number, and position; proposed anchoring layout; and all required hardware.

1.4 Design Requirements

A. **General:** The precast cable-stayed concrete mat and connection designs shown represent minimum precast construction requirements. The manufacturer shall verify the mat and connection designs for all handling, installation, and service conditions, and shall provide any additional materials necessary to meet the design conditions.

1.5 Delivery, Storage and Handling

A. **General:** Mats shall be handled to position consistent with their shape and design; they shall be lifted and supported from design incorporated support points and provided with strong backs and other devices as required. Lifting or handling equipment shall be capable of maintaining units during manufacture, storage, transportation, installation, and in position for fastening.

B. Blocking and supports, lateral restraints and protective materials during transport and storage shall be clean and nonstaining, without causing harm to exposed surfaces. Edges and exposed faces of members shall be protected to prevent straining, chipping, or spalling of concrete.

C. Units shall be marked with date of production.

D. Precast units shall be stored off the ground in a manner to be protected from weather, marring, and overload.

E. **Stainless Steel Hardware:** Stainless steel hardware shall be transported, handled, stored, and protected in wood crates.

PART 2 -- PRODUCTS

2.1 Concrete Materials

A. **Cement:** Portland cement shall conform to AASHTO M85.

B. **Aggregate:** Aggregate shall conform to IDOT Specification 4110, fine aggregate for Portland cement concrete and/or IDOT Specification 4115, coarse aggregate for Portland cement concrete.

1. Water Absorption, Coarse ASTM C 127
2. Water Absorption, Fine ASTM C 128

C. **Stainless Steel Cable:** Longitudinal cables shall be of 1 x 19 construction x 5/32-inch diameter with a breaking strength of 3,300 lbs or greater. Transverse cables shall be of 1 x 19 construction x 1/8-inch diameter with a breaking strength of 2,100 lbs or greater. All cables shall be Type 302 stainless steel.

D. **Air Entrainment Admixture:** ASTM C 260.

E. **Water Reducing or Retarding Admixtures:** ASTM C 494 C, D, or F/G, with no chloride, bromide, and fluoride ingredients.

2.2 Support Devices

A. **Connecting and Support Devices:** ASTM A 666, Type 316L stainless steel.

B. **Bolts:** ASTM A 193, Grade B8M (Type 316).

C. **Nuts and Washers:** ASTM A 194, Grade 8M (Type 316).

D. **Weld Filler Metal:** Stainless steel to stainless steel; AWS A5.4, Grade 316L stainless steel filler metal; stainless steel to carbon steel, AWS A5.4, Grade 309 filler metal, 3/32-inch diameter.

2.3 Accessories

A. **Plates, Angles, Anchors, and Studs:** ASTM A 666, Type 316 L stainless steel.

B. **Austenitic Steel Castings for Embedments and Anchorage Assemblies:** ASTM A 351, Type CF3M, with Type 316 stainless steel bolts, nuts, and washers.

C. **Anchors:** Anchors shall be as manufactured by Royal Concrete Products.

D. **Geotextile:** As specified in Section 02276 - "Geotextile Fabrics."

E. **Wire Rope Clips:** Aluminum CP2-6P by Indusco, Inc. of Baltimore, MD or approved equal.

2.4 Forms

A. **Forms:** Manufacturer's standard with smooth, hard, dense, and rigid casting surface; without bow, warpage, oil canning, or other imperfections.

B. **Form Release Agent:** Manufacturer's standard, nonstaining, nonpetroleum based; compatible with concrete surface sealer.

C. **Surface Sealer:** Clear, flat, penetrating, nonyellowing, nonclouding solution; high concentration of organosilane in an aqueous alcoholic vehicle which is designed to provide water repellent concrete surfaces from which graffiti can be easily removed. Oil-type silicones, paraffins, waxes, vinyls, modified urethanes, or acrylics shall not be used. Sealant shall be tested by manufacturer and proved compatible with surface sealer.

2.5 Fabrication

A. **General:** Precast concrete units shall be fabricated by a licensed shop in accordance with ACI 318. Plant records and quality control program shall be maintained during production of precast units. Records and access to plant shall be available to the ENGINEER upon request.

Rigid molds shall be used, constructed to maintain precast unit uniform in shape, size, and finish, free from castings and dents, gouges, oil canning, or other irregularities that will adversely affect appearance of strength of units. Consistent quality shall be maintained during manufacture.

Reinforcing steel, anchors, inserts, plates, angles, and other cast-in-place items shall be embedded as indicated on shop drawings. Reinforcement shall be fabricated and placed in conformance with ACI 318. No tack welding of or to reinforcement is permitted. Welding when allowed shall conform to AWS D1.4 requirements. No carbon steel chairs, spacers, nails or tie wire shall be used in positioning reinforcing and embedments.

Maximum permissible crack width is 0.005 inch.

Connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories shall be fabricated to permit initial placement and final attachment.

Anchors, inserts, lifting devices, and other accessories shall be placed and embedded in accordance with approved shop drawings, accurately positioned in their designed location and anchored to prevent dislocation during mat construction. All anchor pilot holes shall be backfilled with a 90/10 percent Portland cement/bentonite slurry.

Units shall be moist cured with water mist to develop concrete quality and to minimize surface drying and appearance blemishes such as nonuniformity, staining, or surface cracking.

Minor patching in plant is acceptable, providing structural adequacy and appearance of units are not impaired.

B. **Fabrication and Tooling of Stainless Steel Connections and Embedments:** All tools used during fabrication shall be made of stainless steel. Use of carbon steel tools is prohibited.

Erection slings, cables, blocking, hardware and restraints shall be nonmetallic or stainless steel. Cribbing or crating shall be wood.

2.6 Finish of Precast Units

A. **Backs and Sides (Unexposed Edges):** Smooth, dense, uniform surface free from blemishes. Defects in backs and sides (unexposed edges) shall be repaired as approved.

B. Repairs will be acceptable only if structural adequacy and appearance of product are not impaired.

2.7 Manufacturers, or Equal

A. Approved or equal manufacturers of cable-stayed concrete mats:

1. Royal Concrete Products, Inc., Ramsey, MN

PART 3 -- EXECUTION

3.1 Installation

A. **Examination:** The CONTRACTOR shall verify that the site is ready to receive work of this Section. Beginning of installation means acceptance of existing condition.

B. **Preparation:** The CONTRACTOR shall provide for placement procedures and induced loads, during installation, maintain temporary bracing in place until final support is provided, provide necessary hoisting equipment and safety and protective devices.

C. **Installation:** The units shall be installed in accordance with approved shop drawings without damage to shape or finish or adjacent work. Damaged mats shall be replaced or repaired. Unless otherwise shown, members shall be installed within allowable tolerances. Pickup points, boxouts, inserts and bearing surfaces shown shall be grouted with nonshrink grout.

D. **Anchors:** Anchors shall be installed in accordance with manufacturer's written instructions. Penetrations in geomembrane liner resulting from anchor installation shall be plugged with a 90/10 percent Portland cement/bentonite slurry.

E. **Geotextile Fabric/Geomembrane Liner:** Wherever geotextile fabric/geomembrane liner material is placed, the foundation surface shall be relatively smooth and free of stones, sticks and other debris or irregularities that might puncture the fabric/liner. Placement of granular material, cable-stayed concrete mats and other construction operations shall not tear, puncture or shift the fabric.

3.2 Protection

A. Adjacent surfaces shall be protected from damage, disfiguration or discoloration from subsequent operations.

-- END OF SECTION --