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Expanded Site Inspection Report

Des Moines (ex) Ordnance Plant Site
Ankeny, Polk County, Iowa

EPA ID: IA8210890028

March 2004

Prepared for:
U.S. Environmental Protection Agency
901 North 5th Street
Kansas City, Kansas 66101

Prepared by:
Black & Veatch Special Projects Corp.
6601 College Blvd.
Overland Park, Kansas 66211

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Abbreviations and Acronyms

ASR	Analytical Services Request
bgs	below ground surface
BVSPC	Black & Veatch Special Projects Corp.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Program
COC	chain-of-custody
CRQL	contract required quantitation limit
DPT	direct-push technology
DMACC	Des Moines Area Community College
DMOP	Des Moines (ex) Ordnance Plant
DMWW	Des Moines Water Works
ESI	expanded site inspection
FSP	field sampling plan
G-M	Geiger-Mueller
HRS	Hazard Ranking System
IAC	Iowa Administrative Code
IDNR	Iowa Department of Natural Resources
ISU	Iowa State University
JDDMW	John Deere Des Moines Works
LEL	lower explosive limit
MCL	maximum contaminant level
mg/kg	milligram per kilogram
ng/kg	nanogram per kilogram
NPL	National Priorities List
O2	oxygen
ORP	oxygen reduction potential
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PETN	pentaerythritoltetranitrate
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million

PR	photorevised
PVC	polyvinyl chloride
QAPP	quality assurance project plan
SARA	Superfund Amendments and Reauthorization Act
SCDM	Superfund Chemical Data Matrix
SVOC	semivolatile organic compound
TNT	trinitrotoluene
ug/kg	microgram per kilogram
ug/L	microgram per liter
USACE	U.S. Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

Executive Summary

Black & Veatch Special Projects Corp. (BVSPC), under contract with the U.S. Environmental Protection Agency (USEPA), conducted an Expanded Site Inspection (ESI) at the Des Moines (Ex) Ordnance Plant (DMOP) in Ankeny, Iowa. The ESI was performed under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The ESI was performed to satisfy the requirements outlined in USEPA Work Assignment No. 069-SISI-078G under USEPA Contract No. 68-W5-0004.

The objectives of this ESI were to further determine the nature of contaminants present at the site, to determine if release of hazardous materials to the environment has occurred or may occur, and if a release has occurred, to determine attribution to those contaminants to the site. The information is needed to allow preparation of a Hazard Ranking System (HRS) scoring package for the DMOP site. The HRS scoring package will be used to evaluate proposing the DMOP site for the National Priorities List (NPL).

The DMOP is located in Ankeny, Polk County, Iowa, approximately 4 miles north of Des Moines, Iowa. The DMOP site originally consisted of two separate areas, the Manufacturing Area and the Accuracy Range. The Accuracy Range, which is located approximately 1 mile west of the Manufacturing Facility, is now largely under water from the construction of the Sayorville dam and reservoir and was not investigated during this ESI. The Manufacturing Area encompasses approximately 2,445 acres. Construction of the DMOP site was completed 1942 and was operated until 1945. In 1947, 586 acres of the DMOP property was deeded to John Deer and Company, and 1,634 acres were deeded to Iowa State University (ISU). In 1965, John Deere deeded the 38-acre sewage treatment plant/landfill area to the City of Ankeny.

Review of existing investigation reports and site reconnaissance efforts by BVSPC resulted in the identification of 21 sites on the DMOP site which were investigated as potential source areas for the ESI in June 2002. In addition to the identified sites, background soil, sediment, and groundwater samples were collected during the ESI to establish standards of comparison for naturally occurring metals at the site. Observed release levels were defined as concentrations that are three times or greater than background for metals and any detection of other parameters. In addition, four private wells within a 4-mile radius of the DMOP site were sampled.

Analytical results of the ESI indicate that groundwater, surface soils , and sediment at he DMOP site have localized areas of contamination at concentrations above observed release levels.

Contamination pathways and targets were evaluated for three site at the DMOP site. There sites were chosen based on the type of contamination present, the waste characteristics, and the proximity of the contamination to human and biological targets.

Groundwater samples were collected at five of the potential source areas. Contamination above observed release levels were detected at all five potential source areas. Local drinking water wells near the DMOP site are completed in both the surficial aquifer and the bedrock aquifers. Confining layers are present between the aquifers.

The landfill/lagoon complex was used at the waste site to evaluate the groundwater pathway for the DMOP because of the presence of groundwater contamination detected in the groundwater at this location. The closest drinking water well to the landfill/lagoon complex is 0.9 miles northwest of the area. At least 201 people within a 4-mile radius of the landfill/lagoon complex drink the local groundwater. Analysis of groundwater samples from the landfill/lagoon complex indicated observed releases of metals, explosives, and VOCs. Arsenic exceeded the maximum contaminant level (MCL) and observed release levels for the DMOP site. Selected residential wells were sampled within 4 miles of the DMOP site and arsenic levels were within the expected background range. Based on the findings of this ESI, the groundwater pathway may be a potential concern at the DMOP site.

Contaminant concentrations in all the sediment samples collected at the DMOP site during the ESI contained contaminant concentrations above observed release levels. The closest drinking water intake is approximately 7 miles downstream of the DMOP site. Saylor Creek is not a known fishery although it does provide food fish for the sport fishes in the Des Moines River. The Des Moines River is an identified sport fishery. There are some wetlands located on the DMOP site, but most of the wetlands occur along the Des Moines River. Benzo(a)pyrene can be traced from the surface soil at the Primer Manufacturing Building to the sediment in the unnamed tributary at sampling location SD-08. Based on the drinking water intake and the sensitive environment, the surface water pathway is of concern at the DMOP site.

The Chemical Storage Area was found to have surface soil contamination above observed release levels. No residents currently live within 1/4 mile of the Chemical Storage Area, but at least 766 residents live within 1 mile. The Chemical Storage Area has limited public access. Grass covers the Chemical Storage Area and is used to graze dairy cattle. Thirty-two different contaminants were detected above observed release values in the surface soil at the Chemical Storage Area. Eight of these contaminants exceeded health-based benchmarks. Based on the findings of this ESI, the soil exposure pathway is of potential concern at the DMOP site.

No air sampling was conducted during the ESI at the DMOP site.

1.0 Introduction

Black & Veatch Special Projects Corp. (BVSPC), under contract with the U.S. Environmental Protection Agency (USEPA), conducted an Expanded Site Inspection (ESI) at the Des Moines (Ex) Ordnance Plant (DMOP) in Ankeny, Iowa. The ESI was performed under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The ESI was performed to satisfy the requirements outlined in USEPA Work Assignment No. 069-SISI-078G under USEPA Contract No. 68-W5-0004.

The objectives of this ESI were to further determine the nature of contaminants present at the site, to determine if release of hazardous materials to the environment has occurred or may occur, and if a release has occurred, to determine attribution to those contaminants to the site. The inspection sought to further define the possible pathways by which contaminants could migrate from the site and to define the populations and environments that contamination would potentially affect.

The information is needed to allow preparation of a Hazard Ranking System (HRS) scoring package for the DMOP. The HRS assesses the relative degree of risk to human health and the environment posed by uncontrolled waste sites. The HRS scoring package will be used to evaluate proposing the DMOP site for the National Priorities List (NPL).

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2.0 Site Description

This section presents a description of the DMOP site including location, operational history, and waste characteristics.

2.1 Site Location

The DMOP is located in Ankeny, Polk County, Iowa, approximately 4 miles north of Des Moines, Iowa (Ref. 1). The DMOP site originally consisted of two separate areas, the Manufacturing Area and the Accuracy Range (Ref. 2, pp. 1, 3). The Accuracy Range, which is located approximately 1 mile west of the Manufacturing Facility, is now largely under water from the construction of the Sayorville dam and reservoir (Refs. 2, p. 1; 1) and was not investigated during this ESI. The Manufacturing Area encompasses approximately 2,445 acres (Refs. 3, p. 3; 2, p. 10). Figure 1-1 shows a base map of the DMOP site.

2.2 Site Description

Polk County is characterized by a continental climate with marked seasonal contrast in precipitation and temperatures. Summers are warm with daily temperatures reaching 83 degrees F or higher. Daily high temperatures during the winter months are 28.2 degrees F to 33.8 degrees F (Ref. 4, Part 1, pp. 15-16). Net annual average precipitation for Ankeny, Iowa, is 33.32 inches (Ref. 5, pp. 1-2).

The site consists of 2,445 acres of mainly agricultural use land (Ref. 3, p. 3). Some intact buildings and several remnants of buildings are scattered across the site. The site contains the John Deere Des Moines Works (JDDMW) manufacturing facility, a Des Moines Area Community College (DMACC) campus, the former Ankeny landfill and sewage treatment plant, and the Iowa State University (ISU) experimental farms (Ref. 1). Approximately 586 acres of DMOP land was sold to John Deere and Company in 1947 (Ref. 3, pp. 4-5). This land included the main manufacturing building of the DMOP and the landfill/sewage treatment plant area. John Deere began using the property for the production of various farm implements (Ref. 3, pp. 4-5). The State of Iowa was deeded 1,634 acres of land in 1947 (Ref. 3, p. 5). This land was used by ISU Ankeny Farm Research for experimental agricultural research (Ref. 3, p. 5). In 1951, a portion of land east of the sewage treatment plant was deeded to ISU, and John Deere purchased a portion of land in the northeast corner of the site from ISU (Ref. 3, p. 5). In 1965, John Deere deeded the 38-acre sewage treatment plant/landfill area to the City of Ankeny (Ref. 3, p. 5). ISU deeded a portion of land in the southeast corner of the site for the construction of the DMACC campus in 1972 (Ref. 3, p. 5). In 1979, the State of Iowa sold the land south of Oralabor

Road to private owners, and the area north of Ordnance Road was also subdivided and is privately owned (Ref. 3, p. 5).

The City of Ankeny would like to see the DMOP site developed as a commercial and industrial area. Maps published in the local yellow pages show the currently undeveloped portions of the DMOP site as the Ordnance Road Business Park and the Crossroads Business and Industry Center (Ref. 6, p. 51).

2.3 Operational History and Waste Characteristics

On July 2, 1940, the Seventy-sixth Congress of the United States passed Public Law 703 to begin the construction of several small arms ammunition facilities, and Des Moines, Iowa, was chosen as one of the sites to construct a new plant (Ref. 3, p. 3). The U.S. Rubber Company was chosen to supervise, direct, and control the plant, and the site at Ankeny was chosen for plant construction (Ref. 3, p. 3). Construction of the DMOP site began in July 1941, and the original construction was completed in April 1942 (Ref. 3, p. 3). The DMOP site was operational as a munitions plant from 1942 to 1945 (Ref. 3, pp. 3-4). During that time, the Plant produced 0.30 caliber and 0.50 caliber ammunition. The 0.30 caliber ammunition production included ball, armor piercing, tracer, and frangible munitions. The 0.50 caliber ammunition production included ball, armor piercing, M1 tracer, M10 tracer, and armor piercing incendiary tracer munitions (Ref. 3, pp. 3-4). Auxiliary processes at the DMOP site included chemical testing, ammunition testing, and utilities operation (Ref. 7, pp. 2-4). Figure 2-1 provides a general lay-out map of the DMOP.

Currently regulated hazardous materials were used extensively during the years of DMOP operation. Metal-forming processes at DMOP involved annealing or heat treating, Cronak finishing, acid quenching, and chromium plating. Approximately 71 million pounds of nitrocellulose (smokeless powder) and 800,000 pounds of primer mixture were used at the DMOP from 1943 to 1945 (Ref. 2, p. 10). Other chemicals used at the DMOP site include: potassium chlorate, lead sulfacyanate, antimony sulfide, pentaerythritoltetranitrate (PETN), trinitrotoluene (TNT), strontium nitrate, strontium peroxide, strontium oxalate, barium peroxide, barium nitrate, calcium resinate, magnesium, chromic acid, sulfuric acid, and sodium dichromate (Ref. 2, pp. 10-11).

During periods of maximum production, the DMOP employed 19,000 people, but by 1945 production demand had dropped. The contract with U.S. Rubber Company was terminated on July 31, 1945, and DMOP properties were transferred to buyers through the War Assets Administrator (Ref. 3, pp. 3-5).

2.4 Summary of Previous Findings

The following subsections present the findings of previous investigations at the DMOP site. The JDDMW Area portion of the site was not included in the scope of this ESI; therefore, findings from previous investigations for this portion of the DMOP site are not discussed in this section.

2.4.1 Sewage Lagoon and Landfill Complex

The sewage lagoon and landfill complex was built in 1941 through 1943 as part of the DMOP (Ref. 8, p. 9). The landfill received solid and sludge wastes from the DMOP until 1945 and from JDDMW from 1947 through 1971, when the landfill was closed (Ref. 8, p. 9). Wastes were routinely buried and burned at the landfill from 1941 through 1971 (Refs. 8, p. 11; 3, p. 17; 7, p. 2-16). The lagoon complex received sanitary and process waste water from the DMOP (Ref. 9). The sanitary sewage facilities operated until approximately 1991 (Ref. 7, p. 2-16). The sanitary sewage and process waste water facilities were operated by the DMOP through 1945 and the JDDMW through 1965 when the City of Ankeny took over operation of the sanitary sewage portion of the facility (Ref. 8, p. 18). JDDMW continued to operate the process waste water portion of the facility until 1976 (Ref. 8, p. 18).

A variety of contaminants have been detected at the Ankeny Landfill/Lagoon Complex. Surface water and stream sediment samples at the landfill/lagoon complex have been found to contain high concentrations of metals and low concentrations of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) (Ref. 7, p. 2-27). Groundwater samples from monitoring wells were found to contain high concentrations of chromium, copper, lead, iron, manganese, arsenic, and selenium. Nitrocellulose has also been detected in the groundwater at the landfill/lagoon complex. SVOCs and VOCs have also been detected in the groundwater at the landfill/lagoon complex (Ref. 7, p. 2-30).

2.4.2 Scrap Burial Area A

Scrap Burial Area A is located approximately 1,000 feet north of Oralabor Road and 500 feet southeast of the Ankeny Landfill/Lagoon Complex (Ref. 10, p. 6-1) as shown on Figure 2-1. Scrap Burial Area A encompasses an area approximately 30 feet by 30 feet square (Ref. 3, p. 17). Soil samples collected at this location contained elevated concentrations of lead, benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene. Groundwater at Scrap Burial Area A contained slightly elevated concentrations of barium, nickel, selenium, zinc, and nitrocellulose (Ref. 10, p. 6-3).

2.4.3 Scrap Burial Area B

Scrap Burial Area B is located south of Oralabor Road immediately south of the DMACC entrance as shown on Figure 2-1. Shell casings have been reported found in this area (Ref. 1, p. 18). Metals have been detected in the soils and groundwater, and nitrocellulose has been detected in the groundwater at Scrap Burial Area B (Ref. 10, pp. 6-8 - 6-9). All detectable concentrations of contaminants have been relatively low at this site (Ref. 10, p. 6-13). Access to collect samples at Scrap Burial Area B was not obtained during the ESI.

2.4.4 Burn Pit Area

The Burn Pit Area is located south of Oralabor Road and east of a small tributary to Saylor Creek as shown on Figure 2-1. The burn pit was used to dispose of scrap explosives and consisted of an open concrete block pit occupying an area approximately 400 feet square (Ref. 10, p. 6-13). Surface soil samples collected in the Burn Pit Area found benzo(a)pyrene, barium, and lead at elevated concentrations during the 1996 site investigation (Ref. 10, pp. 6-15 - 6-18). One sample contained lead at a concentration of 19,200 ppm (Ref. 10, p. 6-17). Groundwater at the site contained elevated concentrations of barium, chromium, selenium, zinc, and nitrocellulose (Ref. 10, p. 6-17). In November 1996, the U.S. Army Corps of Engineers (USACE) is believed to have removed 10 to 15, 55-gallon drums of soil and ash during a removal action at the site (Refs. 11; 12, pp. 4-5). Access to collect samples at the Burn Pit Area was not obtained during the ESI.

2.4.5 Burn Area A

Burn Area A encompasses approximately 1.2 acres, and it is estimated that one-third to one-half of the site was excavated or covered by the construction of Oralabor Road in the early 1990s (Ref. 10, p. 6-19). The remaining area is north of Oralabor Road and consists of unplowed farmland and a portion of the northern shoulder of Oralabor Road as shown on Figure 2-1. The area encompassing Burn Area A is no longer plowed by ISU because the corn would not grow in this area. The area is now planted with alfalfa (Ref. 13). Distressed corn was observed on the edges of the area planted with alfalfa during the ESI (Ref. 13). Antimony, arsenic, barium, chromium, lead, mercury, polynuclear aromatic hydrocarbons (PAHs), and nitrocellulose have been detected at elevated levels in the soils at Burn Area A (Refs. 10, p. 6-22; 2, pp. 34-39). Low levels of barium, chromium, copper, nickel, selenium, strontium, and zinc were detected in groundwater at Burn Area A (Ref. 10, p. 6-22).

2.4.6 *Burn Area B*

Burn Area B is approximately 125 feet by 125 feet and consists of a natural shallow depression or prairie pothole that is located on the southeastern portion of the DMOP Site as shown on Figure 2-1 (Ref. 10, p. 6-23). Distressed corn was observed at Burn Area B during the ESI (Ref. 13). Low levels of arsenic, barium, copper, lead, nickel, selenium, and zinc were detected in soil samples from the site, and low levels of arsenic, barium, selenium, zinc, and nitrocellulose were detected in the groundwater at Burn Area B (Ref. 10, p. 6-27).

2.4.7 *Lime Sludge Drying Beds*

The Lime Sludge Drying Beds are located in a grass-covered field south of Magazine Road as shown on Figure 2-1 (Ref. 2, p. 25). The beds themselves are shallow, rectangular depressions used to dry process lime sludges (Ref. 2, p. 25). Soil sampling at this site detected arsenic, barium, cadmium, chromium, lead, mercury, and nitrocellulose (Ref. 2, pp. 27-29).

2.4.8 *TNT/PETN Storage Magazine Bunker*

The TNT/PETN Storage Magazine Bunker is located in an open field at the southern end of the old Primer Manufacturing and Storage Area (Ref. 2, p. 41). Low-levels of arsenic, barium, cadmium, chromium, and lead were detected in one soil sample at the site (Ref. 2, p. 43). Groundwater samples were not previously collected at this site. This area was included in the investigation as part of the PETN Sieve Houses.

2.5 ESI Investigation

All the potential source areas listed in Section 2.4 were investigated during the ESI. In addition, the following potential source areas were investigated:

- Blacksmith Shop
- Magazine Loop
- Chemical Storage Area
- Former Pond
- Former Slough
- Nursery and Slough
- Outside Maintenance Shop
- Powder Canning Area
- Powder Storage Magazines
- Possible Dump Site
- Primer Manufacturing/Powder Canning

- Paint Storage Area
- Powder Sampling Platforms
- Storage Areas
- Tracer/Igniter Manufacturing/Storage
- Warehouses

In addition to the identified sites, background soil and groundwater samples were collected during the ESI to establish standards for comparison for naturally occurring metals at the DMOP. Sediment samples were also collected from creeks on the DMOP, upgradient of the DMOP, and downgradient of the DMOP. Surface soil samples were also collected from residential properties (the dairy homes and Campus View Apartments) and the DMACC day care facility during the ESI. Groundwater samples were also collected from four private residential wells within 4 miles of the DMOP.

It should be noted that the warehouse samples were moved in the field because the nature of the businesses currently occupying the former warehouse area precluded sampling in the area. Therefore, these samples were moved to areas determined to be potential source areas based on aerial photographs from 1945 (Ref. 14, pp. 17-19). Surface soil sample WH-01 location corresponds to an area identified as a possible disposal area on the 1945 aerial. Surface soil samples WH-02 and WH-03 locations correspond to areas identified as OSA-2 and OSA-3 on the 1945 aerial, respectively. These were identified as areas containing piles of solid wastes (Ref. 14, pp. 17-19).

3.0 Waste/Source Sampling

This section present a summary of the sampling activities completed at the DMOP site during the ESI.

3.1 ESI Sampling Efforts

ESI sampling efforts were completed at the DMOP site by BVSPC in June 2003. Field activities were performed in accordance with ESI planning documents consisting of the Field Sampling Plan (FSP) (Ref. 15), Quality Assurance Project Plan (QAPP) (Ref. 16), and Health and Safety Plan prepared by BVSPC.

The ESI sampling effort included collection of background samples (soil, groundwater, and sediment), sediment samples from the major drainages in and around the DMOP, groundwater and surface soil samples from several potential source areas, surface soil samples from identified potential residential and day care target properties, and residential well samples.

3.2 Data Usability

3.2.1 Data Validation

Samples were shipped to the USEPA Region VII Laboratory in Kansas City, Kansas, where they were re-packaged and sent to designated Contract Laboratory Program (CLP) laboratories. The specified analyses were performed, and results in the form of raw laboratory data were generated. All parameters included in the analyses are presented in Appendix E. A data quality assessment was then performed on the raw laboratory data in accordance with USEPA CLP National Functional Guidelines. Results of the assessment are presented in the Transmittal of Sample Analysis Results for the Analytical Services Request (ASR) for this ESI (ASR Number 2600). The transmittal letter and associated validation results are presented in Appendix E with the analytical results. Through the data validation process, the laboratory data were sometime qualified using standard data validation nomenclature.

Results of the data validation process have determined that, except where noted, the data are defensible, and are usable for the intended purposes.

3.2.2 Common Laboratory Contaminants

In addition to data validation, common laboratory contaminants should be considered when determining data usability. Acetone and methylene chloride are frequently present in the laboratory environment as both substances are used as extraction solvents for certain analytical methods and as laboratory glassware cleaners. Phthalates are used as extraction solvents and are present in plastics. The USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (Ref. 17, p. 43) lists the following substances as being commonly introduced by laboratory processes:

1. Common laboratory contaminants: CO2, siloxanes, diethyl ether, hexane, certain freons (1,1,2-trichlro-1,2,2-trifluoroethane or fluorotrichloromethane), and phthalates at levels less than 100 micrograms per liter (ug/L) or 4.0 milligrams per kilogram (mg/kg).
2. Solvent preservatives, such as cyclohexane which is a methylene chloride preservative. Related by-products include cyclohexanone, cyclohexenone, cyclohexanol, cyclohexenol, chlorocyclohexene, and chlorocyclohexanol.
3. Aldol reaction products of acetone include: 4-hydroxy-4-methyl-2-pentanone, 4-methyl-2-penten-2-one, and 5,5-dimethyl-2(5H)-furanone.

Although these substances can be unintentionally introduced into samples during laboratory processing, the same substances are also commonly found as environmental contaminants. Because of the numerous past and present industrial activities on various parts of the DMOP site, the detection of substances that are commonly used in laboratories should not be ruled out as potentially being environmental contaminants.

Because the scope of this ESI is broad and includes a limited number of samples from a large number of waste sites, it is difficult to attribute substances like acetone, methylene chloride, and 2-butanone to either laboratory handling or to an environmental release. For this reason, detections of these substances at the waste sites will be listed in this ESI as an observed release, but it is important to note that they may or may not be representative of actual contamination.

3.3 Background Concentrations

Background samples were collected in order to document the natural variation of metals present in the soils, groundwater, and sediment. Background samples ensure that in areas where natural levels of metals are present, the natural levels are not reported as contamination (Ref. 18). When metals are present in a sample at three times the background level or higher and the contamination is at least partially attributably to the site, the sample can be used to document an observed release (Ref. 19, p. 1). The next three subsections discuss the methodology in the collection of background samples and also present the observed release criteria for metals in soil, groundwater, and sediment. These observed release criteria will be used for comparison with all other samples to document contamination.

3.3.1 Background Metals in Soil Samples

Four surface soil samples (BK-1, BK-2, BK-3, and BK-4) were collected specifically for background purposes. The background surface soil samples were collected in the Westside Park directly north of the DMOP site. This location was chosen to maintain soil types similar to those encountered on the DMOP site. Figure 3-1 shows the locations of the background soil samples. The analytical results for the background soil samples are provided in Appendix E. Table 3-1 presents the highest background concentration found and the observed release value, (three times the highest background level), that will be used as the benchmark for establishing soil contamination at the DMOP site.

In some cases, background sample results were qualified as estimated values with a "J", signaling a degree of uncertainty in the measurement. In cases where "J" values were reported, the values were adjusted to correct for potential bias. All background samples were treated as having "unknown" bias and were adjusted as such according to the methods laid out in "Using Qualified Data to Document an Observed Release and Observed Contamination," (Ref. 19, p. 8).

When the concentration of a metal in a background sample was at or below the Contract Required Quantitation Limit (CRQL), the data was flagged with a "U" qualifier. In cases where all background data was qualified "U" for a particular analyte, any detection of that analyte above the undetected concentration in an environmental sample signals an observed release, (meaning that "3 times background" concentration does not have to be established because there is no detected background concentration).

Antimony results were flagged as "R" for invalid sample/data, and no value was reported. Unacceptable recovery in the matrix spike sample caused no antimony results to be reported for background samples. Based on the other soil samples collected during this ESI, it is unlikely that antimony is naturally present at detectable concentrations in soils at the site.

Besides metals, all other analytes that were screened for do not typically occur in natural soil. Thus, any concentrations of VOCs, SVOCs, pesticides, herbicides, dioxins, or explosives that were found above the CRQL will be listed as documentation of an observed release.

3.3.2 Background Metals in Groundwater Samples

Piezometer PZ-14 was installed in Westside Park and sampled to establish background values for naturally occurring metals present in the shallow aquifer at the DMOP site. The piezometer was purged and sampled using a peristaltic pump. Figure 3-1 shows the location of this piezometer. The metal concentrations present in the groundwater sample from the piezometer will be used as the background value for groundwater. For water samples from the suspected waste sites, comparisons will be made between the observed release level and the environmental samples. Any environmental sample with three times the background concentration or higher will be considered as documentation of an observed release. All sample results for the background piezometer (PZ-14) are presented in Appendix E. Table 3-2 provides the highest background concentration found and the observed release concentration that will be used as the benchmark for establishing groundwater contamination at the DMOP site.

In some cases, background sample results were qualified as estimated values with a "J", signaling a degree of uncertainty in the measurement. In cases where "J" values were reported, the values were adjusted to correct for potential bias. All background samples were treated as having '"unknown" bias and were adjusted as such according to the methods laid out in "Using Qualified Data to Document an Observed Release and Observed Contamination," (Ref. 19; p. 8).

When the concentration of a metal in a background sample was at or below the CRQL, the data was flagged with a "U" qualifier. In cases where all background data was qualified "U" for a particular analyte, any detection of that analyte in an environmental sample signals an observed release, (meaning that "3 times background" concentration does not have to be established because there is no detected background concentration).

Besides metals, all other analytes that were screened for do not typically occur in natural groundwater. Thus, any concentrations of VOCs, SVOCs, pesticides, herbicides, or explosives that were found above the CRQL will be listed as documentation of an observed release.

3.3.3 Background Metals in Sediment

One sediment sample (SD-01) was collected from Rock Creek upgradient of the DMOP site to establish background metals concentrations. The metal concentrations present in the sample were used as the background value for sediment. For stream sediment samples from locations downgradient of suspected waste sites, comparisons will be made between the background sample and the environmental samples. Any environmental sample with three times the background concentration or higher will be considered as documentation of an observed release. All sample results for SD-1 are presented in Appendix E. Table 3-3 provides the highest background concentration found and the observed release concentration that will be used as the benchmark for establishing sediment contamination at the DMOP site.

In some cases, background sample results were qualified as estimated values with a "J", signaling a degree of uncertainty in the measurement. In cases where "J" values were reported, the values were adjusted to correct for potential bias. All background samples were treated as having '"unknown" bias and were adjusted as such according to the methods laid out in "Using Qualified Data to Document an Observed Release and Observed Contamination," (Ref. 19, p. 8).

When the concentration of a metal in a background sample was at or below the CRQL, the data was flagged with a "U" qualifier. In cases where all background data was qualified "U" for a particular analyte, any detection of that analyte in an environmental sample signals an observed release, (meaning that "3 times background" concentration does not have to be established because there is no detected background concentration).

Besides metals, all other analytes that were analyzed for do not occur naturally in sediment. Thus, any concentrations of VOCs, SVOCs, pesticides, herbicides, or explosives that were found above the CRQL will be listed as documentation of an observed release.

3.4 ESI Results

This section describes the sampling results of the ESI conducted by BVSPC in June 2003 at the DMOP site.

3.4.1 Ankeny Landfill/Lagoon Complex

Groundwater and surface soil sampling was conducted at the landfill/lagoon complex as part of the ESI. Groundwater sampling was conducted at four existing wells and two temporary piezometers. One temporary piezometer planned for installation to the east of the landfill was not completed because no water bearing unit was encountered during drilling. The existing wells were sampled using submersible Whale® pumps and the temporary piezometers were sampled using peristaltic pumps. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the well, piezometer, and surface soil sampling locations at the landfill/lagoon complex.

Appendix D contains the water level measurements for the piezometers and wells sampled at the landfill/lagoon area. Table 3-4 presents a summary of the detected contaminants at the landfill/lagoon area during the ESI. Only values above observed release levels or maximum contaminant levels (MCLs) are listed for metals, and all detections of

VOCs, SVOCs, herbicides, pesticides, perchlorate, and explosives are listed. It should be noted that PZ-06 and PZ-07 produced very little water. Only VOCs, SVOCs, metals, and perchlorate were sampled for at PZ-06. Only VOCs, SVOCs, metals, mercury, and perchlorate were sampled for at PZ-07.

3.4.1.1 VOC Contamination.

VOCs were detected in the groundwater and surface soil at the landfill/lagoon complex. VOCs detected in the groundwater include 2-butanone at PZ-07 at 6.8 ug/L, acetone at PZ-07 at 38 ug/L, and cyclohexane at MW-04 at 1.4 ug/L.

VOCs were also found in the soils collected at the lagoon/landfill complex. 2-Butanone and acetone were detected in two samples (SSL-01 and SSL-04). The highest concentrations of 2-butanone and acetone were in SSL-01 at concentrations of 59 micrograms per kilogram (ug/kg) and 11 ug/kg, respectively. Carbon disulfide was detected in one surface soil sample at the landfill/lagoon complex (SSL-01) at a concentration of 12 ug/kg.

3.4.1.2 SVOC Contamination.

No SVOCs were detected in the groundwater samples collected in the landfill/lagoon complex area.

SVOCs, including mainly PAHs, were detected in two samples from the landfill/lagoon complex (SSL-01 and SSL-04). The SVOCs detected in SSL-01 include fluoranthene (910 ug/kg), phenanthrene (980 ug/kg), and pyrene (770 ug/kg). SVOCs detected in SSL-04 include benzo(a)anthracene (960 ug/kg), benzo(a)pyrene (930 ug/kg), benzo(b)fluoranthene (960 ug/kg), benzo(g,h,i)perylene (560 ug/kg), benzo(k)fluoranthene (560 ug/kg), butylbenzylphthalate (3300 ug/kg), chrysene (980 ug/kg), fluoranthene (2200 ug/kg), indeno(1,2,3-cd)pyrene (520 ug/kg), phenanthrene (1300 ug/kg), and pyrene (1800 ug/kg).

3.4.1.3 Metals Contamination.

Groundwater samples from all four wells and two piezometers sampled at the landfill/lagoon complex contained at least one of the following metals above the observed release values: aluminum, arsenic, iron, potassium, and vanadium. Arsenic was detected in MW-01 at a concentration of 142 ug/L which is above the MCL of 10 ug/L. MW-01 had the most detection of metals above observed release values (five metals) and PZ-07 had the least (one metal).

Surface soil samples from all four sampling locations at the landfill/lagoon complex contained at least one of the following metals above the observed release values: arsenic, chromium, copper, lead, silver, and zinc. Surface soil at sample location SSL-02 contained the most metals above observed release levels (four metals). Surface soil at SSL-04 only contained one metal (copper) above observed release levels.

3.4.1.4 Pesticides and Herbicides Contamination.

No pesticides or herbicides were detected in the groundwater samples collected in the landfill/lagoon complex area.

Pesticides including polychlorinated biphenyl (PCB) arochlor 1254, dieldrin, endrin aldehyde, DDD, DDE, DDT, and trans-chlordane were detected in surface soil samples from the landfill/lagoon area. Surface soil sample SSL-02 contained the highest number of pesticides (five). One surface soil sample, SSL-03, contained PCB arochlor 1254 at a concentration of 110 ug/kg. One surface soil sample, SSL-02, contained dieldrin at a concentration of 5 ug/kg. One surface soil sample, SSL-03, contained endrin aldehyde at a concentration of 12 ug/kg. DDD was detected in surface soil samples SSL-02 and SSL-03 at concentrations of 2.3 ug/kg and 5.7 ug/kg, respectively. DDE was detected in surface soil samples SSL-02 and SSL-04 at concentrations of 54 ug/kg and 6.9 ug/kg, respectively. DDT was detected in all four surface soil samples collected at the landfill/lagoon complex at concentrations ranging from 0.78 ug/kg to 12.82 ug/kg. One surface soil sample, SSL-02, contained trans-chlordane at a concentration of 2.3 ug/kg.

Only one herbicide, pentachlorophenol, was detected in the surface soil at the landfill/lagoon complex. Pentachlorophenol was detected in SSL-03 at a concentration of 7.8 ug/kg.

3.4.1.5 Explosives.

Explosives including 2,6-dinitrotoluene and nitrobenzene were detected in the groundwater samples collected at the landfill/lagoon complex. 2,6-Dinitrotoluene was detected in the groundwater sample from PZ-07 at 0.69 ug/L. Nitrobenzene was detected in the groundwater sample from PZ-06 at 1.7 ug/L.

No explosives were detected in the surface soil samples collected at the landfill/lagoon complex.

3.4.1.6 Dioxins.

Dioxins were analyzed for in the surface soil samples collected at the landfill/lagoon complex and were detected in all four samples. Eleven different dioxins were detected in the surface soil samples. The soil sample collected at SSL-02 contained the highest number of dioxins, eleven. The 2,3,7,8-dioxin total equivalents ranged from 1.6 nanograms per kilogram (ng/kg) in SSL-01 to 36.4 ng/kg in SSL-02.

3.4.2 Scrap Burial Area A

Surface soil sampling was conducted at Scrap Burial Area A as part of the ESI. Figure 3-1 shows the location of the one surface soil sample collected at Scrap Burial Area A (SBA-01). Table 3-5 presents a summary of the detected contaminants at Scrap Burial Area A during the ESI. Only values above observed release levels are listed for metals, and all detections of VOCs, SVOCs, herbicides, pesticides, and explosives are listed.

3.4.2.1 VOC Contamination.

Two VOCs, 2-butanone and acetone, were detected in the surface soil sample from Scrap Burial Area A. 2-Butanone was detected at 2.8 ug/kg and acetone was detected at 16 ug/kg.

3.4.2.2 SVOC Contamination.

SVOCs, including mainly PAHs, were detected in the surface soil sample collected at Scrap Burial Area A. The SVOCs detected in SBA-01 include anthracene (540 ug/kg), benzo(a)anthracene (2100 ug/kg), benzo(a)pyrene (2400 ug/kg), benzo(b)fluoranthene (3100 ug/kg), benzo(g,h,i)perylene (2800 ug/kg), benzo(k)fluoranthene (2400 ug/kg), chrysene (2500 ug/kg), dibenzo(a,h)anthracene (1100 ug/kg), fluoranthene (3300 ug/kg), indeno(1,2,3-cd)pyrene (2600 ug/kg), phenanthrene (1400 ug/kg), and pyrene (3000 ug/kg).

3.4.2.3 Metals Contamination.

Copper and lead were detected in the above observed release levels in the surface soil sample collected at Scrap Burial Area A at concentrations of 828 milligrams per kilogram (mg/kg) and 446 mg/kg, respectively.

3.4.2.4 Pesticides and Herbicides Contamination.

Pesticides including DDD, DDE, and DDT were detected in the surface soil sample from Scrap Burial Area A at concentrations of 8.8 ug/kg, 0.52 ug/kg, and 1.09 ug/kg, respectively.

3.4.3 Burn Area A

Surface soil sampling was conducted at Burn Area A as part of the ESI. Figure 3-1 shows the location of the one surface soil sample collected at Burn Area A (BAA-01). Table 3-6 presents a summary of the detected contaminants at Burn Area A during the ESI. Only values above observed release levels are listed for metals, and all detections of VOCs, pesticides, and explosives are listed. No SVOCs, herbicides, or explosives were detected at Burn Area A.

3.4.3.1 VOC Contamination.

Two VOCs, 2-butanone and acetone, were detected in the surface soil sample from Burn Area A. 2-Butanone was detected at 1.6 ug/kg and acetone was detected at 11 ug/kg.

3.4.3.2 Metals Contamination.

Seven metals were detected above observed release levels in the surface soil sample collected from Burn Area A. Cadmium was detected at 2.28 mg/kg, chromium was detected at 76.1 mg/kg, cobalt was detected at 16.7 mg/kg, copper was detected at 5610 mg/kg, lead was detected at 3674 mg/kg, nickel was detected at 69.4 mg/kg, and zinc was detected at 2450 mg/kg.

3.4.3.3 Pesticides and Herbicides Contamination.

Pesticides including dieldrin, DDE, and DDT were detected in the surface soil sample from Burn Area A at concentrations of 110 ug/kg, 37 ug/kg, and 4.37 ug/kg, respectively.

3.4.4 Burn Area B

Surface soil sampling was conducted at Burn Area B as part of the ESI. Figure 3-1 shows the location of the one surface soil collected at Burn Area B (BAB-01). Table 3-7 presents a summary of the detected contaminants at Burn Area B during the ESI. Only values above observed release levels are listed for metals, and all detections of VOCs, pesticides, and explosives are listed. No SVOCs, herbicides, or explosives were detected at Burn Area B.

3.4.4.1 VOC Contamination.

Four VOCs; 2-butanone, acetone, benzene, and toluene; were detected in the surface soil sample from Burn Area B. 2-Butanone was detected at 26 ug/kg, acetone was detected at 140 ug/kg, benzene was detected at 21 ug/kg, and toluene was detected at 22 mg/kg.

3.4.4.2 Metals Contamination.

Three metals were detected above observed release levels in the surface soil sample collected from Burn Area B. Chromium was detected at 195 mg/kg, copper was detected at 1690 mg/kg, and zinc was detected at 823 mg/kg.

3.4.4.3 Pesticides and Herbicides Contamination.

Seven pesticides; including cis-chlordane, trans-chlordane, dieldrin, DDE, DDT, endrin, and heptachlor epoxide; were detected in the surface soil sample from Burn Area B.

Cis-chlordane, trans-chlordane, dieldrin, DDE, DDT, endrin, and heptachlor epoxide were detected at 24 ug/kg, 140 ug/kg, 43 ug/kg, 99 ug/kg, 140 ug/kg, 12 ug/kg, and 43 ug/kg, respectively.

3.4.5 Lime Sludge Drying Beds

Surface soil sampling was conducted at the Lime Sludge Drying Beds as part of the ESI. Figure 3-1 shows the location of the one surface soil sample collected at the Lime Sludge Drying Beds (LSDB-01). Table 3-8 presents a summary of the detected contaminants at the Lime Sludge Drying Beds during the ESI. Only values above observed release levels are listed which include all detections of VOCs, and pesticides. No metals, SVOCs, herbicides, or explosives were detected at the Lime Sludge Drying Beds.

3.4.5.1 VOC Contamination.

Two VOCs, 2-butanone and acetone, were detected in the surface soil sample from the Lime Sludge Drying Beds. 2-Butanone was detected at 41 ug/kg and acetone was detected at 19 ug/kg.

3.4.5.2 Pesticides and Herbicides Contamination.

Two pesticides, including endosulfan I and DDD, were detected in the surface soil sample from Burn Area B. Endosulfan was detected at 4.1 ug/kg and DDD was detected at 0.7 ug/kg.

3.4.6 Blacksmith Shop

Surface soil sampling was conducted at former location of the Blacksmith Shop as part of the ESI. Figure 3-1 shows the location of the one surface soil sample collected at the Blacksmith Shop (BS-01). Table 3-9 presents a summary of the detected contaminants at Blacksmith Shop during the ESI. Only values above observed release levels are listed which includes all detections of VOCs and pesticides. No metals, SVOCs, herbicides, or explosives were detected at the Blacksmith Shop.

3.4.6.1 VOC Contamination.

Two VOCs, 2-butanone and acetone, were detected in the surface soil sample from the Blacksmith Shop. 2-Butanone was detected at 1.3 ug/kg and acetone was detected at 13 ug/kg.

3.4.6.2 Pesticides and Herbicides Contamination.

Three pesticides, dieldrin, DDE, and DDT, were detected in the surface soil sample from the former Blacksmith Shop. Dieldrin, DDE, and DDT were detected at 1.6 ug/kg, 15 ug/kg, and 20 ug/kg, respectively.

3.4.7 Magazine Loop

Groundwater and surface soil sampling was conducted in the Magazine Loop area as part of the ESI. Groundwater sampling was conducted at two temporary piezometers. The temporary piezometers were sampled using peristaltic pumps. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the piezometer and surface soil sampling locations in the Magazine Loop area. The piezometers in the Magazine Loop area include PZ-08 and PZ-11. The surface soil samples in the Magazine Loop area include CML-01, the Powder Storage Magazines samples (PSM-01 and PSM-02), and the Powder Sampling Platform sample (PSP-01).

Appendix D contains the water level measurements for the piezometers sampled in the Magazine Loop area. Table 3-10 presents a summary of the detected contaminants in the Magazine Loop area during the ESI. Only values above observed release levels or MCLs are listed for metals, and all detections of VOCs, pesticides, and explosives are listed. No SVOCs or herbicides were detected in the groundwater or surface soil samples collected from the Magazine Loop area. It should be noted that PZ-11 produced very little water. Only VOCs, SVOCs, metals, explosives, and perchlorate were sampled for at PZ-11.

3.4.7.1 VOC Contamination.

VOCs were detected in the groundwater and surface soil in the samples from the Magazine Loop area. One VOC, acetone, was detected in the groundwater. It was detected at PZ-11 at a concentration of 6.5 ug/L.

VOCS were also found in the surface soil samples collected in the Magazine Loop area. 2-Butanone, acetone, and methyl acetate were detected. 2-Butanone and acetone were detected in all three surface soil samples. 2-Butanone ranged in concentration from 3.1 ug/kg (PSM-02) to 17 ug/kg (PSM-01). Acetone ranged in concentration from 36 ug/kg (PSM-02) to 78 ug/kg (PSM-01). Methyl acetate was detected in CML-01 at a concentration of 50 ug/kg.

3.4.7.2 Metals Contamination.

Groundwater samples from both piezometers sampled in the Magazine Loop area contained at least one of the following metals above the observed release values: aluminum, iron, and potassium. The groundwater sample from PZ-08 contained aluminum at 332 ug/L. The groundwater sample from PZ-11 contained iron and potassium at 416 ug/L and 6525 ug/L, respectively.

No metals above observed release levels were detected in the surface soil samples from the Magazine Loop area.

3.4.7.3 Pesticides and Herbicides Contamination.

No pesticides or herbicides were detected in the groundwater samples collected in the Magazine Loop area.

Pesticides including dieldrin, DDE, and DDT were detected in surface soil samples from the Magazine Loop area. Surface soil sample CML-01 contained the highest number of pesticides (three). Surface soil sample PSM-01 contained one pesticide, dieldrin. Surface soil sample PSP-01 contained one pesticide, DDE. No pesticides were detected in surface soil sample PSM-02.

3.4.7.4 Explosives.

The explosive nitrobenzene was detected in the groundwater sample collected from PZ-08 in the Magazine Loop area. Nitrobenzene was detected in the groundwater sample at 0.44 ug/L. No explosives were detected in the surface soil samples collected int the Magazine Loop area.

3.4.8 Chemical Storage Area

Groundwater and surface soil sampling was conducted in the Chemical Storage Area as part of the ESI. Groundwater sampling was conducted at one temporary piezometer. The temporary piezometer was sampled using a peristaltic pump. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the piezometer and surface soil sampling locations in the Chemical Storage Area which includes PZ-1, and CSA-01 through CSA-04.

Appendix D contains the water level measurements for the piezometer sampled in the Chemical Storage Area. Table 3-11 presents a summary of the detected contaminants in the Chemical Storage Area during the ESI. Only values above observed release levels or MCLs are listed for metals, and all detections of VOCs, SVOCs, and pesticides are listed. No explosives or herbicides were detected in the samples collected from the Chemical Storage Area. It should be noted that PZ-01 produced very little groundwater. Only VOCs, metals, and explosives were sampled for at PZ-01.

3.4.8.1 VOC Contamination.

VOCs were detected in the groundwater and surface soil in the samples from the Chemical Storage Area. Three VOCs; 2-butanone, acetone, and cyclohexane; were detected in the groundwater sample from PZ-01 at concentrations of 8 ug/L, 27 ug/L, and 1 ug/L, respectively.

VOCs were also found in the soils collected in the Magazine Loop area. Acetone was detected in all four surface soil samples and ranged in concentration from 2.4 ug/kg (CSA-02) to 66 ug/kg (CSA-01). 2-Butanone was detected in two surface soil samples ranging in concentration from 13 ug/kg (CSA-03) to 21 ug/kg (CSA-04).

3.4.8.2 SVOC Contamination.

SVOCs were not analyzed for in the groundwater sample collected in the Chemical Storage Area.

SVOCs, including mainly PAHs, were detected in all four samples from the Chemical Storage Area (CSA-01 through CSA-04). The SVOCs detected in the Chemical Storage Area include acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. CSA-01 contained the highest number of SVOCs (seventeen).

3.4.8.3 Metals Contamination.

Metals including aluminum, iron, and potassium, were detected in the groundwater sample from PZ-01 above the observed release levels. Aluminum was detected at 1663 ug/L, iron was detected at 1520 ug/L, and potassium was detected at 11613 ug/L.

Seven metals were detected in the surface soil samples from the Chemical Storage Area above observed release levels. CSA-01 contained the most metals, six, including arsenic (13.9 mg/kg), cadmium (2.28 mg/kg), cobalt (29.6 mg/kg), manganese (9760 mg/kg), nickel (216 mg/kg), and thallium (15.6 mg/kg). CSA-04 contained copper at 87.4 mg/kg. No metals were detected in CSA-02 or CSA-03 above observed release levels.

3.4.8.4 Pesticides and Herbicides Contamination.

Pesticides and herbicides were not analyzed for in the groundwater sample collected in the Chemical Storage Area.

Pesticides including 2,4-D, endosulfan I, endosulfan II, DDD, DDE, and DDT were detected in surface soil samples from Chemical Storage Area. Surface soil sample CSA-04 contained the highest number of pesticides (six). Surface soil sample CSA-03 contained two pesticides, DDE and DDT. Surface soil sample CSA-02 contained three pesticides, DDD, DDE and DDT. No pesticides were detected in surface soil sample CSA-01.

3.4.9 Former Pond

Surface soil sampling was conducted at the former pond as part of the ESI. The surface soil sample was collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling location at the former pond (FP-01).

Table 3-12 presents a summary of the detected contaminants at the former pond during the ESI. Only values above observed release levels are listed which include all detections of VOCs and pesticides. No SVOCs, metals, explosives, or herbicides were detected in the surface soil sample collected from the former pond.

3.4.9.1 VOC Contamination.

Two VOCs were detected in the surface soil sample collected at the former pond. Acetone was detected at a concentration of 36 ug/kg. 2-Butanone was detected at a concentration of 6.1 ug/kg.

3.4.9.2 Pesticides and Herbicides Contamination.

Pesticides including dieldrin, DDE, and DDT were detected in the surface soil sample collected at the former pond. Dieldrin was detected at 34 ug/kg; DDE was detected at 6.8 ug/kg; and DDT was detected at 0.44 ug/kg.

3.4.10 Former Slough

Surface soil sampling was conducted at the former slough as part of the ESI. The surface soil sample was collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling location at the former slough (FS-01).

Table 3-13 presents a summary of the detected contaminants at the former slough during the ESI. Only values above observed release levels are listed which include all detections of VOCs and pesticides. No SVOCs, metals, explosives, or herbicides were detected in the surface soil sample collected from the former slough.

3.4.10.1 VOC Contamination.

Three VOCs were detected in the surface soil sample collected at the former slough. Acetone was detected at a concentration of 66 ug/kg, 2-butanone was detected at a concentration of 2.3 ug/kg, and methyl acetate was detected at 32 ug/kg.

3.4.10.2 Pesticides and Herbicides Contamination.

Seven pesticides including 2,4-D, cis-chlordane, trans-chlordane, dieldrin, DDE, DDT, and heptachlor epoxide were detected in the surface soil sample collected at the former slough. 2,4-D was detected at 9.4 ug/kg; cis-chlordane was detected at 7 ug/kg; trans-chlordane was detected at 19 ug/kg; dieldrin was detected at 2.93 ug/kg; DDE was detected at 34 ug/kg; DDT was detected at 52 ug/kg; and heptachlor epoxide was detected at 37 ug/kg.

3.4.11 Nursery and Slough

Surface soil sampling was conducted at the former nursery and slough as part of the ESI. The surface soil sample was collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling location at the former nursery and slough (NS-01).

Table 3-14 presents a summary of the detected contaminants at the former nursery and slough during the ESI. Only values above observed release levels are listed which include all detections of VOCs and pesticides. No SVOCs, metals, explosives, or herbicides were detected in the surface soil sample collected from the former nursery and slough.

3.4.11.1 VOC Contamination.

Three VOCs were detected in the surface soil sample collected at the former nursery and slough. Acetone was detected at a concentration of 34 ug/kg, 2-butanone was detected at a concentration of 3.7 ug/kg, and methyl acetate was detected at 88 ug/kg.

3.4.11.2 Pesticides and Herbicides Contamination.

Five pesticides including aldrin, trans-chlordane, dieldrin, DDE, and DDT were detected in the surface soil sample collected at the former nursery and slough. Aldrin was detected at 79 ug/kg; trans-chlordane was detected at 3.1 ug/kg; dieldrin was detected at 70 ug/kg; DDE was detected at 53 ug/kg; and DDT was detected at 6.79 ug/kg.

3.4.12 Outside Maintenance Shop

Surface soil sampling was conducted at the former Outside Maintenance Shop as part of the ESI. The surface soil sample was collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling location at the Outside Maintenance Shop (OMS-01).

Table 3-15 presents a summary of the detected contaminants at the Outside Maintenance Shop during the ESI. Only values above observed release levels are listed which include all detections of VOCs. No SVOCs, metals, explosives, pesticides, or herbicides were detected in the surface soil sample collected from the Outside Maintenance Shop.

3.4.12.1 VOC Contamination.

One VOC, acetone, was detected in the surface soil sample collected at the Outside Maintenance Shop. Acetone was detected at a concentration of 3.8 ug/kg.

3.4.13 Powder Canning Area

Surface soil sampling was conducted in the Powder Canning Area as part of the ESI. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling locations in the Powder Canning Area (PCA-01 and PCA-02).

Table 3-16 presents a summary of the detected contaminants in the Powder Canning Area during the ESI. Only values above observed release levels are listed which is all detections for VOCs, SVOCs, and pesticides. No metals, explosives, or herbicides were detected in the samples collected from the Powder Canning Area.

3.4.13.1 VOC Contamination.

Two VOCs were detected in the surface soil in the samples from the Powder Canning Area. 2-Butanone and acetone were detected in both surface soil samples. 2-Butanone ranged in concentration from 24 ug/kg (PCA-01) to 47 ug/kg (PCA-02). Acetone ranged in concentration from 32 ug/kg (PCA-02) to120 ug/kg (PCA-01).

3.4.13.2 SVOC Contamination.

SVOCs, including mainly PAHs, were detected in both surface soil samples from the Powder Canning Area. The SVOCs detected in the Powder Canning Area include anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene.

3.4.13.3 Pesticides and Herbicides Contamination.

One pesticide, DDD, was detected in surface soil sample PCA-01 from Powder Canning Area at a concentration of 0.72 ug/kg. No pesticides were detected in surface soil sample PCA-02. No herbicides were detected in the surface soil at the Powder Canning Area.

3.4.14 *Possible Dump Site*

Surface soil sampling was conducted at the possible dump site as part of the ESI. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling location at the possible dump site (PD-01).

Table 3-17 presents a summary of the detected contaminants at the possible dump site during the ESI. Only values above observed release levels are listed which is all detections for VOCs and pesticides. No SVOCs, metals, explosives, or herbicides were detected in the samples collected at the possible dump site.

3.4.14.1 VOC Contamination.

Two VOCs were detected in the surface soil sample from the possible dump site. 2-Butanone was detected at a concentration of 2.2 ug/kg and acetone was detected at a concentration of 23 ug/kg.

3.4.14.2 Pesticides and Herbicides Contamination.

Four pesticides, aldrin, dieldrin, DDE and DDT, were detected in the surface soil sample collected at the possible dump site. Aldrin was detected at 2.3 ug/kg, dieldrin was detected at 9.7 ug/kg, DDE was detected at 29 ug/kg, and DDT was detected at 1.56 ug/kg. No herbicides were detected in the surface soil at the possible dump site.

3.4.15 *Primer Composition Store House*

Surface soil sampling was conducted at the Primer Composition Store House as part of the ESI. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling locations (PCSH-01 and PCSH-02) at the Primer Composition Store House. In addition, one piezometer (PZ-04) was installed at the Primer Composition Store House, but did not yield any water. Therefore, no groundwater sample was collected at the Primer Composition Store House.

Table 3-18 presents a summary of the detected contaminants at the Primer Composition Store House during the ESI. Only values above observed release levels are listed which is all detections for VOCs and pesticides. No SVOCs, metals, explosives, or herbicides were detected in the samples collected at the Primer Composition Store House.

3.4.15.1 VOC Contamination.

Three VOCs were detected in the surface soil samples from the Primer Composition Store House area. 2-Butanone was detected at concentrations of 7 ug/kg (PCSH-01) and

4.1 ug/kg (PCSH-02). 2-Hexanone was detected at a concentration of 10 ug/kg in PCSH-01. Acetone was detected at concentrations of 42 ug/kg (PCSH-01) and 26 ug/kg (PCSH-02).

3.4.15.2 Pesticides and Herbicides Contamination.

Two pesticides, dieldrin and DDT, were detected in the surface soil samples collected at the Primer Composition Store House. Dieldrin was detected at concentrations of 0.66 ug/kg (PCSH-01) and 3.9 ug/kg (PCSH-02). DDT was detected at a concentration of 0.33 ug/kg in PCSH-01. No herbicides were detected in the surface soil at the Primer Composition Store House.

3.4.16 Primer Manufacturing/Powder Canning Area

Groundwater and surface soil sampling was conducted in the Primer Manufacturing/Powder Canning Area as part of the ESI. Groundwater sampling was conducted at one temporary piezometer. The temporary piezometer was sampled using a peristaltic pump. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the piezometer and surface soil sampling locations in the Primer Manufacturing/Powder Canning Area which includes PZ-03, and PMPC-01 through PMPC-05.

Appendix D contains the water level measurements for the piezometer sampled in the Primer Manufacturing/Powder Canning Area. Table 3-19 presents a summary of the detected contaminants in the Primer Manufacturing/Powder Canning Area during the ESI. Only values above observed release levels or MCLs are listed for metals, and all detections of VOCs, SVOCs, explosives, and pesticides are listed. No herbicides were detected in the samples collected from the Primer Manufacturing/Powder Canning Area. It should be noted that PZ-03 produced very little water. Only metals and explosives were sampled for at PZ-03.

3.4.16.1 VOC Contamination.

VOCs were not analyzed for in the groundwater sample collected from the Primer Manufacturing/Powder Canning Area.

VOCs were found in the surface soil samples collected in the Primer Manufacturing/Powder Canning Area. Acetone was detected in four of the surface soil samples and ranged in concentration from 97 ug/kg (PMPC-05) to 160 ug/kg (PMPC-01). 2-Butanone was detected in three of the surface samples and ranged in concentration from 2.6 ug/kg (PMPC-04) to 6.8 ug/kg (PMPC-01). 2-Hexanone was only detected in the field duplicate of PMPC-01 at a concentration of 160 ug/kg.

3.4.16.2 SVOC Contamination.

SVOCs were not analyzed for in the groundwater sample collected in the Primer Manufacturing/ Powder Canning Area.

SVOCs, including mainly PAHs, were detected in all but one surface soil sample from the Primer Manufacturing/Powder Canning Area. No SVOCs were detected in PMPC-03. The SVOCs detected in the surface soil at the Primer Manufacturing/Powder Canning Area include acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.4.16.3 Metals Contamination.

The metal potassium was detected in the groundwater sample from PZ-03 above the observed release levels. Potassium was detected at 118000 ug/L.

No metals were detected above observed release values in the surface soil at the Primer Manufacturing/Powder Canning Area.

3.4.16.4 Pesticides and Herbicides Contamination.

Pesticides and herbicides were not analyzed for in the groundwater sample collected in the Primer Manufacturing/Powder Canning Area.

Pesticides including trans-chlordane, dieldrin, DDD, DDE, DDT, and heptachlor epoxide were detected in surface soil samples from the Primer Manufacturing/Powder Canning Area. Surface soil sample PMPC-05 contained the highest number of pesticides (six). Surface soil samples PMPC-01 and PMPC-02 each contained three pesticides, PMPC-03 contained one pesticide, and PMPC-04 contained two pesticides.

3.4.16.5 Explosives.

The explosive nitrobenzene was detected in the groundwater sample collected at the Primer Manufacturing/Powder Canning Area. Nitrobenzene was detected in the groundwater sample from PZ-03 at 0.88 ug/L. No explosives were detected in the surface soil samples from the Primer Manufacturing/Powder Canning Area.

3.4.17 Paint Storage Area

Surface soil sampling was conducted at the Paint Storage Area as part of the ESI. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling location at the Paint Storage Area (PSA-01).

Table 3-20 presents a summary of the detected contaminants at the Paint Storage Area during the ESI. Only values above observed release levels are listed which is all detections for pesticides. No VOCs, SVOCs, metals, explosives, or herbicides were detected in the sample collected at the Paint Storage Area.

3.4.17.1 Pesticides and Herbicides Contamination.

One pesticide, DDD, was detected in the surface soil sample collected at the Paint Storage Area. DDD was detected at 0.47 ug/kg. No herbicides were detected in the surface soil at the Paint Storage Area.

3.4.18 PETN Sieve Houses

Surface soil sampling was conducted at the PETN Sieve House as part of the ESI. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling locations at the PETN Sieve House (PSH-01 and PSH-02).

Table 3-21 presents a summary of the detected contaminants at the PETN Sieve House during the ESI. Only values above observed release levels are listed which is all detections for VOCs and pesticides. No SVOCs, metals, explosives, or herbicides were detected in the samples collected at the PETN Sieve House.

3.4.18.1 VOC Contamination.

Two VOCs were detected in the surface soil samples from the PETN Sieve House. 2-Butanone was detected at concentrations of 3.2 ug/kg (PSH-01) and 5 ug/kg (PSH-02). Acetone was detected at concentrations of 18 ug/kg (PSH-01) and 35 ug/kg (PSH-02).

3.4.18.2 Pesticides and Herbicides Contamination.

Three pesticides, cis-chlordane, dieldrin, and DDT, were detected in surface soil sample PSH-01 at concentrations of 2.7 ug/kg, 5 ug/kg, and 0.43 ug/kg, respectively. No pesticides were detected in PSH-02. No herbicides were detected in the surface soil at the PETN Sieve House.

3.4.19 Storage Areas

Surface soil sampling was conducted at the Storage Areas as part of the ESI. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling location at the Storage Areas (SA-01).

Table 3-22 presents a summary of the detected contaminants at the Storage Areas during the ESI. Only values above observed release levels are listed which is all detections for VOCs and pesticides. No SVOCs, metals, explosives, or herbicides were detected in the samples collected at the Storage Areas.

3.4.19.1 VOC Contamination.

One VOC, acetone, was detected in the surface soil sample from the Storage Areas. Acetone was detected at a concentration of 8 ug/kg.

3.4.19.2 Pesticides and Herbicides Contamination.

Five pesticides, dieldrin, DDD, DDE, and DDT, were detected in the surface soil sample collected at the Storage Areas. Dieldrin was detected at 2.35 ug/kg, DDD was detected at 0.6 ug/kg, DDE was detected at 100 ug/kg, and DDT was detected at 56 ug/kg. No herbicides were detected in the surface soil at the Storage Areas.

3.4.20 Tracer/Igniter Manufacturing/Storage Area

Groundwater and surface soil sampling was conducted in the Tracer/Igniter Manufacturing/Storage Area as part of the ESI. Groundwater sampling was conducted at one temporary piezometer. The temporary piezometer was sampled using a peristaltic pump. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the piezometer and surface soil sampling locations in the Tracer/Igniter Manufacturing/Storage Area which includes PZ-02, and TIMS-01 through TIMS-04.

Appendix D contains the water level measurements for the piezometer sampled in the Tracer/Igniter Manufacturing/Storage Area. Table 3-23 presents a summary of the detected contaminants in the Tracer/Igniter Manufacturing/Storage Area during the ESI. Only values above observed release levels or MCLs are listed for metals, and all detections of VOCs, SVOCs, explosives, pesticides and herbicides.

3.4.20.1 VOC Contamination.

No VOCs were detected in the groundwater sample collected from the Tracer/Igniter Manufacturing/Storage Area.

VOCs were found in the soils collected at the Tracer/Igniter Manufacturing/Storage Area. Acetone was detected in all four of the surface soil samples and ranged in concentration from 3.1 ug/kg to 140 ug/kg. 2-Butanone was detected in two of the surface samples and ranged in concentration from 14 ug/kg (TIMS-03) to 18 ug/kg (TIMS-04).

3.4.20.2 SVOC Contamination.

No SVOCs were detected in the groundwater samples collected in the Tracer/Igniter Manufacturing/Storage Area.

SVOCs, including mainly PAHs, were detected in all four surface soil samples from the Tracer/Igniter Manufacturing/Storage Area. The SVOCs detected in the surface soil at the Tracer/Igniter Manufacturing/Storage Area include acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.4.20.3 Metals Contamination.

Two metals, aluminum and iron, were detected in the groundwater sample from PZ-02 above the observed release levels. Aluminum was detected at 4810 ug/L. Iron was detected at 8910 ug/L.

Two metals, arsenic and zinc, were detected above observed release values in the surface soil at the Tracer/Igniter Manufacturing/Storage Area. Arsenic was detected in TIMS-04 at 8.61 ug/L. Zinc was detected in TIMS-01 at 268 ug/L

3.4.20.4 Pesticides and Herbicides Contamination.

No pesticides or herbicides were detected in the groundwater samples collected in the Tracer/Igniter Manufacturing/Storage Area.

Pesticides including dieldrin, DDE, DDT, and endrin were detected in surface soil samples from the Tracer/Igniter Manufacturing/Storage Area. The surface soil sample TIMS-01 contained the highest number of pesticides (four). Surface soil sample TIMS-02 contained three pesticides, and TIMS-04 contained two pesticides. No pesticides were detected in TIMS-03.

The herbicide pentachlorophenol was detected in TIMS-01 at a concentration of 6.5 ug/kg. No other herbicides were detected in the surface soil at the Tracer/Igniter Manufacturing/Storage Area.

3.4.20.5 Explosives.

The explosive nitrobenzene was detected in the groundwater sample collected at the Tracer/Igniter Manufacturing/Storage Area. Nitrobenzene was detected in the groundwater sample from PZ-02 at 0.3 ug/L. No explosives were detected in the surface soil samples from the Tracer/Igniter Manufacturing/Storage Area.

3.4.21 *Warehouses*

Surface soil sampling was conducted south of the former warehouses at locations identified on a 1945 aerial photograph of the site as being areas of potential solid waste disposal as discussed in Section 2.5 as part of the ESI. Surface soil samples were collected directly from the ground surface by the sampler. Figure 3-1 shows the surface soil sampling locations south of the warehouses (WH-01 through WH-03).

Table 3-24 presents a summary of the detected contaminants warehouse sampling locations during the ESI. Only values above observed release levels are listed which is all detections for VOCs and pesticides. No SVOCs, metals, explosives, or herbicides were detected in the samples collected at the warehouse sampling locations.

3.4.21.1 VOC Contamination.

Three VOCs including 2-butanone, acetone, and methyl acetate, were detected in the surface soil samples from the warehouse sampling locations. 2-Butanone was detected in all three samples at concentrations ranging from 2.3 ug/kg (WH-01) to 2.8 ug/kg (WH-02). Acetone was detected in all three samples at concentrations ranging from 31 ug/kg (WH-03) to 41 ug/kg (WH-01). Methyl acetate was detected in two samples at concentrations ranging from 17 ug/kg (WH-01) to 2.8 ug/kg (WH-02).

3.4.21.2 Pesticides and Herbicides Contamination.

Five pesticides including dieldrin, DDD, DDE, DDT, and heptachlor epoxide, were detected in the surface soil samples collected at the warehouse sampling locations. Dieldrin was detected in all three samples at concentrations ranging from 25 ug/kg (WH-02) to 42 ug/kg (WH-01). DDD was detected in all three samples at concentrations ranging from 6.5 ug/kg (WH-02) to 13 ug/kg (WH-01). DDE was detected in all three samples at concentrations ranging from 38 ug/kg (WH-02) to 100 ug/kg (WH-03). DDT was detected in all three samples at concentrations ranging from 4.6 ug/kg (WH-01) to 5.07 ug/kg (WH-03). Heptachlor epoxide was detected in WH-01 at a concentration os 4.3 ug/kg. No herbicides were detected in the surface soil at the warehouse sampling locations.

3.5 Sediment Sampling Locations

As was discussed in Section 3.3.3, a background sediment sample was collected upstream of the DMOP. Figure 3-2 shows the sediment sampling locations. Sample location SD-01 functioned as the location for background sediment sampling. The sampling results are discussed in Section 3.3.3. All sediment samples results will be evaluated against the background concentrations. Table 3-3 provides the background concentrations of metals found in the sediment samples.

Table 3-25 lists a summary of the detected contaminants in the sediment samples. Only values that are above observed release levels are listed for metals, and all detections for VOCs, SVOCs, and pesticides are listed. No herbicides or explosives were detected in any of the sediment samples.

3.5.1 Sediment Sample SD-02

Sediment sample SD-02 was located immediately downstream of the former outfall of the sewer from the DMOP. The sample was collected in a draw north of Oralabor Road and downstream of visible rubble from the former sewer outfall. No SVOCs or pesticides were detected in SD-02.

3.5.1.1 VOC Contamination.

Acetone was the only VOC detected in SD-02. Acetone was detected at a concentration of 5 ug/kg.

3.5.1.2 Metals Contamination.

Nickel was detected in SD-02 at a concentration of 11.9 mg/kg which is above the observed release level.

3.5.2 Sediment Sample SD-03

Sediment sample SD-03 was located just downstream of the confluence of the draw in which SD-02 was located and Rock Creek. No SVOCs, metals, or pesticides were detected in SD-02.

3.5.2.1 VOC Contamination.

Two VOCs, 2-butanone and acetone, were detected in SD-03. 2-Butanone was detected at a concentration of 1.2 ug/kg. Acetone was detected at a concentration of 3.4 ug/kg.

3.5.3 Sediment Sample SD-04

Sediment sample SD-04 was located immediately upstream of Magazine Road in an unnamed drainage ditch that originates on the JDDMW property. The sample was collected north of Magazine Road and south of the former Magazine Loop. No SVOCs, metals, or pesticides were detected in SD-04.

3.5.3.1 VOC Contamination.

Acetone was the only VOC detected in SD-04. Acetone was detected at a concentration of 1.1 ug/kg.

3.5.4 Sediment Sample SD-05

Sediment sample SD-05 was in the same unnamed drainage ditch as SD-04. The sample was located between Magazine Road and State Street and downstream of SD-04 and the Powder Canning Area. No VOCs, SVOCs, or pesticides were detected in SD-05.

3.5.4.1 Metals Contamination.

Nickel was the only metal detected in SD-05 above observed release levels. Nickel was detected at a concentration of 11.4 mg/kg.

3.5.5 Sediment Sample SD-06

Sediment sample SD-06 was in the same unnamed drainage ditch as SD-04 and SD-05. The sample was located between Magazine Road and State Street and downstream of the SD-04 and SD-05 and the Powder Canning Area. No SVOCs or pesticides were detected in SD-06.

3.5.5.1 VOC Contamination.

Four VOCs including 2-butanone, acetone, benzene, and toluene, were detected in SD-06. 2-Butanone was detected at a concentration of 4.7 ug/kg. Acetone was detected at a concentration of 49 ug/kg. Benzene was detected at a concentration of 44 ug/kg. Toluene was detected at a concentration of 15 ug/kg.

3.5.5.2 Metals Contamination.

Nickel and potassium were detected in SD-06 above observed release levels. Nickel was detected at a concentration of 15.7 mg/kg. Potassium was detected at a concentration of 1476 mg/kg.

3.5.6 Sediment Sample SD-07

Sediment sample SD-07 was located immediately downstream of the confluence of two unnamed drainage ditches. The sample was located southeast of State Street and is located in an area of identified wetland. No SVOCs, metals, or pesticides were detected in SD-07.

3.5.6.1 VOC Contamination.

Two VOCs including 2-butanone and acetone were detected in SD-07. 2-Butanone was detected at a concentration of 1.7 ug/kg. Acetone was detected at a concentration of 7.4 ug/kg.

3.5.7 Sediment Sample SD-08

Sediment sample SD-08 was located in an unnamed drainage ditch downstream of the Primer Manufacturing/Powder Canning area. The sample was located just east of an unnamed gravel road upstream of the landfill/lagoon complex.

3.5.7.1 VOC Contamination.

Two VOCs including 2-butanone and acetone were detected in SD-08. 2-Butanone was detected at a concentration of 2.3 ug/kg. Acetone was detected at a concentration of 83 ug/kg.

3.5.7.2 Metals Contamination.

Nickel was detected in SD-08 above observed release levels. Nickel was detected at a concentration of 17 mg/kg.

3.5.7.3 SVOC Contamination.

Ten SVOCs were detected in SD-08 including benzo(a)anthracene (810 ug/kg), benzo(a)pyrene (830 ug/kg), benzo(b)fluoranthene (850 ug/kg), benzo(g,h,i)perylene (490 ug/kg), benzo(k)fluoranthene (640 ug/kg), chrysene (910 ug/kg), fluoranthene (1900 ug/kg), indeno(1,2,3-cd)pyrene (560 ug/kg), phenanthrene (980 ug/kg), and pyrene (1500 ug/kg).

3.5.7.4 Pesticides Contamination.

Six pesticides including trans-chlordane, dieldrin, DDD, DDE, DDT, and heptachlor epoxide, were detected in SD-08. Trans-chlordane was detected at 0.86 ug/kg. Dieldrin was detected at 0.84 ug/kg. DDD was detected at 2.9 ug/kg. DDE was detected at 2.4 ug/kg. DDT was detected at 3.82 ug/kg. Heptachlor epoxide was detected at 0.24 ug/kg.

3.5.8 Sediment Sample SD-09

Sediment sample SD-09 was located in an unnamed drainage ditch at a point of entry for discharge and runoff from the landfill/lagoon complex and downstream of SD-08. This sample location is also downstream of the Primer Manufacturing/Powder Canning area. No SVOCs or metals were detected at SD-09.

3.5.8.1 VOC Contamination.

One VOC, acetone, was detected in SD-09. Acetone was detected at a concentration of 98 ug/kg.

3.5.8.2 Pesticides Contamination.

Four pesticides including trans-chlordane, dieldrin, DDE, and DDT, were detected in SD-09. Trans-chlordane was detected at 0.26 ug/kg. Dieldrin was detected at 6.7 ug/kg. DDE was detected at 9.5 ug/kg. DDT was detected at 0.5 ug/kg.

3.5.9 Sediment Sample SD-10

Sediment sample SD-10 was located in an unnamed drainage ditch downstream of the landfill/lagoon complex, just before the drainage ditch crosses under State Street. No SVOCs or metals were detected at SD-10.

3.5.9.1 VOC Contamination.

Two VOCs, 2-butanone and acetone, were detected in SD-10. 2-Butanone was detected at a concentration of 12 ug/kg. Acetone was detected at a concentration of 7.4 ug/kg.

3.5.9.2 Pesticides Contamination.

Two pesticides including dieldrin and DDT were detected in SD-10. Dieldrin was detected at 8.2 ug/kg. DDT was detected at 5.8 ug/kg.

3.5.10 Sediment Sample SD-11

Sediment sample SD-11 was located at the confluence of two unnamed drainage ditches downstream of the Scrap Burial Area A. No SVOCs or metals were detected at SD-11.

3.5.10.1 VOC Contamination.

One VOC, acetone, was detected in SD-11. Acetone was detected at a concentration of 12 ug/kg.

3.5.10.2 Pesticides Contamination.

One pesticide, DDE, was detected in SD-11. DDE was detected at 0.48 ug/kg.

3.5.11 Sediment Sample SD-13

Sediment sample SD-13 was located at the confluence of two unnamed drainage ditches downstream of the ISU dairy and agricultural operations. No SVOCs or pesticides were detected in SD-13.

3.5.11.1 VOC Contamination.

One VOC, acetone, was detected in SD-13. Acetone was detected at a concentration of 15 ug/kg.

3.5.11.2 Metals Contamination.

Nickel was detected in SD-13 above observed release levels. Nickel was detected at a concentration of 14.2 mg/kg.

3.5.12 Sediment Sample SD-14

Sediment sample SD-14 was located in the unnamed drainage ditch downstream of the SD-13. SD-14 was located just south of the DMACC property line and downstream of ISU agricultural operations. No SVOCs or pesticides were detected in SD-14.

3.5.12.1 VOC Contamination.

Two VOCs, 2-butanone and acetone, were detected in SD-14. 2-Butanone was detected at a concentration of 1.3 ug/kg. Acetone was detected at a concentration of 46 ug/kg.

3.5.12.2 Metals Contamination.

Nickel was detected in SD-14 above observed release levels. Nickel was detected at a concentration of 14.2 mg/kg.

3.5.13 Sediment Sample SD-15

Sediment sample SD-15 was located along the northeastern shore of the DMACC lake.

3.5.13.1 VOC Contamination.

Two VOCs including 2-butanone and acetone were detected in SD-15. 2-Butanone was detected at a concentration of 15 ug/kg. Acetone was detected at a concentration of 3.8 ug/kg.

3.5.13.2 Metals Contamination.

Nickel was detected in SD-15 above observed release levels. Nickel was detected at a concentration of 14 mg/kg.

3.5.13.3 SVOC Contamination.

Three SVOCs were detected in SD-15 including 2-methylnaphthalene, naphthalene, and phenanthrene. 2-Methylnaphthalene was detected at 6000 ug/kg. Naphthalene was detected at 2500 ug/kg. Phenanthrene was detected at 830 ug/kg.

3.5.13.4 Pesticides Contamination.

Two pesticides including DDD and DDE were detected in SD-15. DDD was detected at 0.66 ug/kg. DDE was detected at 13 ug/kg.

3.5.14 Sediment Sample SD-18

Sediment sample SD-18 was located in an unnamed lake east of State Street. The property that the lake occupies used to be part of the DMOP. This lagoon was selected because it was first lagoon in the treatment process and it was the most accessible to sediment sampling. No SVOCs or pesticides were detected in SD-18.

3.5.14.1 VOC Contamination.

Two VOCs, 2-butanone and acetone, were detected in SD-18. 2-Butanone was detected at a concentration of 10 ug/kg. Acetone was detected at a concentration of 2.9 ug/kg.

3.5.14.2 Metals Contamination.

Nickel and potassium were detected in SD-18 above observed release levels. Nickel was detected at a concentration of 12.6 mg/kg. Potassium was detected at a concentration of 1550 mg/kg.

3.5.15 Sediment Sample SD-19

Sediment sample SD-19 was located the first sewage lagoon in the sewage lagoon/landfill complex. No SVOCs or pesticides were detected in SD-19.

3.5.15.1 VOC Contamination.

One VOC, acetone, was detected in SD-19. Acetone was detected at a concentration of 2.7 ug/kg.

3.5.15.2 Metals Contamination.

Nickel and potassium were detected in SD-19 above observed release levels. Nickel was detected at a concentration of 13.2 mg/kg. Potassium was detected at a concentration of 1420 mg/kg.

3.6 Residential and Day Care Facility Surface Soil Sampling

Two areas of residential use and one day care facility were identified on the DMOP site. One area included two homes associated with the ISU dairy operations. These homes are located north of Magazine Road, across from the dairy. In addition, a small apartment complex is located on the DMACC campus for student housing. There is also a day care facility located on the DMACC campus. Figure 3-1 shows the residential property and day care facility sampling locations.

Table 3-26 lists a summary of the detected contaminants in the surface soil samples collected from the residential properties. Only values that are above observed release levels are listed for metals, and all detections for VOCs and pesticides are listed. No SVOCs, herbicides, or explosives were detected in any of the residential surface soil samples.

Table 3-27 lists a summary of the detected contaminants in the surface soil samples collected from the day care facility. Only values that are above observed release levels are listed which include all detections for VOCs, herbicides, PCBs, and pesticides are listed. No SVOCs, metals, or explosives were detected in any of the day care facility surface soil samples.

3.6.1 Dairy Homes

Four soil samples were located on the dairy home properties. All surface soil samples were located within 200 feet of the residence. DH-01 and DH-03 were located on the westernmost dairy home property. DH-02 and DH-04 were located on the easternmost dairy home property. No herbicides, PCBs, or pesticides were detected on the dairy home properties.

3.6.1.1 VOC Contamination.

Two VOCs including 2-butanone and acetone were detected at the dairy home properties. 2-Butanone was detected in three surface soil samples at concentrations ranging from 3.2 ug/kg (DH-03) to 29 ug/kg (DH-01). Acetone was detected in three surface soil samples at concentrations ranging from 25 ug/kg (DH-04) to 300 ug/kg (DH-03). No VOCs were detected in DH-02.

3.6.1.2 Pesticides Contamination.

Three pesticides including b-BHC, DDE, and DDT were detected in the surface soils at the dairy home properties. B-BHC was only detected in one samples, DH-01, at a concentration of 11 ug/kg. DDE and DDT were both detected in DH-01 and DH-02. The DDE concentrations ranged from 4.7 ug/kg (DH-02) to 28 ug/kg (DH-01). The DDT concentrations ranged from 0.28 ug/kg (DH-02) to 2.18 ug/kg (DH-01).

3.6.2 Campus View Apartments

Four soil samples were located on the Campus View Apartments property. All surface soil samples were located within 200 feet of the apartment complex. No herbicides or PCBs were detected on the Campus View Apartments property.

3.6.2.1 VOC Contamination.

Three VOCs including 2-butanone, acetone, and bis(2-ethylhexyl)phthalate were detected at the Campus View Apartments property. 2-Butanone was detected in three surface soil samples at concentrations ranging from 38 ug/kg (CVA-02) to 45 ug/kg (CVA-03). Acetone was detected in three surface soil samples at concentrations ranging from 22 ug/kg (CVA-04) to 51 ug/kg (CVA-02). Bis(2-Ethylhexyl)phthalate was detected in CVA-02 at a concentration of 520 ug/kg. No VOCs were detected in CVA-01.

3.6.2.2 Metals Contamination.

Calcium was detected in one surface soil sample at the Campus View Apartments property (CVA-02) above observed release levels. Calcium was detected at a concentration of 152000 mg/kg.

3.6.2.3 Pesticides Contamination.

Four pesticides including dieldrin, DDE, DDT, and heptachlor were detected in the surface soils at the Campus View Apartments property. Dieldrin was detected in CVA-03 and CVA-04 at concentrations of 0.54 ug/kg and 4.4 ug/kg, respectively. DDE was detected in three samples at concentrations ranging from 0.93 ug/kg (CVA-02) to 11 ug/kg (CVA-04). DDT was detected in CVA-03 at a concentration of 1.09 ug/kg. Heptachlor was detected in CVA-02 at a concentration of 0.27 ug/kg.

3.6.3 DMACC Day Care Facility

Four surface soil samples were located at the DMACC day care facility. All surface soil samples were located within 200 feet of the day care facility. No metals were detected at the day care facility.

3.6.3.1 VOC Contamination.

Two VOCs including 2-butanone and acetone were detected at the day care facility. 2-Butanone was detected in DC-03 at a concentration of 31 ug/kg. Acetone was detected in DC-03 and DC-04 at concentrations of 19 ug/kg and 51 ug/kg, respectively. No VOCs were detected in DC-01 or DC-02.

3.6.3.2 Pesticides and Herbicides Contamination.

Seven pesticides including trans-chlordane, dieldrin, endrin aldehyde, heptachlor epoxide, DDD, DDE, and DDT were detected in the surface soil samples at the day care facility. Six pesticides were detected in DC-01. Five pesticides were detected in each of DC-02 and DC-03. Three pesticides were detected in DC-04.

One herbicide, dicamba, was detected at the day care facility. It was detected in DC-02 at a concentration of 22 ug/kg.

PCB arochlor 1254 was detected in two samples at the day care facility. Arochlor 1254 was detected in DC-01 and DC-02 at concentrations of 270 ug/kg and 510 ug/kg, respectively.

3.7 Private Well Sampling

For this ESI, four private wells near the DMOP site were sampled. Wells were selected with the assistance of the Iowa Department of Natural Resources (IDNR) Geological Survey. Wells were selected based on their proximity to the site, aquifer in which the well is completed, and availability of access. Table 3-28 lists the addresses of the residential wells sampled, screen interval (where known), and the aquifer (where known). Appendix K includes the available well construction information for the private wells sampled. Figure 3-3 shows the location of the private wells sampled.

The residential well at 1915 NE 78th Ave. (RW-01) is no longer in use but the hand pump was still functional. The homeowner did not have any well construction information about the well. This residence is connected to city water.

The residential well at 7340 NW 2nd Court (RW-02) was installed in 1997 according to the well log in Appendix K.

The residential wells at 3506 NW 80th Lane (RW-04) and 3570 NW 80th Lane (RW-03) are part of the Rock Creek Height Water Association. Each well services about five houses.

Table 3-23 presents a summary of the detected contaminants in the private wells during the ESI. Only values three times above background or MCLs are listed for metals, and all detections of VOCs are listed. No SVOCs, explosives, pesticides, or herbicides were detected in the residential well samples.

3.7.1 VOC Contamination

One VOC, toluene was detected in the residential well samples. Toluene was detected at 0.76 ug/L in the sample from 7340 NW 2nd Court (RW-02).

3.7.2 Metals Contamination

Elevated levels of metals (greater than three times above background) were detected in all of the residential well samples. None of the samples had detections above MCLs.

One residential well sample contained elevated levels of copper. The sample from 7340 NW 2nd Court (RW-02) contained copper at 48.4 ug/L which is well below the MCL of 1300 ug/L.

There is no established MCL for copper but there is a National Secondary Drinking Water Standard established for copper. The detection of copper is well below the National Secondary Drinking Water Standard of 1000 ug/L.

All four residential well samples contained elevated concentrations of iron, with the highest concentration of 3042 ug/L detected in the sample from 7340 NW 2nd Court (RW-02). There is no established MCL for iron but there is a National Secondary Drinking Water Standard established for iron of 300 ug/L. Only one detection, the sample from 3506 NW 80th Lane (RW-04), was below the National Secondary Drinking Water Standard.

Three of the four residential well samples contained potassium at elevated concentrations. Potassium concentrations ranged from 6200 ug/L (7340 NW 2nd Court) to 11048 ug/L (3506 NW 80th Lane). Potassium does not have an MCL or National Secondary Drinking Water Standard.

Three of the four residential well samples contained sodium at elevated concentrations. Sodium concentrations ranged from 304762 ug/L (3506 NW 80th Lane) to 476000 ug/L (7340 NW 2nd Court). Sodium does not have an MCL or National Secondary Drinking Water Standard.

Zinc was detected at elevated concentrations in one residential well sample. Zinc was detected at a concentration of 220 ug/L in the sample from 1915 NE 78th Avenue. There is no established MCL for zinc but there is a National Secondary Drinking Water Standard established for zinc of 5000 ug/L. The detected concentration of zinc was well below the National Secondary Drinking Water Standard.

4.0 Exposure Pathway Analysis of the DMOP Site

Analytical results of the ESI indicate that groundwater, surface soils, and sediment at the DMOP site have localized areas of contamination. For the purpose of the HRS evaluation, three individual waste sites will be discussed in Section 4.0. These sites have been chosen based on the type of contamination present, the waste characteristics of the contaminants, and the proximity of the contamination to human and biological target receptors.

4.1 Operational History and Waste Characteristics

4.1.1 Sewage Lagoon/Landfill Complex

The sewage lagoon and landfill complex was built in 1941 through 1943 as part of the DMOP (Ref. 8, p. 9). The landfill received solid and sludge wastes from the DMOP until 1945 and from JDDMW from 1947 through 1971, when the landfill was closed (Ref. 8, p. 9). Wastes were routinely buried and burned at the landfill from 1941 through 1971 (Refs. 8, p. 11; 3, p. 17; 7, p. 2-16). DMOP would have placed wastes associated with small caliber ammunition production in the landfill including brass bullet cuttings, smokeless powders, and priming composition (Ref. 20, pp. 2-7 - 2-11). The major wastes believed to have been landfilled by JDDMW include paper and wood type trash, grinding sludges, heat treating sludges, paint wastes, plating sludges , and air pollution dust (Ref. 20, pp. 2-7 - 2-11).

The lagoon complex received sanitary and process waste water from the DMOP (Ref. 9). The sanitary sewage facilities operated until approximately 1991 (Ref. 7, p. 2-16). The sanitary sewage and process waste water facilities were operated by the DMOP through 1945 and the JDDMW through 1965 when the City of Ankeny took over operation of the sanitary sewage portion of the facility (Ref. 8, p. 18). JDDMW continued to operate the process waste water portion of the facility until 1976 (Ref. 8, p. 18). The types of wastes received by the lagoon treatment complex from the DMOP operations are believed to have included explosive smokeless powders, priming compositions, and bullet casings (Ref. 20, pp. 2-4 - 2-7). The types of wastes received by the facility from the JDDMW include caustic paint strippers and rinse waters, coolants and oils, alkaline and acid wash solutions, process cooling waters, and plating waste waters (Ref. 20, pp. 2-4 - 2-7).

As was presented in Section 3.4.1 and Table 3-4, the sewage lagoon/landfill complex was found to contain groundwater contamination. Although there were many other potential source areas on the DMOP site where groundwater contamination was detected, the sewage lagoon/landfill complex will be used to evaluate the groundwater pathway at the DMOP site.

4.1.2 Primer Manufacturing/Powder Canning Area

The Primer Manufacturing/Powder Canning area consisted of one primer manufacturing building, two primer chemical distribution houses, four primer mixing buildings, two primer pre-mix houses, four primer pre-dry houses, one wet PETN sieve house, one TNT/PETN storage magazine bunker, and twelve primer store houses (Ref 7, p. 2-19). The primer manufacturing building and the TNT/PETN storage magazine bunker remain standing at the site. The remaining structures have been demolished.

As was presented in Section 3.5.7 and Table 3-25, contamination was detected in the sediment at SD-08, just downstream of the Primer Manufacturing/Powder Canning area. Of particular concern are the detections of the PAHs, including benzo(a)pyrene, in SD-08. The same PAHs, including benzo(a)pyrene, were detected in surface soil sample PMPC-05 (Section 3.4.16 and Table 3-19). Although there were many other sediment samples on the DMOP site where contamination was detected, the Primer Manufacturing/Powder Canning area will be used to evaluate the surface water pathway at the DMOP site.

4.1.3 Chemical Storage Area

The Chemical Storage Area is located north of the limes sludge drying beds. Four buildings were present at the chemical storage area during the ESI field work. The four buildings were used to store magnesium, nitrate, chlorate, peroxide, and other ingredients used in the manufacturing process (Refs. 21; 22; 9, p. 3)

As was presented in Section 3.4.8 and Table 3-11, contamination was detected in the surface soil and groundwater at the Chemical Storage Area. Although there were many other surface soil samples on the DMOP site where contamination was detected, the sample results from the Chemical Storage Area will be used to evaluate the soil and air pathways at the DMOP site.

4.2 Groundwater Pathway

4.2.1 Regional Hydrogeology

The DMOP site lies within the Northern Iowa Drift Plains Landform Region (Ref. 7, p. 3-1). The surficial aquifer at the site is the glacial drift (Ref. 23, pp. 38-41). In general, the drift aquifer yields very little water and what water is yielded is of poor quality (Refs. 23, pp. 45; 2, p. 20).

The site is underlain by two major soil types: The Webster Soil Series and the Nicollet Soil Series (Ref. 4, Sheets 22-23). The Webster soil consists of dark colored, poorly drained soils and is found on the flats and swales in the area (Ref. 4, Part 1, pp. 125-127). This soil is found on slopes ranging from 0 to 2 percent and may be greater than 60 inches deep, and is moderately permeable (Ref. 4, Part 1, pp. 125-127; Part 2, p. 219). The Nicollet soil covers the flats and lowlands of the area and is characterized by dark-colored, friable, somewhat poorly drained soils (Ref. 4, Part 1, pp. 96-99). The Nicollet soil is developed on 1 to 3 percent slopes and is moderately permeable (Ref. 4, Part 1, pp. 96-99).

The Ankeny area is underlain by the Wisconsin glacial drift which consists of unconsolidated deposits of glacial clay, loams, till and loess (Ref. 7, p. 3-2). The Wisconsin glacial drift is thin, yet it can yield considerable amounts of water to shallow wells. The water comes from thin layers and lenses of sand and gravel within the till. A better source for domestic drinking water is found in the sandy lower portion of the loess, whenever present (Ref. 7, p. 3-2).

The deposits of soil and unconsolidated sediment are underlain by bedrock of the Marmaton and Cherokee Groups pf the Des Moinesian Series. The Des Moinesian Series is primarily characterized by shale unit, with some thin seams of coal and some interbedded limestone and sandstone. The series is approximately 250 feet thick and lies unconformably on the St. Louis Formation. Sandstone strata within the Des Moinesian Series, at depths of 150 and 230 feet below ground surface (bgs), are often locally used as a drinking water source. The Mississippi-age St. Louis Formation is characterized by sandy and cherty limestone that yields fair to low amounts of water (Ref. 7, p. 3-2).

The three main bedrock aquifers of the area are commonly called the lower, middle, and upper bedrock aquifers. The upper bedrock aquifer consists of limestone formations within the Mississippian-age St. Louis Formation. The middle aquifer consists of Devonian and Silurian dolomites and limestones at an approximate depth of 400 to 1,450 feet bgs. The lower aquifer is the Ordovician-age St. Peter and Prairie du Chein sandstones and dolomites and the Cambrian-age Jordan and St. Lawrence sandstones and dolomites. These bedrock units are found at depths of approximately 2,050 to 2,600 feet bgs (Ref. 7, p. 3-2).

Many of the shallow temporary piezometers installed during the ESI yielded little water. The piezometers were installed no deeper than 40 feet bgs. In two instances, no water was encountered to 40 feet bgs and the piezometer was not installed.

4.2.2 Groundwater Pathway Targets

The locations of private and municipal wells within 4-miles of the site were identified in order to evaluate the population potentially affected by possible groundwater contamination from the DMOP site. Information on existing wells was obtained from the IDNR Geological Survey (Ref. 24) and previous water well studies (Ref. 7, pp. 3-3 and Figure 3-1).

The City of Ankeny currently purchases its entire water supply from the Des Moines Water Works (Ref. 25, p. 4-1). The City has two wells completed in the Jordan Aquifer, but they are no longer used to supply drinking water (Ref. 25, p. 4-1). Both wells are more than 2,500 feet deep (Ref. 25, p. 4-1). No other municipal wells were identified within 4 miles of the site.

The closest residential well is approximately 0.9 miles northwest of the landfill/lagoon complex as shown on Figure 4-1. Some of the residential wells were sampled as part of this ESI. One of the residential wells sampled was not used as a drinking water source. Well logs and well construction information available for the private wells is provided in Appendix K.

In order to calculate the number of people served per well, the 2000 U.S. Census data for Polk County, Iowa, was used. It was assumed that residential wells are serving 2.45 residents (Ref. 26). It is known that some of the private wells serve more than one household (specifically two of the residential wells sampled during the ESI, see Section 3.7). However, because the exact number of wells serving more than one household and the number of households served by each are unknown, to be conservative, it was assumed that each well only served one household. The total number of residents served by the private wells are listed below (Ref. 34):

Distance	Population
0 to ¼ mile	0 persons
¼ to ½ mile	0 persons
½ to 1 mile	5 persons
1 to 2 miles	32 persons
2 to 3 miles	44 persons
3 to 4 miles	120 persons

4.2.3 Groundwater Analytical Results

As was discussed throughout Section 3.1 of this ESI, groundwater contamination is present at many different potential sources across the DMOP site. Groundwater samples were collected at five potential source areas at the DMOP. Groundwater contamination above observed release values were detected at all five sources areas. It should be noted that all groundwater samples at the potential source areas were collected from the surficial aquifer and the residential well samples were collected from the upper bedrock aquifer.

The landfill/lagoon area exhibited some of the highest concentrations of contaminants above observed release values. Table 3-4 lists the analytical results for the sampling that was conducted at the landfill/lagoon area during the ESI. Explosives and metals were detected in the groundwater at the two temporary piezometers installed at the landfill/lagoon area. Arsenic was detected above observed release values in surface soil samples collected from the landfill/lagoon area and in MW-01. Arsenic was detected at a concentration of 142 ug/L in the sample from MW-01. This concentration is 14 times the MCL for arsenic (10 ug/L) and more than twice the observed release criteria established for groundwater at the DMOP site (60 ug/L). It is important to note that arsenic was not detected in any of the residential wells sampled during the ESI above observed release levels (Table 3-29).

4.2.4 Groundwater Pathway Conclusions

Local drinking water wells near the DMOP are completed in both the surficial and bedrock aquifers. Confining layers are present between the aquifers.

The landfill/lagoon complex was used as the waste site to evaluate the groundwater pathway for the DMOP because of the presence of groundwater contamination detected at this location. The closest drinking water well to the landfill/lagoon complex is 0.9 miles northwest of the area. At least 201 people within a 4-mile radius of the landfill/lagoon complex drink the local groundwater. This is believed to be a low estimate as it was calculated based solely on each identified well serving one household.

Analysis of groundwater samples from the landfill/lagoon complex indicated observed releases of metals, explosives, and VOCs. Arsenic exceeded the MCL and observed release levels for the DMOP site. Selected residential wells were sampled within 4 miles of the DMOP site and arsenic levels were within the expected background range. Based on the findings of this ESI, the groundwater pathway may be a potential concern at the DMOP site.

4.3 Surface Water Pathway

4.3.1 Hydrogeologic Setting

Saylor Creek and its tributaries receive runoff from the majority of the DMOP site (Ref. 1). The western portion of the site drains into Rock Creek (Ref. 1). In addition, in the past, the sewage treatment lagoon outfall was to an unnamed tributary to Rock Creek (Ref. 9, p. 9). Saylor Creek ultimately discharges into the Des Moines River approximately 5 miles south of the DMOP (Ref. 1). Rock Creek discharges into the Des Moines River just below the Saylorville Dam approximately 3 miles southwest of the DMOP site (Ref. 1).

4.3.2 Surface Water Targets

Surface water targets were identified within 15 miles downstream of the site. Surface water targets include drinking water resources, fisheries, and sensitive environments. The nearest surface water intake is located along the Des Moines River approximately 7 miles south of the DMOP site. The surface water intake is located approximately 1.25 miles downstream of the confluence of Saylor Creek and the Des Moines River. This intake is operated by the Des Moines Water Works (DMWW). This intake provides approximately 40 percent of the drinking water in the DMWW system. The DMWW serves approximately 350,000 customers (Ref. 27). Water quality data for this intake is provided in the 2003 Consumer Confidence Report provided on the DMWW website (Ref. 28).

Fishing was observed in DMACC Lake during the ESI and IDNR reports that the lake provides some sport fishing opportunities (Ref. 29). In addition, Rock Creek and Saylor Creek are reported to produce many minnows that serve as food for the sport fish in the Des Moines River. These creeks may also contain important nursery habitat for sport fishes but neither stream would support a sport fishery (Ref. 29). The Des Moines River is considered a significant fishery resource by IDNR (Ref. 30).

There are several sensitive environments located adjacent to the intermittent streams on the DMOP site and along Sayorville Creek and the Des Moines River as shown on Figure 4-3. Several areas identified as inland herbaceous wetlands, inland forested wetlands, and inland scrub swamps are located both on the DMOP site and downstream (Ref. 31). One State designated endangered species, the spotted skunk (*Spilogale putorius*), occurs within 4 miles of the DMOP site (Refs. 30; 32).

4.3.3 Sediment Analytical Results

As was discussed in Section 3.5, sediment contamination above observed release values was found across the DMOP site. Of the 15 sediment sample locations that were sampled for potential release, all 15 locations had an observed release in the sediment. The stream sediment at sample location SD-08 was found to be contaminated with a variety of substances. These same substances, mainly PAHs including benzo(a)pyrene, were also found above observed release values in the surface soil samples PMPC-05 collected outside the Primer Manufacturing Building. The presence of benzo(a)pyrene in the surface soil and the sediment downstream demonstrates an observed release to surface water from Site activities.

4.3.4 *Surface Water Pathway Conclusions*

The closest drinking water intake is approximately 7 miles downstream of the DMOP site. Saylor Creek is not a known fishery although it does provide food fish for the sport fishes in the Des Moines River. The Des Moines River is an identified sport fishery. There are some wetlands located on the DMOP site, but most of the wetlands occur along the Des Moines River.

Benzo(a)pyrene can be traced from the surface soil at the Primer Manufacturing Building to the sediment in the unnamed tributary at sampling location SD-08. Based on the drinking water intake and the sensitive environment, the surface water pathway is of concern at the DMOP site.

4.4 Soil/Air Pathways

4.4.1 *Physical Setting*

The Chemical Storage Area is located in the northwestern portion of the DMOP site just south of the gravel road extension of Magazine Road. The gravel road is used by ISU personnel to access the western portion of the DMOP site. Access to the gravel road is semi-secured by a gate that is typically kept closed but not locked.

The Chemical Storage Area is in a fenced pasture used for dairy cattle grazing. Four DMOP storage buildings remain standing but abandoned at the Chemical Storage Area. Based on historical information, a side rail line ran along the south sides of the four buildings. Loading docks are present on the south side of each building. As part of the ESI, one temporary piezometer and four surface soil samples were located at the Chemical Storage Area. The surface soil samples were located south of each building just off the loading docks. As discussed in Section 3.4.8, analytical results of the groundwater and surface soil samples confirmed the presence of soil and groundwater contamination at the Chemical Storage Area.

4.4.2 *Soil Exposure and Air Pathway Targets*

Figure 4-4 provides a map of targets and target distances for the Chemical Storage Area. No residents live on or within 200 feet of the Chemical Storage Area. As discussed in Section 4.4.1, the Chemical Storage Area is not readily accessible to the general public. Dairy cattle are grazed at the Chemical Storage Area. There are no schools or day care facilities located at the Chemical Storage Area.

There are no terrestrial sensitive environments located at the Chemical Storage Area. However, there are sensitive environments within 4 miles of the Chemical Storage Area.

One wetland area is located within 1/4 miles of the Chemical Storage Area. In addition, the Margo Frankel Woods State Park is located approximately 3 miles south of the Chemical Storage Area and has been designated a wildlife refuge (Ref. 33).

Table 4-1 provides the population within a 4-mile radius of the Chemical Storage Area. The nearest residences are located approximately 0.75 miles east, west, and southeast of the Chemical Storage Area. Approximately 766 residents live within 1 mile of the Chemical Storage Area (Ref. 34). In addition to residents, workers and schools are present within a 4-mile radius of the site (Ref. 1).

4.4.3 Soil Analytical Results

Surface soil samples collected at the Chemical Storage Area were characterized by observed releases of the following contaminants as listed on Table 3-11: arsenic, cadmium, cobalt, copper, manganese, nickel, thallium, 2,4-D, endosulfan I, endosulfan II, DDD, DDE, DDT, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, 2-butanone, and acetone. Substances which exceed health-based benchmarks (Ref. 35) are listed in Table 4-1 and include arsenic, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Air sampling was not conducted as part of the ESI.

4.4.4 Soil/Air Pathway Conclusions

The Chemical Storage Area was found to have surface soil contamination. No residents currently live within 1/4 mile of the Chemical Storage Area, but at least 766 residents live within 1 mile. The Chemical Storage has limited public access. Grass covers the Chemical Storage Area and is used to graze dairy cattle. Thirty-two different contaminants were detected above observed release values in the surface soil at the Chemical Storage Area. Eight of these contaminants exceeded health-based benchmarks. Based on the findings of this ESI, the soil and air pathways are of potential concern at the DMOP site.

5.0 ESI Field Activities

Field investigation techniques and procedures used by BVSPC during the ESI are discussed in this section. Each type of field activity conducted during the ESI is discussed. Specific activities at each potential source area are discussed in Section 3.0.

5.1 Temporary Piezometers

Ten temporary piezometers were installed during this ESI for the purpose of obtaining groundwater samples. Boreholes are to be probed using direct-push technology (DPT) methods. The piezometers were installed by PSA Environmental of Lee's Summit, Missouri. Probing activities were monitored with a photo ionization detector (PID), a lower explosive limit (LEL), oxygen (O2) meter, and a Geiger-Mueller (G-M) counter. PID readings were found to be at or below background levels in the breathing zone, so no personal protective equipment (PPE) upgrade was required. No LEL/O2 meter readings show the presence of a potentially explosive environment. No soils were found to have three times the background level of radiation

The borings were logged by the onsite geologist. Boring logs for the temporary piezometers were prepared in accordance with the procedures outlined in the FSP (Ref. 15) and are provided in Appendix B. Using 3.25-inch probe rods, the boreholes were probed to at least 10 feet into the water table, and boring logs were used to select the specific screen depth for the temporary piezometers. The screen interval was set to monitor the top of the uppermost unconfined aquifer system, and the screens were placed at the direction of the field geologist. The piezometers were constructed using 1-inch diameter, Geoprobe Prepack well screens. Two, 5-foot sections of pre-packed screen were used per piezometer. Pre-pack screens contain clean, 20/40 mesh silica sand packed around the screen. Riser pipe consisted of Schedule 40, polyvinyl chloride (PVC) pipe.

After installing the pre-pack well screen and riser pipe, the annular space was backfilled with silica sand filter pack that conformed to screen gradation analysis requirements of not less than 95 percent of the sand passing US Standard Sieve No. 20 and not more than 5 percent passing US Standard Sieve No. 40. The filter pack extends at least 2 feet from the top of the pre-pack to no more than 5 feet. The annular space above the sand pack was be backfilled with 3 to 5 feet of bentonite chips or pellets. The annular space above the bentonite was backfilled with cement-bentonite grout and tremied into place. The piezometers have a 3-foot, concrete surface seal. A locking above ground or flush mount cover was be installed to secure each well head.

5.1.2 Temporary Piezometer Development

Piezometers were developed no sooner than 24 hours after installation to allow for grout curing. Piezometers were developed using pumps. Temperature, pH, specific conductivity, oxidation-reduction potential (ORP), dissolved oxygen, and turbidity were monitored during development, and recorded. Development data was recorded on well development forms. The completed well development forms are provided in Appendix (Appendix C). Several of the piezometers purged dry relatively quickly. Development was considered complete when a piezometer purged dry. If piezometer produced water, development continued until field parameters stabilized (less than 0.2 pH or a 10% change for other parameters between four consecutive readings), and the water was clear and free of fines.

In all cases, the utmost care was taken not to collapse the screens during development activities. Piezometer development fluids were disposed to the ground at the piezometer site. After development was completed, the new temporary piezometers will be sampled following the sampling will procedures outlined in Section 5.2.

5.2 Piezometer and Existing Monitoring Well Sampling

This section presents the sampling procedures used for the new temporary piezometers and the existing monitoring wells. Four existing monitoring wells were present at the sewage lagoon/landfill complex at the DMOP Site. These existing monitoring wells were installed by a contractor for the USEPA in 1987 (Ref. 36, pp. 5-4 - 5-7). All monitoring wells were locked after sampling.

5.2.1 Water Level Measurements

Water level measurements were collected prior to sampling each piezometer and well. Water levels were measured and recorded to the nearest 0.01 foot from the top of the PVC riser pipe by reading the measurement directly from the probe cable. Water level data were recorded in the field logbooks and on the well purge sheets and are included in Appendix D.

5.2.2 Depth to Bottom Measurements

After water level was measured, depth to bottom was measured. Depth to bottom was measured and recorded to the nearest 0.01 foot from the top of the PVC riser pipe by reading the measurement directly from the probe cable. Depth to bottom measurements were recorded in the field logbooks and on the purge sheets. Appendix D provides the depth to bottom measurements for all wells that were measured. After measuring depth to bottom, the probe was decontaminated by spraying the cable with distilled water and wiping with paper towels as the cable was rewound on the reel.

5.2.3 *Well Purging Procedures*

From the depth to bottom and depth to water measurements, well volume calculations were made by the field team. The field team had three purging options to choose from for well purging: a peristaltic pump, a submersible Whale® pump, or a polyethylene bailer. Based on depth, well conditions, and expected levels of contamination, the field teams would use best professional judgment on which method would work best for each well. The same general procedures applied to well purging, regardless of which method was chosen:

1) The sampler documented in the field logbook and on field sheets: the exact location of where and how the sample was being collected, the date, the time, and the weather conditions.
2) If purging equipment or tubing needed to be set down, it was placed on plastic sheeting or in new trash bags to prevent contamination of the equipment.
3) Purging began.
4) Field parameters, (temperature, pH, specific conductivity, turbidity, Eh, and dissolved oxygen), were measured every 10-15 minutes and were recorded on the well purging forms (Appendix C).
5) Purging continued until the field parameters stabilized, (less than 0.2 pH or a 10% change for the other parameters between four consecutive readings), and the water was clear and free of fines.
6) The sampler donned a pair of clean, surgical gloves and collected the sample.
7) Following sample collection, sample documentation (i.e., sample number and chain-of-custody [COC] record) were completed and noted on the field sheets and in the field logbook.
8) The sample jars were placed on ice.

Purging was also considered complete after the removal of three well volumes. Some piezometers and wells were purged dry before parameters stabilized or before three well volumes were removed. In those instances, samples were collected as soon as there was enough water to fill the sample containers. In a few cases, the water volume was so low that even at fully re-charged levels the piezometer or well did not produce enough water to fill all of the required sample containers. In those cases, the field team leader directed the field crew on which containers were to be filled and which were to be omitted. A list of final field parameters for all wells is included in Appendix D of this document.

Table 5-1 provides a list of the sample methods, containers, preservatives, and holding times that were used for groundwater samples. Groundwater from monitoring wells was analyzed for VOCs, SVOCs, metals, mercury, cyanide, explosives, pesticides, herbicides, and perchlorate. A detailed list of which wells were analyzed for which contaminants can be found on a location by location basis in Section 3.0 of this document.

5.3 Surface Soil Sampling

The following procedures were followed when collecting surface soil samples at the DMOP site:

1. The sampler documented in the field logbook and on field sheets: the exact location of where and how the sample was collected, the date, the time, and the weather condition.
2. The sampler donned a clean pair of surgical gloves.
3. The sampler used a clean hand trowel to collect a sample from a depth of 0 to 6 inches bgs. Grass and rocks were removed from the sample.
4. The samples were monitored with a PID and a G-M meter.
5. The sampler collected the VOC sample aliquot first from undisturbed soil by using a plastic syringe with the end cut. The remainder of the soil was homogenized in a decontaminated stainless steel bowl and scooped into the other remaining jars.
6. Following sample collection, sample documentation (i.e., sample number and COC record) was filled out and noted on the field sheets and in the field logbook.
7. The sample jars were placed in a cooler on ice.

Table 5-1 provides a list of sample methods, containers, preservatives, and holding times that were used for surface soil samples. Surface soil samples were analyzed for VOCs, SVOCs, metals, mercury, cyanide, explosives, pesticides, herbicides, and perchlorate.

5.4 Sediment Sampling

Sediment samples were collected at 16 different locations on the DMOP site as well as in a stream upgradient and downgradient of the site. The same procedures used for collecting surface soil samples, (Section 5.4), were used for sediment samples. Sediment samples were collected near the stream bank or pond edge or in other shallow, back water areas that could be easily accessed by wading.

Table 5-1 provides a list of sample methods, containers, preservatives, and holding times that were used for stream sediment samples. Stream sediment samples were analyzed for VOCs, SVOCs, metals, mercury, cyanide, explosives, pesticides, herbicides, and perchlorate.

5.5 Private Well Sampling

Four residential wells were sampled to assess aquifer conditions around the DMOP site. The private wells were all equipped with dedicated pumps, and samples were collected at a point in the distribution system nearest the well head and prior to any water treatment system, where possible. The purging and sampling of private wells was as follows:

1. Permission to sample the well/access the property was arranged by BVSPC prior to any personnel arriving on private property.
2. The sampler documented in the field logbook and on purge sheets the exact location of where and how the sample was to be collected.
3. The tap was opened and allowed to flow 10 to 20 minutes or more prior to sample collection in order to purge any stagnant water that may exist in pipes or the pressure tank. Field parameters, (temperature, pH, specific conductivity, turbidity, Eh, and dissolved oxygen), were measured every few minutes (Appendix D).
4. Purging continued until field parameters stabilized (less than 0.2 pH or a 10% change for other parameters between four consecutive readings), and the water was clear and free of fines. Purging was considered complete when parameters stabilized.
5. Following purging, the flow from the tap was reduced for sample collection in order to minimize agitation and aeration of the sample.
6. The sampler donned a clean pair of surgical gloves.
7. Sample containers were filled directly from the reduced flow of the water tap.
8. Following sample collection, sample documentation (i.e., sample number and COC record) was filled out and were noted on the field sheets and in the field logbook.
9. After collection, the samples were placed in a cooler on ice.

Purge sheets for all private wells are included in Appendix C. Purge times may vary from the procedure listed above because in some cases, private residents would make specific requests about purge times, as some had concerns about the amount of water that would be purged out of wells with low recharge. In all cases, the field team did their best to accommodate the concerns of private citizens while obtaining the necessary sampling data.

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6.0 Summary and Conclusions

The DMOP site encompasses approximately 2,445 acres. The DMOP was constructed in 1942 and ammunition was manufactured at the site until 1945. Since 1945 the property has been subdivided and used for agricultural, commercial, and industrial purposes. Based on the analytical results of this ESI, it can be concluded that the DMOP site contains widespread low level contamination of the groundwater, soils, and sediment. A total of 11 different contaminants were detected above observed release levels in the groundwater across the DMOP site. A total of 63 different contaminants were detected above observed release levels in the surface soil across the DMOP site, and a total of 24 different contaminants were detected above observed release levels in the sediment across the DMOP site.

Contamination pathways and targets were evaluated based on three areas at the DMOP site. The groundwater pathway was evaluated based on the Landfill/Lagoon Complex. Although none of the residential wells sampled were found to contain groundwater contaminants attributable to the DMOP site, the groundwater pathway is of some concern at the DMOP site because of the numerous private wells in the areas and because of the presence of the contaminants exceeding MCLs in the groundwater.

Sample location SD-08 was used to evaluate the surface water pathway at the DMOP site. Benzo(a)pyrene contamination attributable to the Primer Manufacturing Area was detected in the sediment at this location. A DMWW drinking water intake is located approximately 7 miles downstream of the DMOP. There are several wetlands along Saylor Creek on the DMOP site and downstream within the 15-mile target distance. In addition, the Des Moines River is considered a fishery, but it is uncertain what total amount of human consumption of fish is attributable to this fishery. Because of the wetlands and the drinking water intake located within the 15-mile target distance, the surface water is considered a concern at the DMOP site.

The Chemical Storage Area was used to evaluate the soil exposure and air pathways at the DMOP site. No residents live at the Chemical Storage Area. Agriculture (dairy cattle grazing) is conducted at the Chemical Storage Area. Surface soils pose a potential threat to the surrounding community, as the contamination present at the Chemical Storage Area includes concentrations of eight substances above health-based benchmarks.

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7.0 References

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TABLES

Table 3-1
Background Soil Metal Concentrations

Analyte	Background Value (mg/kg)	Location Detected	Observed Release Value (mg/kg)
Aluminum	21580 *	BK-01	64740
Antimony	N/A	BK-01	N/A
Arsenic	6.99 (U)	BK-01	6.99
Barium	690.27 *	BK-01	2070.8
Beryllium	1.33 (U)	BK-01	1.33
Cadmium	1.33 (U)	BK-01	1.33
Calcium	38300	BK-02	114900
Chromium	22.83 *	BK-01	68.5
Cobalt	13.3 (U)	BK-01	13.3
Copper	12.3	BK-03	36.9
Iron	15200	BK-01	45600
Lead	41.62 *	BK-03	124.9
Magnesium	12000	BK-02	36000
Manganese	766	BK-01	2298
Mercury	0.137 (U)	BK-01	0.137
Nickel	15.8	BK-03	47.4
Potassium	2170 *	BK-03	6510
Selenium	8.47 (U)	BK-04	8.47
Silver	2.66 (U)	BK-01	2.66
Sodium	1330 (U)	BK-01	1330
Strontium	342 *	BK-02	1026
Thallium	6.66 (U)	BK-01	6.66
Vanadium	46.23 *	BK-01	138.7
Zinc	72.8	BK-03	218.4

Notes :
U=reported concentration at or below the Contract Required Quantitation Limit (CRQL). Therefore any sample concentration above that level establishes an observed release. The detection limit is used as the observed release criteria, rather than three times background (Ref. A9).
*=J-qualified data that has been adjusted using standard adjustment factors (Ref. A9). All J-coded values were treated as having an unknown bias.
N/A=not applicable

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Table 3-2
Background Groundwater Metal Concentrations

Analyte	Background Value from PZ-14 (ug/l)	Observed Release Value (ug/l)
Aluminum	200 (U)	200
Antimony	60 (U)	60
Arsenic	15 (U)	15
Barium	250	750
Beryllium	5 (U)	5
Cadmium	5 (U)	5
Calcium	104000	312000
Chromium	10 (U)	10
Cobalt	50 (U)	50
Copper	25 (U)	25
Iron	100 (U)	100
Lead	10 (U)	10
Magnesium	34500	103500
Manganese	1002.24 *	3006.7
Mercury	0.2 (U)	0.2
Nickel	40 (U)	40
Potassium	5000 (U)	5000
Selenium	35 (U)	35
Silver	10 (U)	10
Sodium	22554 *	67662
Strontium	337	1011
Thallium	25 (U)	25
Vanadium	50 (U)	50
Zinc	60 (U)	60

Notes :
U=reported concentration at or below the Contract Required Quantitation Limit (CRQL). Therefore any sample concentration above that level establishes an observed release. The detection limit is used as the observed release criteria, rather than three times background (Ref. A9).
*=J-qualified data that has been adjusted using standard adjustment factors (Ref. A9). All J-coded values were treated as having an unknown bias.
N/A=not applicable

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Table 3-3
Background Sediment Metal Concentrations

Analyte	Background Value at SD-01 (mg/kg)	Observed Release Value (mg/kg)
Aluminum	5410	16230
Antimony	N/A	N/A
Arsenic	4.07 (U)	4.07
Barium	99.1	297.3
Beryllium	1.36 (U)	1.36
Cadmium	1.36 (U)	1.36
Calcium	35100	105300
Chromium	9.18	27.5
Cobalt	13.6 (U)	13.6
Copper	8.97 *	26.9
Iron	9530	28590
Lead	6.17	18.5
Magnesium	10800	32400
Manganese	637.36 *	1912.1
Mercury	0.152 (U)	0.152
Nickel	10.9 (U)	10.9
Potassium	1360 (U)	1360
Selenium	9.50 (U)	9.5
Silver	2.71 (U)	2.71
Sodium	1360.(U)	1360
Strontium	32.5	97.5
Thallium	6.78 (U)	6.78
Vanadium	16.5	49.5
Zinc	60.15 *	180.5

Notes :
U=reported concentration at or below the Contract Required Quantitation Limit (CRQL). Therefore any sample concentration above that level establishes an observed release. The detection limit is used as the observed release criteria, rather than three times background (Ref. A9).
*=J-qualified data that has been adjusted using standard adjustment factors (Ref. A9). All J-coded values were treated as having an unknown bias.
N/A=not applicable

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Table 3-4
Sewage Lagoon/Landfill - Contaminant Summary Table, June 2003

GROUNDWATER

Contaminant	MCL	Observed Release	Units	Sample Results by Location					
				MW-01	MW-02	MW-04	MW-05	PZ-06	PZ-07
2,6-Dinitrotoluene	--	detection	ug/L						0.69
Nitrobenzene	--	detection	ug/L					1.7	
Aluminum	--	200	ug/L	2566 *	2958 *	1410 *	1050		
Arsenic	10	60	ug/L	142					
Iron	--	100	ug/L	6780	5220 *	5810	10000 *	301	
Potassium	--	5000	ug/L				8500	9090	7980
Vanadium	--	50	ug/L	50.4					
Zinc	--	60	ug/L	83.7 *				25	
2-Butanone	--	detection	ug/L						6.8
Acetone	--	detection	ug/L						38
Cyclohexane	--	detection	ug/L			1.4			

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.
Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.
– No established MCL.

Table 3-4 (Continued)
Sewage Lagoon/Landfill - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location			
			SSL-01	SSL-02	SSL-03	SSL-04
Pentachlorophenol	detection	ug/kg			7.8	
Arsenic	6.99	mg/kg	6.53 / 7.11		8.45	
Chromium	68.5	mg/kg		850		
Copper	36.9	mg/kg	108 / 108	932	76.3	104
Lead	124.9	mg/kg		420		
Silver	2.66	mg/kg	2.68 / 2.38 (U)			
Zinc	218.4	mg/kg		784		
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	detection	ng/kg	1030 / 739	1250	1430	2230
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-furan	detection	ng/kg	36.9 / 27.1	147	77.9	106
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	detection	ng/kg	114 / 80.4	494	201	215
1,2,3,4,6,7,8-Heptachlorodibenzo-p-furan	detection	ng/kg	23.6 / 17.6	205	37.4	29.9
1,2,3,4,7,8,9-Heptachlorodibenzo-p-furan	detection	ng/kg		6.81		
1,2,3,4,7,8-Hexachlorodibenzo-p-furan	detection	ng/kg		5.4		
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	detection	ng/kg	5.98 / 5 (U)	123	15	6.93
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	detection	ng/kg	6.73 / 5.39	52	16.5	
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	detection	ng/kg		9.39		
2,3,7,8-Dioxin Total Equivalents	detection	ng/kg	2.9 / 1.6	36.4	6.24	3.58
2,3,7,8-Tetrachlorodibenzo-p-dioxin	detection	ng/kg		105		
2,3,7,8-Tetrachlorodibenzo-p-furan	detection	ng/kg	0.15 * / 1 (U)	0.66 *	0.55 *	0.21 *
Arochlor 1254	detection	ug/kg			110	
Dieldrin	detection	ug/kg		5.0		

Table 3-4 (Continued)
Sewage Lagoon/Landfill - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location			
			SSL-01	SSL-02	SSL-03	SSL-04
Endrin Aldehyde	detection	ug/kg			12	
p,p'-DDD	detection	ug/kg		2.3 *	5.7	
p,p'-DDE	detection	ug/kg		54		6.9
p,p'-DDT	detection	ug/kg	6.4 / 4.1 (U)	12.82 *	0.78 *	8.0
trans-Chlordane	detection	ug/kg		2.3		
Benzo(a)anthracene	detection	ug/kg				960
Benzo(a)pyrene	detection	ug/kg				930
Benzo(b)fluoranthene	detection	ug/kg				960
Benzo(g,h,i)perylene	detection	ug/kg				560 *
Benzo(k)fluoranthene	detection	ug/kg				560
Butylbenzylphthalate	detection	ug/kg				3300
Chrysene	detection	ug/kg				980
Fluoranthene	detection	ug/kg	910 / 400 (U)			2200
Indeno(1,2,3-cd)pyrene	detection	ug/kg				520
Phenanthrene	detection	ug/kg	980 / 400 (U)			1300
Pyrene	detection	ug/kg	770 / 400 (U)			1800
2-Butanone	detection	ug/kg	59 / 28			13 *
Acetone	detection	ug/kg	3.5 * / 11 *			6.5 *
Carbon Disulfide	detction	ug/kg	12 / 12			

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.
Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.
– No established MCL

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Table 3-5
Scrap Burial A - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location
			SBA-01
Copper	36.9	mg/kg	828 *
Lead	12.9	mg/kg	446
p,p'-DDD	detection	ug/kg	8.8 *
p,p'-DDE	detection	ug/kg	0.52 *
p,p'-DDT	detection	ug/kg	1.09 *
Anthracene	detection	ug/kg	540
Benzo(a)anthracene	detection	ug/kg	2100
Benzo(a)pyrene	detection	ug/kg	2400
Benzo(b)fluoranthene	detection	ug/kg	3100
Benzo(g,h,i)perylene	detection	ug/kg	2800
Benzo(k)fluoranthene	detection	ug/kg	2400
Chrysene	detection	ug/kg	2500
Dibenzo(a,h)anthracene	detection	ug/kg	1100
Fluoranthene	detection	ug/kg	3300
Indeno(1,2,3-cd)pyrene	detection	ug/kg	2600
Phenanthrene	detection	ug/kg	1400
Pyrene	detection	ug/kg	3000
2-Butanone	detection	ug/kg	2.8 *
Acetone	detection	ug/kg	16 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-6
Burn Area A - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location BAA-01
Cadmium	1.33	mg/kg	2.28 *
Chromium	68.5	mg/kg	76.1 *
Cobalt	13.3	mg/kg	16.7
Copper	36.9	mg/kg	5610
Lead	124.9	mg/kg	3674 *
Nickel	47.4	mg/kg	69.4
Zinc	218.4	mg/kg	2450
Dieldrin	detection	ug/kg	110
p,p'-DDE	detection	ug/kg	37
p,p'-DDT	detection	ug/kg	4.37 *
2-Butanone	detection	ug/kg	1.6 *
Acetone	detection	ug/kg	11 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-7
Burn Area B - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location BAB-01
Chromium	68.5	mg/kg	195 * / 139 *
Copper	36.9	mg/kg	1690 / 1660
Zinc	218.4	mg/kg	823 / 924
cis-Chlordane	detection	ug/kg	24 / 28
Dieldrin	detection	ug/kg	43 / 49
Endrin	detection	ug/kg	12 * / 7.7
Heptachlor Epoxide	detection	ug/kg	43 / 38
p,p'-DDE	detection	ug/kg	99 / 87
p,p'-DDT	detection	ug/kg	140 * / 10.1 *
trans-Chlordane	detection	ug/kg	140 / 130
2-Butanone	detection	ug/kg	26 * / 2 *
Acetone	detection	ug/kg	140 * / 110 *
Benzene	detection	ug/kg	21 / 15
Toluene	detection	ug/kg	22 / 16

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-8
Lime Sludge Drying Beds - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location
			LSDB-01
Endosulfan I	detection	ug/kg	4.1
p,p'-DDD	detection	ug/kg	0.7 *
2-Butanone	detection	ug/kg	41
Acetone	detection	ug/kg	19 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-9
Blacksmith Shop - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location
			BS-01
Dieldrin	detection	ug/kg	1.6 *
p,p'-DDE	detection	ug/kg	15
p,p'-DDT	detection	ug/kg	20
2-Butanone	detection	ug/kg	1.3 *
Acetone	detection	ug/kg	13 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

Table 3-10
Magazine Loop - Contaminant Summary Table, June 2003

GROUNDWATER

Contaminant	MCL	Observed Release	Units	Sample Results by Location	
				PZ-08	PZ-11
Nitrobenzene	--	detection	ug/L	0.44	
Aluminum	--	200	ug/L	332	
Iron	--	100	ug/L		416
Potassium	--	5000	ug/L		6525 *
Acetone	--	detection	ug/L		6.5

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

-- No established MCL.

SOIL

Contaminant	Observed Release	Units	Sample Results by Location			
			CML-01	PSM-01	PSM-02	PSP-01
Dieldrin	detection	ug/kg	7.8	5.3		
p,p'-DDE	detection	ug/kg	25			4.6
p,p'-DDT	detection	ug/kg	2.2 *			
2-Butanone	detection	ug/kg	7.6 *	17	3.1 *	12
Acetone	detection	ug/kg	64 *	78 *	36 *	68 *
Methyl Acetate	detection	ug/kg	50			

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

Table 3-11
Chemical Storage Area - Contaminant Summary Table, June 2003

GROUNDWATER

Contaminant	MCL	Observed Release	Units	Sample Results by Location
				PZ-01
Aluminum	--	200	ug/L	1663 *
Iron	--	100	ug/L	1520 *
Potassium	--	5000	ug/L	11613 *
2-Butanone	--	detection	ug/L	8.0
Acetone	--	detection	ug/L	27
Cyclohexanene	--	detection	ug/L	1.0

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

-- No established MCL.

SOIL

Contaminant	Observed Release	Units	Sample Results by Location			
			CSA-01	CSA-02	CSA-03	CSA-04
Arsenic	6.99	mg/kg	13.9			
Cadmium	1.33	mg/kg	2.28 *			
Cobalt	13.3	mg/kg	29.6			
Copper	36.9	mg/kg				87.4
Manganese	2298	mg/kg	9760			
Nickel	47.4	mg/kg	216			
Thallium	6.66	mg/kg	15.6			
2,4-D	detection	ug/kg				85.7
Endosulfan I	detection	ug/kg				14
Endosulfan II	detection	ug/kg				27
p,p'-DDD	detection	ug/kg		47		95
p,p'-DDE	detection	ug/kg		190	0.66 *	410
p,p'-DDT	detection	ug/kg		6.2 *	0.55 *	18.7 *
Acenaphthene	detection	ug/kg	820	20000		27000
Anthracene	detection	ug/kg	2300	63000	1800	57000
Benzo(a)anthracene	detection	ug/kg	3700	93000	4100	130000
Benzo(a)pyrene	detection	ug/kg	2700	68000	3600	110000
Benzo(b)fluoranthene	detection	ug/kg	2800	58000	3400	110000
Benzo(g,h,i)perylene	detection	ug/kg	1800	39000	2200	73000
Benzo(k)fluoranthene	detection	ug/kg	2400	70000	3400	110000
Carbazole	detection	ug/kg	890	14000		19000
Chrysene	detection	ug/kg	4300	99000	4700	150000
Dibenzo(a,h)anthracene	detection	ug/kg	980	18000	1100	37000
Dibenzofuran	detection	ug/kg	960	20000		16000
Fluoranthene	detection	ug/kg	11000	220000	13000	300000
Fluorene	detection	ug/kg	1300	32000	1100	29000
Indeno(1,2,3-cd)pyrene	detection	ug/kg	1800	39000	2100	73000

Table 3-11 (Continued)
Chemical Storage Area - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location			
			CSA-01	CSA-02	CSA-03	CSA-04
Naphthalene	detection	ug/kg	750			
Phenanthrene	detection	ug/kg	11000	250000	11000	230000
Pyrene	detection	ug/kg	8700	160000	9300	260000
2-Butanone	detection	ug/kg			13 *	21 *
Acetone	detection	ug/kg	66	2.4 *	3.3 *	8.9 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

Table 3-12
Former Pond - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location
			FP-01
Dieldrin	detection	ug/kg	34
p,p'-DDE	detection	ug/kg	6.8
p,p'-DDT	detection	ug/kg	0.44 *
2-Butanone	detection	ug/kg	6.1 *
Acetone	detection	ug/kg	36 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-13
Former Slough - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location FS-01
2,4-D	detection	ug/kg	9.4
cis-Chlordane	detection	ug/kg	7.0
Dieldrin	detection	ug/kg	2.93 *
Heptachlor Epoxide	detection	ug/kg	37
p,p'-DDE	detection	ug/kg	34
p,p'-DDT	detection	ug/kg	52
trans-Chlordane	detection	ug/kg	19
2-Butanone	detection	ug/kg	2.3 *
Acetone	detection	ug/kg	26 *
Methyl Acetate	detection	ug/kg	32

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-14
Nursery & Slough - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location
			NS-01
Aldrin	detection	ug/kg	79
Dieldrin	detection	ug/kg	70
p,p'-DDE	detection	ug/kg	53
p,p'-DDT	detection	ug/kg	6.79 *
trans-Chlordane	detection	ug/kg	3.1
2-Butanone	detection	ug/kg	3.7 *
Acetone	detection	ug/kg	34 *
Methyl Acetate	detection	ug/kg	88

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-15
Outside Machine Shop - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location
			OSM-01
Acetone	detection	ug/kg	3.8 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.
Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-16
Powder Canning Area - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location	
			PCA-01	PCA-02
p,p'-DDD	detection	ug/kg	0.72 *	
Anthracene	detection	ug/kg	560	
Benzo(a)anthracene	detection	ug/kg	1400	540
Benzo(a)pyrene	detection	ug/kg	1300	450
Benzo(b)fluoranthene	detection	ug/kg	1100	530
Benzo(g,h,i)perylene	detection	ug/kg	780	
Benzo(k)fluoranthene	detection	ug/kg	1400	
Chrysene	detection	ug/kg	1700	580
Dibenzo(a,h)anthracene	detection	ug/kg	400	
Fluoranthene	detection	ug/kg	3500	1300
Indeno(1,2,3-cd)pyrene	detection	ug/kg	830	
Phenanthrene	detection	ug/kg	2600	1100
Pyrene	detection	ug/kg	2900	910 *
2-Butanone	detection	ug/kg	24	47
Acetone	detection	ug/kg	120 *	32 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-17
Possible Dump Site - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location
			PD-01
Aldrin	detection	ug/kg	2.3
Dieldrin	detection	ug/kg	9.7
p,p'-DDE	detection	ug/kg	29
p,p'-DDT	detection	ug/kg	1.56 *
2-Butanone	detection	ug/kg	2.2 *
Acetone	detection	ug/kg	23 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.
Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-18
Primer Composition Store House - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location	
			PCSH-01	PCSH-02
Dieldrin	detection	ug/kg	0.66 *	3.9
p,p'-DDT	detection	ug/kg	0.33 *	
2-Butanone	detection	ug/kg	7 *	4.1 *
2-Hexanone	detection	ug/kg		10 *
Acetone	detection	ug/kg	42 *	26 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-19
Primer Manufacturing/Powder Canning - Contaminant Summary Table, June 2003

GROUNDWATER

Contaminant	MCL	Observed Release	Units	Sample Results by Location
				PZ-03
Nitrobenzene	--	detection	ug/L	0.88
Potassium	--	5000	ug/L	118000

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.
Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.
-- No established MCL.

SOIL

Contaminant	Observed Release	Units	Sample Results by Location				
			PMPC-01	PMPC-02	PMPC-03	PMPC-04	PMPC-05
Dieldrin	detection	ug/kg					230
Heptachlor Epoxide	detection	ug/kg					66
p,p'-DDD	detection	ug/kg	3.8 (U) / 1.0 *	0.99 *			340
p,p'-DDE	detection	ug/kg	0.52 * / 3.9 (U)	1.7 *		110	1300
p,p'-DDT	detection	ug/kg	10 * / 11 *	1.87 *	0.44 *	150 *	210.6 *
trans-Chlordane	detection	ug/kg		0.44 *			8.0 *
Acenaphthene	detection	ug/kg	380 (U) / 430	1900			
Anthracene	detection	ug/kg	380 (U) / 1100	6100			3300
Benzo(a)anthracene	detection	ug/kg	630 / 2300	9800		5000	14000
Benzo(a)pyrene	detection	ug/kg	620 / 2300	8000		4800	13000
Benzo(b)fluoranthene	detection	ug/kg	860 / 2700	9200		8000	13000
Benzo(g,h,i)perylene	detection	ug/kg	470 / 1300 *	5000		2900 *	9200 *
Benzo(k)fluoranthene	detection	ug/kg	470 / 1200	400		2900	10000
Carbazole	detection	ug/kg	380 (U) / 530	1500			
Chrysene	detection	ug/kg	920 / 2800	11000		5400	15000
Dibenzo(a,h)anthracene	detection	ug/kg	380 (U) / 590	2300			4000
Dibenzofuran	detection	ug/kg	380 (U) / 460	1500			
Fluoranthene	detection	ug/kg	2400 / 7100	30000		13000	30000
Fluorene	detection	ug/kg	380 (U) / 610	2600			
Indeno(1,2,3-cd)pyrene	detection	ug/kg	420 / 1400	5600		2600	8700
Naphthalene	detection	ug/kg		500			
Phenanthrene	detection	ug/kg	1900 / 7600	25000		8800	15000
Pyrene	detection	ug/kg	1600 * / 6000	24000 *		12000	25000
2-Butanone	detection	ug/kg	12 (U) / 6.8 *		2.9 *	2.6 *	
2-Hexanone	detection	ug/kg	12 (U) / 160 *				
Acetone	detection	ug/kg	12 (U) / 160 *		110 *	140	97

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.
Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-20
Paint Storage Area - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location
			PSA-01
p,p'-DDD	detection	ug/kg	0.47 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-21
PETN Sieve Houses - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location	
			PSH-01	PSH-02
cis-Chlordane	detection	ug/kg	2.7	
Dieldrin	detection	ug/kg	5	
p,p'-DDT	detection	ug/kg	0.43 *	
2-Butanone	detection	ug/kg	3.2 *	5.0 *
Acetone	detection	ug/kg	18 *	35 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-22
Storage Areas - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location
			SA-01
Dieldrin	detection	ug/kg	2.35 *
p,p'-DDD	detection	ug/kg	0.6 *
p,p'-DDE	detection	ug/kg	100
p,p'-DDT	detection	ug/kg	56
Acetone	detection	ug/kg	8.0 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-23
Tracer/Igniter Manufacturing/Storage - Contaminant Summary Table, June 2003

GROUNDWATER

Contaminant	MCL	Observed Release	Units	Sample Results by Location
				PZ-02
Nitrobenzene	--	detection	ug/L	0.3
Aluminum	--	200	ug/L	4810
Iron	--	5000	ug/L	8910

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

-- No established MCL.

SOIL

Contaminant	Observed Release	Units	Sample Results by Location			
			TIMS-01	TIMS-02	TIMS-03	TIMS-04
Pentachlorophenol	detection	ug/kg	6.5			
Arsenic	detection	mg/kg				8.61
Zinc	detection	mg/kg	268			
Dieldrin	detection	ug/kg				6.5
Endrin	detection	ug/kg	0.47 *	0.47 *		
p,p'-DDE	detection	ug/kg	0.55 *	0.43 *		6.7
p,p'-DDT	detection	ug/kg	0.94 *	0.71 *		
Acenaphthene	detection	ug/kg	2700		420	
Anthracene	detection	ug/kg	7700	3400	1100	
Benzo(a)anthracene	detection	ug/kg	11000	6300	1800	1100
Benzo(a)pyrene	detection	ug/kg	8700	5200	1400	1100
Benzo(b)fluoranthene	detection	ug/kg	7700	4300	1500	1100
Benzo(g,h,i)perylene	detection	ug/kg	4700	2700	850	710
Benzo(k)fluoranthene	detection	ug/kg	8500	5400	1100	930
Carbazole	detection	ug/kg	2600			
Chrysene	detection	ug/kg	12000	6600	1900	1300
Dibenzo(a,h)anthracene	detection	ug/kg	2500		410	
Dibenzofuran	detection	ug/kg	3400			
Fluoranthene	detection	ug/kg	27000	15000	4700	2500
Fluorene	detection	ug/kg	5700		560	
Indeno(1,2,3-cd)pyrene	detection	ug/kg	4600	2800	880	690
Naphthalene	detection	ug/kg	3700			
Phenanthrene	detection	ug/kg	29000	13000	4900	1400
Pyrene	detection	ug/kg	19000	11000	3700	1900
2-Butanone	detection	ug/kg			14	18
Acetone	detection	ug/kg	24	3.1 *	140	15 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-24
Warehouses - Contaminant Summary Table, June 2003

SOIL

Contaminant	Observed Release	Units	Sample Results by Location		
			WH-01	WH-02	WH-03
Dieldrin	detection	ug/kg	42	25	35
Heptachlor Epoxide	detection	ug/kg	4.3		
p,p'-DDD	detection	ug/kg	13	6.5	12
p,p'-DDE	detection	ug/kg	50	38	100
p,p'-DDT	detection	ug/kg	4.6 *	4.45 *	5.07 *
2-Butanone	detection	ug/kg	2.3 *	2.8 *	2.6 *
Acetone	detection	ug/kg	41 *	34 *	31 *
Methyl Acetate	detection	ug/kg	17	35	

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-25
Sediment - Contaminant Summary Table, June 2003

Contaminant	Observed Release	Units	Sample Results by Location															
			SD-01	SD-02	SD-03	SD-04	SD-05	SD-06	SD-07	SD-08	SD-09	SD-10	SD-11	SD-13	SD-14	SD-15	SD-18	SD-19
Nickel	10.9	mg/kg		11.9			11.4	15.7		17				14.2	14.2	14.0	12.6	13.2
Potassium	1360	mg/kg						1476									1550	1420
Dieldrin	detection	ug/kg								0.84 *	6.7	8.2						
Heptachlor Epoxide	detection	ug/kg								0.24 *								
p,p'-DDD	detection	ug/kg								2.9 *			0.48 *			0.66 *		
p,p'-DDE	detection	ug/kg								2.4 *	9.5	5.8				13		
p,p'-DDT	detection	ug/kg								3.82 *	0.5 *							
trans-Chlordane	detection	ug/kg								0.86 *	0.26 *							
2-Methylnaphthalene	detection	ug/kg														6000		
Benzo(a)anthracene	detection	ug/kg								810								
Benzo(a)pyrene	detection	ug/kg								830								
Benzo(b)fluoranthene	detection	ug/kg								850								
Benzo(g,h,i)perylene	detection	ug/kg								490 *								
Benzo(k)fluoranthene	detection	ug/kg								640								
Chrysene	detection	ug/kg								910								
Fluoranthene	detection	ug/kg								1900								
Indeno(1,2,3-cd)pyrene	detection	ug/kg								560								
Naphthalene	detection	ug/kg														2500		
Phenanthrene	detection	ug/kg								980						830		
Pyrene	detection	ug/kg								1500								
2-Butanone	detection	ug/kg	6.9 *		1.2 *			4.7 *	1.7 *	2.3 *		12 *			1.3 *	12	10 *	
Acetone	detection	ug/kg	3.5 *	5 *	3.4 *	1.1 *		49 *	7.4 *	83	98 *	7.4 *	12	15	46	3.8 *	2.9 *	2.7 *
Benzene	detection	ug/kg						44										
Toluene	detection	ug/kg						15										

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

– No established MCL

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Table 3-26
Residential Soil - Contaminant Summary Table, June 2003

DAIRY HOMES

Contaminant	Observed Release	Units	Sample Results by Location			
			DH-01	DH-02	DH-03	DH-04
B-BHC	detection	ug/kg	11			
p,p'-DDE	detection	ug/kg	28	4.7		
p,p'-DDT	detection	ug/kg	2.18 *	0.28 *		
2-Butanone	detection	ug/kg	29		3.2 *	4.7 *
Acetone	detection	ug/kg	190 *		300 *	25 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

CAMPUS VIEW APARTMENTS

Contaminant	Observed Release	Units	Sample Results by Location			
			CVA-01	CVA-02	CVA-03	CVA-04
Calcium	114900	mg/kg		152000		
Dieldrin	detection	ug/kg			0.54 *	4.4
Heptachlor	detection	ug/kg		0.27 *		
p,p'-DDE	detection	ug/kg		0.93 *	2.6 *	11
p,p'-DDT	detection	ug/kg			1.09 *	
bis(2-Ethylhexyl)phthalate	detection	ug/kg		520		
2-Butanone	detection	ug/kg		38 *	45 *	41 *
Acetone	detection	ug/kg		51 *	24 *	22 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-27
Day Care Soil - Contaminant Summary Table, June 2003

DAY CARE SOIL

Contaminant	Observed Release	Units	Sample Results by Location			
			DC-01	DC-02	DC-03	DC-04
Dicamba	detection	ug/kg		22		
Aloclor 1254	detection	ug/kg	270	510		
Dieldrin	detection	ug/kg		5.1	11	4.5
Endrin Aldehyde	detection	ug/kg	0.48 *			
Heptachlor Epoxide	detection	ug/kg	4.8	9.5		
p,p'-DDD	detection	ug/kg	1.7 *		0.45 *	
p,p'-DDE	detection	ug/kg	29	33	61	16
p,p'-DDT	detection	ug/kg	1.56 *	1.01 *	1.87 *	0.61 *
trans-Chlordane	detection	ug/kg	5.3	13	4.8	
2-Butanone	detection	ug/kg			31	
Acetone	detection	ug/kg			19 *	51 *

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.

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Table 3-28
Residential Well Construction Information

Address	Screen Interval (feet bgs)	Aquifer	Year of Construction
3506 NW 80th Lane	410 to 602	Limestone	1978
3570 NW 80th Lane	360 to 610	Limestone	1975
7340 NW 2nd Court	410 to 462	Limestone	1997
1915 NE 78th Avenue	Unknown	Unknown	Unknown

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Table 3-29
Residential Wells - Contaminant Summary Table, June 2003

GROUNDWATER

Contaminant	MCL	Observed Release	Units	Sample Results by Location			
				1915 NE 78th Ave. (RW-01)	7340 NW 2nd Court (RW-02)	3570 NW 80th Ln. (RW-03)	3570 NW 80th Ln. (RW-04)
Copper	1300	25	ug/L		48.4 *		
Iron	--	100	ug/L	1930	3024 *	508	178
Potassium	--	5000	ug/L		6200	10726 *	11048 *
Sodium	--	67662	ug/L		476000	384921 *	304762 *
Zinc	--	60	ug/L	220 *			
Toluene	1000	detection	ug/L		0.76		

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.
Blank spaces in table indicate that the contaminant was either undetected or detected at a level within the range of established background concentrations.
-- No established MCL.

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Table 4-1
Resident Population Within 4-Mile Radius of the Chemical Storage Area

Distance Ring	Population
0 to 1/4 mile	0
1/4 to 1/2 mile	0
1/2 to 1 mile	766
1 to 2 miles	12428
2 to 3 miles	15312
3 to 4 miles	17349
Total	45855

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Table 4-2

Health-Based Benchmarks for Surface Soils Compared to Sample Results at the Chemical Storage Area

Contaminant	Units	Observed Release at the Chemical Storage Area	Reference Dose Screen Concentration	Cancer Risk Screen Concentration
Arsenic	mg/kg	**13.9**	23	.043
Cadmium	mg/kg	2.28 *	3.9	--
Cobalt	mg/kg	29.6	--	--
Copper	mg/kg	87.4	--	--
Manganese	mg/kg	9760	11000	--
Nickel	mg/kg	216	1600	--
Thallium	mg/kg	15.6	--	--
2,4-D	ug/kg	85.7	780000	--
Endosulfan I	ug/kg	14	470000	--
Endosulfan II	ug/kg	27	470000	--
p,p'-DDD	ug/kg	95	--	2700
p,p'-DDE	ug/kg	410	--	1900
p,p'-DDT	ug/kg	18.7 *	39000	1900
Acenaphthene	ug/kg	27000	4700000	--
Anthracene	ug/kg	63000	23000000	--
Benzo(a)anthracene	ug/kg	**130000**	--	880
Benzo(a)pyrene	ug/kg	**110000**	--	880
Benzo(b)fluoranthene	ug/kg	**110000**	--	880
Benzo(g,h,i)perylene	ug/kg	73000	--	--
Benzo(k)fluoranthene	ug/kg	**110000**	--	8800
Carbazole	ug/kg	19000	--	32000
Chrysene	ug/kg	**150000**	--	88000
Dibenzo(a,h)anthracene	ug/kg	**37000**	--	88
Dibenzofuran	ug/kg	20000	--	--
Fluoranthene	ug/kg	300000	3100000	--
Fluorene	ug/kg	32000	3100000	--
Indeno(1,2,3-cd)pyrene	ug/kg	**73000**	--	880
Naphthalene	ug/kg	750	3100000	--
Phenanthrene	ug/kg	250000	--	--
Pyrene	ug/kg	260000	2300000	--
2-Butanone	ug/kg	21 *	47000000	--
Acetone	ug/kg	66	7800000	--

Notes:

Bolded values indicates concentrations exceeds one or more benchmark.

Observed release value listed is the highest observed release concentration detected in the surface soil at the Chemical Storage Area.

Health-based benchmarks selected from the Superfund Chemical Data Matrix (Ref. 35).

-- Indicates health-based value is not available.

* Denotes J-coded value that has been corrected for laboratory bias. J-coded corrections are listed at the end of Appendix E.

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Table 5-1
Sample Methods, Containers, Preservation, and Maximum Holding Times

Parameter	Method[1]		Container Requirements	Preservative	Holding Time	
	Extraction	Analysis			Extraction	Analysis
Water (Non-residential)						
VOCs	TCL by CLP		2 x 40 ml vials, in 1L cubitainer, with charcoal thimble	HCl, 4°C	---	14 days
SVOCs	TCL by CLP		1 x 128 oz. amber glass	4°C	7 days	40 days
PCBs/Pesticides	TCL by CLP		1 x 128 oz. amber glass	4°C	7 days	40 days
Herbicides	SW-846 8150 & 8151A		1 x 128 oz. amber glass	4°C	7 days	40 days
Metals	TAL by CLP		1 x 1L plastic cubitainer	HNO_3, 4°C	180 days	180 days
Mercury	TAL by CLP		1 x 1L plastic cubitainer	HNO_3, 4°C	180 days	180 days
Cyanide	TAL by CLP		1 x 1L plastic cubitainer	NaOH to pH>12, 4°C	---	14 days
Explosives (including nitrocellulose)	SW-846 8330		1 x 128 oz. amber glass	4°C	7 days	40 days
Perchlorate	Perchlorate by IC		1 x 1L plastic cubitainer	4°C	---	28 days
Water (Residential)						
VOCs (LDL)	TCL by CLP		2 x 40 ml vials, in 1L cubitainer, with charcoal thimble	HCl, 4°C	---	14 days
SVOCs	TCL by CLP		1 x 128 oz. amber glass	4°C	7 days	40 days
PCBs/Pesticides	TCL by CLP		1 x 128 oz. amber glass	4°C	7 days	40 days
Herbicides	SW-846 8150 & 8151A		1 x 128 oz. amber glass	4°C	7 days	40 days
Metals	TAL by CLP		1 x 1L plastic cubitainer	HNO_3, 4°C	180 days	180 days
Mercury	TAL by CLP		1 x 1L plastic cubitainer	HNO_3, 4°C	180 days	180 days
Cyanide	TAL by CLP		1 x 1L plastic cubitainer	NaOH to pH>12, 4°C	---	14 days
Explosives (including nitrocellulose)	SW-846 8330		1 x 128 oz. amber glass	4°C	7 days	40 days
Perchlorate	Perchlorate by IC		1 x 1L plastic cubitainer	4°C	--	28 days

Table 5-1 (Continued)
Sample Methods, Containers, Preservation, and Maximum Holding Times

Parameter	Method[1]		Container Requirements	Preservative	Holding Time	
	Extraction	Analysis			Extraction	Analysis
Soil/Sediments						
VOCs	TCL by CLP		4 x 40 ml vials, in 1L cubitainer, with charcoal thimble	2 vials sodium bisulfate, 2 vials unpreserved; all vials 4°C	---	14 days
SVOCs	TCL by CLP		8 oz. glass jar	4°C	14 days	40 days
PCBs/Pesticides	TCL by CLP		8 oz. glass jar	4°C	14 days	40 days
Herbicides	SW-846 5150 & 8151A		8 oz. glass jar	4°C	14 days	40 days
Metals/Mercury	TAL by CLP		8 oz. glass jar	4°C	180 days	180 days
Cyanide	TAL by CLP		8 oz. glass jar	4°C	180 days	180 days
Explosives	SW-846 8330		8 oz. glass jar	4°C	14 days	40 days
Perchlorate	Perchlorate by IC		8 oz. glass jar	4°C	180 days	180 days
Dioxin/Furans[2]	EPA Method 1316B	SW-846 8290	8 oz. glass jar	4°C	---	365 days

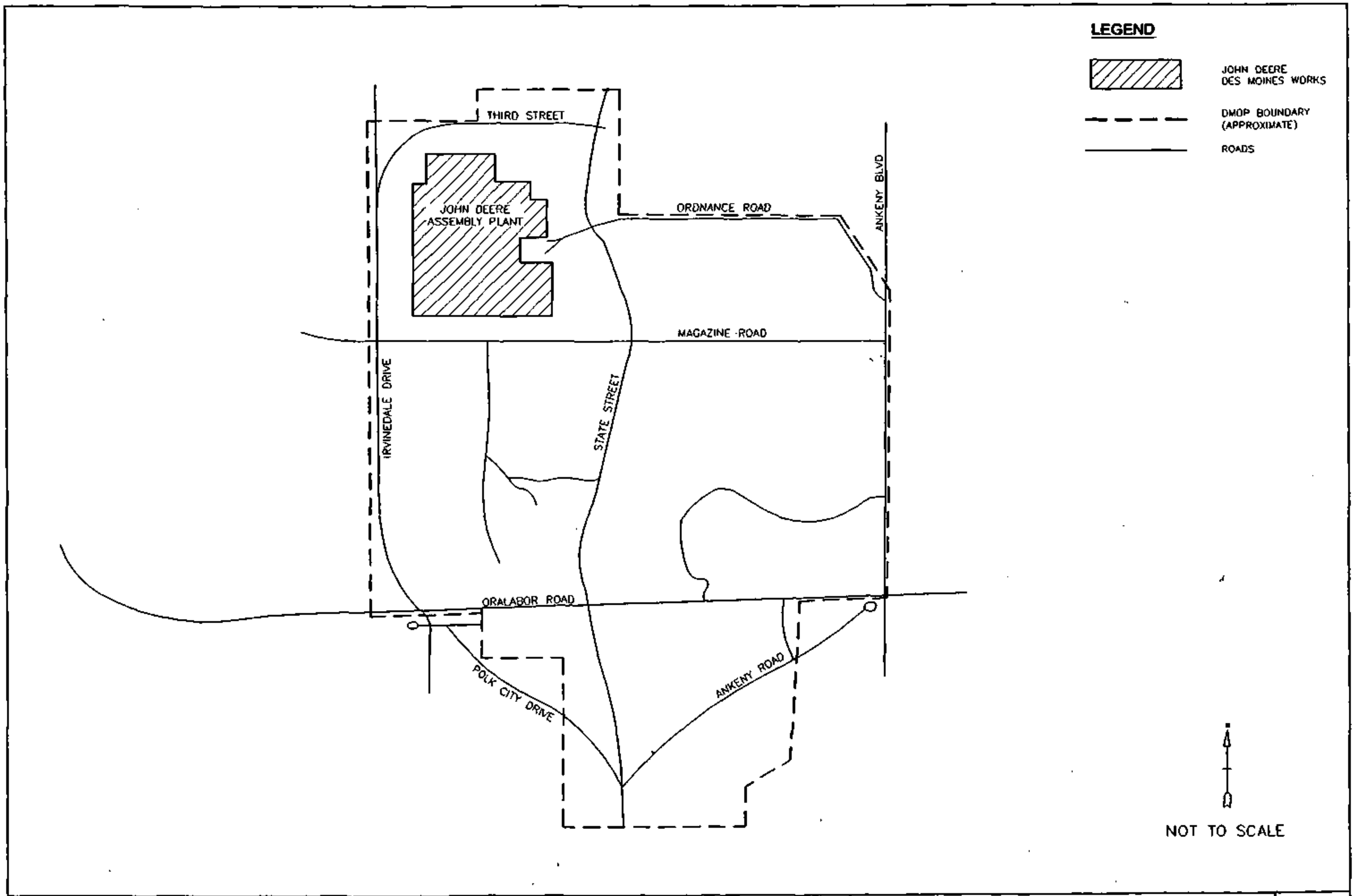
Note 1: All method detection limits, as provided by EPA Region VII Laboratory, are included in Appendix A of this document.
Note 2: Dioxins/Furans analyses will only be completed on selected samples, as outlined in the Field Sampling Plan (BVSPC, 2003).

TCL=Target Compound List
ml=milliliters
LDL=Lower Detection Limit
PCBs=Polychlorinated Biphenyls
HNO_3=Nitric Acid
IC=Ion chromatograph

CLP=Contract Laboratory Program
HCl=Hydrochloric Acid
oz.=ounce
TAL=Target Analyte List
NaOH=sodium hydroxide

FIGURES

PLOTTER: HP PEN TABLE: HALF PLOT SCALE: 1=1 Original dwg size 11 x 8.5 Revised By: ON Jan 14, 2003 @ 10:40am
Drawing: O:\PRJ\46911\C0007591.dwg ACAD 15.05 Plot By: kin07995 Jan 14, 2003, 10:41am Attached Xref:

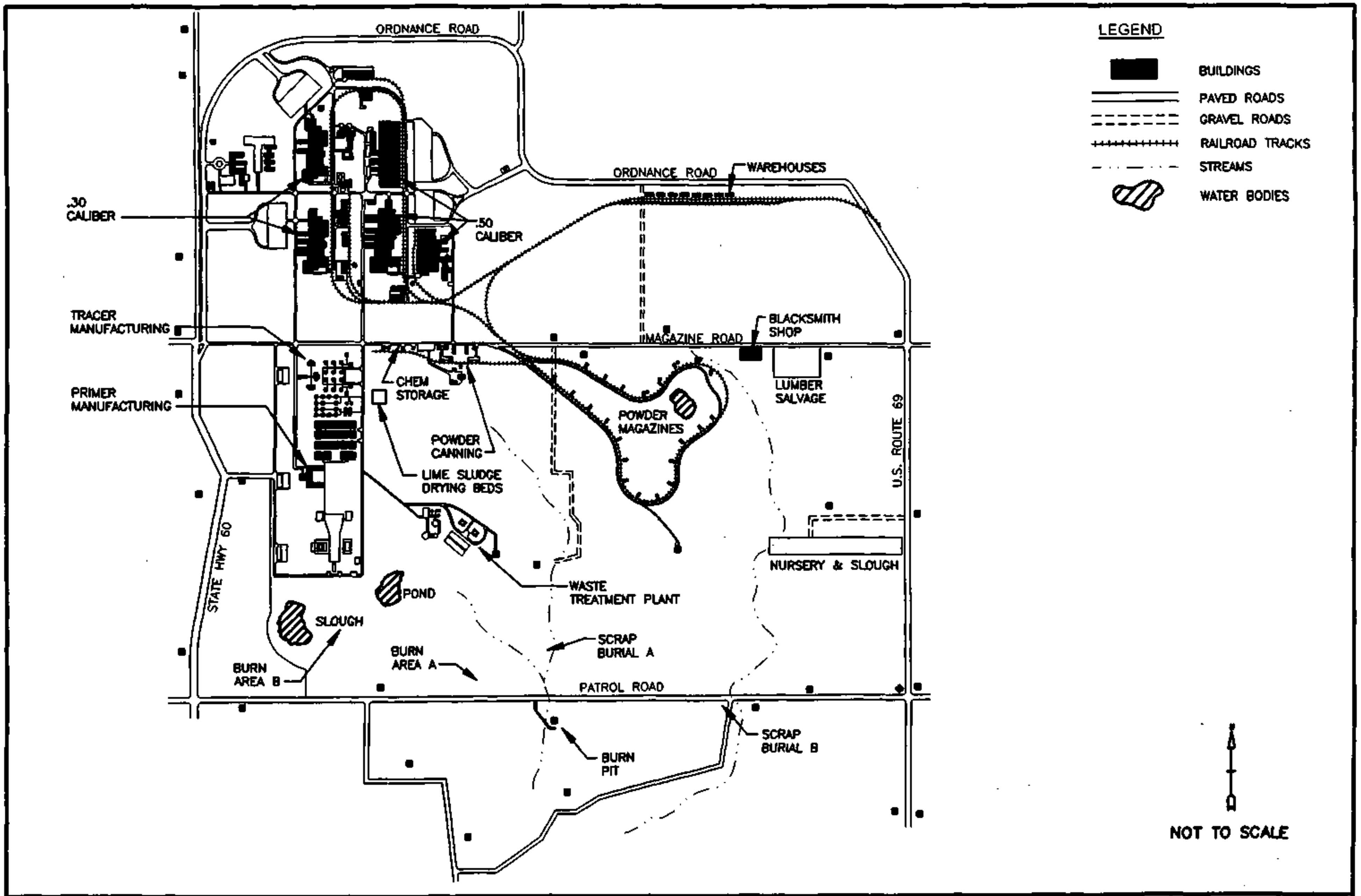


BLACK & VEATCH
SPECIAL PROJECTS CORP.

EXPANDED SITE INSPECTION
DES MOINES (EX) ORDNANCE PLANT
ANKENY, IOWA

SITE LOCATION MAP

FIGURE
1-1



BLACK & VEATCH
SPECIAL PROJECTS CORP.

EXPANDED SITE INSPECTION
DES MOINES (EX) ORDNANCE PLANT
ANKENY, IOWA

HISTORICAL SITE LAYOUT
(CIRCA 1943)

FIGURE
2-1

Unscanned Items

A map or maps that could not be scanned
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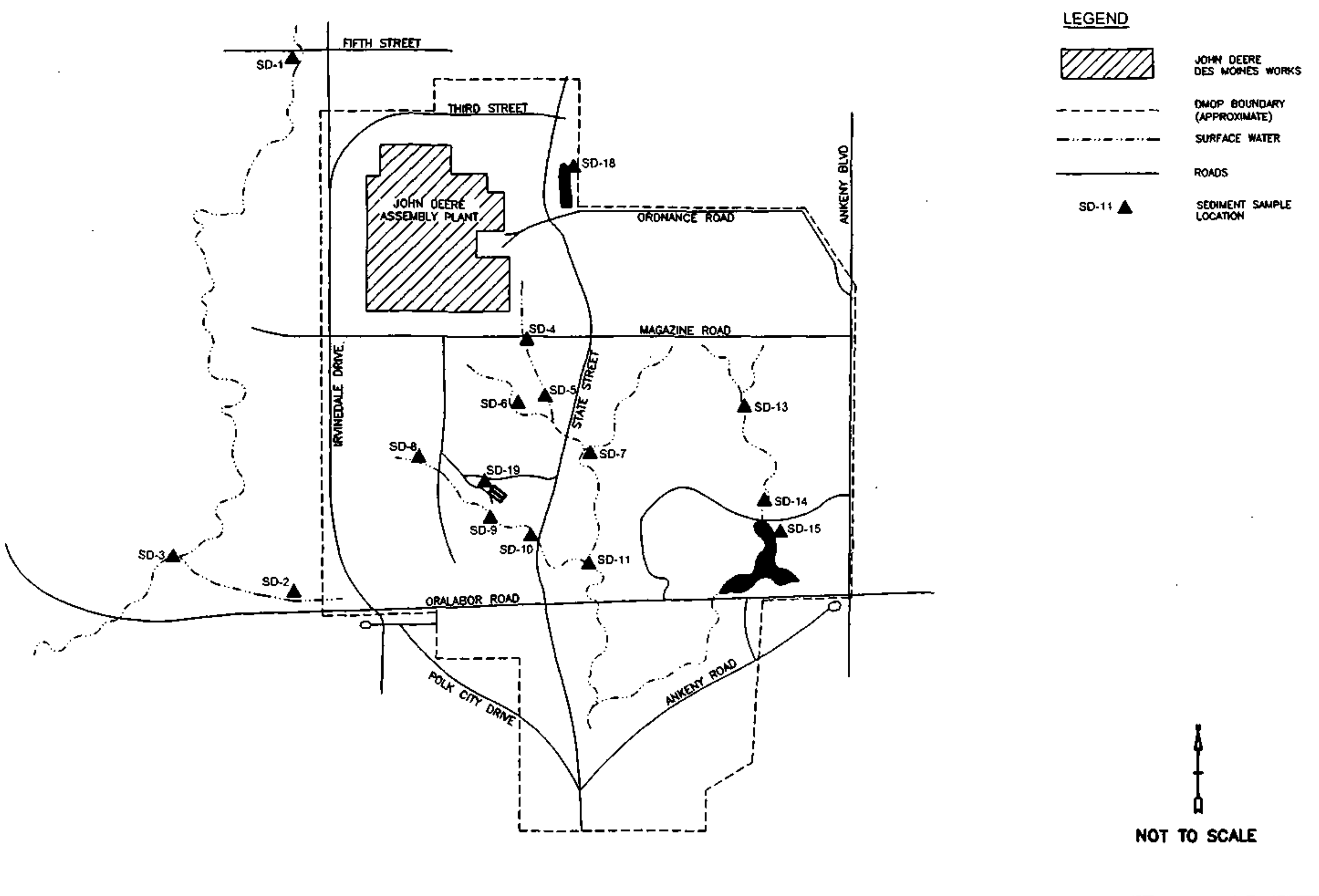
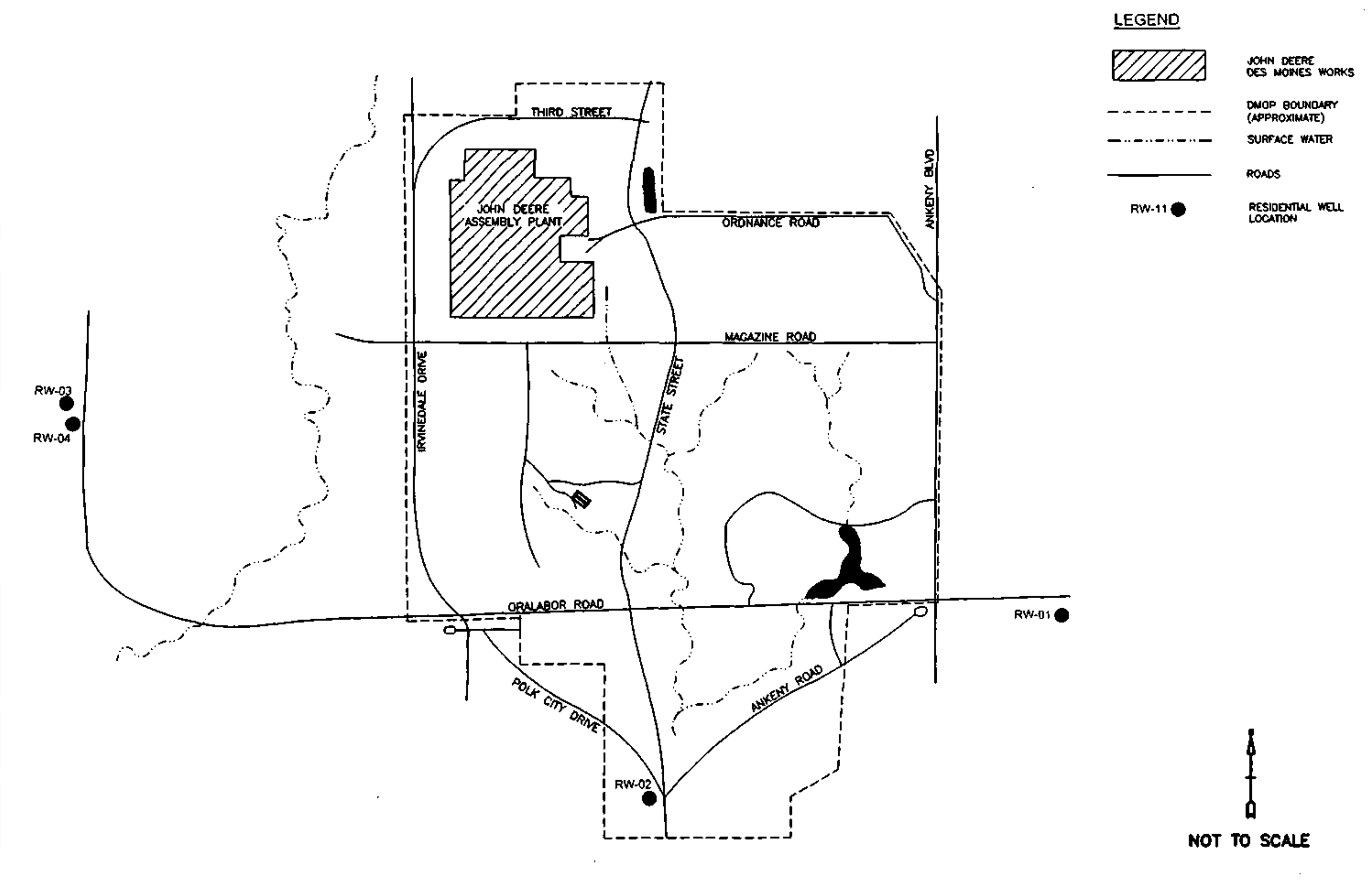


BLACK & VEATCH SPECIAL PROJECTS CORP.	EXPANDED SITE INSPECTION DES MOINES (EX) ORDNANCE PLANT ANKENY, IOWA	ESI SEDIMENT SAMPLING LOCATIONS	FIGURE 3-2

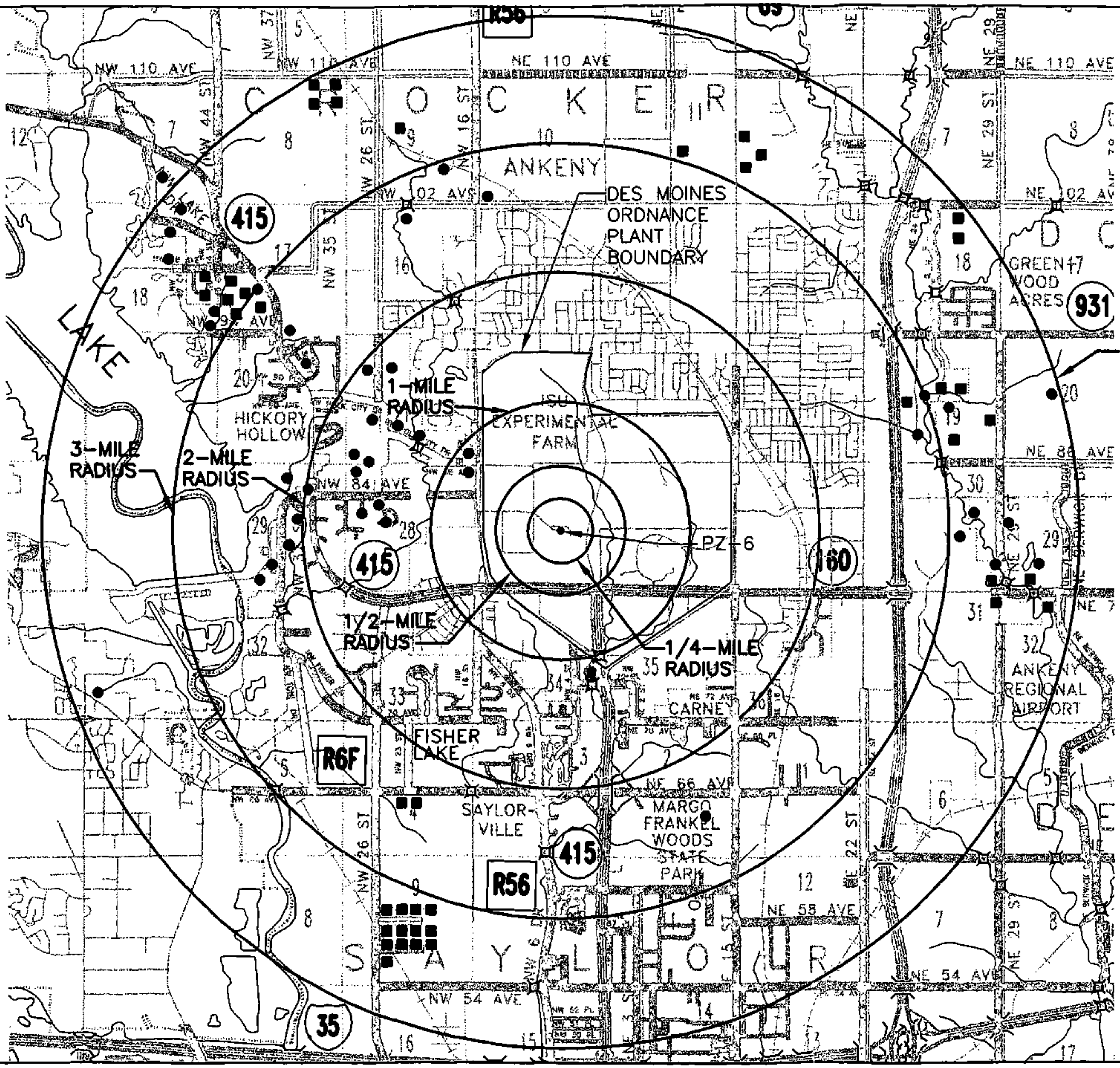


BLACK & VEATCH
SPECIAL PROJECTS CORP.

EXPANDED SITE INSPECTION
DES MOINES (EX) ORDNANCE PLANT
ANKENY, IOWA

ESI RESIDENTIAL WELL LOCATIONS

FIGURE
3-3



PLAN

NORTH

NOTES:

1. ALL WELL LOCATIONS ARE APPROXIMATE.
2. REFS. TETRA TECH 2002; IDNR GEOSAM WELL INFORMATION

■ SHALLOW PRIVATE WELLS (<150FT DEEP)

● DEEP PRIVATE WELLS (>150FT DEEP)

LEGEND

INTERSTATE HIGHWAY
DIVIDED HIGHWAY
NON-DIVIDED HIGHWAY
PAVED COUNTY ROAD — OR —
BITUMINOUS COUNTY ROAD
GRAVEL COUNTY ROAD
EARTH COUNTY ROAD — OR —

INTERSTATE HIGHWAY
UNITED STATES HIGHWAY
STATE HIGHWAY
COUNTY HIGHWAY

RAILROAD
PIPELINE
AIRPORT ±
HYDROLOGY
BRIDGE

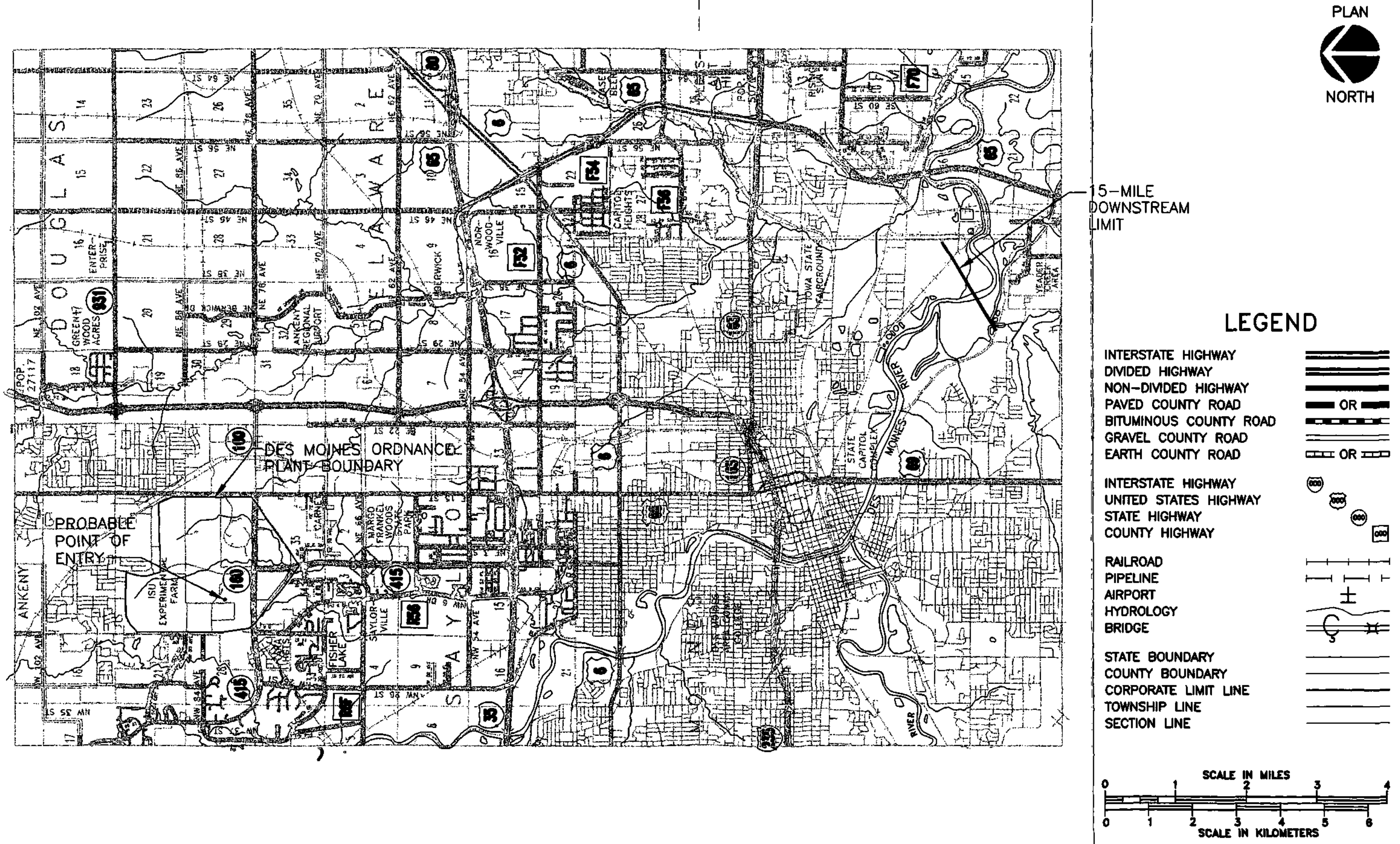
STATE BOUNDARY
COUNTY BOUNDARY
CORPORATE LIMIT LINE
TOWNSHIP LINE
SECTION LINE

SCALE IN MILES
0 1 2 3 4

0 1 2 3 4 5 6
SCALE IN KILOMETERS

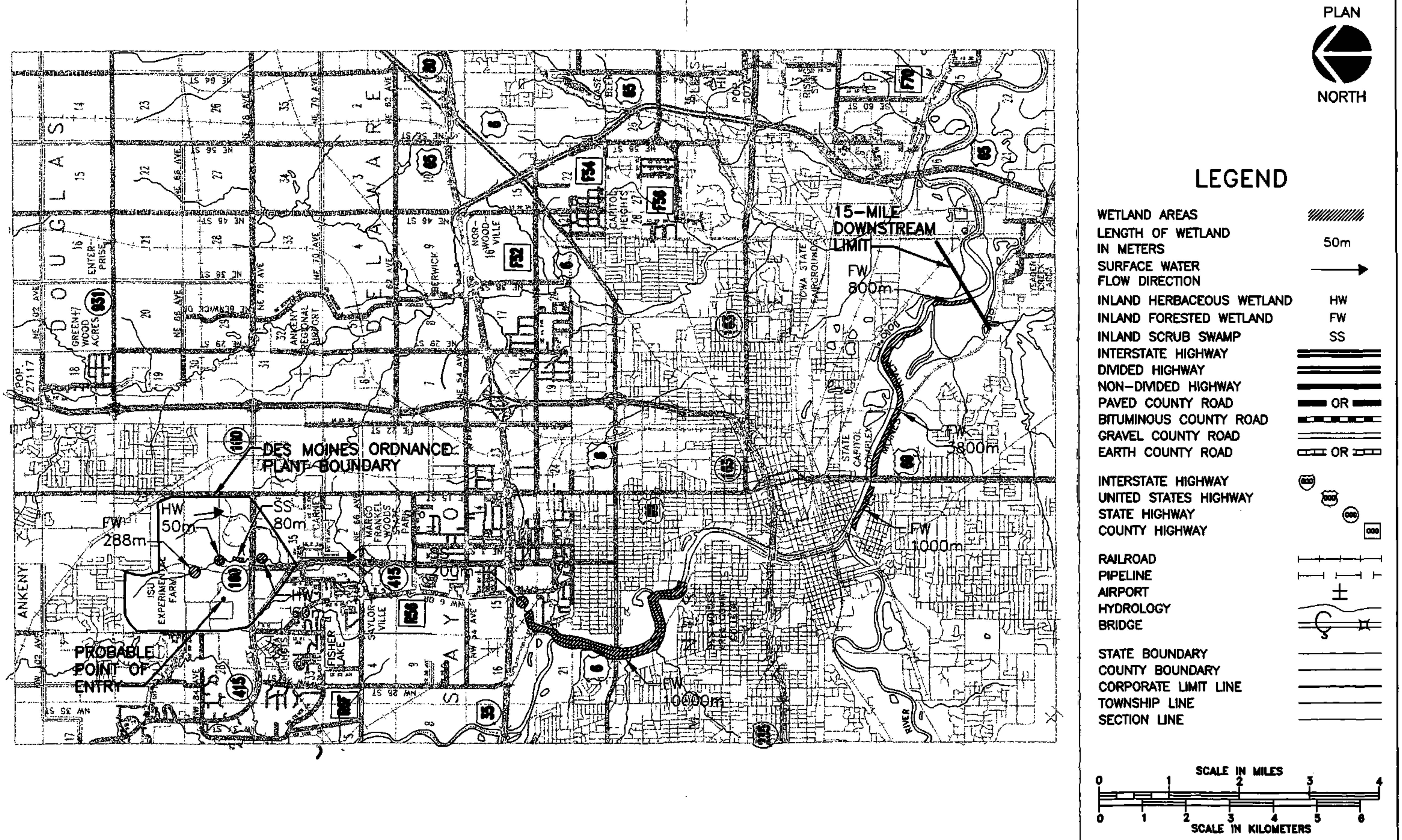
EXPANDED SITE INSPECTION DES MOINES (EX) ORDNANCE PLANT ANKENY, IOWA
GROUNDWATER PATHWAY 4-MILE RADIUS MAP

FIGURE 4-1



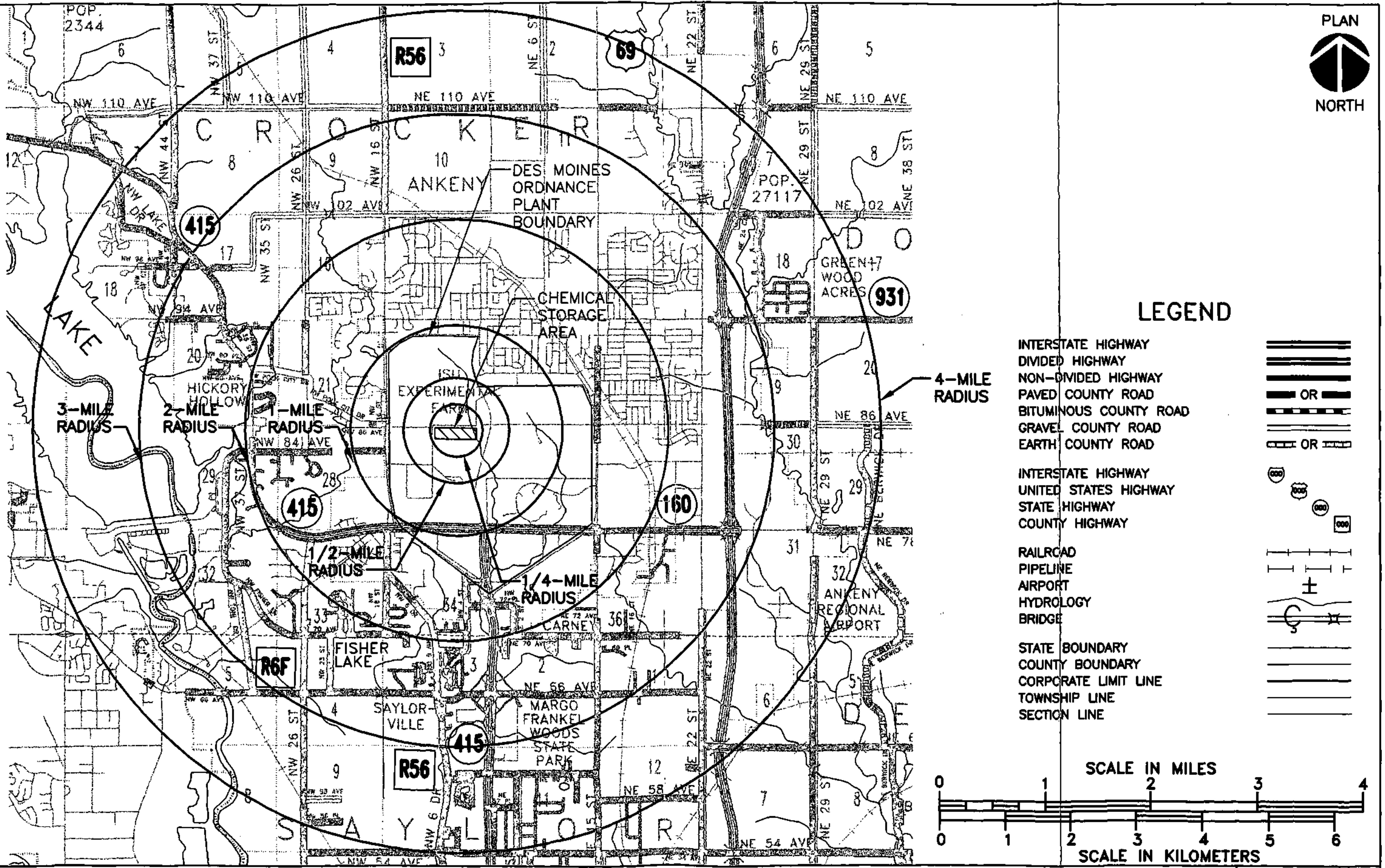
EXPANDED SITE INSPECTION DES MOINES (EX) ORDNANCE PLANT ANKENY, IOWA
SURFACE WATER PATHWAY 15-MILE/DISTANCE MAP DOWNSTREAM

FIGURE 4-2



EXPANDED SITE INSPECTION DES MOINES (EX) ORDNANCE PLANT ANKENY, IOWA
TERRESTRIAL SENSITIVE ENVIRONMENTS

FIGURE 4-3



EXPANDED SITE INSPECTION DES MOINES (EX) ORDNANCE PLANT ANKENY, IOWA
SOIL AND AIR EXPOSURE PATHWAY 4-MILE RADIUS MAP

FIGURE 4-4