Five Year Review Report

First Five Year Review Report for the Hardage/Criner Superfund Site McClain County, Oklahoma

U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202-2722

September 2002

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Five Year Review Memorandum

Hardage/Criner Superfund Site
EPA ID# OKD000400093
McClain County, Oklahoma

This U.S. Environmental Protection Agency (EPA) memorandum documents the performance, determinations, and approval of the Hardage/Criner Superfund Site Five Year Review, including the attached Five Year Review Report prepared by EPA.

Summary of Five Year Review Findings

All immediate threats at the Hardage/Criner Superfund Site, McClain County, Oklahoma (the site) have been addressed, and the remedy components determined by the Order of August 9, 1990, of the United States District Court for the Western District of Oklahoma (the Court) in *United States v. Royal N. Hardage, et al.*, C.A. No. 86-1401-P (W.D.Okla.), as amended, (the Court Order) are expected to remain protective of human health and the environment. The Court Order, which was issued in response to a United States complaint under section 106(a) and 107(a) of the Comprehensive Environmental Response, Compensation & Liability Act (CERCLA), 42 U.S.C. §§9606(a), 9607(a), specified remedial objectives for the site without specifying cleanup goals for individual contaminated environmental media. The remedial objectives are to control the surface water pathway, preclude site access and direct contact with the waste, control air emissions from the source areas, and preclude the use of affected ground water. The remedy components form the basis of a waste containment remedy at the Hardage site and must be monitored in perpetuity. The V-Trench and Southwest Recovery Wells must be maintained and operated indefinitely. The institutional controls required by the Court Order dedicate the site solely to the remedial activities ordered by the Court, as well as control access and use of the site itself and certain adjoining properties.

Actions Needed

The recommended actions below address issues concerning data collection and performance monitoring of the Court selected remedy components. While these issues are not currently significant enough to call into question the protectiveness of the remedy, the performance monitoring data will be needed to assess the future remedy protectiveness:

- Determine if changes in the pumping rates can be used to achieve the performance standard for hydraulic containment in the Southwest Wells Recovery System.
- Determine why the performance standard for monitoring hydraulic containment has not been continuously met in the V-Trench piezometers.
- Repair the damaged piezometers and implement the quarterly collection of fluid levels from the Permanent Mounds Liquid Recovery System (PLRS) piezometers and the

generation of a liquid level elevation map to assess the effects of PLRS operation.

- Evaluate alternative sample collection methods for volatile organic compounds (VOCs) from ground water monitoring wells.
- Re-submit the proposed risk assessment for the Northwest Borrow Area ground water seeps incorporating the updated VOC concentration profile and the updated cancer slope factor and toxicity data for 1,1-dichloroethene.
- Provide an annual assessment of the phytoremediation field test and reduction in the Northwest Borrow Area ground water seeps.
- Update the 1998 Performance Monitoring Plan for Long-Term Operation of the Remedy for the Hardage site upon resolution of the above issues.
- Provide a written report to the EPA of the results of the scheduled 2002 inspection of the site Composite Cap.

Determinations

I have determined that the remedy for the Hardage/Criner Superfund Site, McClain County, Oklahoma, is protective of human health and the environment, and will remain so provided the action items identified in the Five Year Review Report are addressed as described above and in the report.

Myron O. Knudson — 9-27-02

Myron O. Knudson, P.E., Director, Date
Superfund Division
U.S. Environmental Protection Agency Region 6

CONCURRENCES

Five year REVIEW

for the

Hardage/Criner Superfund Site
EPA ID# OKD000400093

By: _____ Date: 9-26-02
Vincent Malott
Remedial Project Manager

By: _____ Date: 9-26-02
Gustavo T. Chavarria, Chief
AR/OK/TX Project Management Section

By: _____ Date: 9/26/02
William K. Honker, Chief
AR/OK/TX Branch

By: _____ Date: Sept. 26, 2002
James L. Turner
Senior Attorney, Office of Regional Counsel

By: _____ Date: 09/26/02
Mark Peycke, Chief
Superfund Branch, Office of Regional Counsel

By: _____ Date: _____
Pam Phillips, Deputy Director
Superfund Division

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Five Year Review Report

First Five Year Review Report for Hardage/Criner Superfund Site McClain County, Oklahoma

September 2002

PREPARED BY:

Region 6
United States Environmental Protection Agency
Dallas, Texas

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List of Acronyms

AGV	Active Gas Vent
ARARs	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EPA	United States Environmental Protection Agency
HSC	Hardage Steering Committee
HSRC	Hardage Site Remediation Corporation
mg/L	milligrams per liter
µg/L	micrograms per liter
MLRS	Mounds Liquid Recovery System
NAPL	Non-Aqueous Phase Liquids
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NES	Nationwide Environmental Services, Inc.
NPL	National Priorities List
ODEQ	Oklahoma Department of Environmental Quality
O&M	Operations and Maintenance
PRP	Potentially Responsible Party
PLRS	Permanent Mounds Liquid Recovery System
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SOW	Scope of Work
USC	United States Code
USGS	United States Geological Survey
WTP	Water Treatment Plant

Executive Summary

The Hardage/Criner Superfund Site, McClain County, Oklahoma, ("Hardage site" or "the site") is under the jurisdiction of the United States District Court of Western Oklahoma and operates under a 1990 Court Order and not under a traditional EPA Record of Decision. The Court Order specified remedial objectives for the site without specifying cleanup goals for individual media. The remedial objectives are to control the surface water pathway, preclude site access and direct contact with the waste, control air emissions from the source areas, and preclude the use of affected ground water. The Court Order remedy components form the basis of a waste containment remedy at the Hardage site and must be monitored in perpetuity. The remedy components include a composite cap over the former disposal area; a liquid recovery well system in the former disposal area; a hydraulic containment system composed of a V-Trench and Southwest Wells Recovery System to prevent further migration of contaminated ground water from the source areas; a water treatment plant for the recovered ground water; natural attenuation for a portion of the contaminated ground water; institutional controls on the property and ground water usage; and a ground water and surface water monitoring system.

The Hardage Steering Committee completed construction of the Court Order remedy in 1995. EPA signed a Preliminary Close Out Report (PCOR) on September 30, 1997 to trigger the construction completion milestone. However, the trigger for this Five Year review was the start of construction in 1991. The assessment of this Five Year review found that all immediate threats at the site have been addressed, and the Court selected remedy components are expected to be remain protective of human health and the environment. The remedy components form the basis of a waste containment remedy at the Hardage site and must be monitored in perpetuity. The V-Trench and Southwest Recovery Wells must be maintained and operated indefinitely. The institutional controls ordered by the Court dedicate the Hardage site itself solely to the remedial activities ordered by the Court, as well as require the purchase of adjoining properties, the restriction of public access, and the recording of restrictive covenants controlling site use.

Five Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: Hardage/Criner Superfund Site

EPA ID *(from WasteLAN)*: OKD000400093

Region: 6	**State:** OK	**City/County:** McClain

SITE STATUS

NPL status: X Final ☐ Deleted ☐ Other (specify) _____

Remediation status (choose all that apply): ☐ Under Construction X Operating X Complete

Multiple OUs?* ☐ YES X NO	**Construction completion date:** _09 /30 /1997 _

Has site been put into reuse? ☐ YES X NO

REVIEW STATUS

Lead agency: X EPA ☐ State ☐ Tribe ☐ Other Federal Agency _____

Author name: Vincent Malott

Author title: Remedial Project Manager	**Author affiliation:** U.S. EPA

Review period: 2/13/2001 to 09/16/2002

Date(s) of site inspection: 10/14-15 /2001 and 6/18-19/2002

Type of review:
X Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion

Review number: X 1 (first) ☐ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:
☐ Actual RA Onsite Construction at OU #____ X Actual RA Start
☐ Construction Completion ☐ Previous Five Year Review Report
☐ Other (specify) _____

Triggering action date *(from WasteLAN)*: 11/20/1991

Five Year Review Summary Form (continued)

Issues:

- Monitoring data indicates that there are site areas where the performance standard for hydraulic containment in the Southwest Wells Recovery System and V-Trench has not been continuously met.
- There is an absence of current monitoring data to evaluate the fluid level beneath the Barrel Mound and Main Pit area.
- Sampling procedures for collection of volatile organic compounds (VOCs) from ground water monitoring wells are not current with recommended procedures.
- VOC concentration data relative to the exposure concentrations and risk levels calculated for the Northwest Borrow Area ground water seeps have been found to be variable. Also, the 1,1-dichloroethene cancer slope factors and non-cancer toxicity factors used in the proposed risk assessment for the Northwest Borrow Area have been updated.
- The effectiveness of the ongoing phytoremediation field testing and expected reduction in the Northwest Borrow Area ground water seeps.
- The 1998 Performance Monitoring Plan for Long-Term Operation of the Remedy is not current for the Hardage site.
- EPA has not been provided by HSRC with a written report of the results of the scheduled 2002 inspection of the site Composite Cap.

Recommendations and Follow-up Actions:

- Determine if changes in the pumping rates can be used to achieve the performance standard for hydraulic containment in the Southwest Wells Recovery System.
- Determine why the performance standard for monitoring hydraulic containment has not been continuously met in the V-Trench piezometers.
- Repair the damaged piezometers and implement the quarterly collection of fluid levels from the Permanent Mounds Liquid Recovery System piezometers and the generation of a liquid level elevation map to assess the effects of PLRS operation.
- Evaluate alternative sample collection methods for VOCs from ground water monitoring wells.
- Re-submit the proposed risk assessment for the Northwest Borrow Area ground water seeps incorporating the updated VOC concentration profile and the updated cancer slope factor and toxicity data for 1,1-dichloroethene.
- Provide an assessment of the phytoremediation field test and reduction in the Northwest Borrow Area ground water seeps in the Annual Remedial Status Report.
- Update the 1998 Performance Monitoring Plan for Long-Term Operation of the Remedy for the Hardage site upon resolution of the above issues.

- Provide a written report to the EPA of the results of the scheduled 2002 inspection of the site Composite Cap.

Protectiveness Statement:

All immediate threats at the site have been addressed, and the Court selected remedy components are expected to be remain protective of human health and the environment, provided that the issues and recommendations in this report are properly addressed. The Court Order specified remedial objectives for the site without specifying cleanup goals for individual media. The remedy components form the basis of a waste containment remedy at the Hardage site and must be monitored in perpetuity. The V-Trench and Southwest Recovery Wells must be maintained and operated indefinitely. The institutional controls imposed by the Court dedicate the Hardage site solely to the remedial activities ordered by the Court, as well as restricting access and use on the site and some adjacent properties.

Other Comments:

The issue concerning the risk to human health and the environment from the seeps along the Northwest Borrow Area and the recommended action to address the seeps should be resolved within the current year. This issue does not impact the current protectiveness since the Hardage site has implemented institutional controls controlling site access and the site workers have access to a Health and Safety Plan concerning sampling procedures. The second issue concerning the proposal to discontinue pumping from the Southwest Wells should be evaluated against the remedial objectives and remedy components specified in the Court Order.

Hardage/Criner Superfund Site
McClain County, Oklahoma
First Five Year Review Report

I. Introduction

The purpose of this First Five Year Review is to determine whether the remedy at the Hardage/Criner Superfund Site ("Hardage site" or "the site") is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in the attached Five Year Review reports. In addition, Five Year Review reports identify issues found during the review, if any, and recommendations to address them.

The EPA has conducted this First Five Year Review pursuant to section 121 of the Comprehensive Environmental Response, Compensation & Liability Act (CERCLA), 42 U.S.C. §9621(c), which states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section 9604 or 9606 of this title, the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The agency interpreted this requirement further in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP); 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after initiation of the selected remedial action.*

The United States Environmental Protection Agency (EPA), Region 6, has conducted the Five Year review of the remedy implemented at the Hardage site in McClain County, Oklahoma. The CERCLA remedy for source control and management of migration was imposed *de novo* by the United States District Court for the Western District of Oklahoma in the case of *United States*

v. Royal N. Hardage, et al., C.A. No. 86-1401-P (W.D.Okla.) (*Hardage II*) in an order of August 9, 1990 (the Court Order). *See Hardage II*, 750 F.Supp. 1460 (W.D.Okla., 1990), *aff'd.* 982 F.2d 1436 (10th Cir., 1992), *cert. denied* 510 U.S. 913 (1993). This remedy and the imposition of costs upon the thirty-five arranger and transporter defendants was ordered pursuant to sections 106(a) and 107(a) of CERCLA, 42 U.S.C. §§9606(a), 9607(a); and the Court Order has been amended several times, most notably by orders of May 2, 1991, April 13, 1992, and August 31, 1993. Most of the *Hardage II* defendants were and are members of the Hardage Steering Committee (HSC), which is the entity formed by the site potentially responsible parties (PRPs), that is responsible for carrying out remediation. This Five Year review was conducted by the site Remedial Project Manager (RPM) for the entire site from February 2001 through September 2002. This report documents the results of the review. Nationwide Environmental Serves, Inc., (NES) under contract to the Hardage Site Remedy Corporation (HSRC), the cleanup arm of the HSC, provided support for preparation of this Five Year review report through the submittal of background information, summary data tables, illustrations, and a draft Hardage Five Year Review Report.

This is the first Five Year review for the Hardage site. The Five Year review is required due to the presence of hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure.

II. Site Chronology

9/1972 - 11/1980	Site operated as an Oklahoma Controlled Industrial Hazardous Waste Land Disposal Facility.
1978	State of Oklahoma filed complaints against the site operator for suspected lead contamination of the air around the Site.
9/1979	OSDH began proceedings to revoke the site permit as a result of Royal Hardage's use of un-permitted pits, his failure to seal permeable lenses in the pits, his improper closure of pits, his failure to retain runoff, and his improper storage of wastes at the Site.
1979	Preliminary EPA investigations and inspections of the Site indicated poor waste management practices posing threats to public health and the environment.
9/1980	United States filed suit in *United States v. Hardage (Hardage I)* on behalf of EPA against Royal Hardage seeking cleanup and closure of the site. U.S. complaint alleged endangerment under §7003 of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §6973.
11/1980	Royal Hardage closed the site prior to the effective date of the RCRA Subtitle C regulations.
1980 - 1986	EPA RCRA and CERCLA investigations and studies. Royal Hardage filed bankruptcy. *Hardage I* was dismissed in 1985, and U.S. filed CERCLA suit in *Hardage II* on June 25, 1986.
1984	EPA notified arranger and transporter companies that used the Hardage site that they were CERCLA potentially responsible parties (PRPs). HSC was formed by the PRPs.

1986 - 1989	HSC site investigations and *Hardage II* case discovery. EPA made second CERCLA remedy selection after 1986 remedy was not found compliant with RCRA land disposal restrictions. PRPs found liable in *Hardage II*, and EPA entered $11 million *de minimis* settlement with 179 PRPs.
8/09/1990	U.S. District Court rejected EPA remedy and selected HSC site remedy *de novo* in *Hardage II*.
9/1990	HSC site Remedial Design /Remedial Actions began.
5/1993	Site Remedial Design completed.
08/31/1993	Modifications to the remedy were identified in the Order Modifying Remedy Implementation: Mounds Liquids Recovery System and On Site Class-I Non-Hazardous Injection Well.
10/1993	Site remedial construction contract signed.
11/1993	Site remedial construction commenced started.
5/1994	Site V-Trench construction completed.
2/1995	Site Water Treatment Plant brought on-line.
9/1995	The site remedial construction contractor finished its six-month shakedown and operation and maintenance (O&M) started.
1995	HSRC contracted with Nationwide Environmental Services, Inc. (NES) for long-term O&M for the site remedy.
9/1997	EPA signed Hardage site Preliminary Close Out Report (PCOR).

III. Background

Physical Characteristics

The Hardage site is located on State Highway 122, 3/4 mile west of Criner, Oklahoma and the intersection of State Highways 122 and 59. The site is in McClain County, Oklahoma, approximately 30 miles south-southwest of Oklahoma City. The population is approximately 20 persons within a one mile radius of the Site.

The Hardage site covers approximately 160 acres and is bordered by open farmland. The topography of the area is flat to gently rolling hills. The principal disposal operations were conducted along a north-south trending ridge at the center of the property. Relief is about 100 feet from the ridge to the adjacent stream valley. The Site is bounded on the southwest by the North Criner Creek flood plain. North Criner Creek flows in a southeasterly direction past the site, eventually discharging to the Canadian River. Runoff from the western side of the site enters North Criner Creek and runoff from the eastern side drains into a series of three small farm ponds.

Land and Resource Use

Land use surrounding the Hardage site is primarily rural agricultural, and has historically been used for agricultural purposes. Institutional controls restrict the site and some adjoining property use surrounding the Hardage site.

History of Contamination

Royal N. Hardage owned and operated a waste disposal facility at the present-day Hardage site. The Oklahoma State Department of Health (OSDH) permitted the Hardage facility as an Industrial Hazardous Waste Land Disposal Facility in September 1972. The site began operation in September 1972 and closed in November 1980, due to its inability to meet newly imposed standards of Subtitle C of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §6921. Over the eight-year period of operation, in excess of 20 million gallons of waste were transported to the Hardage site for storage and/or disposal. Originally, liquids and sludges from drums and tank trucks were discharged directly into unlined pits. As disposal areas filled, wastes were transferred to other areas. Later, drums were no longer emptied, but piled into what became the drum or barrel mound. Ultimately, the site consisted of chemical impoundments including the large unlined, unsealed main pit, a series of small temporary pits, and two large mounds (the barrel mound and the sludge mound). The types of waste generally accepted at the site included oil recycling wastes, acids, caustics, lead, cyanide, arsenic, aromatic and chlorinated solvents, pesticides, PCBs, and other substances.

Initial Response

In 1978, the State of Oklahoma filed complaints against the facility for suspected lead contamination of the air around the Site. In September 1979, the Oklahoma State Department of Health (OSDH), predecessor to the Oklahoma Department of Environmental Quality (ODEQ), began proceedings to revoke the facility permit as a result of Royal Hardage's use of un-permitted pits, his failure to seal permeable lenses in the pits, his improper closure of pits, his failure to retain runoff, and his improper storage of wastes at the Site. During 1979, preliminary EPA investigations and inspections of the Site indicated poor waste management practices posing threats to public health and the environment. In September 1980, the U.S. Department of Justice (DOJ) filed suit in *United States v. Hardage* on behalf of EPA against Mr. Hardage. The complaint alleged violations of Section 7003 of RCRA, 42 U.S.C. §6973, and sought injunctive relief for proper cleanup and closure of the Site. The Site was closed in November 1980, and Royal Hardage subsequently filed bankruptcy in 1983. Following their notification by EPA in 1984 of potential CERCLA liability for the site, and the DOJ then filed a second action against approximately 35 potentially responsible parties (PRPs), who had been arrangers and transporters for hazardous waste disposal at the site, seeking to recover costs and impose an EPA CERCLA selected remedy. Ultimately, the remedy was determined de novo after a

trial. In the Court Order, the Judge ordered imposition of the HSC remedy, rejecting the 1989 EPA CERCLA site remedy as arbitrary and capricious. Thus, the site is under the jurisdiction of the United States District Court of Western Oklahoma and operates under a Court-ordered Remedy and not under a traditional EPA CERCLA Record of Decision (ROD).

Basis for Taking Action

During site operations, approximately 21 million gallons of industrial wastes including acidic, caustic and corrosive wastes, many classified as carcinogenic, were disposed on the Hardage site. The principal source of contamination is some 278,000 cubic yards of sludges, waste drums, highly contaminated soils, and waste liquids contained in three waste disposal areas near the center of the property. Hazardous substances detected in the source area include: 1,2-dichloroethane, 1,1,2-trichloroethane, 1,1-dichloroethene, tetrachloroethene, trichloroethene, lead, chromium, PCBs, and toxaphane.

Hazardous substances from the source area have contaminated the ground water present in Strata I, II, and III. Ground water flows east toward the east farm ponds, and west-southwest toward the North Criner Creek alluvium. Stratum IV and V consist of low permeability mudstones and silty mudstones that separates the shallow ground water from saline water in Stratum VI.

IV. Remedial Actions

Remedy Selection

The Court selected the following remedial objectives for the Hardage site remedy but did not select specific numerical cleanup standards for attainment by the remedy. The remedial objectives as described in the 1990 Judgment and Order (see Section VIII, Finding No. 12, page 53) include:

- Control the surface water pathway;
- Preclude site access and direct contact with waste;
- Control air emissions from the source areas;
- Preclude the use of affected ground water; and
- Provide for a contingent response to ensure continued maintenance of the quality of North Criner Creek.

The Court selected the following remedy components for the Hardage site as described in the 1990 Judgment and Order (see Section VIII, Finding No. 16, pages 56-58). The remedy components form the basis of a waste containment remedy at the Hardage site and must be monitored in perpetuity.

- V-shaped, gravel-filled interceptor trench constructed at the top of the Stratum IV to provide hydraulic control of the source areas by capture and removal of affected ground water and non-aqueous phase liquids for subsequent treatment.

- Composite cap over source areas to prevent direct contact with wastes, to control surface water flow in source areas, to limit erosion of affected soils, to reduce infiltration of precipitation, and to provide passive gas collection and treatment.

- Permanent vertical liquid recovery wells in the barrel mound and the main pit to extract pumpable liquids for off-site treatment by incineration and disposal in order to protect the stability of the barrel mound and main pit and to reduce the volume of free liquids.

- Southwest interceptor wells to prevent migration of affected ground water in the North Criner Creek alluvium.

- Water treatment system to treat ground water collected from the trench and wells to standards applicable for discharge into North Criner Creek.

- Natural attenuation and, if necessary, control of migration of constituents presently found in the alluvial ground water to effect cleanup of alluvial ground water and to prevent significant expansion of the area of affected ground water.
- Institutional controls to limit public access to affected areas, to prohibit future withdrawal of affected ground water, and to continue the public water supply to area residents.

- A ground water and surface water monitoring system to monitor ground water and surface water for continued effectiveness of the remedy.

Remedy Implementation

As agent for the Hardage Responsible Parties, the HSRC is managing the implementation of the remedy for the Hardage site. As noted above, the elements of the remedy are identified in the Court Order. HSRC let the construction contract on October 12, 1993, and physical construction of the remedy commenced in November 1993. The remedy was completed in February 1995 and the entire Remedy was in operation by May 1995. The construction contractor finished its initial six-month operation and maintenance contract on September 6, 1995. The EPA issued its Preliminary

Close Out Report (PCOR) for the remedy on September 30, 1997. Implementation of the site remedy components are as follows:

V-Trench Recovery System

The V-Trench consists of a gravel-filled ground water interceptor trench 2,600-feet long constructed to the base of Stratum III. The V-Trench has six recovery well sumps (designated TRS-2, 4, 6, 8, 10, 12), seven instrumented in-trench piezometers (designated TPZ-1i, 3i, 5i, 7i, 9i, 11i, 13i), and 12 in-trench observation wells (designated TOW-1 through 12). Three instrumented piezometers (designated TPZ-14i, 16i, and 18i) and four non-instrumented piezometers (designated TPZ-20, 21, 22, 23, 24) are located down gradient of the trench. A monitoring well nest MW-21S and 21M are incorporated into the trench monitoring system.

The V-Trench wells provide hydraulic control by capture of affected ground water. The performance criteria for demonstrating hydraulic capture by the V-Trench is for the water level within the trench piezometer (e.g., TPZ-3i) to be a minimum of 1 foot lower than the water level in the respective piezometer located 100 feet down gradient (e.g., TPZ-20). The TPZ well pairs (trench piezometer/down gradient piezometer) are 1i/14i, 3i/20, 5i/16i, 7i/21, 9i/22, 11i/18i, and 13i/23. Captured ground water is subsequently pumped to the Water Treatment Plant for treatment. The pathway for direct contact with constituents in captured ground water from the V-Trench is eliminated by the closed loop nature of the water treatment system.

Composite Cap

The Composite Cap is a multilayer cap placed over the Barrel Mound, Sludge Mound, and Main Pit. The Cap covers an area of 14 acres and prevents contact with affected materials. The Cap also functions to inhibit percolation of surface water through affected materials and prevent leaching of constituents to ground water. The Cap has a surficial vegetative layer of grass that intercepts precipitation and releases water via evapotranspiration.

The surface water pathway is being controlled by the Composite Cap and various on-site surface water control features. Surface water control features at the Site include topographic grading of the Cap to provide positive drainage off the Cap and from areas upgradient of ground water recovery features to minimize infiltration and prevent unnecessary collection of excess ground water. Other surface water control features include culverts, rip-rap-filled drainage channels, and a surface water detention pond. The detention pond was designed to collect surface water runoff and decrease the peak storm water discharge from a 50-year, 24-hour storm event. The pond is an earthen structure constructed with a 40-mil geomembrane liner covered with vegetated soil, a rip-rap centerline channel and spillway, and a corrugated metal pipe outlet. These features are passive structures that undergo periodic visual inspection and routine maintenance as needed.

Air emissions from waste beneath the Composite Cap are controlled through the Active Gas Venting (AGV) system. The AGV system consists of eleven vents and a blower that collects gases and vapors that accumulate beneath the low permeability layer of the Cap. Collected gases and vapors are treated on-site using gas-phase activated carbon.

Permanent Mounds Liquid Recovery System

The Court approved HSC preliminary remedy design for the mounds liquids extraction system assumed a well spacing of 50 feet with approximately 68 extraction wells planned for installation across the Main Pit and Barrel Mound source areas. As a Court approved interim measure to address the rise in liquid levels in the Barrel Mound area, a Mounds Liquid Recovery System (MLRS) consisting of 14 extraction wells became operational in December 1992. Initial operations over a 5-month period produced approximately 1,330,000 pounds of non-aqueous phase liquids (NAPL) that were sent off-site for thermal destruction. The system was shut-down during the start-up of construction in 1993.

Analysis of data collected from the interim MLRS operation indicated that 16 extraction wells instead of the planned 68 extraction wells could be used to remove all of the recoverable liquids from the Barrel Mound and Main Pit. This modification was approved by the EPA and the ODEQ and was approved by the Court in the amended Court Order dated August 31, 1993. On June 11, 1995, the Permanent Mounds Liquid Recovery System (PLRS) was placed into operation. The PLRS consists of 16 recovery wells (designated RW-1 through 16), 9 piezometers (designated MB-19 - 21, 23 - 28), a toe drain recovery sump, and the associated collection and storage system.

The Court Order required the removal of all pumpable liquids from the Barrel Mound and Main Pit. Data collected during the interim MLRS operation and other studies identified a 2 to 3 foot layer of viscous, tarry waste-sediment mixture at the bottom of the Barrel Mound and Main Pit source areas that was not pumpable. The 1993 amended Court Order specified that the bottom mass could be left in place and no further attempts shall be made to remove it.

The 1993 amendment also granted the flexibility for the HSC/HSRC to discontinue using the non-aqueous phase liquid (NAPL) separator based on achieving the most cost effective operating scenario. In 2001, HSC/HSRC discontinued use of the separator.

Southwest Wells Recovery System

The Southwest Wells Recovery System (Southwest Wells) consist of a line of recovery wells installed at 50-foot intervals along a line approximately 900-feet long to capture affected ground water in Stratum III. Nineteen recovery wells (designated SWWR-1 through 19) are installed along the alignment, along with three instrumented in-line piezometers (designated SWPZ-3i, 13i, 22i) and

15 non-instrumented in-line piezometers (designated SWPZ-1, 2, 7, 8, 9, 10, 11, 12, 17, 18, 19, 20, 21, 26, 27) that are installed between each recovery well. The performance criteria for demonstrating hydraulic capture by the Southwest Wells is for the water level within the in-line piezometers (located between the recovery wells) to be at a minimum of 0.1 foot lower than the nearest down-gradient piezometer. The optimal monitoring point for evaluation of the performance criteria was determined to be 25-feet down-gradient of the in-line piezometer based on the first year of operating data. The final monitoring scheme consists of five lines of piezometers with three instrumented piezometers (SWPZ-4i, 14i, 23i) and four non-instrumented piezometers (SWPZ-24, 25, 28, and 29) installed down-gradient of the in-line piezometers. The lines of Hardage site piezometers include (in-line piezometer/down-gradient piezometer) 3i/4i, 9/28, 13i/14i, 19/29, and 22i/23i-24-25. Two off-end monitoring wells, SWMW-1 and 2 are installed off each end of the alignment. The captured ground water is pumped to the Water Treatment Plant, where it is treated to appropriate levels before mixing with treated V-Trench water. The Southwest Wells work in conjunction with the V-Trench recovery system to prevent the migration of affected ground water down-gradient to the North Criner Creek alluvium or North Criner Creek surface water. Three recovery wells (SWW-13, SWW-15, and SWW–18) did not pump any ground water during 1998 due to the dewatering of terrace deposits by the Southwest Wells. The pathway for direct contact with constituents in captured ground water is eliminated by the closed circuit nature of the Southwest Wells and the Water Treatment Plant.

Water Treatment Plant

The Court Order requires that ground water recovered from the V-Trench and Southwest Wells cannot be mixed before treatment. As a result, the Water Treatment Plant (WTP) consists of two separate treatment systems for the V-Trench and Southwest Wells ground water. In 2001, 9,228,400 gallons of water were treated at an average of 17.6 gallons per minute and a cumulative volume of 52,786,880 gallons. Ground water is treated separately to standards applicable for discharge to North Criner Creek. All WTP effluent was disposed via the Class I Non-Hazardous Injection Well until 2001; and subsequently, following Court approval of an HSC remedy modification proposal in an agreed order on September 13, 2001, via an infiltration gallery.

Natural Attenuation of the Alluvial Aquifer

Ground water sampling to monitor natural attenuation of contaminants in the North Criner Creek Alluvial aquifer is accomplished using a network of twenty monitoring wells, located down-gradient of Site source areas. Monitoring wells are sampled on an annual basis to monitor ground water quality and to monitor the effects of natural attenuation of constituents, if present. Monthly water quality samples are collected from MW-34M which is screened in the lowest freshwater aquifer at the Site. The local ground water gradient at the Site is primarily to the south-southwest. The majority of alluvial monitoring wells are located between source areas at the Site and North Criner

Creek to monitor constituent migration, and all wells are within the Institutional Control Boundary to prevent unauthorized access to the wells.

North Criner Creek

The surface water monitoring system consists of four sampling stations along North Criner Creek. These are designated NCC-1, NCC-2, NCC-3 and NCC-4. Surface water sampling stations NCC-2 and NCC-4 (stations closest to the Site) are sampled quarterly for volatile organic compounds (VOCs). Stations NCC-1 (furthest down gradient station) and NCC-3 (furthest up-gradient station) are sampled annually for VOCs. Sampling of NCC-1 and NCC-3 is performed in the Fall (typically October), during low stream flow conditions. The samples should be collected when the flow in the creek is less than 1 cubic feet per second, when possible. A USGS gaging station, located immediately up-gradient of NCC-4, is used to measure stream flow in North Criner Creek.

Institutional Controls

Site access and use is effectively controlled through the use of Institutional Controls ordered by the Court. The site itself is still owned by Royal Hardage, but by virtue of the Court Order, the site is dedicated to implementation and operation of the site remedy. Uses are controlled by restrictive covenants, and public and private access and use are strictly controlled by HSC. Only authorized personnel are allowed on-site. The primary physical manifestation of the Institutional Controls is the perimeter industrial security fence that surrounds the Hardage site. The security fence is 9-feet high consisting of an 8-foot high chain link fabric plus three strands of barbed wire supported by 45-degree extensions. The fence restricts access of both unauthorized persons and animals. Signs are posted at regular intervals on the security fence identifying the site as a Hazardous Waste Site and warn against unauthorized entry. A motorized gate at the main entrance prevents unauthorized entrance and is operated by an intercom and keypad system. This allows ready access by the Site workers, while restricting access by others. The security fence surrounds approximately 160 acres of land consisting of the former disposal area, the water treatment plant, office building, and other active control and monitoring systems. Site lighting is provided by floodlights that are operated by photocell detectors and hand switches. In addition, surrounding the security fence, perimeter fencing runs along the border of approximately 333 acres of land within the institutional controls boundary. This land includes other properties adjoining the site, and it was ordered to be acquired by the HSC by the Court Order, as amended, and subject to restrictive covenants governing uses. Installation of a public water supply to area residents has removed these residents from all well water supplies. Water is supplied through underground piping by McClain County Rural Water District 7. Because access to affected ground water has been prohibited, there is no longer an exposure pathway from constituents in ground water to potential users. Property use within the institutional control boundary area is restricted from further agricultural, commercial, or recreational use.

Class I Non-Hazardous Waste Injection Well

The August 31, 1993 amended Court Order modifying the remedy also changed the disposal method for treated water from the Water Treatment Plant (WTP). The initial design, which had the treated water discharge into North Criner Creek, was changed to discharge into an on-site Class I non-hazardous injection well. The injection well operated form February 28, 1995, until October 30, 2001. The well is cased to 7,300 feet and injects treated water into four geological formations: the Permian Fortuna and Noble-Olson formations, and the Pennsylvanian Griffin and Yule-Funk formations. These are brine formations (>10,000 ppm total dissolved solids) containing non-potable water.

Infiltration Gallery

In accordance with an agreed order of the Court of September 13, 2001, an infiltration gallery was completed on October 30, 2001, for disposal of treated water from the Water Treatment Plant. The infiltration gallery replaced the injection well for disposal of the treated water from the Water Treatment Plant. Water is pumped to the injection well equalization tank and is then conveyed through 1000 feet of conveyance piping and ultimately to five 100-foot long distribution pipes buried at a depth of 5 to 6 feet. The gallery is designed to handle a flow rate of 25 gallons per minute.

Systems Operations/Operations and Maintenance

HSRC contracted with Nationwide Environmental Services, Inc. (NES) for long-term operation and maintenance (O&M) of the site remedy.

Data collected per the 1996 Performance Monitoring Plan (PMP) and Revised 1998 PMP was evaluated to determine if the performance of the remedy components is meeting the performance criteria specified in the PMP and design documents.

V-Trench Recovery System

The V-Trench recovery system produced 5,899,600 gallons in 2001 and 40,115,820 gallons since operations began in 1995. Water level elevations are reported in an appendix to the annual remedial status report. The piezometer well pairs that are instrumented are also plotted on a chart comparing the annual record of water levels for each well. The non-instrumented piezometers are monitored on a quarterly basis, but the data is not plotted on a chart comparing the water levels to the instrumented piezometer. A review of the well data information indicates that the V-Trench is maintaining the hydraulic capture of the ground water consistently with a few exceptions. The exceptions were noted when comparing the data for some well pairs for varying lengths of time, but an explanation is not provided in the text of the annual remedial status report. These gradient reversals were noted for selected well pairs

Composite Cap

The Composite Cap is primarily a passive structure that prevents direct contract with waste at the main source areas and prevents erosion and migration of the entrained materials. The Cap was inspected for exposure of source materials and breaches in its layers, such as the vegetative cover or liner material. The Cap did not show any signs of breaches, leaks, tears, or other evidence that would suggest the Cap or the vegetative cover is compromised. The Cap was surveyed during construction and at two (2) years after completion of the remedy. The next scheduled survey was planned for 2002, but no report of it has yet been received by the EPA from the HSRC. See Recommended Actions in this report.

The Cap contains two mechanical systems: the Active Gas Vent (AGV) system and the Thermal Oxidation Unit (TOU), both of which function to control and treat vapors that originate from the capped source areas. Due to higher than expected operational efficiencies in the AGV carbon treatment units, operation of the TOU to treat AGV off-gases has not been needed to date. Reported emissions from the AGV system is noted in the Annual Remedial Status Report.

Permanent Mounds Liquid Recovery System

The composite cap has reduced the amount of infiltration and recharge to the mound liquids. The total volume of liquids pumped by the PLRS rapidly decreased from 90,000 gallons in 1995 to less than 20,000 gallons in 1997 to 9,390 gallons in 2001. The system has produced a cumulative volume of 400,830 gallons since start-up in 1992. Periodic adjustment of the depth of the recovery well intakes is necessary because of the rise in the sludge level in the wells. Recovered liquids are stored for shipment and are incinerated off-site at the Safety-Kleen hazardous waste facility in Deer Park, Texas. In 2001, five shipments of NAPL and aqueous liquids totaling 99,537 pounds were sent to the Safety Kleen facility. The volume of liquids recovered through the PLRS is reported in the quarterly and annual remedial status report.

The HSRC implemented a trial period of weekly pumping instead of daily pumping between June and October 2000. The reduced or pulse pumping schedule was evaluated to determine if liquid production could be enhanced by allowing a greater recovery time between each pumping cycle. The weekly pumping schedule resulted in a reduced volume of liquids pumped from the Barrel Mound and Main Pit and daily pumping was started again in October 2000.

Liquid levels will be monitored from the PLRS piezometers manually on a quarterly basis. Liquid levels from the piezometers will be used to generate a liquid level elevation map to assess the effects of PLRS operation on a quarterly basis.

Southwest Wells Recovery System

The Southwest Wells produced 3,499,553 gallons of ground water in 2001 and 13,470,740 gallons since operations began in 1995. Water level elevations are reported in an appendix to the Annual Remedial Status Report. The piezometer well pairs that are instrumented have daily water elevations reported in a table. The non-instrumented piezometers are monitored on a quarterly basis, and the data is reported in a table. The comparison of data from the in-line piezometers and the down gradient piezometers have been compared over time in a chart format, but was not present in the 2001 Annual Remedial Status Report. The use of charts in addition to the data tables would assist the reviewer in determining whether the Southwest Wells are achieving the performance standard set for the system. A review of the well data information indicates that the Southwest Wells are maintaining the hydraulic capture of the ground water consistently with a few exceptions. The exceptions were noted when comparing the data for some well pairs for varying lengths of time but an explanation is not provided in the text of the annual remedial status report. These gradient reversals were noted for selected well pairs.

The captured ground water is pumped to the Water Treatment Plant, where it is treated to appropriate levels and combined with treated V-Trench water for deep well injection. The Southwest Wells work in conjunction with the V-Trench recovery system to prevent the migration of affected ground water down gradient to the North Criner Creek Alluvium or North Criner Creek surface water. Three recovery wells (SWW-13, SWW-15, and SWW–18) did not pump any ground water during 1998 due to the dewatering of terrace deposits by the SWW system. Analysis of the capture efficiency of the SWW system indicates the system has generally achieved the performance standard and hydraulic containment is being achieved in most sections of the Southwest Well System.

Water Treatment Plant

The Water Treatment Plant treats affected ground water captured by the V-Trench and Southwest Wells. As of September 1999, over 26,214,000 gallons of ground water have been treated by the WTP. Ground water is treated separately to standards applicable for discharge to North Criner Creek. The WTP effluent is treated to meet TCLP concentrations and ODEQ discharge limits for organic compounds. All WTP effluent is disposed via the infiltration gallery. Historical water quality data for the treated WTP effluent indicates the system is operating as designed. The exposure pathway for contact with contaminants in pre- and post-treated ground water is eliminated by the closed capture treatment system and disposal via the infiltration gallery.

Natural Attenuation of Alluvial Aquifer

Regular ground water monitoring of the alluvial aquifer, and surface water monitoring of North Criner Creek, were implemented as Remedy components to ensure the protectiveness of natural

attenuation. An evaluation of hazardous substance constituent trends in alluvial wells down-gradient of the Southwest Wells recovery system indicates that concentrations are generally downward. Temporal fluctuations in chemical constituent levels are attributed to periodic dilution of alluvial ground water by inflowing surface water during periods of high creek stage, or, where a change in only one constituent has occurred, to reactions such as biodegradation. Water level measurements indicate a generally upward gradient near North Criner Creek resulting in the stream gaining water from the alluvial aquifer.

North Criner Creek

The absence of constituents in North Criner Creek is additional supporting evidence that natural attenuation is occurring. Surface water monitoring has confirmed the absence of constituents in North Criner Creek. EPA split samples with NES during the June 2002 sampling event for sampling stations NCC-1, NCC-2, and NCC-4. All of the samples analyzed by the EPA laboratory were non-detect for VOCs.

Institutional Controls

Inspection of all requirements of the institutional controls indicate they are functioning as designed, and all necessary operation and maintenance is being performed. Incursions through the site fencing have previously been caused by cattle.

Class I Non-Hazardous Waste Injection Well

Monthly reports are submitted to ODEQ reporting injection volume, injection pressure, annulus pressure, injection rate, and analytical results for the treated water from the Water Treatment Plant and monthly sampling from monitoring well M-34M. Quarterly reports are submitted to ODEQ providing injectivity plots. Mechanical integrity tests were performed to verify the integrity of the injection well. The injection well is currently in a stand-by mode while the treated water is diverted into the infiltration gallery.

Infiltration Gallery

Monthly reports are submitted to ODEQ reporting injection volume and analytical results for the treated water from the Water Treatment Plant and monthly sampling from monitoring well M-34M.

Northwest Borrow Area

During construction of the Composite Cap, soils were obtained from on-site borrow areas located northwest and west of the Site to provide materials for construction. Excavation of soil resulted in the creation of a borrow pit, referred to as the Northwest Borrow Area (NWBA), covering an area of approximately 11 acres, and extending from a few feet to up to 30-feet below the original topographic surface. The NWBA is located between the site security fence and the Hardage site boundary, but within the overall institutional control boundary designated in the Court ordered remedy. Following heavy precipitation, ground water seepage was observed in the east slope of the NWBA. Two seeps were subsequently sampled for chemical analysis. Water samples collected from one seep contained 27 VOCs and six SVOCs and the source of the constituents appears to be the past operations.

An investigation was subsequently conducted to determine the extent of affected ground water in the NWBA. Results indicated that geologic Stratum I (the shallowest geologic unit at the Site) along the northern boundary of the Site had been affected by historical waste disposal activities at the North Pond Area and/or the West Pond Area. Ground water in Stratum I flows predominately to the south toward the V-Trench recovery system. The portion of Stratum I ground water flow that emerges as seeps in the NWBA is not captured or treated by the present remedy components under the Court Order. The seeps are present during periods of heavy precipitation, and are estimated to flow for approximately 71 days per year along a smaller confined area of the NWBA. The highest total VOCs detected in the seep was 5,340 ug/L in well SP-14. The resultant surface water flows accumulates in the low areas with overflow into drainage areas that eventually discharge to North Criner Creek. Fate and transport analysis indicted constituents would primarily volatilize from the water prior to reaching other surface water bodies that might support aquatic life. The seeps are often dry during the summer months.

Summary information and a risk assessment concerning the Northwest Borrow Area is available in the "Investigation Report and Risk Assessment Northwest Borrow Area" prepared by NES in November 1997. This proposed risk assessment was submitted by HSRC to EPA for review and consideration. The risk assessment concluded that there was no risk to humans or ecological receptors and that only monitoring of the seep was appropriate for the NWBA. Risk characterization in the assessment was based on potential exposure to an on-site worker and a hypothetical trespasser. The exposure pathways were based on inhalation of vapors from the seeps, direct contact with water from the seeps, and incidental ingestion (trespasser only). The duration of the worker exposure was based on ½ hour per day, for 12 days per year, for 25 years based on a monitoring schedule for the area. The trespasser exposure was based on an age group of 10 - 18 years for 2 hours, for 2 days per month, for 6 months per year.

While not an official component of the site remedy required by the Court Order, routine monitoring and reporting of seep water quality is conducted as part of the Site O&M surface water and ground water monitoring program. An evaluation of the current analytical data with the exposure point concentrations used in the risk assessment would provide an assessment of whether site conditions remain protective of human health.

A phytoremediation test plot was installed on a portion of the NWBA in March 2000. The primary objective of the phytoremediation field test is to use all of the ground water via plant evapotranspiration before it reaches Seep 14 (SP-14). The field test consists of four 300-foot rows of trees orientated perpendicular to ground water flow and installed 55 to 95 feet upgradient of Seep 14 in the NWBA. The rows span the entire area of the seeps and the distance between the rows is wide enough to address migration of ground water during winter months when the trees are dormant. NES submitted a "Phytoremediation Field Test Installation Report" dated May 11, 2000, describing the design and installation of the field test. The effectiveness of the phytoremediation test plot will depend on the growth rate of the trees and the concurrent decline in the observed water flowing from the seeps.

V. Progress Since the Last Five Year Review

This is the first Five Year Review for the site.

VI. Five Year Review Process

Administrative Components

The Hardage site First Five Year Review was first initiated in 1997 by Ruby Williams, EPA Remedial Project Manager. NES on behalf of the HSRC, submitted a draft Five Year Review Report to EPA for consideration in December 1999. Parts of the draft report were incorporated, as appropriate, into this expanded final version. Findings from the October 2001 and June 2002 sites inspections and data review are also incorporated into this report. This report was drafted and finalized by Vincent Malott, EPA Remedial Project Manager, with Agency review and comment.

Community Involvement

An open house sponsored by the HSRC, ODEQ, and EPA was held on February 26, 2002, at the Union Hill Baptist Church on Highway 39 and Crawford Road. A notice of the open house availability was published in the local newspaper. While a precise count of the attendees at the meeting is not available, there were 26 entries on the sign-in sheet.

Document Review

This Five Year Review consisted of a review of relevant documents, including the Court Order and its several amendments, as well as O&M records and monitoring data, and the draft Five Year Review prepared by NES under contract to the HSRC. See Attachment 2 for a list of principal reference documents.

Data Review

Monitoring data on the performance of the individual remedy components is contained in the prior quarterly reports and annual reports as well as separate monthly and quarterly reporting to ODEQ on the injection well operation.

In the annual report, the annual volume, average gallons per minute, and cumulative total of liquid extracted by the PLRS system since start-up are reported. The annual volume of liquids produced by the system has continued to decline since start-up. In the Revised Performance Monitoring Plan for Long-Term Operation (January 1998), the volume of liquids recovered and liquid levels from the PLRS recovery wells are recorded from the panel view display when the pumps are activated. In addition, the liquid levels from the PLRS piezometers will be monitored quarterly to generate a liquid level elevation map to assess the effects of PLRS operation on a quarterly basis. However, neither the liquid levels from the piezometers and PLRS recovery wells, nor the liquid level maps, were reported in the annual remedial status reports. In general, the PLRS piezometers are not available to measure liquid levels, because the sludge has plugged the screen or because the well casing has failed.

Water level measurements from the V-Trench and Southwest Wells Recovery System piezometers is used to evaluate the hydraulic containment for ground water contamination for each of these two systems. The performance standard for evaluating hydraulic containment in the Southwest Wells Recovery System is for the pumping wells to maintain at least a 0.1 foot water level in the in-line piezometers lower than the down-gradient piezometer. A review of the water level data for the Southwest Well Recovery System piezometers indicates that while the performance standard has been generally met, there are areas where the performance standard has not been continuously met. This issue has been noted in the Annual Remedial Status Reports for 2001, 1999, and 1998.

Similarly, the performance criteria for demonstrating hydraulic capture by the V-Trench is for the water level within the trench piezometer to be a minimum of 1 foot lower than the water level in the respective piezometer located 100 feet down-gradient. A review of the water level data for the Southwest Well Recovery System piezometers indicates that while the performance standard has been generally met, there are areas where the performance standard has not been continuously met. This

issue was not identified in the Annual Remedial Status Report (e.g., TPZ well pairs 5i/16i in the 2001 and 1999 annual reports and 11i/18i in the 2001 and 2000 annual reports).

Monitoring of the alluvial aquifer is conducted to measure the natural attenuation of the alluvial ground water and verify that there is not significant expansion of the affected ground water. In the EPA guidance document "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (OSWER Directive No. 9200.4-17P, April 21, 1999), the following four indicators are used for evaluating the performance of a natural attenuation remedy: 1) demonstrate that natural attenuation is occurring according to expectations; 2) detect changes in environmental conditions that may reduce the efficacy of the natural attenuation processes; 3) identify any potentially toxic or mobile transformation products; and 4) verify that the plume is not expanding either down-gradient, laterally, or vertically.

Cleanup of the alluvial aquifer through natural attenuation is measured through the VOC concentration trends for the alluvial aquifer monitoring wells. Of the 20 monitoring wells installed in the alluvial aquifer, 15 remain non-detect for VOCs. However, of the remaining 5 wells, only 4 wells have demonstrated a declining trend for total VOC concentrations since 1995. There is a concern regarding the absence of a declining concentration trend for VOCs detected in monitoring well AW-A01. This monitoring well is located at the down-gradient extent of alluvial aquifer contamination. Since 1995, VOC concentrations have fluctuated with no persistent downward trend to indicate either a shrinking or stable plume boundary. However, monitoring data collected from the next line of down-gradient monitoring wells (MW-33, 34M, 34S, 31, and 32) have remained non-detect for VOCs, suggesting the contamination measured in well AW-A01 is discharging into North Criner Creek.

The environmental conditions remain unchanged that may affect the efficacy of the natural attenuation remedy component. Ground water flow in the alluvial aquifer continues to discharge into the North Criner Creek based on water level measurements for well clusters reported in the annual reports. In addition, the North Criner Creek water samples have remained non-detect for any potentially toxic or mobile transformation products from the VOCs detected in the ground water. Verification that significant plume expansion is not occurring in the alluvial aquifer is one of the measurements for the natural attenuation remedy component. Lines of monitoring wells provide information on the size and concentration of the contaminant plume in the alluvial aquifer. An evaluation of the constituent concentrations in the wells indicates that the plume has remained within the current monitoring well network with no significant expansion of the area of affected ground water.

Quarterly analysis of surface water samples taken at locations SW-2 and SW-4 during 2001, found that no VOCs were detected in the surface water. Annual sampling taken at locations SW-1

and SW-3 were also non-detect for VOCs. A review of data reported in the 1998 - 2001 Annual Remedial Status Reports also reported non-detect for VOCs in the North Criner Creek.

A review of the monthly and quarterly reports submitted to ODEQ indicated that the injection well and infiltration gallery have been maintained and operated within the regulatory limits established by ODEQ.

Site Inspection

EPA conducted site inspections in October 2001 and June 2002 as part of the Five Year Review process. EPA received allegations by a HSRC contract employee concerning performance of the Court-ordered remedy at the Site. EPA subsequently met with representatives of HSC and received written information and data concerning performance of the Court-ordered remedy. EPA and HSC jointly agreed to an inspection of the PLRS in conjunction with scheduled well maintenance and repair activities. During the inspection on October 14-15, 2002, extraction wells RW-9, RW-8, RW-15, and RW-5 were disconnected, inspected, analyzed, measured, and photographed. Measurements revealed a liquid interval of 0.0 to 2.3 feet and sludge layers of 1.6 to 20 feet in thickness. Based on these observations, the extraction well pumps and piping were set in the wells at or very near the intended depth and are being properly operated. Further there was no evidence of improper operation of either monitor wells or waste water treatment facilities at the Hardage site. An EPA report dated November 15, 2001 summarizes the inspection activities and findings. This report is attached to a report filed with the U.S. District Court by EPA on February 18, 2002.

In response to issues raised during a Hardage site public meeting in February 2002, concerning the reliability of water quality data collected by the HSRC contractors, EPA conducted a ground water and surface water split sampling event on June 18-19, 2002. Samples were collected from 13 ground water monitoring wells and 3 surface water locations and analyzed for VOCs by the EPA Houston Laboratory. The sample results and recommendations concerning sampling procedures by the NES personnel are contained in a letter dated August 30, 2002 (attachment 3).

VII. Technical Assessment

Question A: Are the Court Order remedy components functioning as intended?

The review of documents, monitoring data, and the results of the site inspection indicates that the remedy components are generally functioning as intended by the Court Order. The composite cap over the Main Pit and Barrel Mound prevents direct contact with the contaminants, controls surface water flow in source areas, limits erosion of affected soils, and reduces infiltration of precipitation. A separate vapor recovery system installed with the composite cap controls emissions produced from the Main Pit and Barrel Mound. Pumpable liquids are still being removed from the Main Pit and

Barrel Mound areas. The V-trench and Southwest Recovery Wells provide general, if not always continuous, hydraulic containment of the ground water contaminant plume originating from the Main Pit and Barrel Mound, and the water is treated through the operating Water Treatment Plant. For the remaining ground water contamination unaffected by the ground water containment system, monitoring data indicates that natural attenuation is proceeding to reduce contaminant concentrations in the alluvial aquifer. The site security fence and institutional controls prevent contact with contaminants present in the ground water or in the seeps in the Northwest Borrow Area.

NES, responsible for long-term operation and maintenance of the Court Order remedy components, has identified areas for system optimization. One example was the replacement of the injection well with an infiltration gallery for the disposal of the treated water from the WTP. NES has also implemented a short-term test to evaluate a weekly pumping cycle instead of daily pumping in an effort to increase the volume of liquids recovered by the PLRS extraction wells. The testing revealed that a daily pumping schedule still produced a higher volume of liquids than a weekly pumping cycle and the system was returned to the original operational status. Alternative treatment methods in the WTP were also attempted by NES with the use of a passive treatment cell containing iron fillings to chemically degrade the organic contaminants. The testing did not support the replacement of the air stripper to remove VOCs from the extracted water. EPA will continue to work with the HSRC and NES on opportunities for system optimization.

The institutional controls are in place and limit public access to affected areas, prohibit future withdrawal of affected ground water, and continue public water supply to area residents. Institutional control requirements ordered by the Court include perimeter fencing, security fencing with an electronic gate, warning signs, and access restrictions and land use restrictions recorded in restrictive covenants. Installation of a public water supply to area residents has removed these residents from all well water supplies. No activities were observed that would have violated the institutional controls.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the Court Order remedy selection still valid?

The Court Order specified remedial objectives for the Hardage site without specifying cleanup goals for individual media. There have been no changes in the exposure assumptions or physical conditions of the site that would affect the protectiveness of the Court Order remedy.

Changes in Standards and "To Be Considereds"

The Court Order selected the remedial objectives for the Hardage site remedy but did not select specific numerical cleanup standards for attainment by the remedy. The Court in selecting the remedy did not specify specific standards or ARARs that the remedy must comply with during

operations. However, the HSRC has complied with those ARARs for operating the remedy. The following ARARs are listed for specific components of the operating remedy.

- Air emissions at the Hardage site are regulated by federal and state laws. The federal regulations are the Clean Air Act (CAA), 29 U.S.C. 7408 7413, the National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 C.F.R. 61, and the National Emission Standards for Hazardous Air Pollutants for Source Categories, 40 C.F.R. 63. The Oklahoma regulation is OAC 252:100-41. The Oklahoma statute regarding hazardous air emissions adopts the federal standards, while the Oklahoma statute regarding toxic air emissions contains regulations in addition to the federal standards. Routine on-site analysis of effluent vapors from the AGV indicates the Hardage site is in compliance with all federal and state air regulations. AGV activated carbon treatment units effectively remove all constituents from the influent gases and vapors. When positive readings occur during routine analysis, this indicates a potential constituent breakthrough. The carbon units are then replaced and a new sample is analyzed.

- The Injection Well received discharges of the treated water from the Water Treatment Plant from 1995 to 2001 and was operated in compliance with 40 C.F.R. 146 and OAC 252:652. The Injection Well is operated and maintained according to site manuals and guidance as well as the federal and state regulations.

- The regulations regarding water discharges and quality are the Federal Water Pollution Control Act (FWPCA), 33 U.S.C. §1342, the federal Safe Drinking Water Act (SDWA), 40 C.F.R. 141, the state regulations found at OAS 252:605, and the discharge limits for North Criner Creek.

- Hazardous substances stored at the site are those removed from the source areas beneath the Composite Cap by the Permanent Mounds Liquid Recovery System. The hazardous materials recovered by the PLRS are collected and shipped off-site to an RCRA-licensed incineration facility (Safety-Kleen, Deer Park, Texas). All off-site shipments of waste are tracked using required manifest records.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

Institutional controls require prevention of public access to the affected area, prohibition of withdrawal of affected ground water, and supply of public water supply to area residents. As such, there are no current exposure pathways except for the on-site workers and trespassers. These two exposure pathways were used to develop a human health risk assessment for the seeps in the Northwest Borrow Area located outside the site security fence, but within the institutional control boundary and perimeter fence line. No ecological targets were identified during the ecological

screening risk assessment. EPA is evaluating the risk assessment and will provide a separate written response to the risk assessment and the supporting data.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

All ground water and surface samples analyzed for the Hardage site were consistent with the extent of contamination and the remedial objectives identified in the 1990 Court remedy with the exception of the seeps in the Northwest Borrow Area. All ground water and surface samples analyzed for the Hardage site were consistent with the extent of contamination and the remedial objectives identified in the Court Order with the exception of the seeps in the Northwest Borrow Area. The EPA has not issued written acceptance of the HSRC risk assessment and its proposal for no further action. However, the EPA updated the Integrated Risk Information System (IRIS) Health Assessment Summary for 1,1-dichloroethene in August 2002. By issuing the re-evaluation of 1,1-dichloroethene, the EPA withdrew the cancer slope factors for 1,1-dichloroethene and issued new non-cancer toxicity factors. The new factors will likely reduce the calculated risks under the potential exposure scenarios contained in the risk assessment submitted by HSC. The HSRC risk assessment should be updated to reflect this new information and to incorporate the updated VOC concentration profile for the NWBA. At this time, there is no other information that calls into question the current protectiveness of the remedy required by the Court Order.

VIII. Issues

- Monitoring data indicates that there are site areas where the performance standard for hydraulic containment in the Southwest Wells Recovery System and V-Trench has not been continuously met. This issue does not currently affect the protectiveness of the remedy component, but could affect the remedy protectiveness determination of the next five year review.

- There is an absence of current monitoring data to evaluate the fluid level beneath the Barrel Mound and Main Pit area. This issue does not currently affect the protectiveness of the remedy component, but could affect the remedy protectiveness determination of the next five year review.

- Sampling methods for collection of VOCs from ground water monitoring wells are not current with recommended procedures. This issue does not currently affect the protectiveness of the remedy component, but could affect the remedy protectiveness determination of the next five year review.

- VOC concentration data relative to the exposure concentrations and risk levels calculated for the Northwest Borrow Area ground water seeps have been found to be variable. Also, the EPA has issued a re-evaluation of the 1,1-dichloroethene cancer slope factor and has issued new non-cancer toxicity factors. This issue does not currently affect the protectiveness of the remedy component, but could substantially impact the risk calculation for this potential exposure pathway.

- Whether phytoremediation field testing and reduction in the Northwest Borrow Area ground water seeps has been successful. This issue does not affect the protectiveness of the remedy component, but could eliminate a potential exposure pathway relative to the site remedy protectiveness determination of the next five year review.

- The 1998 Performance Monitoring Plan for Long-Term Operation of the Remedy is not current for the Hardage site. This issue does not affect the protectiveness of the remedy component, but could affect the data review necessary to determine remedy protectiveness in the next five year review.

- EPA has not been provided by HSRC with a written report of the results of the scheduled 2002 inspection of the site Composite Cap. This issue does not currently affect the protectiveness of the remedy component, but could affect the remedy protectiveness determination of the next five year review.

IX. Recommendations and Follow-Up Actions

- Determine if changes in the pumping rates can be used to achieve the performance standard for hydraulic containment in the Southwest Wells Recovery System. The performance standard for evaluating hydraulic containment in the Southwest Wells Recovery System is for the pumping wells to maintain at least a 0.1 foot water level in the in-line piezometers lower than the down-gradient piezometer. A review of the water level data for the Southwest Well Recovery System piezometers indicates that while the performance standard has been generally met, there are areas where the performance standard has not been continuously met. This issue has been noted in the Annual Remedial Status Reports for 2001, 1999, and 1998.

  In an effort to better demonstrate that this performance standard is being maintained by the Southwest Wells Recovery System, the piezometer well pairs that are instrumented should also be plotted on a chart comparing the annual record of water levels for each well. The non-instrumented piezometers that are monitored on a quarterly basis should also be plotted on a chart comparing the water levels to the instrumented piezometer. The use of charts would be in addition to the data tables currently found in the annual reports.

This issue is also related to a proposal submitted by NES on behalf of the HSRC to discontinue pumping in the Southwest Well Recovery System.

- Determine why the performance standard for monitoring hydraulic containment has not been continuously met in the V-Trench piezometers. The performance criteria for demonstrating hydraulic capture by the V-Trench is for the water level within the trench piezometer to be a minimum of 1 foot lower than the water level in the respective piezometer located 100 feet down gradient. A review of the water level data for the Southwest Well Recovery System piezometers indicates that while the performance standard has been generally met, there are areas where the performance standard has not been continuously met. This issue was not identified in the Annual Remedial Status Report (e.g., TPZ well pairs 5i/16i in the 2001 and 1999 annual reports and 11i/18i in the 2001 and 2000 annual reports).

- Repair the damaged piezometers and implement the quarterly collection of fluid levels from the PLRS piezometers, and the generation of a liquid level elevation map to assess the effects of PLRS operation. The presence of a viscous, tarry waste-sediment mixture has plugged the screens in the piezometers or has caused casing failure in all or most of the piezometers.

  The viscous, tarry mixture at the bottom of the Barrel Mound and Main Pit area also reduces the effectiveness of the vertical recovery wells. During the October 2001 EPA inspection of four PLRS recovery wells, the depth to the bottom sludge was variable at each well location. NES is not currently recording the measured depth to the top of the sludge, or base of well casing if no sludge is present, or the top of the liquid level within the well. This information could be used to adjust the depth of the pump intake to better recover the pumpable liquids. During the maintenance activities on the PLRS recovery wells, NES should collect this information and adjust the pump intakes for each well. Also, the information for each of the 16 PLRS recovery wells (e.g., construction information, pump intake, sludge and liquid levels, etc.) should be presented in a graphic display or table format for inclusion in the annual Remedial Status Report. This information will provide an easily referenced source prior to any inspection by EPA and/or ODEQ during PLRS maintenance activities.

- Evaluate alternative sample collection methods for VOCs from ground water monitoring wells. EPA developed recommendations for the ground water sampling following oversight of the annual performance monitoring ground water sampling event conducted by NES in June 2002. The recommendations were provided in a letter dated August 30, 2002, to NES responsible for implementing the ground water monitoring program at the Hardage site (see Attachment 3). Revisions to the sampling and analysis plan should be provided to the EPA and the ODEQ for review prior to amending the Performance Monitoring Plan for Long-Term Operation of the Remedy Implementation.

- Re-submit the proposed risk assessment for the Northwest Borrow Area ground water seeps incorporating the updated VOC concentration profile and the updated cancer slope factor and toxicity data for 1,1-dichloroethene. Update the VOC data relative to exposure concentrations and risk levels calculated for the Northwest Borrow Area ground water seeps. Currently, the monthly sample data is totaled for all VOCs and then compared with the total VOCs used in the risk assessment calculations. A more effective determination of any change in the risk to human health and the environment can be performed through a comparison of the individual VOCs utilized to calculate risk rather than a comparison with the total VOC concentration.

- Provide an assessment of the phytoremediation field test and reduction in the Northwest Borrow Area ground water seeps in the annual report. The effectiveness of the phytoremediation effort should be considered against the reduction in flow from the seeps within the Northwest Borrow Area.

- Update the 1998 Performance Monitoring Plan for Long-Term Operation of the Remedy for the Hardage site. This recommended action should be completed by the HSRC upon resolution of the above issues.

- Provide a written report to the EPA of the results of the scheduled 2002 inspection of the site Composite Cap.

X. Protectiveness Statement

All immediate threats at the site have been addressed, and the Court selected remedy components are expected to be remain protective of human health and the environment. The Court Order specified remedial objectives for the site without specifying cleanup goals for individual media. The remedy components form the basis of a waste containment remedy at the Hardage site and must be monitored in perpetuity. The V-Trench and Southwest Recovery Wells must be maintained and operated indefinitely. The institutional controls ordered by the Court dedicate the Hardage site solely to the remedial activities ordered by the Court and restrict access and use of the site and certain adjoining properties.

XI. Next Review

The Second Five Year Review for the Hardage site is required by September 2007, five years from the date of this review.

ATTACHMENT I

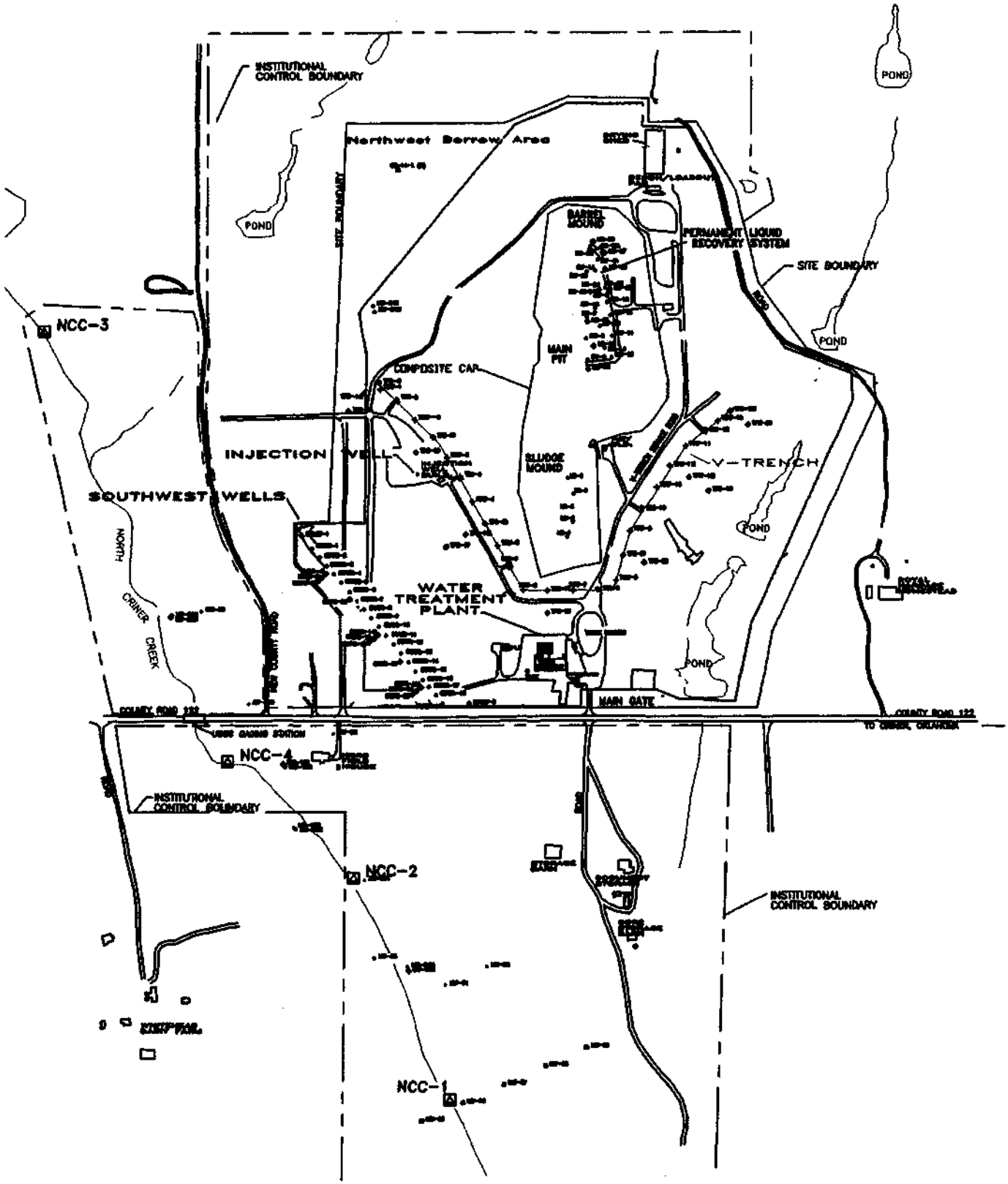

Figure 1. HARDAGE SITE LAYOUT

ATTACHMENT 2

List of Principal Documents Reviewed

1990 Court Order, United States v. Royal Hardage, et al., C.A. No. 86-1401-P (W.D. Oklahoma)

1993 Court Order, United States v. Royal Hardage, et al., C.A. No. 86-1401-P (W.D. Oklahoma)

Hardage Superfund Site, Hardage Site Remedy Corporation, Annual Remedial Status Reports, 2001, 2000, 1999, and 1998

Hardage Superfund Site, Hardage Site Remedy Corporation, Five Year Review Report, December 1999

Hardage Superfund Site, Hardage Site Remedy Corporation, Revised Performance Monitoring Plan for Long-Term Operation of the Remedy Implementation, January 1998

Hardage Superfund Site, U.S. Environmental Protection Agency, Preliminary Close Out Report, September 1997

Hardage Superfund Site, Hardage Site Remedy Corporation, Investigation Report and Risk Assessment, Northwest Borrow Area, November 1997

Hardage Superfund Site, Hardage Site Remedy Corporation, Evaluation of the Southwest Wells and Alluvial Natural Attenuation, March 2001

ATTACHMENT 3

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

August 30, 2002

Mr. Ben Costello
HSRC Project Manager
Nationwide Environmental Services, Inc. (NES)
710 Kipling Street, Suite 303
Denver, Colorado 80215

Re: Hardage Site Annual Performance Monitoring Sampling Event June 18-19, 2002

Dear Mr. Costello:

Enclosed are the analytical results of samples collected by the U.S. Environmental Protection Agency during the annual remedy performance monitoring sampling event conducted by NES personnel on June 18 - 19, 2002. Samples were collected from 13 wells and 3 surface water locations along with 2 trip blanks for volatile organic analysis (VOA) by the EPA Region 6 laboratory. The following table lists the VOA detections for each of the samples.

Monitoring Well	VOA Compound	Results
M13S	ND	
M13M	ND	
M33	ND	
M34M	ND	
M34S	ND	
M36	ND	
M37	ND	
SWR1	ND	
M12M	1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dichloroethane cis-1,2-Dichloroethene Tetrachloroethene 1,1,2-Trichloroethane Trichloroethene	8.0 ug/L 32.2 ug/L 4.0 ug/L 130 ug/L 3.3 ug/L 32.7 ug/L 59.5 ug/L

Monitoring Well	VOA Compound	Results
M12S	1,1-Dichloroethene cis-1,2-Dichloroethene 1,1,2-Trichloroethane Trichloroethene	2.3 6.2 4.6 4.5
M21M	Benzene	3.1
SP14	1,1-Dichloroethane 1,1-Dichloroethene cis-1,2-Dichloroethene trans-1,2-Dichloroethene Tetrachloroethene 1,1,1-Trichloroethane 1,1,2-Trichloroethane Trichloroethene 1,1,2-Trichloro-1,2,2-Trifluoroethane Vinyl Chloride	17.9 420 1,670 2.0 239 315 4.6 446 100 3.8
SW19	ND	
Surface Water	VOA Compound	Results
CS1	ND	
CS2	ND	
CS4	ND	

I also have the following recommendations regarding the current ground water monitoring wells and sampling procedures based on observations of the NES sampling team during the performance monitoring sampling event.

1. A bailer is generally not recommended when sampling for volatile organic compounds (VOCs) because of potential bias during sampling. Exceptions to this recommendation are for wells with slow recovery rates or with minimal water in the well.

2. A preferable method is the use of a low-flow, variable speed pump to perform a low-flow sampling method. EPA published a Ground Water Issue Paper in 1996 describing the procedure, which is available on-line at www.epa.gov/ada/pubs/issue.html.

3. A number of alternate sampling devices are available for collection of ground water samples for volatile organic analysis. One such device is the passive diffusion bag sampler, which is an effective tool for the collection of chlorinated and aromatic VOCs, because these compounds can diffuse into the sampler. The sampling device offers cost savings due to the reduced sampling time and a potentially better representative sample of the ground water than samples collected with a bailer. I have attached a fact sheet from the U.S. Geological Survey (USGS) on the sampling device. The internet training course

on the use of the sampling device and link to the full U.S.G.S. publication can be found on the internet at www.itrcweb.org.

4. The shallow ground water monitoring wells such as M13S and M34S should be redeveloped in an effort to lower the turbidity of the samples. While sample turbidity does not directly influence the VOC results, the present condition of wells now in use would likely reduce the effectiveness of the diffusion bags, because of the suspended material adhering to the bag surface.

5. When purging the wells, the water levels in wells should be recorded before, during, and after purging the wells. If the water level is lowered to the top of the screen during the well purging, then purging should be discontinued and the sample should be collected from the monitoring well.

6. If the water level is below the top of the well screen prior to purging the well and the well is purged dry, then the sample should be taken no sooner than two hours after purging or 90% recovery of the water level.

Finally, I want to thank NES for their cooperation and logistical support during the sampling event. If you have any questions regarding the sampling results or recommendations, please contact me at (214) 665-8313, or have counsel call Jim Turner of our legal staff at (214) 665-3159.

Sincerely,

Vincent Malott

Vincent Malott
Remedial Project Manager

Enclosures
(1) USGS Fact Sheet
(2) EPA Analytical Report

cc: Hal Cantwell, Oklahoma Dept. of Environmental Quality