Final Monitoring Plan for Site Restoration at Murdock, Nebraska

prepared by
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Final Monitoring Plan for Site Restoration at Murdock, Nebraska

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Monitoring Plan for Murdock, Nebraska
Version 01, 02/17/06

Notation

BGL below ground level
CCC Commodity Credit Corporation
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
EE/CA Engineering Evaluation/Cost Analysis
EPA U.S. Environmental Protection Agency
ft foot (feet)
gpm gallon(s) per minute
GWEX groundwater extraction well
hr hour(s)
in. inch(es)
µg/L microgram(s) per liter
µg/m³ microgram(s) per cubic meter
mi mile(s)
USDA U.S. Department of Agriculture
VOC volatile organic compound
yr year(s)
1 Introduction

1.1 Background

In early 2005, Argonne National Laboratory conducted an Engineering Evaluation/Cost Analysis (EE/CA; Argonne 2005b) to address carbon tetrachloride contamination identified in groundwater and surface water at Murdock, Nebraska, approximately 22 mi east-northeast of Lincoln (Figure 1.1). The EE/CA study was performed for the Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA), as the technical basis for a proposed removal action for the Murdock site. The EE/CA was conducted in compliance with an Administrative Order on Consent issued for Murdock by the U.S. Environmental Protection Agency (EPA 1991).

Three removal action alternatives were examined through the use of site-specific data and predictive simulations of groundwater flow and contaminant transport performed with calibrated numerical models. The alternatives were evaluated individually and compared against performance criteria established under the National Oil and Hazardous Substances Pollution Contingency Plan and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). On the basis of these evaluations, an alternative employing phytoremediation in conjunction with seasonal groundwater extraction and treatment by spray irrigation was recommended by the CCC/USDA to permanently reduce the carbon tetrachloride contaminant levels in groundwater and surface water at the site. The proposed alternative is being implemented in cooperation with the EPA.

Under the direction of the CCC/USDA and the EPA, implementation of the chosen removal action occurred in phases, beginning in April 2005. Installation of all the required remediation systems was completed by the end of August 2005.
Specific technical objectives of the removal action are as follows:

- To eliminate pathways for potential human exposure to carbon tetrachloride concentrations above the regulatory limit of 44.2 µg/L in surface water at the site.

- To minimize or eliminate any detrimental environmental impacts of carbon tetrachloride discharge to the surface waters of a tributary creek located immediately north of the town.

- To permanently reduce carbon tetrachloride concentrations in the groundwater and surface water at Murdock and hence restore these resources for potential beneficial use.

To evaluate the effectiveness of the selected remedy and its ability to achieve the objectives specified for this site, monitoring is required. This document outlines the proposed scope of a long-term program for monitoring of the removal action at Murdock. In this section the specific remedial objectives of the action are summarized, and a brief overview of the chosen remedy is provided. Section 2 summarizes the results of a baseline sampling event that documented the distribution of carbon tetrachloride contamination in selected media at the Murdock site immediately before cleanup activities began. Section 3 recommends a strategy for subsequent monitoring of the removal action at Murdock, as well as criteria for evaluating the performance of the remedial systems and the progress of the restoration effort.

1.2 Overview of the Removal Action Components

The removal action implemented at Murdock involves several innovative technologies used in sequence along the plume migration pathway to decrease carbon tetrachloride levels in groundwater and in water naturally discharged to the surface at the headwaters of a small creek (a tributary to Pawnee Creek) north of the town. The primary elements of this system are (1) a groundwater extraction well and treatment unit, (2) a phytoremediation planting area, and (3) constructed wetlands (Figure 1.2).

A groundwater extraction well (GWEX-1) has been installed to remove contaminated groundwater from the upgradient, more concentrated portion of the plume. GWEX-1 is operated
seasonally at an estimated pumping rate of 35 gpm. A specially designed spray treatment apparatus (Figure 1.3) simultaneously volatilizes carbon tetrachloride from the produced groundwater and irrigates property owned by the Elmwood-Murdock Public School system.

Selected vegetation types planted in the headwaters area of the tributary creek reduce carbon tetrachloride concentrations in the relatively shallow groundwater and surface waters via phytoremediation processes. Approximately 2,000 trees, representing six species (Niobe willow, black willow, eastern cottonwood, hybrid poplar, green ash, and northern catalpa), cover an area of approximately 4.5 acres (Figures 1.2 and 1.4). Removal of the carbon tetrachloride occurs as a result of uptake, transpiration, and volatilization of the contaminated groundwater by the trees and degradation of the carbon tetrachloride within the plant tissues, as well as via enhanced microbial activity in the root zone created by the plantings. At locations where the static groundwater level is typically more than 4–5 ft below ground level (BGL), in the “deep” planting zone (Figure 1.2), a special technique was used to plant the trees in 24-in.-diameter boreholes lined with plastic sleeves. This “tree well” technique limits the availability of shallow soil water and direct precipitation to the trees, and hence it promotes vertical root growth and uptake of the deeper contaminated groundwater. In the remaining “surface” planting zone (Figure 1.2), the trees were installed without borehole liners to give the roots access to contaminated groundwater typically encountered at depths of less than 4 ft BGL.

Additional vegetation, including a mixture of native prairie grasses, wildflowers, and other species, was planted between the trees and in the adjacent areas. These cover plantings (1) enhance erosion control, (2) intercept local precipitation and runoff and hence promote the uptake of deeper contaminated groundwater by the trees, (3) help protect the trees from physical damage, (4) provide a transitional buffer zone between the tree planting area and the surrounding croplands, and (5) create a barrier to herbicide drift.

Shallow wetlands constructed downstream from the main planting area provide an additional phytoremediation “polishing” stage for the water discharged to the tributary creek (Figures 1.2 and 1.5). By increasing the local residence time and surface exposure area of the flow entering the downstream portion of the tributary, the wetlands promote further carbon tetrachloride evaporation and degradation by water-loving plants and associated microbes.
FIGURE 1.1 Location of Cass County and Murdock, Nebraska.
FIGURE 1.2 Locations of the GWEX-1 well, the spray irrigation treatment area, the shallow and deep phytoremediation planting areas, and the constructed wetlands at Murdock, with the location of the former CCC/USDA grain storage facility. Source of photograph: NAIP (2003).
FIGURE 1.3 Traveling spray irrigation unit used to process groundwater pumped seasonally from extraction well GWEX-1 at Murdock.
FIGURE 1.4  Distribution of trees planted in the southwestern portion of the phytoremediation treatment area at Murdock, at the headwaters of the tributary creek (July 2005).
FIGURE 1.5 Southwestern portion of the wetlands treatment area, shortly after construction and grading of the wetlands basin (fall 2005).
2 Baseline Sampling Studies

An initial event to collect samples for analyses for volatile organic compounds (VOCs) was conducted at Murdock in July 2005, shortly after the groundwater extraction system was installed and the main phytoremediation areas were planted. This sampling was performed to (1) provide a current “snapshot” of the carbon tetrachloride distribution in the previously identified groundwater plume and the surface waters at the headwaters of the tributary creek and (2) establish baseline data for future comparisons that will permit evaluation of the performance of the remedial systems implemented at the site and progress toward restoration of the Murdock aquifer.

The July 2005 sampling activities included (1) groundwater and surface water sampling throughout the area affected by the carbon tetrachloride plume, (2) tissue sampling of the newly planted vegetation in the phytoremediation area, and (3) ambient air sampling in the planted and preexisting vegetated areas along the tributary creek. The results of these analyses are summarized below.

2.1 Groundwater Analysis Results

To determine current levels of carbon tetrachloride contamination in the upgradient portion of the groundwater plume, groundwater samples for VOCs analyses were collected at nine permanent observation locations along and south of Waverly Road (MW2, SB63–SB65, SB68–SB72), as well as at GWEX-1 (Figure 2.1). These observation points were installed during previous work at Murdock to facilitate periodic sampling along both the approximate central axis of the identified groundwater plume and near its lateral margins. At each of these locations, a cluster of two or more borings provides vertical resolution of the contaminant distribution within the plume. Construction information for these selected observation points, as well as for the full suite of permanent observation points available at the Murdock site, is summarized in Appendix A.

To complement the preexisting observation points, 15 new permanent observation wells were installed at 9 locations near the headwaters of the tributary creek north of Waverly Road, both in and adjacent to the phytoremediation planting area (Figure 2.1). Well clusters PMW1, PMW2, PMW9, and PMW3 were installed along a linear trend roughly following the central path of groundwater flow and contaminant migration toward the tributary creek. Wells
PMW4–PMW7 are located on an approximate transect across the contaminant plume in the area where groundwater discharge to the creek has been consistently observed, and well PMW8 is near the identified downgradient erosional limit of the Murdock aquifer (Argonne 2005a). Construction data and well registration information for these wells are in Appendix A.

The results of the groundwater analyses are summarized in Table 2.1, and the maximum carbon tetrachloride level detected at each sampling location is illustrated in Figure 2.2. The general configuration of the carbon tetrachloride plume shown in Figure 2.2 is consistent with measurements made in 2002 and 2004 (Argonne 2005a). The present data, however, provide a more detailed picture of the carbon tetrachloride distribution in the headwaters area of the tributary creek. Concentrations of carbon tetrachloride above 1,000 µg/L were detected at monitoring wells PMW1D and PMW2D, indicating that along the axis of the carbon tetrachloride plume, highly elevated levels of the contaminant are now approaching the phytoremediation planting area.

Two additional groundwater samples were collected from within the root system at two of the deep tree planting locations (W410 and W103, Figure 2.2), through vertical ventilation tubes installed for root aeration in each of the tree wells. Carbon tetrachloride was found at tree well W410 but was not detected at tree well W103 (Table 2.1). These results suggest that some uptake of contaminated groundwater by the trees at W410 began before baseline sampling. The high ratio of chloroform to carbon tetrachloride (31 µg/L versus 38 µg/L, respectively) at this location suggests that some degradation of carbon tetrachloride also preceded the baseline sampling.

### 2.2 Surface Water Analysis Results

One surface water sample was collected, at location SWP13 (Figure 2.2). The estimated carbon tetrachloride concentration for this sample (351 µg/L; Table 2.1) was similar to levels detected at this location in 2004 (Argonne 2005a). Earlier periodic sampling at this location consistently identified SWP13 as the approximate point of maximum carbon tetrachloride discharge (on the basis of measured concentrations) to the surface waters of the tributary creek.
TABLE 2.1 Results of organic analyses on groundwater and surface water samples collected in the baseline sampling at Murdock, Nebraska, in July 2005.

<table>
<thead>
<tr>
<th>Location</th>
<th>Sample</th>
<th>Depth (ft BGL)</th>
<th>Date</th>
<th>Carbon</th>
<th>Tetra-chloride</th>
<th>Chloroform</th>
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<td>SB64S</td>
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TABLE 2.1 (Cont.)

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a ND, contaminant not detected at an instrument detection limit of 0.1 µg/L.
b Qualifier J indicates an estimated concentration below the method quantitation limit of 1 µg/L.
c Qualifier C indicates an estimated concentration outside the calibration range for carbon tetrachloride at zero dilution; insufficient sample for reanalysis at dilution.

2.3 Plant Tissue Analysis Results

As noted in Section 1.2, the vegetation planted in the phytoremediation area is expected to take up, transpire, and degrade carbon tetrachloride as the plants take root and mature. Previous sampling of preexisting natural vegetation along the tributary creek (Argonne 2005b) indicated that these processes should result in elevated levels of carbon tetrachloride in plant tissues over time. To obtain baseline data, plant tissue samples were collected from new trees in the phytoremediation area and analyzed for VOCs.

The vegetation sampling included all six species of trees. Sampling occurred in every other row, at every fourth or fifth tree in the sampled row. Background samples were collected at two locations in nearby areas that have not been affected by the groundwater plume. Samples of branches and leaves collected in July 2005 were analyzed by a headspace technique based on a modification of EPA Method 5021-1 (http://www.epa.gov/epahome/index/). The concentrations of carbon tetrachloride and chloroform in the plant tissue samples are summarized in Table 2.2,
### TABLE 2.2 Results of organic analyses on vegetation samples collected in the baseline sampling at Murdock, Nebraska, in July 2005.

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<td>MU-212-B-18459</td>
<td>7/19/05</td>
<td>ND 2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W854</td>
<td>MU-212-L-18458</td>
<td>7/19/05</td>
<td>ND 2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W859</td>
<td>MU-207-B-18457</td>
<td>7/19/05</td>
<td>ND 2.0</td>
<td></td>
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<tr>
<td>W859</td>
<td>MU-207-L-18456</td>
<td>7/19/05</td>
<td>ND 2.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W908</td>
<td>MU-9-B-18431</td>
<td>7/19/05</td>
<td>ND ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W908</td>
<td>MU-9-L-18430</td>
<td>7/19/05</td>
<td>ND 1.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Background samples**

<table>
<thead>
<tr>
<th>Location</th>
<th>Samplea</th>
<th>Date</th>
<th>Concentration (µg/kg)</th>
<th>Carbon Tetra-chloride</th>
<th>Chloro-form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bruttig-1</td>
<td>MU-Bruttig-B-18563</td>
<td>7/20/05</td>
<td>ND 1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bruttig-1</td>
<td>MU-Bruttig-L-18562</td>
<td>7/20/05</td>
<td>ND 1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bruttig-2</td>
<td>MU-Bruttig-B-18565</td>
<td>7/20/05</td>
<td>ND 3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bruttig-2</td>
<td>MU-Bruttig-L-18564</td>
<td>7/20/05</td>
<td>ND 2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bruttig-3</td>
<td>MU-Bruttig-B-18567</td>
<td>7/20/05</td>
<td>ND 2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bruttig-3</td>
<td>MU-Bruttig-L-18566</td>
<td>7/20/05</td>
<td>ND 2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creek-1</td>
<td>MU-WCreek-B-18573</td>
<td>7/20/05</td>
<td>ND ND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creek-1</td>
<td>MU-WCreek-L-18572</td>
<td>7/20/05</td>
<td>ND ND</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
and the maximum carbon tetrachloride concentrations identified at each location are shown in Figure 2.3.

A total of 206 plant tissue samples were collected at 102 locations in the shallow and deep planting zones. Insignificant headspace concentrations of carbon tetrachloride (< 1 µg/kg) were found in most of the tissue samples. The results indicated, however, that some uptake of contaminated groundwater — by Niobe willows at six locations in the surface planting zone — had already occurred at the time of sampling. The detected carbon tetrachloride concentrations at these locations were generally low (< 4 µg/kg). The only exception was a concentration of 43.2 µg/kg at location E309 (Figure 2.3).

Twelve plant tissue samples were collected at six locations in two uncontaminated “background” sites near the phytoremediation area: (1) along the western branch of the tributary creek and (2) at a private residence (Bruttig) along Waverly Road, east of the plume migration pathway (Figure 2.3). No carbon tetrachloride was found in these samples. Headspace concentrations of chloroform ranged from < 1 µg/kg to 3.1 µg/kg, reflecting apparently
ubiquitous low levels of chloroform in the natural vegetation in the vicinity of the tributary creek headwaters (Table 2.2).

2.4 Ambient Air Analysis Results

Under the existing preremedial conditions at Murdock, carbon tetrachloride may be introduced to the ambient air in the creek headwaters area as a result of both direct volatilization from the groundwater and surface water and via uptake and transpiration by the preexisting vegetation. The results discussed in Section 2.3 suggest that the phytoremediation plantings had relatively little impact on ambient air prior to the time of the baseline sampling. Increased volatilization of carbon tetrachloride to the atmosphere should occur, however, as these plantings mature.

Ambient air was collected in July 2005 at three locations in the phytoremediation zone (AM1, AM3, AM4; Figure 2.4) and at one location in the preexisting vegetation (AM2) along the part of the creek impacted by the carbon tetrachloride plume. A “background” air sample was also collected outside the plume area, along a waterway about 1,300 ft west of the town and 150 ft south of Waverly Road (AM5; Figure 2.4). The sampling was conducted by placing preevacuated canisters at 4–5 ft above ground surface (near the vegetation canopy level) and collecting ambient air over a 4-hr time period. To minimize wind effects, sampling at each location occurred during the early morning on each of three consecutive days. The air samples were shipped to Severn-Trent Laboratory in Burlington, Vermont, for VOCs analyses by EPA Method TO-15. The results are summarized in Table 2.3. The maximum concentrations of carbon tetrachloride found at each location are shown in Figure 2.4.

The results for the ambient air samples indicate that carbon tetrachloride and chloroform in the “background” samples (location AM5) were below the detection limits of 1.3 µg/m³ and 0.98 µg/m³, respectively. Air samples collected in the phytoremediation planting area (locations AM1, AM3, and AM4) also contained no detectable carbon tetrachloride or chloroform, except that one sample recovered at AM3 on one of the three sampling days had a carbon tetrachloride concentration at the detection limit of 1.3 µg/m³.
Air sampling in the preexisting vegetation area was performed at location AM2 (Figure 2.4). Previous sampling by Argonne (2005b) identified high levels of carbon tetrachloride in the tissues of mature trees growing at this location. The results for all three days of air sampling at AM2 indicated low concentrations of carbon tetrachloride in the ambient air near the creek, ranging from 1.4 µg/m³ to 3.5 µg/m³; no chloroform was detected (Table 2.3).

**TABLE 2.3** Results of organic analyses on air samples collected on three consecutive days, at five locations at Murdock, in the baseline sampling in July 2005.

<table>
<thead>
<tr>
<th>Concentration on Days 1, 2, and 3</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ppbv</td>
<td>µg/m³</td>
<td>ppbv</td>
</tr>
<tr>
<td>Location AM1, between trees W507 and W508</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>0.55</td>
<td>2.7</td>
<td>0.59</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>0.5 U³</td>
<td>1 U</td>
<td>0.55</td>
</tr>
<tr>
<td>Trichlorofluoromethane</td>
<td>0.24</td>
<td>1.3</td>
<td>0.27</td>
</tr>
<tr>
<td>Chloroform</td>
<td>0.2 U</td>
<td>0.98 U</td>
<td>0.2 U</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>0.2 U</td>
<td>1.3 U</td>
<td>0.2 U</td>
</tr>
<tr>
<td>Acetone</td>
<td>5 U</td>
<td>12 U</td>
<td>8.6</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>0.5 U</td>
<td>1.5 U</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Location AM2, in the preexisting trees along the east side of the creek near SWP03, east of SWP03 and 20 ft west of tree E210

| Dichlorodifluoromethane           | 0.57  | 2.8   | 0.57  | 2.8   | 0.57  | 2.8   |
| Chloromethane                     | 0.5 U | 1 U   | 0.5 U | 1 U   | 0.96  | 2.8   |
| Trichlorofluoromethane            | 0.26  | 1.5   | 0.27  | 1.5   | 0.28  | 1.6   |
| Chloroform                        | 0.2 U | 0.98 U| 0.2 U | 0.98 L| 0.2 U | 0.98 U|
| Carbon Tetrachloride              | 0.46  | 2.9   | 0.22  | 1.4   | 0.55  | 3.5   |
| 1,2-Dichloropropane               | 0.2 U | 0.92 U| 0.2 U | 0.92 L| 0.68  | 3.1   |
| Toluene                           | 0.2 U | 0.75 U| 0.2 U | 0.75 L| 0.52  | 2.8   |
| Acetone                           | 5 U   | 12 U  | 5 U   | 12 U  | 11    | 26    |
| Methyl Ethyl Ketone               | 0.5 U | 1.5 U | 0.59  | 1.7   | 0.92  | 2.7   |
| n-Hexane                          | 0.2 U | 0.7 U | 0.2 U | 0.7 U | 0.33  | 1.2   |

Location AM3, east of the creek between trees E423 and E528

| Dichlorodifluoromethane           | 0.59  | 2.9   | 0.58  | 2.9   | 0.58  | 2.9   |
| Chloromethane                     | 0.5 U | 1 U   | 0.51  | 1.1   | 0.5 U | 1 U   |
| Trichlorofluoromethane            | 0.26  | 1.5   | 0.27  | 1.5   | 0.36  | 2.8   |
| Chloroform                        | 0.2 U | 0.98 U| 0.2 U | 0.98 L| 0.2 U | 0.98 U|
| Carbon Tetrachloride              | 0.2   | 1.3   | 0.2 U | 1.3 U | 0.2 U | 1.3 U |
| Toluene                           | 0.2 U | 0.75 U| 0.2 U | 0.75 L| 0.43  | 1.6   |
| Methyl Ethyl Ketone               | 0.59  | 1.7   | 0.53  | 1.6   | 0.5 U | 1.5 U |
| n-Hexane                          | 0.2 U | 0.7 U | 0.2 U | 0.7 U | 0.25  | 0.88  |
### TABLE 2.3 (Cont.)

<table>
<thead>
<tr>
<th>Concentration on Days 1, 2, and 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1 ppbv µg/m³ Day 2 ppbv µg/m³ Day 3 ppbv µg/m³</td>
</tr>
</tbody>
</table>

**Location AM4, west of the creek between trees W635 and W636**

- **Dichlorodifluoromethane**: 0.59 2.9 0.58 2.9 0.6 3
- **Chloromethane**: 0.53 1.1 0.5 U 1 U 0.53 1.1
- **Trichlorofluoromethane**: 0.26 1.5 0.26 1.5 0.3 1.7
- **Methylene Chloride**: 0.5 U 1.7 U 0.5 U 1.7 U 0.77 2.7
- **Chloroform**: 0.2 U 0.98 U 0.2 U 0.98 U 0.2 U 0.98 U
- **Carbon Tetrachloride**: 0.2 U 1.3 U 0.2 U 1.3 U 0.2 U 1.3 U
- **Benzene**: 0.2 U 0.64 U 0.2 U 0.64 U 0.32 1
- **Toluene**: 0.2 U 0.75 U 0.2 U 0.75 U 2 7.5
- **Xylene (m-, p-)**: 0.2 U 0.87 U 0.2 U 0.87 U 0.33 1.4
- **Methyl Ethyl Ketone**: 0.66 1.9 0.67 2 1.7 5
- **2,2,4-Trimethylpentane**: 0.2 U 0.93 U 0.2 U 0.93 U 0.25 1.2
- **n-Hexane**: 0.2 U 0.7 U 0.2 U 0.7 U 0.8 2.8
- **Xylene (total)**: 0.2 U 0.87 U 0.2 U 0.87 U 0.34 1.5

**Location AM5, a background monitoring location on the east edge of the waterway, about 150 ft south from the center of Waverly Road**

- **Dichlorodifluoromethane**: 0.61 3 0.59 2.9 0.58 2.9
- **Chloromethane**: 0.5 U 1 U 0.59 1.2 0.53 1.1
- **Trichlorofluoromethane**: 0.26 1.5 0.26 1.5 0.33 1.9
- **Methylene Chloride**: 0.5 U 1.7 U 0.5 U 1.7 U 5.7 20
- **Chloroform**: 0.2 U 0.98 U 0.2 U 0.98 U 0.2 U 0.98 U
- **Carbon Tetrachloride**: 0.2 U 1.3 U 0.2 U 1.3 U 0.2 U 1.3 U
- **Trichloroethylene**: 0.2 U 1.1 U 0.2 U 1.1 U 0.2 1.1
- **1,2-Dichloropropane**: 0.2 U 0.92 U 0.2 U 0.92 U 0.46 2.1
- **Toluene**: 0.2 U 0.75 U 0.2 U 0.75 U 6.3 24
- **Xylene (m-, p-)**: 0.2 U 0.87 U 0.2 U 0.87 U 0.27 1.2
- **Styrene**: 0.2 U 0.85 U 0.2 U 0.85 U 0.21 0.89
- **Acetone**: 5 U 12 U 12 29 16 38
- **Cyclohexane**: 0.2 U 0.69 U 0.2 U 0.69 U 0.54 1.9
- **Methyl Ethyl Ketone**: 0.54 1.6 1.1 3.2 3 8.8
- **n-Hexane**: 0.2 U 0.7 U 0.2 U 0.7 U 3.5 12
- **Xylene (total)**: 0.2 U 0.87 U 0.2 U 0.87 U 0.28 1.2

*Qualifier U indicates that the contaminant was not detected at indicated reporting limit.*
FIGURE 2.1 Locations of groundwater and surface water samples collected for volatile organic analyses during the July 2005 baseline sampling event. Source of photograph: NAIP (2003).
FIGURE 2.2 Results of analyses for carbon tetrachloride (maximum values) in water samples collected during the July 2005 baseline sampling event. Source of photograph: NAIP (2003).
FIGURE 2.3 Results of analyses for carbon tetrachloride (maximum values) in vegetation samples collected in the surface and deep phytoremediation planting zones during the July 2005 baseline sampling event. Source of photograph: NAIP (2003).
FIGURE 2.4 Results of analyses for carbon tetrachloride (maximum values) in ambient air samples collected during the July 2005 baseline sampling event. Source of photograph: NAIP (2003).
3 Recommended Monitoring Programs

Restoration of the groundwater and surface waters at Murdock is expected to occur over a period of approximately 30 yr or more under the selected removal action described in Section 1 (Argonne 2005b). An initial period of approximately 5 yr is expected to be required for the vegetation introduced in the phytoremediation plantings and constructed wetlands to reach maturity and hence to attain full design capabilities for the uptake and removal of carbon tetrachloride from groundwater and surface water. During this initial period, the remedial effectiveness of the combined treatment systems is therefore expected to increase progressively.

This section outlines two phases of sampling and monitoring of groundwater, surface water, and remedial systems recommended for the Murdock site. During each phase, the monitoring efforts are targeted to address the following specific goals, in keeping with the technical objectives of the removal action outlined in Section 1.1:

- To verify and document the performance of the remediation systems.
- To monitor the migration of the remaining carbon tetrachloride contamination and evaluate the progress of the site restoration.
- To ensure the protection of human health and the environment.

The sampling and monitoring activities proposed here were developed to provide technically defensible data of the type and quantity that are generally consistent with removal actions regulated by the EPA (under CERCLA) or by the Nebraska Department of Environmental Quality (NDEQ), and that are in keeping with the applicable or relevant and appropriate requirements identified for the Murdock site in Appendix A of the EE/CA (Argonne 2005b).

3.1 Initial (Five-Year) Sampling and Monitoring

Approximately 5 yr may be required for the phytoremediation and constructed wetlands components of the Murdock remedial systems to attain their full groundwater and surface water treatment capacity. During this period, the seasonal patterns of groundwater extraction, spray irrigation treatment, and use by the Elmwood-Murdock Public Schools will also be generally
established. Relatively intense sampling and monitoring are therefore proposed to evaluate and document the performance of these systems for treatment of the carbon tetrachloride contamination. Additional sampling is recommended to assess the progress of the combined treatment efforts in reducing carbon tetrachloride concentrations in the groundwater and surface waters at Murdock. The activities proposed for implementation during the initial (5-yr) period of monitoring at the site are summarized in Table 3.1.

3.1.1 Monitoring of the Spray Irrigation Treatment System (Groundwater)

With the approval of the EPA and the NDEQ, GWEX-1 and the associated spray irrigation treatment unit at Murdock are to be operated seasonally, at the discretion of the Elmwood-Murdock Public School system, for the irrigation of school property. The operations are to be performed in accord with a statement of discharge requirements issued by the NDEQ for these facilities (NPDES Tracking No. NE0137464; Appendix B).

In keeping with the NDEQ requirements, samples of the treated groundwater sprayed from the irrigation unit will be collected quarterly during periods of active use and analyzed for carbon tetrachloride, chloroform, and pH levels. Procedures to be used for sampling and analyzing the discharged spray were previously documented (Argonne 2000, 2004). These procedures are in use at Utica, Nebraska, and are accepted by the NDEQ. The results of the analyses are to be reported quarterly. Coincident with each spray sampling event, samples of the untreated groundwater supplied to the treatment unit will also be collected and analyzed for VOCs to enable determination of the carbon tetrachloride removal efficiency of the spray irrigation unit.

Cumulative groundwater production from GWEX-1 will be recorded by using a totalizing flow meter. The results will be used in conjunction with the groundwater and spray analysis data to estimate the quantities of carbon tetrachloride (and chloroform) removed from the aquifer by GWEX-1 and treated by the spray irrigation unit.

The NDEQ has identified the outfall from the spray irrigation unit as a land application (Appendix B). No specific target concentrations for the removal of carbon tetrachloride (or chloroform) by the spray irrigation treatment unit at Murdock are therefore established in the NDEQ’s discharge requirements; only the actual concentrations discharged to the surface need to
## TABLE 3.1 Monitoring plan for the Murdock removal action.

<table>
<thead>
<tr>
<th>Location</th>
<th>Measurement Parameter and Frequency in Initial Five Years of Monitoring</th>
<th>Long-Term Measurement Parameter and Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quarterly</td>
<td>Twice Yearly</td>
</tr>
<tr>
<td></td>
<td>Continuous Automated Water Level</td>
<td>Manual Water Level</td>
</tr>
<tr>
<td>Extraction-Spray Irrigation System (Groundwater)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QWEX-1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Spray Unit Discharge</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Phytoremediation Treatment Area (Vegetation)

| PWI1S                     | x         | x            | x            | x            | x        | x            | x            |
| PWI1D                     | x         | x            | x            | x            | x        | x            | x            |
| PWI2S                     | x         | x            | x            | x            | x        | x            | x            |
| PWI2D                     | x         | x            | x            | x            | x        | x            | x            |
| PWI4                      | x         | x            | x            | x            | x        | x            | x            |
| PWI5                      | x         | x            | x            | x            | x        | x            | x            |
| PWI6                      | x         | x            | x            | x            | x        | x            | x            |
| PWI7                      | x         | x            | x            | x            | x        | x            | x            |

Phytoremediation Treatment Area (Groundwater)

| PMWI1S                   | x         | x            | x            | x            | x        |
| PMWI1D                   | x         | x            | x            | x            | x        |
| PMWI2S                   | x         | x            | x            | x            | x        |
| PMWI2D                   | x         | x            | x            | x            | x        |
| PMWI4                    | x         | x            | x            | x            | x        |
| PMWI5                    | x         | x            | x            | x            | x        |
| PMWI6                    | x         | x            | x            | x            | x        |
| PMWI7                    | x         | x            | x            | x            | x        |

Phytoremediation and Wetlands Treatment Areas (Surface Water)

| SWI1                     | x         | x            | x            | x            | x        |
| SWI2                     | x         | x            | x            | x            | x        |

Phytoremediation and Wetlands Treatment Areas (Ambient Air)

| AA1                      | x         | x            | x            | x            | x        |
| AA2                      | x         | x            | x            | x            | x        |
| AA3                      | x         | x            | x            | x            | x        |
| BA1                      | x         | x            | x            | x            | x        |

Upgradient Plume Area (Groundwater)

| 1S, 1D                   | x         | x            | x            | x            | x        |
| 2S, 2D                   | x         | x            | x            | x            | x        |
| 3S, 3D                   | x         | x            | x            | x            | x        |
| 4S, 4D                   | x         | x            | x            | x            | x        |
| MW06                     | x         | x            | x            | x            | x        |
| TEST-1                   | x         | x            | x            | x            | x        |
| WP4P                     | x         | x            | x            | x            | x        |
| WP51D                    | x         | x            | x            | x            | x        |
| WP54                     | x         | x            | x            | x            | x        |
| SB63S, SB63D             | x         | x            | x            | x            | x        |
| SB64S, SB64D             | x         | x            | x            | x            | x        |
| SB65S, SB65D             | x         | x            | x            | x            | x        |
| SB66S, SB66D             | x         | x            | x            | x            | x        |
| SB67S, SB67D             | x         | x            | x            | x            | x        |
| SB70S, SB70D             | x         | x            | x            | x            | x        |
| SB71S, SB71D             | x         | x            | x            | x            | x        |
| SB72S, SB72D             | x         | x            | x            | x            | x        |

Abbreviations: Geochem, geochemistry; GW(Ph), groundwater in phytoremediation area; GW(Pi), groundwater in upgradient plume area; GW(Sp), groundwater in extraction well–spray irrigation system; SW, surface water; Veg, vegetation; VOCs, volatile organic compounds.

Additional measurements will include dissolved oxygen, redox potential, and concentrations of Fe²⁺ and breakdown products. Additional parameters will be included if required (see Section 3.1.2).

Locations are subject to change as the configuration of the groundwater plume evolves over time.

Critical temporary piezometers for water level monitoring; permission to retain these piezometers is being requested.
be reported. The NDEQ document qualitatively notes, however, that the discharge may not be toxic to aquatic life in surface waters of the state outside the mixing zones allowed in NDEQ Title 117 — *Nebraska Surface Water Quality Standard*. This standard defines a carbon tetrachloride concentration of 44.2 µg/L as the maximum acceptable level for the chronic exposure of aquatic life in surface waters. A maximum target concentration of 44.2 µg/L is therefore proposed as the quantitative evaluation criterion for assessment of the spray irrigation treatment system’s performance at Murdock.

### 3.1.2 Monitoring of the Phytoremediation Treatment System (Groundwater)

Carbon tetrachloride removal from the Murdock aquifer within the phytoremediation treatment area is expected to occur through the combined effects of

- Hydraulic “pumping” of the contaminated groundwater as a result of plant uptake,

- Transpiration and degradation of carbon tetrachloride within plant tissues, and

- Enhanced microbial degradation (reductive dechlorination) in the root zone created by the plants.

The effectiveness of each of these removal processes is expected to increase as the phytoremediation plantings approach maturity.

**Evidence of Hydraulic “Pumping” Effects.** To monitor for direct evidence of hydraulic “pumping” effects in the phytoremediation area during the developmental period, a water level measuring network of 16 observation points with automated water level recorders is proposed (Figure 3.1 and Table 3.1). The recorders will be programmed to collect measurements at a relatively high frequency (approximately hourly) and will be downloaded quarterly to permit analysis of the accumulated data. The automated monitoring will facilitate the detection of potential diurnal or seasonal fluctuations in groundwater levels associated with cyclic use of water by the plants, as well as potential longer-term, cumulative trends in depression of the local groundwater levels over time. The results, together with data collected from the weather station on the site, will serve as the basis for quantitative estimation of groundwater withdrawal rates by the phytoremediation plantings.
To further document the patterns of groundwater flow into the phytoremediation treatment area, the automated water level readings will be supplemented by quarterly manual measurements at additional permanent observation points across the Murdock site (Table 3.1 and Appendix A).

**Evidence of Carbon Tetrachloride Removal.** To verify the removal of carbon tetrachloride from groundwater by the phytoremediation plantings, a program of vegetation sampling and analysis for VOCs is proposed. Samples of plant tissues (primarily leaf and stem materials) will be collected from selected tree locations on an approximate grid pattern (Figure 3.2) designed for representative coverage of both the surface and deep planting areas and also the range of species (see Section 1.2) installed at the site. The data will provide a quantitative, comparative basis for the evaluation of contaminant uptake by the plantings in relation to the initial vegetation sampling results presented in Section 2.3.

In light of the seasonal growth cycles associated with the phytoremediation plantings, sampling of the vegetation at approximately six-month intervals is proposed during the initial (5-yr) monitoring period: (1) in early spring, before the onset of significant plant growth, and (2) in late summer or early fall, near the end of the growing cycle. Such sampling will minimize sampling effort and costs but will effectively document the temporal patterns and net annual effects of carbon tetrachloride uptake and elimination by the phytoremediation system. Supplemental vegetation sampling may also be conducted at selected times and locations during the initial monitoring period to document the effects of specific climatic or other environmental factors on the uptake of carbon tetrachloride by the plantings. The proposed vegetation sampling will coincide (whenever possible) with GWEX-1 and spray treatment sampling described in Section 3.1.1 and with the groundwater, surface water, and air sampling activities described in Sections 3.1.3–3.1.5 (Table 3.1).

**Evidence of Enhanced Microbial Degradation.** Though microbial activity within the root zone created by the phytoremediation plantings is expected to augment the removal of carbon tetrachloride from the groundwater, direct measurement of the microbial activity at regular intervals is neither easy nor economical.

As a logistically viable alternative, a program of geochemical sampling and analysis of the groundwater within the phytoremediation area is proposed to monitor the anticipated development of the reducing/anaerobic conditions required for the microbial degradation of carbon tetrachloride by reductive dechlorination. This monitoring will include measurements of
dissolved oxygen content, oxidation-reduction potential, and reduced iron (Fe\(^{2+}\)) levels at the locations listed in Table 3.1 and shown in Figure 3.3, in conjunction with direct analyses for possible dechlorination daughter products (chloroform, dichloromethane [methylene chloride], etc.).

If the development of reducing/anaerobic conditions is demonstrated and elevated levels of daughter products are identified, additional geochemical indicators of anaerobic microbial activity, including dissolved methane and carbon dioxide levels, nitrate/nitrite ratios, and sulfate/sulfide ratios, will also be determined. Sampling and analyses for these additional parameters will also be performed in conjunction with the sampling activities described in Sections 3.1.3–3.1.5 (Table 3.1).

### 3.1.3 Monitoring of the Surface Water Treatment Systems

Carbon tetrachloride levels in the surface waters of the tributary creek are expected to decrease through the effects of multiple processes, including

- Contaminant removal from the influent groundwater as a result of upgradient extraction by GWEX-1 and treatment in the phytoremediation area;

- Phytoremediation and microbial degradation at and near the surface, in the phytoremediation and wetlands treatment areas; and

- Direct evaporation, plus mixing and dilution with uncontaminated precipitation and runoff, in the phytoremediation and wetlands treatment areas.

The combined effects of these processes will determine the level of carbon tetrachloride removal achieved in the effluent surface waters released from the treatment areas to the downstream reaches of the tributary creek and hence to Pawnee Creek. To quantitatively evaluate the effectiveness of the processes, surface water sampling for VOCs analyses is recommended at three critical locations along the tributary creek, as shown in Figure 3.4 (also Table 3.1).
Sampling point SWM1, which coincides with the surface water sampling location previously designated SWP13, lies near the upgradient edge of the phytoremediation treatment area. As noted in Section 2.2, past sampling at this location consistently demonstrated the highest levels of carbon tetrachloride detected in surface waters; these levels may therefore be indicative of the maximum concentrations in groundwater seepage to the headwaters of the tributary creek.

Proposed sampling point SWM2 lies directly downstream of the phytoremediation planting area (and upstream of the wetlands) and is intended to monitor the reduction in carbon tetrachloride levels achieved in the phytoremediation treatment zone.

Sampling point SWM3 lies directly downstream of the outfall from the wetlands treatment zone, and hence it will reflect the final contaminant levels achieved in effluent from the combined treatment processes. Location SWM3 should be considered the primary point for quantitative assessment of the net performance of the Murdock treatment efforts, in terms of achieving carbon tetrachloride concentrations in the surface waters of the tributary creek that meet regulatory requirements for the protection of human health and the environment. A maximum target concentration of 44.2 µg/L should be adopted for this discharge, as established by the NDEQ for surface waters under NDEQ Title 117 — Nebraska Surface Water Quality Standard.

Quarterly sampling for VOCs is recommended at locations SWM1–SWM3. Sampling at these points (for two of the events each year) will be timed to coincide with the sampling activities described in Sections 3.1.2, 3.1.4, and 3.1.5 (Table 3.1).

3.1.4 Monitoring of Contaminant Reduction in the Groundwater Plume

Contaminant reduction in the groundwater carbon tetrachloride plume is expected to occur through the effects of multiple processes, including

- Contaminant removal as a result of upgradient extraction by GWEX-1 and downgradient treatment within the phytoremediation area; and
- Evaporation, mixing, dilution, and dispersion of carbon tetrachloride along the groundwater migration pathway.
To determine the impact of the removal action efforts on carbon tetrachloride levels in the plume, twice yearly groundwater sampling for VOCs analyses is recommended (during the initial 5-yr period) at selected points along the approximate central axis of the groundwater plume, as well as within the phytoremediation area (Figure 3.5 and Table 3.1). Past sampling demonstrated that the concentrations detected at these locations typically reflect the maximum carbon tetrachloride levels identified in groundwater along the plume migration pathway. Sampling at these points will be performed in conjunction with the sampling activities described in Sections 3.1.2, 3.1.3, and 3.1.5 (Table 3.1).

At the end of the initial 5-yr monitoring period, groundwater sampling for VOCs analyses is recommended in the full suite of permanent observation points listed in Table 3.1, to permit another delineation of the plume in keeping with the past sampling efforts at this site (documented in Figures 2.9 and 2.10 of the Murdock EE/CA [Argonne 2005b]).

### 3.1.5 Monitoring of Local Atmospheric Carbon Tetrachloride Levels

Atmospheric sampling and analyses for VOCs conducted as part of the Murdock baseline studies identified little or no contamination of the ambient atmosphere by carbon tetrachloride (or chloroform) in the vicinity of the tributary creek headwaters (Section 2.4), despite the documented uptake of carbon tetrachloride by the natural vegetation in this area (Argonne 2005b). The release of carbon tetrachloride to the atmosphere is expected to increase in the phytoremediation and wetlands treatment areas, however, as these areas mature. Throughout the course of the removal action, these treatment areas will remain open to the public for recreational access and to workers for the required sampling, monitoring, and maintenance activities.

To ensure that potential human exposure levels remain within acceptable levels in the treatment areas, a program of atmospheric sampling and analysis for VOCs is recommended. Sampling twice per year (once in early spring, prior to the onset of significant plant growth, and once near the peak of the seasonal growing cycle) is proposed at four locations (Figure 3.6 and Table 3.1). Air sampling locations AA1–AA3 are in the shallow and deep planting areas in the phytoremediation treatment zone and adjacent to the constructed wetlands, along the public walking paths. A fourth air sampling location (BA1) is at the “background” location sampled during the baseline studies (AM5 in the former terminology; Section 2.4). Sampling at BA1 will identify potential changes in atmospheric contaminant levels at Murdock that are unrelated to the
groundwater and surface water restoration activities near the tributary headwaters. The air samples will be collected and analyzed by using the procedures described in Section 2.4.

No enforceable regulatory criteria have been promulgated for the evaluation of carbon tetrachloride contamination in ambient outdoor air in non-occupational settings. Many guidance values have been developed, however, as maximum acceptable contaminant levels for inhalation under a variety of exposure scenarios. The Agency for Toxic Substances and Disease Registry’s intermediate inhalation minimal risk level of 192 µg/m³ (http://www.atsdr.cdc.gov/toxprofiles/tp30-c2.pdf) is recommended as a conservative target concentration for ambient outdoor air sampling results. This target concentration is considered to be protective against both cancer and non-cancer health effects for workers and visitors in the treatment areas near the creek (EPA 2005).

3.1.6 Reporting of the Monitoring Results

The following reporting schedule is recommended:

- **Quarterly** reporting of analytical results for the spray irrigation treatment system monitoring (Section 3.1.1) to the appropriate regulatory agencies, in keeping with the discharge requirements specified for this activity (Appendix B).

- **Quarterly** reporting of analytical results for the surface water monitoring (described in Section 3.1.3) to the appropriate regulatory agencies to document the effectiveness of the groundwater and surface water treatment systems.

- **Annual** reporting of the full results of the sampling and monitoring programs (outlined in Sections 3.1.1–3.1.5) for the current year.

- **As requested** by the regulatory agencies, brief (data only) accounts of individual sampling and monitoring activities.
• At the end of the initial 5-yr monitoring period, a summary report evaluating the development of the Murdock treatment systems and assessing the performance of the monitoring programs, with a new plume delineation.

The reporting schedule is summarized in Table 3.2.

3.2 Long-Term Sampling and Monitoring

The sampling and monitoring programs outlined in Section 3.1 will be critically evaluated at the end of the initial 5-yr development period to (1) determine anticipated needs for long-term performance monitoring of the Murdock remedial systems and (2) demonstrate the progress of the removal action toward the ultimate restoration of the site. A detailed long-term monitoring program will be recommended at that time. The present expectation is that the specific activities outlined in Section 3.1 will be continued, at the revised sampling frequencies suggested below and summarized in Table 3.1.

3.2.1 Monitoring of the Spray Irrigation Treatment System and Discharge

The spray irrigation treatment system influent groundwater and effluent spray will continue to be sampled for VOCs analyses (and results will be reported) quarterly, or on any amended schedule required for compliance with the regulatory discharge requirements (Appendix B) established for these activities.

3.2.2 Monitoring of the Phytoremediation Treatment System

Longer-term monitoring of the phytoremediation treatment system is recommended as follows:

• Quarterly manual water level measurements in the network of observation points listed in Table 3.1 and Appendix A to document longer-term trends in groundwater levels.
TABLE 3.2 Reporting schedule for site restoration monitoring activities at Murdock, Nebraska.

<table>
<thead>
<tr>
<th>Subject of Report</th>
<th>Frequency in Initial Five Years</th>
<th>Frequency after Year Five</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical results for spray irrigation system</td>
<td>Quarterly</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Analytical results for surface water monitoring</td>
<td>Quarterly</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Full results of sampling and monitoring for current year</td>
<td>Annual</td>
<td>Annual</td>
</tr>
<tr>
<td>Brief (data only) accounts of individual sampling and monitoring activities</td>
<td>As requested</td>
<td>As requested</td>
</tr>
<tr>
<td>Summary evaluation of development and performance, with plume delineation</td>
<td>At end of five years</td>
<td>Does not apply</td>
</tr>
<tr>
<td>Full review of monitoring results and evaluation of removal action progress, with plume delineation</td>
<td>Does not apply</td>
<td>Every five years</td>
</tr>
</tbody>
</table>

- *Annual* vegetation sampling, near the end of the growing season, at locations to be selected on the basis of the 5-yr reviews described above and in Section 3.2.6.

- *Annual* sampling of groundwater at selected locations in the phytoremediation treatment area for geochemical analyses to verify the persistence of anaerobic/reducing conditions conducive to the reductive dechlorination of carbon tetrachloride, if the results of the initial (5-yr) monitoring indicated that continued testing is warranted.

### 3.2.3 Monitoring of the Surface Water Treatment Systems and Discharge

Continued *quarterly* sampling of the surface waters at locations SWM1–SWM3 (Figure 3.4) is recommended, as the primary indicator of the net effectiveness of the groundwater and surface water treatment systems for restoration of the surface waters discharged to the tributary creek.
3.2.4 Monitoring of Contaminant Reduction in the Groundwater Plume

Longer-term groundwater monitoring for VOCs levels is recommended as follows:

- **Annual** groundwater sampling at the selected critical observation points identified in Figure 3.5 and listed in Table 3.1.

- **At 5-yr intervals**, groundwater sampling for VOCs analyses in the full suite of permanent observation points summarized in Table 3.1 to permit redelineation of the plume.

Modifications to the sampling points identified in Figure 3.5 may be required as the configuration of the residual plume changes over time. Such modifications will be addressed with the regulatory agencies as needed during the removal action.

3.2.5 Monitoring of Local Atmospheric Carbon Tetrachloride Levels

The utility of long-term air quality sampling at the Murdock site will be evaluated at the end of the 5-yr initial monitoring period, in consultation with the regulatory agencies. If continued monitoring is considered necessary, annual sampling for VOCs analyses, near the peak of the seasonal growing cycle, is recommended at the locations in the treatment areas and at the “background” location shown in Figure 3.6.

3.2.6 Reporting of the Monitoring Results

The following reporting schedule is recommended:

- **Quarterly** reporting of the spray irrigation treatment system sampling and analysis results for VOCs (subject to the NDEQ discharge requirements in Appendix B), as well as the results of the surface water sampling and analyses, to document the ongoing effectiveness of the treatment systems and to meet regulatory requirements.
- Annual reporting of the full results of the sampling and monitoring programs outlined in Sections 3.2.1–3.2.5 during the current year.

- Every 5 yr, full review of the monitoring results and an evaluation of the progress of the removal action toward restoration of the Murdock site, in conjunction with the plume delineation sampling proposed in Section 3.2.4.

The reporting schedule is summarized in Table 3.2.

### 3.3 Summary of Compliance Points and Compliance Values

The following regulatory compliance points and maximum values are recommended for the Murdock treatment systems, on the basis of the discussions in Sections 3.1.1 and 3.1.3:

- For the groundwater extraction–spray irrigation system, a compliance level of 44.2 µg/L is recommended for carbon tetrachloride in spray discharge reaching the ground surface. This level is consistent with the qualitative requirements specified for the discharge by the NDEQ (Appendix B), and it reflects the acceptable level for surface waters promulgated under NDEQ Title 117 — *Nebraska Surface Water Quality Standard*. The discharge will be sampled quarterly, and the results will be reported quarterly.

- For the overall remediation systems, the compliance level specified under NDEQ Title 117 — *Nebraska Surface Water Quality Standard* is a carbon tetrachloride concentration of 44.2 µg/L in surface water. The recommended compliance point is location SWM3, directly downstream of the outfall from the wetlands treatment zone. Surface water at this location will be sampled quarterly, and the results will be reported quarterly.

### 3.4 Investigation Methods

The sampling and analysis methods for ambient air are described in Section 2.4, and the method for sampling discharge from the spray irrigation system is cited in Section 3.1.1. Other
investigational activities will be conducted in accordance with procedures defined in the *Master Work Plan* (Argonne 2002).

Quality control requirements will be those defined in the *Master Work Plan* (Argonne 2002), with the added provision that in each sampling event, one sample from each compliance point (Section 3.3) will be analyzed by a reference laboratory using EPA Contract Laboratory Program methodology. The purpose will be additional verification of the results from Argonne’s Applied Geosciences and Environmental Management Laboratory, beyond the usual requirement of verification analyses for 10% of water samples.
FIGURE 3.1 Locations proposed for the measurement of groundwater levels through use of automated water level recorders during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).
FIGURE 3.2 Approximate locations proposed for the periodic sampling and analysis of vegetation samples for volatile organic compounds during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).
FIGURE 3.3 Locations proposed for the periodic measurement of selected geochemical parameters in groundwater during the initial (five-year) monitoring period, to identify the anticipated development of reducing/anaerobic conditions required for the microbial degradation of carbon tetrachloride by reductive dechlorination. Source of photograph: NAIP (2003).
FIGURE 3.4 Locations proposed for the periodic sampling of surface waters for volatile organic analyses during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).
FIGURE 3.5 Locations proposed for the periodic sampling of groundwater for volatile organic analyses during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).
FIGURE 3.6 Locations proposed for the periodic sampling of ambient air for volatile organic analyses during the initial (five-year) monitoring period. Source of photograph: NAIP (2003).
4 References


EPA, 2005, memorandum from M. Beringer (Data Interpretation and Support Operations Branch, Environmental Services Division, U.S. Environmental Protection Agency Region VII, Kansas City, Kansas) to J. Field (Drinking Water Management Branch; Water, Wetlands, and Pesticides Division, U.S. Environmental Protection Agency Region VII, Kansas City, Kansas), December 21.
Appendix A:

Well Construction Information
FIGURE A.1  Locations of all permanent groundwater observation points at Murdock. Source of photograph: NAIP (2003).
TABLE A.1  Construction data for permanent observation points at Murdock, Nebraska.

<table>
<thead>
<tr>
<th>Location</th>
<th>Screen Interval Depth (ft BGL)</th>
<th>Well Depth (ft BGL)</th>
<th>Location</th>
<th>Screen Interval Depth (ft BGL)</th>
<th>Well Depth (ft BGL)</th>
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<tbody>
<tr>
<td>1S</td>
<td>30–40</td>
<td>40</td>
<td>SB69D</td>
<td>62.2–72.2</td>
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<td>1D</td>
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<td>50.8–58.3</td>
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<td>2S</td>
<td>70.5–80.5</td>
<td>80.5</td>
<td>SB70M</td>
<td>58.4–68.4</td>
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<tr>
<td>2D</td>
<td>85–95</td>
<td>95</td>
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<td>53.1–60.6</td>
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<tr>
<td>3S</td>
<td>64–74</td>
<td>74</td>
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<td>60.7–70.7</td>
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<tr>
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<td>90</td>
<td>SB71D</td>
<td>70–80</td>
<td>80</td>
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<tr>
<td>4S</td>
<td>30–40</td>
<td>40</td>
<td>SB72S</td>
<td>49–56.5</td>
<td>56.5</td>
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<tr>
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<td>83</td>
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<td>76</td>
<td>PMW1S</td>
<td>4.6–14.6</td>
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<tr>
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<td>59</td>
<td>PMW2SA</td>
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<td>15</td>
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<td>PMW2SB</td>
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<td>15</td>
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<tr>
<td>GWEX-1</td>
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<td>56.5</td>
<td>PMW9S</td>
<td>5–9</td>
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<td>SB68M</td>
<td>57.2–67.2</td>
<td>67.2</td>
<td>PMW9M</td>
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<tr>
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<td>67.8–77.8</td>
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<td>PMW9D</td>
<td>19.5–29.5</td>
<td>32</td>
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<tr>
<td>SB69M</td>
<td>51.9–61.9</td>
<td>61.9</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*a Critical temporary piezometer for water level monitoring; permission to retain this piezometer is being requested.
### Monitoring Plan for Murdock, Nebraska

**Version 00, 11/11/05**

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**STATE OF NEBRASKA**

**DEPARTMENT OF NATURAL RESOURCES**

**WATER WELL REGISTRATION**

**FOR DEPARTMENT USE ONLY**

<table>
<thead>
<tr>
<th>Registration Date</th>
<th>Sequence No.</th>
<th>Registration No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner Code No.</td>
<td>Receipt No.</td>
<td>NRD</td>
</tr>
</tbody>
</table>

**a. Well Owner’s First Name**  --

**b. Company Name**  USDA CE PD PSU/CDC

**c. Correspondent Name**  --

**d. Address**  1400 Independence Avenue, SW

**e. City**  Washington

**f. State**  DC

**g. Zip**  20250-0513

**h. Telephone**  202-726-5104

---

**2. a. Contractor’s License No.**  89019

**b. Contractor’s Name**  Dennis J. Anderson

**c. Contractor’s Email Address**  danberson@thielegeotech.com

**d. Drilling Firm Name**  Thiele Geotech, Inc.

**e. Address**  13473 Chandler Road

**f. City**  Omaha

**g. State**  NE

**h. Zip**  68138

**i. Telephone**  (402) 556-2171

---

**3. a. Well location**  NE ¼ of the SW ¼ of Section 10, Township 11 North, Range 10E, East/West, Cass County.

**b. Natural Resources District**  Lower Platte South

**c. The well is**  367 feet from the (O North/West) section line and 2,057 feet from the (O East/South) section line.

**d. Latitude Degree**  40

**e. Minute**  55

**f. Second**  46.56

**g. Longitude Degree**  96

**h. Minute**  17

**i. Second**  9.54

---

**4. a. Permits**

**b. Management Area Permit Number**

**c. Geothermal Permit Number**

**d. Municipal Permit Number**

**e. Well Spacing Permit Number**

**f. RSSS**

---

**5. Purpose of well (Indicate one):**

- Aquiculture
- Commercial/Industrial
- De-watering (over 90 days)
- Domestic
- Ground Heat Exchanger
- Groundwater Source Heat Pump
- Irrigation
- Injection
- Livestock
- Monitoring
- Observation
- Public Water Supply (with open well or borehole)
- Other

---

**6. Wells in a Series**

- Is this well a part of a series?  Yes

---

**7. Replacement and abandoned well information**

- Is this well a replacement well?  Yes

---

<table>
<thead>
<tr>
<th>Registration number of abandoned well</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
</tr>
</tbody>
</table>

**c. Replacement well is**  feet from abandoned well.

**d. Abandoned well last operated**

**e. Original well pump column size**  inches

**f. Completion of original well abandonment on**

---

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Monitoring Plan for Murdock, Nebraska
Version 00, 11/11/05

8. Pump Information
   a. Is pump installed at this time? Yes X No
   b. Pump Installer’s Name
      Pump Installer’s License No. ______
      Pump Installer’s Firm Name ______
      Pump Installer’s Firm Address ______
      City ______ State ______ Zip ______ Telephone ______
   c. Pumping Rate ______ gallons per minute Measured ______ Estimated ______
   d. Drop pipe diameter ______ inches e. Length of drop pipe ______ feet
   f. Pumping equipment installed ______ g. Pump Brand ______
   h. This well is designed and constructed to pump less than 50 gpm X Yes No

9. Well Construction Information.
   a. Total well depth: ______ feet.
   b. Static water level: ______ feet.
   c. Pumping water level: ______ feet.
   d. Well Construction began ______
   e. Well Construction completed: ______
   f. Bore hole diameter in inches Top ______ Bottom ______
   g. Casing and Screen Joints are ______ Welded ______ Glued ______ Threaded X ______ Other ______

10. Well Construction (Casing & Screen): c, d, e, f & g measurements should be in inches to three decimal places
    | Placement Depth in Feet | Casing or Screen | Inside Diameter | Outside Diameter | Wall Thickness | Screen Slot Size | Type of Material | Trade Name |
    |-------------------------|------------------|----------------|-----------------|---------------|----------------|-----------------|-----------|
    | From | To | Casing | Screen | 2.00 | 2.375 | 0.1875 | N/A | PVC | EMI |
    | 0.0  | 4.6 |        |        | 0.00 | 0.00  | 0.00   | 0.00 | 0.00 | 0.00 |

11. Grout and Gravel Pack
    | Placement Depth in Feet | Grout or Gravel Pack | Material Description |
    |-------------------------|----------------------|----------------------|
    | From | To | Beatonite Seal | WyoBe Environplug Bentonite Chips |
    | 0.0  | 2.25 |             |                     |
    | 2.25 | 15.0 | Sand/Gravel Pack | 10/20 Washed Silica Sand |

12. Geologic Materials Logged
    | Depth in Feet | Description |
    |----------------|-------------|
    | From | To | orangish brown silty clay with fine sand |
    | 0.0  | 5.0 | light tan/grey silty clay with fine sand |
    | 5.0  | 11.0 | light tan/grey silty clay sand and clay |
    | 11.0 | 13.0 | tan/grey fine sand with silt and clay |

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

   [Signature]
   Date 8/24/05

   If Contractor is unknown or Deceased
   Well Owner’s Signature Date

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## Monitoring Plan for Murdock, Nebraska

### Version 00, 11/11/05 A-6

#### STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

### FOR DEPARTMENT USE ONLY

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<th>Registration Date</th>
<th>Sequence No.</th>
<th>Registration No.</th>
<th>Owner Code No.</th>
<th>Receipt No.</th>
<th>NRD</th>
</tr>
</thead>
</table>

1. a. Well Owner’s First Name: __________ Last Name: __________
   b. Company Name: US DA/CEPD FSA/CCC
   c. Correspondent Name: __________ Attention: Steve Gilmore
   d. Address: 1400 Independence Avenue, SW
   e. City: Washington
   f. State: DC
   g. Zip Code: 20250-0513
   h. Telephone: 202.720.5104

2. a. Contractor’s License No: 89019
   b. Contractor’s Name: Dennis J. Anderson
   c. Contractor’s Email Address: danderson@thielegeotech.com
   d. Drilling Firm Name: Thiele Geotech, Inc.
   e. Address: 13478 Chandler Road
   f. City: Omaha
   g. State: NE
   h. Zip Code: 68138
   i. Telephone: (402) 556-2171
   j. Drilling Firm’s Email Address: www.thielegeotech.com

3. a. Well location: SE 1/4 of the SW 1/4 of Section 19, Township 11 North, Range 10E East, Cass County.
   b. Natural Resources District: Lower Platte South
   c. The well is
      i. 361 feet from the (☐ North/☐ South) section line and 2064 feet from the (☐ East/☐ West) section line.
      ii. Latitude Degree: 40
          Minutes: 55
          Second: 46.59
      iii. Longitude Degree: 96
          Minutes: 17
          Second: 9.48
   d. Street address and subdivision, if applicable: __________
   e. Lot: __________
   f. If for irrigation, the land to be irrigated is: __________ acres.
   g. Well reference letters, if applicable: PMW-1D
      □ HSS □ PWSID

4. a. Permits: None
   b. Management Area Permit Number: __________
   c. Geothermal Permit Number: __________
   d. Municipal Permit Number: __________
   e. Well Spacing Permit Number: __________
   f. Surface Water Permit Number for Public Water Supply: __________
   g. Industrial Permit Number: __________
   h. Transfer Out-of-State Permit Number: __________
   i. Conduct Permit Number: __________
   j. Other Permit Number: __________
   k. ND EQ: __________

5. a. Purpose of well (indicate one): Water Supply (underground) __________
   b. Water Supply (otherwise indicated): __________
   c. Groundwater Source Heat Pump: __________
   d. Irrigation: __________
   e. Injection: __________
   f. Dewatering (over 90 days): __________
   g. Monitoring: __________
   h. Recovery: __________
   i. Other: __________

6. a. Wells in a Series: Yes / No
   b. If yes, give full number: __________
   c. If no, give full number: __________
   d. If yes, give full number: __________
   e. If no, give full number: __________
   f. If yes, give full number: __________
   g. If no, give full number: __________

7. a. Replacement and abandoned well information: Yes / No
   b. Registration number of abandoned well: __________
   c. Replacement well is: __________ feet from abandoned well.
   d. Abandoned well last operated: __________
   e. Original well pump: __________ inches
   f. Completion of original well abandonment: __________
   g. Location of water use of abandoned well: __________

---

Form provided by Forms-Or-A-Desk, Inc. - Dallas, Texas - (214) 340-9429
8. Pump Information
   a. Is pump installed at this time?   Yes  X No
      Is pump installed by well owner in section 2?  Yes  No Is pump installed by contractor in section 2?  Yes  No
   b. Pump Installer’s License No.   Pump Installer’s Name:
      Pump Installer’s Email Address
      Pump Installer’s Firm Name
      Pump Installer’s Firm Address
      City             State             Zip             Telephone
   c. Pumping Rate   gallons per minute Measured  Estimated
   d. Drop pipe diameter   inches
   e. Length of drop pipe   feet
   f. Pumping equipment installed (motor, etc.)
   g. Pump Brand
   h. This well is designed and constructed to pump less than 50 gpm  X Yes  No

9. Well Construction Information.
   a. Total well depth: 35 feet
   b. Static water level: — feet
   c. Pumping water level: — feet
   d. Well Construction began 04/29/05
   e. Well Construction completed: 04/29/05
   f. Bore hole diameter in inches: Top 8  Bottom 8
   g. Casing and Screen Joints are: Welded  Glued  Threaded  X Other

10. Well Construction (Casing & Screen): c, d, e, & g measurements should be in inches to three decimal places

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 24.6</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
<td>EMI</td>
</tr>
<tr>
<td>24.6 34.6</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
<td>EMI</td>
</tr>
</tbody>
</table>

11. Grout and Gravel Pack

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 21.75</td>
<td>Bentonite Seal</td>
<td>WyoBen Environing Bentonite Chips</td>
</tr>
<tr>
<td>21.75 35</td>
<td>Sand/Gravel Pack</td>
<td>10/20 Washed Silica Sand</td>
</tr>
</tbody>
</table>

12. Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 5</td>
<td>orangish brown silty clay with fine sand</td>
<td>15 30</td>
<td>light tan silty fine sand and clay</td>
</tr>
<tr>
<td>5 11</td>
<td>light tan-gray silty clay with fine sand</td>
<td>30 35</td>
<td>orangish tan silty fine sand and clay</td>
</tr>
<tr>
<td>11 13</td>
<td>light tan-gray silty fine sand and clay</td>
<td>35 38</td>
<td>orangish muddy, fine/medium sand</td>
</tr>
<tr>
<td>13 15</td>
<td>tan-gray fine sand with silt and clay</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge if true.

[Signature]

Water Well Contractor’s Signature   Date

[Signature]

Well Owner’s Signature   Date

If Contractor is unknown or Deceased

Form provided by Forms-On-A-Disk • (214) 340-9429 • FormsOnADisk.com
# Monitoring Plan for Murdock, Nebraska

**Version 00, 11/11/05**

## State of Nebraska
### Department of Natural Resources
#### Water Well Registration

### For Department Use Only

<table>
<thead>
<tr>
<th>Registration Date</th>
<th>Sequence No.</th>
<th>Registration No.</th>
</tr>
</thead>
</table>

#### Owner Code No. | Receipt No. | NRD |

1. **Well Owner’s First Name:** [Name]
   **Last Name:** [Name]

2. **Company Name:** USDA CRPD FSA/CCC
   **Attention:** Steve Gilmore

3. **Contractor’s License No:** 899019
   **Contractor’s Name:** Dennis J. Anderson
   **Drilling Firm Name:** Thiele Geotech, Inc.
   **Address:** 13478 Chandler Road
   **City:** Omaha
   **State:** NE
   **Zip:** 68138
   **Telephone:** (402) 556-2171

4. **Well location:**
   - **SE 1/4 of the SW 1/4 of Section 10, Township 11, North, Range 10E East/West, Cass County.
   - **Natural Resources District:** Lower Platte South
   - **Well:** 646 feet from (the) (Section) section line and 2034 feet from the (section) section line.
   - **Lineage:** 5536 Munsie 17 Second 9.84
   - **Street address and subdivision, if applicable:**
   - **Lot:**
   - **Location of water use, if applicable (give legal descriptions):**
   - **If for irrigation, the land to be irrigated in:**
   - **Acre:**
   - **Well severance letter(s), if applicable:** PMW-254

5. **Permit:** None
   **Management Area Permit Number:** Surface Water Permit Number
   **Confidential Permit Number:** Industrial Permit Number
   **Municipal Permit Number:** Transfer Out-of-State Permit Number
   **Well Spacing Permit Number:** Conduct Permit Number
   **HISS:** Other Permit Number

6. **Purpose of well (indicate one):**
   - **Aquaculture:** Commercial/Industrial
   - **Domestic:** Desalting (over 90 days)
   - **Ground Heat Exchanger:** Groundwater Source Heat Pump
   - **Irrigation:** Injection
   - **Livestock:** Monitoring
   - **Public Water Supply:** Observation
   - **Recovery:** Other

7. **Wells in a Series:**
   - **Is this well a part of a series?** Yes  No
     **No:** go to part of this section.
     **Yes:** go to part of this application
   - **If one or more of the wells in the series is currently registered, give the well registration number:**
   - **How many wells in the series are you registering at this time?**

8. **Replacement and abandoned well information:**
   - **Is this well a replacement well?** Yes  No
   - **Registration number of abandoned well:**
   - **If not registered, date abandoned well was constructed:**
   - **Abandoned well last operated:**
   - **Original well pump column size:**
   - **Location of water use of abandoned well:**

---

Form provided by Form-It-A-Lock, Inc. - Dallas, Texas - 214-345-9420
3. Pump Information
   a. Is pump installed at this time?  Yes  X  No
   b. Pump Installer’s License No.  
   c. Pumping Rate  gallons per minute  Measured  Estimated
   d. Drop pipe diameter  inches
   e. Length of drop pipe  feet
   f. Pumping equipment installed (monitoring):  
   g. Pump Brand  
   h. This well is designed and constructed to pump less than 50 gpm  X  Yes  No

4. Well Construction Information,
   a. Total well depth:  15  feet
   b. Static water level:  --  feet
   c. Pumping water level:  --  feet
   d. Well Construction began:  04/28/05
   e. Well Construction completed:  (estimation)  
   f. Base hole diameter in inches  Top 8  Bottom 8
   g. Casing and Screen Joints are:  Welded  Glazed  Threading  X  Other

10. Well Construction (Casing & Screen): All measurements should be in inches to three decimal places

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 0 to 4.6</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
<td>EMI</td>
</tr>
<tr>
<td>4.6 to 14.6</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
<td>EMI</td>
</tr>
</tbody>
</table>

11. Grout and Gravel Pack

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 0 to 2.6</td>
<td>Bentonite Seal</td>
<td>Wyssman Environmental Bentonite Clay</td>
</tr>
<tr>
<td>2.6 to 15</td>
<td>Sand/Gravel Pack</td>
<td>10/20 Washed Silica Sand</td>
</tr>
</tbody>
</table>

12. Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5</td>
<td>dark brownish orange silty clay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 15</td>
<td>light tan grey fine sand and silt with clay</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

Water Well Constructor’s Signature  D. J. A.  Date  01/09/05

Form provided by Forms-On-A-Disk - (314) 348-8429 - FormsOnADisk.com
**STATE OF NEBRASKA**  
**DEPARTMENT OF NATURAL RESOURCES**  
**WATER WELL REGISTRATION**

**FOR DEPARTMENT USE ONLY**

<table>
<thead>
<tr>
<th>Registration Date</th>
<th>Sequence No.</th>
<th>Registration No.</th>
<th>Owner Code No.</th>
<th>Receipt No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. a. **Well Owner’s First Name** —
   b. **Company Name** USDA CRS FSA/CCC
   c. **Correspondent Name** —
   d. **Address** 1400 Independence Avenue, SW
   e. **City** Washington
   f. **State DC** Zip: 68250-0513
   g. **Telephone** 202-700-5104
   h. **Contractor’s License No.** 89019
   i. **Contractor’s Name** Dennis J. Anderson
   j. **Contractor’s Email Address** danderson@theilgeo.com
   k. **Drilling Firm Name** Thiele Geotech, Inc.
   l. **Address** 15473 Chandler Road
   m. **City** Omaha
   n. **State NE** Zip: 68138
   o. **Telephone** (402) 586-2171
   p. **Drilling Firm’s Email Address** www.theilgeo.com

2. a. **Well location:** SW 1/4 of the SW 1/4 of Section 19, Township 11, Range 10E East/West, Cass County
   b. **Natural Resources District** Lower Platte South
   c. **The well is** 433 feet from the (CI North/South) section line and 2,047 feet from the (CI East/West) section line.
   d. **Latitude Degree** 40
   e. **Minute** 55
   f. **Second** 47.22
   g. **Longitude Degree** 96
   h. **Minute** 17
   i. **Second** 9.66
   j. **Street address and subdivision, if applicable** —
   k. **Lot** —
   l. **Location of water use, if applicable (give legal descriptions)** —
   m. **If for irrigation, the land to be irrigated is** —
   n. **Well service letter(s), if applicable** —
   o. **PMW-2SB**
   p. **HHSS PWSID**

4. a. **Pumps** None
   b. **Management Area Permit Number** —
   c. **Geothermal Permit Number** —
   d. **Municipal Permit Number** —
   e. **Well Spacing Permit Number** —
   f. **Other Permit Number** —
   g. **NDWQ** —

5. a. **Purpose of well (indicate one):** Aquatic/Recreational
   b. **Commercial/Industrial**
   c. **Dewatering (over 90 days)**
   d. **Domestic**
   e. **Ground Heat Exchanger**
   f. **Groundwater Source Heat Pump**
   g. **Irrigation**
   h. **Injection**
   i. **Livestock**
   j. **Monitoring**
   k. **Observation**
   l. **Public Water Supply (on-going operation)**
   m. **Public Water Supply (out of operation)**
   n. **Other**

6. a. **If the well is a part of a series?** X Yes, go to part b of this section
   b. **No, go to part 7 of this application**
   c. **If one or more of the wells in the series is currently registered, give the well registration number** —
   d. **How many wells in the series are you registering at this time?** 15

7. a. **Replacement and abandoned well information**
   b. **Is this well a replacement well?** X Yes
   c. **Registration number of abandoned well** —
   d. **If not registered, date abandoned well was constructed** —
   e. **Replacement well is**
   f. **Abandoned well last operated** —
   g. **Original well pump column size** —
   h. **Location of water use of abandoned well** —

---

Form provided by Forensics Data, Inc. - Dallas, Texas - (214) 569-9439
8. Pump Information
   a. Is pump installed at this time? ___Yes ___No
   b. Is pump installed by owner in section 7? ___Yes ___No
   c. Is pump installed by contractor in section 8? ___Yes ___No
   d. If pump installed by pump installer, please fill out license number below.

   Pump Installer’s License No.
   Pump Installer’s Name
   Pump Installer’s Firm Name
   Pump Installer’s Firm Address
   City
   State
   Zip
   Telephone
   Pump Installer’s Firm Email Address

   e. Pumping Rate ___gallons per minute ___Measured ___Estimated
   f. Length of drop pipe ___inches ___feet
   g. Pump Brand
   h. This well is designed and constructed to pump less than 30 gpm ___Yes ___No

9. Well Construction Information
   a. Total well depth: ___15___ feet
   b. Static water level: ___foot
   c. Pumping water level: ___foot
   d. Well Construction began (month/day/year) ___04/29/95
   e. Well Construction completed (month/day/year) ___04/29/95
   f. Bore hole diameter in inches: Top ___8___ Bottom ___8___
   g. Casting and Screen Joints are ___Welded ___Gland ___Threaded ___X___ Other

10. Well Construction (Casing & Screen): c, d, e, & g measurements should be in inches to three decimal places

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4.6</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
</tr>
<tr>
<td>4.6</td>
<td>14.6</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. Grout and Gravel Pack

<table>
<thead>
<tr>
<th>Placement Depths in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Grout</td>
</tr>
<tr>
<td></td>
<td>2.4</td>
<td>Gravel Pack</td>
</tr>
<tr>
<td></td>
<td>2.4</td>
<td></td>
</tr>
</tbody>
</table>

12. Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>5</td>
<td>dark brownish orange silty clay</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>light brownish fine sand and silt with clay</td>
<td></td>
</tr>
</tbody>
</table>

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

[Signature]

Date: 8/29/05

Water Well Contractor’s Signature

Well Owner’s Signature

If Contractor is unknown or Deceased

Form provided by FarmOn-A-disk: (214) 340-0420 / FarmOnADisk.com
STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date: 
Sequence No.: 
Registration No.: 
Owner Code No.: 
Receipt No.: 
NRD

1. a. Well Owner's First Name: 
   Last Name: 
   b. Company Name: USDA CSFP FSA/CCC
   c. Correspondent Name: 
   Address: 1400 Independence Avenue, SW
   City: Washington
   State: DC
   Zip: 20250
   Phone: 202-720-5104

2. a. Contractor's License No: S0019
   Contractor's Name: Dennis J. Anderson
   Contractor's Email Address: danderson@thielegeo.com
   b. Drilling Firm Name: Thiele Geotech, Inc.
   Address: 13478 Chandler Road
   City: Omaha
   State: NE
   Zip: 68138
   Phone: (402) 556-2171
   Drilling Firm's Email Address: www.thielegeo.com

3. a. Well location: SE ¼ of SW ¼ of Section 10, Township 11 North, Range 10E East/West, Cass County
b. Natural Resources District: Lower Platte South
c. The well is 459 feet from the (North/South) section line and 2,014 feet from the (East/West) section line.
   or Latitude Degree: 40
   longitude Degree: 96
   Minute 55
   minute 17
   Second 47.46
   Second 9.84
d. Street address and subdivision, if applicable: 
   Block: 
   Lot: 
   e. Location of water use, if applicable (give legal descriptions): 
   f. If for irrigation, the land to be irrigated is: 
   g. Well reference letter(s), if applicable: PMW-2D

4. Permits None
   Management Area Permit Number: 
   Geothermal Permit Number: 
   Municipal Permit Number: 
   Well Spacing Permit Number: 
   NDQH
   Surface Water Permit Number: 
   Industrial Permit Number: 
   Transfer Out-of-State Permit Number: 
   Conduct Permit Number: 
   Other Permit Number: 
   HIES
   HIES PWSD

5. Purpose of Well: 
   Domestic: 
   Commercial/Industrial: 
   Ground Heat Exchanger: 
   Groundwater Source Heat Pump: 
   Irrigation: 
   Observation: 
   Drainage (over 90 days): 
   Livestock: 
   Monitoring: 
   Public Water Supply: 
   Public Water Supply: (with storage 96-360)
   Common Aid: 
   Recovery: 
   Other: 

6. Wells in a Series: 
   a. Is this well a part of a series? X Yes; go to part b of this section. 
   No; go to part 7 of this application.
   b. If one or more of the wells in the series is currently registered, give the well registration number: 
   c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information: 
   a. Is this well a replacement well? X Yes. 
   b. Replacement number of abandoned well: 
   c. Replacement well is feet from abandoned well.
   d. Abandoned well last operated: 
   e. Original well pump column size: 
   f. Completion of original well abandonment: 
   g. Location of water use of abandoned well: 

Form provided by Forms-On-A-Disk, Inc. • Dallas, Texas • (214) 346-9429
Monitoring Plan for Murdock, Nebraska
Version 00, 11/11/05

8. Pump Information
   a. Is pump installed at this time? Yes X No
   b. Is pump installed by well owner in section 1? Yes No
   c. Is pump installed by contractor in section 2? Yes No
   d. Pump Installer’s License No.
   e. Pump Installer’s Name
   f. Pump Installer’s Firm Address
   g. Pump Installer’s Firm Name

9. Well Construction Information
   a. Total well depth: 30 feet
   b. Static water level: feet
   c. Pumping water level: feet
   d. Well Construction begun: 04/28/05
   e. Well Construction completed: 04/28/05
   f. Hole diameter in inches
   g. Casing and Screen: Welded
   h. Joint Type: Threaded X Other

10. Well Construction (Casing & Screen)
    Placement Depth in Feet
        From | To  | Casing or Screen | Inside Diameter | Outside Diameter | Wall Thickness | Screen Slot Size | Type of Material | Trade Name
        0   | 19.6| Casting          | 2.00            | 2.375            | 0.1875        | N/A             | PVC             | EMI
        19.6| 29.6| Screen          | 2.00            | 2.375            | 0.1875        | 0.010           | PVC             | EMI

11. Grout and Gravel Pack
    Placement Depth in Feet
        From | To  | Grout or Gravel Pack | Material Description
        0    | 17.6| Bentonite Seal       | WyoBen Environplug Bentonite Chips
        17.6| 30  | Sand/Gravel Pack     | 16/20 Washed Silica Sand

12. Geologic Materials Logged
    Depth in Feet
        From | To  | Description
        0    | 5   | dark brownish orange silty clay
        5    | 20  | light tan-gray fine sand and silt with clay
        20   | 30  | light tan-gray fine sand and silt

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

Water Well Contractor’s Signature: [Signature]
Date: [Date]

Well Owner’s Signature: [Signature]
Date: [Date]
STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

<table>
<thead>
<tr>
<th>Registration Date</th>
<th>Sequence No.</th>
<th>Registration No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner Code No.</td>
<td>Receipt No.</td>
<td>NRD</td>
</tr>
</tbody>
</table>

1. a. Well Owner's First Name --
    b. Company Name USDA CEFD FSA/CCC
    c. Correspondent Name --
    Address 1400 Independence Avenue, SW
    City Washington State DC Zip 20250-0513 Telephone 202.720.5104

2. a. Contractor's License No 89019
    Contractor's Name Dennis J. Anderson
    Contractor's Email Address danlerson@thielegeotech.com
    b. Drilling Firm Name Thiele Geotech, Inc.
    Address 13478 Chandler Road
    City Omaha State NE Zip 68138 Telephone (402) 556-2171
    Drilling Firm's Email Address www.thielegeotech.com

3. a. Well location: SE 1/4 of the SW 1/4 of Section 10, Township 11 North, Range 10E East/West, Cass County.
    b. Natural Resources District Lower Platte South
    c. The well is 581 feet from the (North/South) section line and 2,008 feet from the (East/West) section line.
    d. Street address and subdivision, if applicable --
    e. Location of water use, if applicable (give legal descriptions) --
    f. If for irrigation, the land to be irrigated is -- acres.
    g. Well reference letter(s), if applicable: PMW-3S HEISS FWSID

4. Permits
   Management Area Permit Number
   Geothermal Permit Number
   Municipal Permit Number
   Well Spacing Permit Number
   HISS NDEQ

5. Purpose of well (indicate one): Aquaculture Commercial/Industrial Dewatering (over 90 days)
   Domestic Ground Heat Exchanger Groundwater Source Heat Pump Irrigation Injection
   Livestock X Monitoring Observation Public Water Supply (with or without injection)
   Public Water Supply (without injection) Recovery Other (indicate use)

6. Wells in a Series
   a. Is this well a part of a series? X Yes; go to part b of this section. No, go to part 7 of this application
   b. If one or more of the wells in this series is currently registered, give the well registration number --
   c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information.
   a. Is this well a replacement well? X Yes No
   b. Registration number of abandoned well
   c. Replacement well is 1234 feet from abandoned well.
   d. Abandoned well last operated
   e. Original well pump column size: 3 inches
   f. Completion of original well abandonment on
   g. Location of water used of abandoned well:

Form provided by Forms-On-A-Disk, Inc. • Dallas, Texas • (214) 340-8623
8. Pump Information
   a. Is pump installed at this time? Yes X No
   b. Pump Installer's License No.
   c. Pump Installer's Firm Name
   d. Pump Installer's Firm Address
   e. Pump Installer's Firm Email Address
   f. Pump Installer's Name
   g. Pump Installer's License Number
   h. Pump Installer's Telephone

9. Well Construction Information
   a. Total well depth: 15 ft.
   b. Static water level: -- ft.
   c. Pumping water level: -- ft.
   d. Well Construction began on: 04/25/05
   e. Well Construction completed: 04/25/05
   f. Screen hole diameter in inches: Top 8
      Bottom 8
   g. Casing and Screen Joins are: Welded
      Glue
      Threaded X
      Other

10. Well Construction (Casing & Screen) - a, d, e, & g measurements should be in inches to three decimal places

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>4.5</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
</tr>
<tr>
<td>4.5</td>
<td>14.5</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
</tr>
</tbody>
</table>

11. Grout and Gravel Pack

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>2.4</td>
</tr>
<tr>
<td>2.4</td>
<td>15</td>
<td>Sand/Gravel Pack</td>
</tr>
</tbody>
</table>

12. Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>From</th>
<th>To</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>5</td>
<td>dark gray silty clay</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>10</td>
<td>dark brown silty clay</td>
</tr>
<tr>
<td>10</td>
<td>12.5</td>
<td>12.5</td>
<td>gray silty clay</td>
</tr>
<tr>
<td>12.5</td>
<td>15</td>
<td>15</td>
<td>tan fine/medium sand</td>
</tr>
</tbody>
</table>

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

[Signatures]

Water Well Contractor's Signature: [Signature]
Date: 8/21/05

Well Owner's Signature: [Signature]
Date: [Date]

If Contractor is unknown or deceased:

If Contractor is unknown or deceased [Signature]
Date: [Date]
STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

<table>
<thead>
<tr>
<th>Registration Date</th>
<th>Sequence No.</th>
<th>Registration No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner Code No.</td>
<td>Receipt No.</td>
<td>NRD</td>
</tr>
</tbody>
</table>

1. a. Well Owner's First Name -- Last Name --
   b. Company Name: USDA CEFD PFA/CCE
   c. Correspondent Name: -- Attention: Steve Gilmore
   d. Address: 1400 Independence Avenue, SW

2. a. Contractor's License No: 89019
    b. Contractor's Name: Dennis J. Anderson
    c. Contractor's Email Address: danderson@thesteelvoetech.com
    d. Drilling Firm Name: Thele GeoTech, Inc.
    e. Address: 13478 Chandler Road
    f. City: Omaha
    g. State NE
    h. Zip: 68138
    i. Telephone: (402) 556-2171

3. a. Well Location: NE % of the SW % of Section 10, Township 11 North, Range 10E East/West, Cass County.
    b. Natural Resources District: Lower Platte South
    c. The well is 554 feet from the (□ North □ South) section line and 2,001 feet from the (□ East □ West) section line.
    d. Latitude Degree: 40
       Minutes: 55
       Seconds: 48.42
    e. Longitude Degree: 96
       Minutes: 17
       Seconds: 10.26
    f. Street address and subdivision, if applicable: --
    g. Block: --
    h. Lot: --

4. a. Purpose of well (indicate one): Agriculture
    b. Industrial Permit Number
    c. Domestic Permit Number
    d. Groundwater Source Permit Number
    e. Irrigation Permit Number
    f. Injection Permit Number

5. a. Public Water Supply (without spring): X Monitoring
    b. Observation
    c. Public Water Supply (with spring) 04-6-66
    d. Other

6. Wells in a Series:
   a. Is this well a part of a series? X Yes; go to part b of this section.
   b. If one or more of the wells in the series is currently registered, give the well registration number: --
   c. How many wells in this series are you registering at this time? 15

7. a. Placement and abandonment well information:
    b. Is this well a replacement well? X Yes
    c. Registration number of abandoned well: --
    d. Replacement well legal description: --
    e. Original well pump column size: --
    f. Location of water use of abandoned well: --

---

Form provided by Forms-On-A-Disk, Inc., Dallas, Texas - (214) 348-9020
Monitoring Plan for Murdock, Nebraska
Version 00, 11/11/05 A-17

8. Pump Information
   a. Is pump installed at this time?  Yes  X  No
   b. Is pump installed by well owner in section 2?  Yes  No
   c. Is pump installed by contractor in section 2?  Yes  No
   d. Pump Installer’s License No.  
   e. Pump Installer’s Name  
   f. Pump Installer’s Firm Name  
   g. Pump Installer’s Firm Address  
   h. Pump Installer’s Firm Email Address  

9. Well Construction Information
   a. Total well depth  30  feet
   b. Static water level  --  feet
   c. Pumping water level  --  feet
   d. Well Construction began  04/26/05
   e. Well Construction completed  04/26/05
   f. Bore hole diameter in inches  Top 8  Bottom 8
   g. Casing and Screen Joints are  Welded  Guard  Threaded  X  Other

10. Well Construction (Casing & Gravel): c, d, e, & f measurements should be in inches to three decimal places

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0/0</td>
<td>PVC</td>
</tr>
<tr>
<td>19.5</td>
<td>24.5</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0/0</td>
<td>PVC</td>
</tr>
</tbody>
</table>

11. Grout and Gravel Pack

<table>
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<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Bentonite Seal</td>
</tr>
<tr>
<td>9</td>
<td>17.3</td>
<td>17</td>
</tr>
</tbody>
</table>

12. Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>dark gray silty clay</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>dark brown silty clay</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>12.5</td>
<td>gray silty clay</td>
<td>17</td>
<td>25</td>
</tr>
<tr>
<td>(Additional sheets may be submitted)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

[Signature]
Date: 8/26/05

Well Owner’s Signature
Date: 8/26/05

[Form provided by Forms-On-A-Disk: (214) 410-6429 - formsOnADisk.com]
Monitoring Plan for Murdock, Nebraska  
Version 00, 11/11/05  
A-18

STATE OF NEBRASKA  
DEPARTMENT OF NATURAL RESOURCES  
WATER WELL REGISTRATION  
FOR DEPARTMENT USE ONLY

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<tr>
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<th>Registration No.</th>
<th>Owner Code No.</th>
<th>Receipt No.</th>
<th>NRD</th>
</tr>
</thead>
</table>

1. a. Well Owner’s First Name --  
    b. Company Name USDA CEFD FSA/CCC  
    c. Correspondent Name --  
    Address 1400 Independence Avenue  
    City Washington  
    State DC Zip 20250-0513 Telephone 202.720.5104

2. a. Contractor’s License No 89019  
    Contractor’s Email Address danderson@thielegeotech.com  
    b. Drilling Firm Name Thiele Geotech, Inc.  
    Address 13478 Chandler Road  
    City Omaha  
    State NE Zip 68138 Telephone (402) 556-2171  
    Drilling Firm’s Email Address www.thielegeotech.com

3. a. Well location: SE ¼ of the SW ¼ of Section 10, Township 11 North, Range 10E East/West, Cass County  
    b. Natural Resources District Lower Platte South  
    c. The well is 728 feet from the (N North/S South) section line and 1,762 feet from the (E East/W West) section line.  
    or Latitude Degree 49 Minute 55 Second 50.16  
    Longitude Degree 96 Minute 17 Second 13.32  
    d. Street address and subdivision, if applicable --  
    Block --  
    Lot --  
    e. Location of water use, if applicable (give legal descriptions) --  
    f. If for irrigation, the land to be irrigated is -- acres.  
    g. Well reference letter(s), if applicable: PMW-4 HHSS PWRSID

4. Permits None  
   Management Area Permit Number  
   Geothermal Permit Number  
   Municipal Permit Number  
   Well Spacing Permit Number  
   HHSS NDEQ

5. Purpose of well (indicate one): Aquaculture Commercial/Industrial  
   Domestic Ground Heat Exchanger Groundwater Source Heat Pump Irrigation Injection  
   Livestock X Monitoring Observation Public Water Supply (with piping 6-63B)  
   Public Water Supply (without piping) Recovery Other  
   (describe use)

6. Wells in a Series.  
   a. Is this well a part of a series? X Yes; go to part b of this section. No; go to part 7 of this application  
   b. If one or more of the wells in the series is currently registered, give the well registration number --  
   c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information.  
   a. Is this well a replacement well? Yes X No  
   b. Registration number of abandoned well  
   c. Replacement well is feet from abandoned well.  
   d. Abandoned well last operated (month/yr)  
   e. Original well pump column size: inches  
   f. Completion of original well abandonment on (month/yr)  
   g. Location of water use of abandoned well:

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Monitoring Plan for Murdock, Nebraska
Version 00, 11/11/05

8. Pump Information
   a. Is pump installed at this time? Yes X No
   b. Pump installer's License No. ________
   c. Pump installer’s Name ________
   d. Pump installer’s Firm Name ________
   e. Pump installer’s Firm Address ________
   f. Pump installer’s Firm Email Address ________
   g. Pump Rate: gallons per minute ~ measured
   h. Pump data: __________ feet
   i. Pump data: __________ ft
   j. Pump data: __________ ft
   k. Pump data: __________ ft
   l. Pump data: __________ ft
   m. Pump data: __________ ft
   n. Pump data: __________ ft
   o. Pump data: __________ ft
   p. Pump data: __________ ft
   q. Pump data: __________ ft
   r. Pump data: __________ ft
   s. Pump data: __________ ft
   t. Pump data: __________ ft
   u. Pump data: __________ ft
   v. Pump data: __________ ft
   w. Pump data: __________ ft
   x. Pump data: __________ ft
   y. Pump data: __________ ft
   z. Pump data: __________ ft

9. Well Construction Information
   a. Total well depth: 25 feet
   b. Static water level: __________ feet
   c. Pumping water level: __________ feet
   d. Well Construction began (estimated): __________
   e. Well Construction completed (estimated): __________
   f. Bore hole diameter in inches: Top ________ Bottom ________
   g. Casing and Screen joints are: Welded X
g. Casing and Screen joints are: Threaded X
   h. Casing and Screen joints are: Other ________

10. Well Construction (Casing & Screen) - c, d, e, & f measurements should be in inches to three decimal places

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
</tr>
<tr>
<td>19.5</td>
<td>24.5</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
</tr>
</tbody>
</table>

11. Grout & Gravel Pack

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Packet</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>Beadonite Seal</td>
</tr>
<tr>
<td>0</td>
<td>17.5</td>
<td>Sand/Gravel Pack</td>
</tr>
<tr>
<td>17.5</td>
<td>25</td>
<td>Sand/Gravel Pack</td>
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</table>

12. Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>dark brown silty clay</td>
</tr>
<tr>
<td>5</td>
<td>tan/brown silty sand and clay</td>
</tr>
<tr>
<td>10</td>
<td>tan/brown silty clay with sand</td>
</tr>
<tr>
<td>20</td>
<td>tan silt and sand</td>
</tr>
</tbody>
</table>

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

[Signature]
[Date]

Water Well Contractor’s Signature

[Signature]
[Date]

Well Owner’s Signature

if Contractor is unknown or Deceased

Date
# Monitoring Plan for Murdock, Nebraska

**Version 00, 11/11/05**

---

### STATE OF NEBRASKA

**DEPARTMENT OF NATURAL RESOURCES**

**WATER WELL REGISTRATION**

---

**FOR DEPARTMENT USE ONLY**

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<tbody>
<tr>
<td>Owner Code No.</td>
<td>--</td>
<td>Last Name</td>
<td>--</td>
</tr>
</tbody>
</table>

---

1. **Well Owner’s First Name** --
   **Company Name** USDA CE PD FSA/CCC
   **Correspondent Name** --
   **Address** 1406 Independence Avenue, SW
   **City** Washington
   **State** DC
   **Zip** 20250-0513
   **Telephone** 202.720.5104

---

2. **Contractor's License No** 89619
   **Contractor’s Name** Dennis J. Anderson
   **Contractor’s Email Address** danderson@theilegeo.com
   **Drilling Firm Name** Theile Geotech, Inc.
   **Address** 13478 Chandler Road
   **City** Omaha
   **State** NE
   **Zip** 68138
   **Telephone** (402) 556-2171

---

3. **Well Location:** SE 1/4 of the SW 1/4 of Section 19. Township 11 North, Range 10E East/West, Cass County.
   **Natural Resources District:** Lower Platte South
   **The well is 748 feet from the (SE North/West) section line and 1,847 feet from the (SE East/West) section line.**
   **Or, Latitude Degree 49**
   **Minute 55**
   **Second 50.34**
   **Longitude Degree 96**
   **Minute 17**
   **Second 12.24**
   **Street address and subdivision, if applicable:** --
   **Block:** --
   **Lot:** --
   **Location of water use, if applicable (give legal descriptions):** --
   **If for irrigation, the land to be irrigated is:** --
   **Well reference letter(s), if applicable:** PMW-5

---

4. **Permits: Name**
   **Management Area Permit Number:**
   **Groundwater Permit Number:**
   **Municipal Permit Number:**
   **Well Spacing Permit Number:**
   **NRCS**

---

5. **Purpose of well: (Indicate one):**
   **Aquaculture:**
   **Commercial/Industrial:**
   **Domestic:**
   **Ground Heat Exchanger:**
   **Groundwater Source Heat Pump:**
   **Irrigation:**
   **Livestock:**
   **Monitoring:**
   **Observation:**
   **Public Water Supply (water source:)**
   **Recovery:**
   **Other:**

---

6. **Wells in a Series:**
   **a. Is this well a part of a series?** Yes, go to part b of this section.
   **b. If one or more of the wells in the series is currently registered, give the well registration number:** --
   **c. How many wells in the series are you registering at this time?** 15

---

7. **Replacement and abandoned well information:**
   **a. Is this a replacement well?** Yes, go to replacement well.
   **b. Replacement number of abandoned well:**
   **c. Original well pump column size:** --
   **d. Abandoned well last operated (month/year):**
   **e. Location of water used at abandoned well:**
   **f. Completion of original well abandonment on (month/year):**

---

Form provided by Terra-On-A-Disk, Inc. - Dallas, Texas - (214) 345-9429
8. Pump Information
   a. Is pump installed at this time? Yes X No
   b. Pump installer’s License No.: __________
   c. Pumping Rate: __________ gallons per minute
   d. Drop pipe diameter: __________ inches
   e. Length of drop pipe: __________ feet
   f. Pumping equipment installed: __________
   g. Pump Head: __________ feet
   h. This well is designed and constructed to pump less than 50 gpm: X Yes No

9. Well Construction Information
   a. Total well depth: __________ feet
   b. Static water level: __________ feet
   c. Pumping water level: __________ feet
   d. Well Construction began: __________
   e. Well Construction completed: __________
   f. Bore hole diameter in inches: Top __________ Bottom __________
   g. Casing and Screen joints are: Welded — Glazed — Threaded X Other

10. Well Construction (Casing & Screen) c, d, e, f, & g measurements should be in inches to three decimal places
    a. Placement Depth in Feet
       b. Casing or Screen
       c. Inside Diameter
       d. Outside Diameter
       e. Well Thickness
       f. Screen Slot Size
       g. Type of Material
       h. Trade Name

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Well Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>14.5</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
<td>EMI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
<td>EMI</td>
</tr>
</tbody>
</table>

11. Grout and Gravel Pack
    Placement Depth in Feet
    Grout or Gravel Pack
    Material Description
    From | To  | Grout or Gravel Pack | Material Description |
    0    | 2.5 | Bentonite Seal       | WyoBea Expanding Bentonite Chips |
    2.5  | 15  | Sand/Gravel Pack     | 10/20 Washed Silica Sand      |

12. Geologic Materials Logged
    Depth in Feet
    From | To
    0    | 5  | Description          |
    5    | 10 | Description          |
    10   | 15 | Description          |

    dark brown silty clay
    brown/gray fine/medium sand with silt and clay
    tan fine/medium sand with silt and clay

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

   Water Well Contractor’s Signature: ____________________________
   Date: 8/29/05

   Well Owner’s Signature: ____________________________
   Date: ____________________________

Form provided by FormsOnADisk - (214) 346-6429 - FormsOnADisk.com
**Monitoring Plan for Murdock, Nebraska**

**Version 00, 11/11/05**

---

### STATE OF NEBRASKA

#### DEPARTMENT OF NATURAL RESOURCES

#### WATER WELL REGISTRATION

**FOR DEPARTMENT USE ONLY**

<table>
<thead>
<tr>
<th>Registration Date</th>
<th>Sequence No.</th>
<th>Registration No.</th>
<th>Owner Code No.</th>
<th>Receipt No.</th>
<th>NRD</th>
</tr>
</thead>
</table>

1. a. **Well Owner’s First Name** --
    b. **Company Name** USDA CEFD FSA/CCC
    c. **Correspondent Name** --

<table>
<thead>
<tr>
<th>Address</th>
<th>1400 Independence Avenue, SW</th>
</tr>
</thead>
<tbody>
<tr>
<td>City</td>
<td>Washington</td>
</tr>
<tr>
<td>State</td>
<td>DC</td>
</tr>
<tr>
<td>Zip</td>
<td>68250-5013</td>
</tr>
<tr>
<td>Telephone</td>
<td>202-720-5104</td>
</tr>
</tbody>
</table>

2. a. **Contractor’s License No** 89019
    b. **Contractor’s Name** Dennis J. Anderson
    c. **Contractor’s Email Address** danderson@thielegeotech.com
    d. **Drilling Firm Name** Thiele Geotech, Inc.
    e. **Address** 13478 Chandler Road

| City | Omaha |
| State | NE |
| Zip | 68138 |
| Telephone | (402) 556-2171 |
| Drilling Firm’s Email Address | www.thielegeotech.com |

3. a. **Well location**: SE 1/4 of the SW 1/4 of Section 10, Township 11 North, Range 10 East/West, Cass County.
    b. **Natural Resources District** Lower Platte South
    c. The well is 846 feet from the (☐ North/☐ South) section line and 2,024 feet from the (☐ East/☐ West) section line.
    d. **Lat. Degree** 40, **Min.** 55, **Sec.** 51.3
    e. **Long. Degree** 96, **Min.** 17, **Sec.** 9.9
    f. **Street address and subdivision, if applicable** --
    g. **Lot** --
    h. **Location of water use, if applicable (give legal descriptions)** --
    i. **If for irrigation, the land to be irrigated is** --
    j. **Well reference letter(s), if applicable** PMW-6

4. **Permits**
   - **Management Area Permit Number**
   - **Geothermal Permit Number**
   - **Municipal Permit Number**
   - **Well Spacing Permit Number**

<table>
<thead>
<tr>
<th>Purpose of well (indicate one):</th>
<th>Aquaculture</th>
<th>Commercial/Industrial</th>
<th>Dewatering (over 90 days)</th>
<th>Domestic</th>
<th>Ground Heat Exchanger</th>
<th>Groundwater Source Heat Pump</th>
<th>Irrigation</th>
<th>Injection</th>
<th>Livestock</th>
<th>Monitoring</th>
<th>Observation</th>
<th>Public Water Supply</th>
<th>Recovery</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NDEQ</strong></td>
<td>PMW-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. **Wells in a Series**
   - **Is this well a part of a series?** X Yes, go to part b of this section.
   - **If one or more of the wells in the series is currently registered, give the well registration number** --
   - **How many wells in the series are you registering at this time?** 15

6. **Replacement and abandoned well information**
   - **Is this well a replacement well?** Yes X No
   - **Registration number of abandoned well**
   - **If not registered, date abandoned well was constructed**
   - **Replacement well is** 846 feet from abandoned well.
   - **Abandoned well last operated**
   - **Completion of original well abandonment on**
   - **Location of water use of abandoned well**:

---

Form provided by Forms-On-A-Disk, Inc. - Dallas, Texas - (214) 340-9428
8. Pump Information
   a. Is pump installed at this time? Yes [X] No
   b. Pump Installer’s License No.
   c. Pumping Rate: gallons per minute
   d. Drop pipe diameter: inches
   e. Length of drop pipe: feet
   f. Pumping equipment installed (yes/no): Yes [X] No
   g. Is pump installed by pump installer, please fill out license number below.

9. Well Construction Information.
   a. Total well depth: 15 feet
   b. Static water level: 
   c. Pumping water level: 
   d. Well Construction begun (mm/dd/yy): 04/25/05
   e. Well Construction completed (mm/dd/yy): 04/25/05
   f. Bore hole diameter is inches Top [8] Bottom [8]
   g. Casing and Screen joints are [Welded] [Glued] [Threaded] [X] Other

10. Well Construction (Casing & Screen): a, d, e, & g measurements should be in inches to three decimal places

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4.5</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>EMI</td>
</tr>
</tbody>
</table>

11. Grout and Gravel Pack

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>2.5</td>
<td>Bentonite Seal</td>
</tr>
<tr>
<td>2.5</td>
<td>15</td>
<td>Sand/Gravel Pack</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WyoBex Enviroseal Bentonite Chips</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10/20 Washed Silica Sand</td>
</tr>
</tbody>
</table>

12. Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
<th>From</th>
<th>To</th>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>dark grayish brown silty clay</td>
<td>12.5</td>
<td>15</td>
<td>brown silty clay</td>
<td>(Additional sheets may be submitted)</td>
</tr>
</tbody>
</table>

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

[Signature]

Date: 8/29/05

Well Owner’s Signature: [Signature]

Date: [Date]

If Contractor is unknown or deceased

Form provided by Forms-On-A-Disk: (314) 343-8453 - FormsOnADisk.com
STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

Registration Date ___________________________ Sequence No. ___________________________ Registration No. ___________________________
Owner Code No. ___________________________ Receipt No. ___________________________ NRD

1. a. Well Owner's First Name — Last Name —
b. Company Name —
c. Correspondent Name —
   Address 1460 Independence Avenue, SW
   City Washington
   State DC Zip 20250-0513 Telephone 202.720.5104

2. a. Contractor's License No 89019
   Contractor's Name Dennis J. Anderson
   Contractor's Email Address danderson@thielegeotech.com
   Drilling Firm Name Thiele Geotech, Inc.
   Address 15478 Chandler Road
   City Omaha
   State NE Zip 68138 Telephone (402) 556-2171
   Drilling Firm's Email Address www.thielegeotech.com

b. Natural Resources District Lower Platte South
c. The well is 846 feet from the (C) North of South) section line and 2,103 feet from the (□ East or West) section line.
   or Latitude Degree 49 Second 51.3
   Longitude Degree 96 Second 8.88
d. Street address and subdivision, if applicable —
   Black —
   Lot —
e. Location of water use, if applicable (give legal descriptions) —
f. If for irrigation, the land to be irrigated is —
g. Well reference letter(s), if applicable: PMW.7 HHSS PWSD

4. a. Permit Name
   Management Area Permit Number
   Geothermal Permit Number
   Municipal Permit Number
   Well Spacing Permit Number
   NHIS
   Industrial Permit Number
   Transfer Out-of-State Permit Number
   Conduct Permit Number
   Other Permit Number

5. Purpose of well (indicate one): Aquifer Storage Commercial/Industrial Deepdrilling (over 90 days)
   Domestic Ground Heat Exchanger Groundwater Source Heat Pump Irrigation Injection
   Livestock Monitoring Observation Public Water Supply (not serving 64-65)
   Public Water Supply (without metering) Recovery Other

   a. Is this well a part of a series? □ Yes; go to part b of this section. □ No; go to part 7 of this application
   b. If one or more of the wells in the series is currently registered, give the well registration number —
   c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information.
   a. Is this well a replacement well? □ Yes □ No
   b. Registration number of abandoned well —
   c. Replacement well is —
   d. Abandoned well last operated —
   e. Original well pump column size —
   f. Completion of original well abandonment on —
   g. Location of water use of abandoned well:


## Monitoring Plan for Murdock, Nebraska

**Version 00, 11/11/05**

### 8. Pump Information
- **a.** Is pump installed at this time? _Yes_ _X_ No
- **b.** Pump Installer’s License No. ________________
- **c.** Pumping Rate: ___________ gallons per minute
- **d.** Drop pipe diameter: ___________ inches
- **f.** Pumping equipment installed: ___________
- **h.** This well is designed and constructed to pump less than 50 gpm: _Yes_ _X_ No

### 9. Well Construction Information
- **a.** Total well depth: ___________ feet
- **b.** Static water level: ___________ feet
- **c.** Pumping water level: ___________ feet
- **d.** Well Construction began: ___________ 05/25/05
- **e.** Well Construction completed: ___________ 05/25/05
- **f.** Base hole diameter in inches: Top ___________ Bottom ___________
- **g.** Casing and Screen joints are: Welded _X_ Glued _X_ Threaded _X_ Other ___________

### 10. Well Construction (Casing & Screen) e, d, e, & g measurements should be in inches to three decimal places

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>14.5</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
</tr>
<tr>
<td>14.5</td>
<td>19.5</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
</tr>
</tbody>
</table>

### 11. Grout and Gravel Pack

<table>
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<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>12.5</td>
<td>Bentonite Seal</td>
</tr>
<tr>
<td>12.5</td>
<td>20</td>
<td>Sand/Gravel Pack</td>
</tr>
</tbody>
</table>

### 12. Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>15</td>
<td>20</td>
</tr>
</tbody>
</table>

## (Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

---

**Water Well Contractor’s Signature** ___________ 8/24/05

**Well Owner’s Signature** ___________ Date

If Contractor is unknown or Deceased

**Date**
### Monitoring Plan for Murdock, Nebraska

**Version 00, 11/11/05**

#### STATE OF NEBRASKA

**DEPARTMENT OF NATURAL RESOURCES**

**WATER WELL REGISTRATION**

**FOR DEPARTMENT USE ONLY**

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<th>Registration Date</th>
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</thead>
<tbody>
<tr>
<td>Owner Code No.</td>
<td>Receipt No.</td>
<td>NRD</td>
</tr>
</tbody>
</table>

1. **a. Well Owner's First Name** _____________________________ **Last Name** _____________________________
   **b. Company Name** USDA CEFD FSA/CCC
   **c. Correspondence Name** _____________________________ **Address** 1400 Independence Avenue, SW
   **City** Washington **State** DC **Zip** 68250-0513 **Telephone** 202.720.5104

2. **a. Contractor's License No** 89019 **b. Contractor's Name** Dennis J. Anderson
   **c. Contractor's Email Address** danderson@thielegeotech.com
   **d. Drilling Firm Name** Thiele Geotech, Inc.
   **e. Address** 13478 Chandler Road **f. City** Omaha **State** NE **Zip** 68138 **Telephone** (402) 556-2171
   **g. Drilling Firm's Email Address** www.thielegeotech.com

3. **a. Well Location** SW ¼ of the SW ¼ of Section 10, Township 11, North, Range 10E, East/West, Cass County
   **b. Natural Resources District** Lower Platte South
   **c. The well is** 1,004 feet from the (□ North □ South) section line and 1,814 feet from the (□ East □ West) section line.
   **d. Street address and subdivision, if applicable** --
   **e. Land address and subdivision, if applicable** --
   **f. If for irrigation, the land to be irrigated is** -- acres
   **g. Well reference letter(s), if applicable** PMW-8

4. **Permits**
   **Management Area Permit Number** _____________________________
   **Geothermal Permit Number** _____________________________
   **Municipal Permit Number** _____________________________
   **Well Spacing Permit Number** _____________________________
   **NDRQ** _____________________________
   **Surface Water Permit Number** _____________________________
   **Transfer Out-of-State Permit Number** _____________________________
   **Conduct Permit Number** _____________________________
   **Other Permit Number** _____________________________

5. **Purpose of well (indicate one):**
   **Aquaculture** ☐
   **Commercial/Industrial** ☐
   **Dewatering (over 90 days)** ☐
   **Domestic** ☐
   **Ground Heat Exchanger** ☐
   **Groundwater Source Heat Pump** ☐
   **Irrigation** ☒
   **Injection** ☐
   **Livestock** ☒
   **Monitoring** ☐
   **Observation** ☐
   **Public Water Supply (without spacing)** ☐
   **Public Water Supply (with spacing)** ☐
   **Recovery** ☐
   **Other** ☐

6. **Wells in a series.**
   **a. Is this well a part of a series?** ☒ Yes, go to part b of this section. ☐ No, go to part 7 of this application
   **b. If one or more of the wells in the series is currently registered, give the well registration number** --
   **c. How many wells in the series are you registering at this time?** 15

7. **Replacement and abandoned well information.**
   **a. Is this well a replacement well?** ☒ Yes ☐ No
   **b. Registration number of abandoned well** _____________________________
   **c. Replacement well is** 100 feet from abandoned well.
   **d. Abandoned well last operated** _____________________________
   **e. Original well pump column size** _____________________________
   **f. Completion of original well abandonment on** _____________________________

---

Form provided by Forms-On-A-Disk, Inc. • Dallas, Texas • (214) 340-8429
8. Pump Information
   a. Is pump installed at this time? Yes X No
   b. Pump Owner's License No. Pump Owner's Name
   c. Pumping Rate gallons per minute Measured Estimated
   d. Drop pipe diameter inches
   e. Length of drop pipe feet
   f. Pumping equipment installed (yes/no) Yes
   g. Pump brand
   h. This well is designed and constructed to pump less than 30 gpm X Yes No

9. Well Construction Information.
   a. Total well depth: 15 feet
   b. Static water level: feet
   c. Pumping water level: feet
   d. Well Construction began (month/year) 04/26/05
   e. Well Construction completed (month/year) 04/26/05
   f. Bore hole diameter in inches Top 8 Bottom 8
   g. Casing and Screen Joints are Welded Glue Threaded Other

10. Well Construction (Casing & Screen) - c, d, e, & g measurements should be in inches to three decimal places

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>From To</td>
<td>0 4.5</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
<td>EMI</td>
</tr>
<tr>
<td></td>
<td>4.5 14.5</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
<td>EMI</td>
</tr>
</tbody>
</table>

11. Grout and Gravel Pack

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From To</td>
<td>0 2.2</td>
<td>Bentonite Seal</td>
</tr>
<tr>
<td></td>
<td>2.2 15</td>
<td>Sand/Gravel Pack WyoBen Environplug Bentonite Chips</td>
</tr>
</tbody>
</table>

12. Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From To</td>
<td>light gray silty clay</td>
<td>From To</td>
<td>gray silty clay with fine sand</td>
</tr>
</tbody>
</table>

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

[Signature] 8/29/05

Water Well Owner's Signature Date

Form provided by Forms-On-A-Disk - (214) 340-8429 - FormsOnADisk.com
# Monitoring Plan for Murdock, Nebraska

**Version 00, 11/11/05**

## STATE OF NEBRASKA

### DEPARTMENT OF NATURAL RESOURCES

#### WATER WELL REGISTRATION

### FOR DEPARTMENT USE ONLY

<table>
<thead>
<tr>
<th>Registration Date</th>
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</thead>
<tbody>
<tr>
<td>Owner Code No.</td>
<td>Receipt No.</td>
<td>NRD</td>
</tr>
</tbody>
</table>

1. **Well Owner’s First Name** --  
   **Last Name** --
2. **Company Name** USDA CEFD FSA/CCC
   **Correspondent Name** --  
   **Attention** Steve Gilmore
   **Address** 1400 Independence Avenue, SW
   **City** Washington  
   **State** DC  
   **Zip** 68250-0513  
   **Telephone** 202-720-5104
3. **Contractor’s License No** 89019
   **Contractor’s Name** Dennis J. Anderson
   **Drilling Firm Name** Thiele Geotech, Inc.
   **Drilling Firm’s Email Address** danderson@thielegeotech.com
   **Address** 13478 Chandler Road
   **City** Omaha  
   **State** NE  
   **Zip** 68138  
   **Telephone** (402) 556-2171
4. **Well location** SE 1/4 of the SW 1/4 of Section 10, Township 11 North, Range 10E East/West, Cass County
   **Natural Resources District** Lower Platte South
   **The well is** 512 feet from the (□ North/□ South) section line and 2,037 feet from the (□ East/□ West) section line.
   **or Latitude Degree** 40  
   **Longitude Degree** 96  
   **Second** 55  
   **Minute** 17  
   **Second** 9.78  
   **Lot** --
   **Location of water use, if applicable (give legal descriptions)** --
   **If for irrigation, the land to be irrigated is** -- acres.
   **Well reference letter(s), if applicable:** PMW-98
   **HHSS PWSID**
5. **Permits** None
   **Management Area Permit Number**
   **Geothermal Permit Number**
   **Municipal Permit Number**
   **Well Spacing Permit Number**
   **Other Permit Number**
6. **Surface Water Permit Number**
   **Industrial Permit Number**
   **Transfer Out-of-State Permit Number**
   **Conduit Permit Number**
   **NDNR**
7. **Purpose of well (indicate one):**
   - Aquaculture
   - Commercial/Industrial
   - Dewatering (over 90 days)
   - Domestic
   - Ground Heat Exchanger
   - Groundwater Source Heat Pump
   - Irrigation
   - Injection
   - Livestock
   - Monitoring
   - Observation
   - Public Water Supply (with spacing (□□□□/□□□□))
   - Recovery
   - Other
   **(Refer to Use)**
8. **Wells in a Series.**
   **Is this well a part of a series?** X Yes, go to part b of this section  
   **No; go to part 7 of this application**
   **If one or more of the wells in the series is currently registered, give the well registration number** --
   **How many wells in the series are you registering at this time?** 15
9. **Replacement and abandoned well information.**
   **Is this well a replacement well?** Yes X No
   **Registration number of abandoned well**
   **If not registered, date abandoned well was constructed**
   **Replacement well is**  feet from abandoned well
   **Abandoned well last operated**
   **Original well pump column size**
   **Completion of original well abandonment on**
   **Location of water use of abandoned well:**

---

Form provided by Forms-On-A-Disk, Inc. - Dallas, Texas - (214) 346-9439
### Monitoring Plan for Murdock, Nebraska

#### Version 00, 11/11/05 A-29

<table>
<thead>
<tr>
<th>Pump Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Is pump installed at this time? Yes [X] No</td>
</tr>
<tr>
<td>b. Pump Installer's License No.</td>
</tr>
<tr>
<td>c. Pumping Rate</td>
</tr>
<tr>
<td>d. Drop pipe diameter</td>
</tr>
<tr>
<td>e. Length of drop pipe</td>
</tr>
<tr>
<td>f. Pumping equipment installed</td>
</tr>
<tr>
<td>g. Pump Brand</td>
</tr>
<tr>
<td>h. This well is designed and constructed to pump less than 50 gpm</td>
</tr>
</tbody>
</table>

#### Well Construction Information:

| Total well depth | 9 feet |
| Pumping water level | 8 feet |
| Well Construction began | 04/28/05 |
| Well Construction completed | 04/28/05 |
| Bore hole diameter in inches | Top 8 | Bottom 8 |
| Casing and Screen Joints | Welded | Threaded [X] |

#### Well Construction (Casing & Screen):

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 0 To 5</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
<td>EMI</td>
</tr>
<tr>
<td>From 5 To 9</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
<td>EMI</td>
</tr>
</tbody>
</table>

#### Grout and Gravel Pack

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 0 To 3.5</td>
<td>Bentonite Seal</td>
<td>WyoBen Environing Bentonite Chips</td>
</tr>
<tr>
<td>From 3.5 To 9</td>
<td>Sand/Gravel Pack</td>
<td>10/20 Washed Silica Sand</td>
</tr>
</tbody>
</table>

#### Geologic Materials Logged

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 0 To 5</td>
<td>dark brown silty clay</td>
</tr>
<tr>
<td>From 5 To 9</td>
<td>tan/gray silty clay</td>
</tr>
</tbody>
</table>

(Additional sheets may be submitted)

---

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

[Signature] 8/29/05

Well Wall Contractor's Signature

[Signature] 8/29/05

Well Owner's Signature

If Contractor is unknown or Deceased
<table>
<thead>
<tr>
<th>Registration Date</th>
<th>Sequence No.</th>
<th>Registration No.</th>
<th>Owner Code No.</th>
<th>Receipt No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. a. Well Owner’s First Name</td>
<td>___________</td>
<td>Last Name</td>
<td>___________</td>
<td></td>
</tr>
<tr>
<td>b. Company Name</td>
<td>USDA CEPD FSA/CCC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Correspondent Name</td>
<td>___________</td>
<td>Attention</td>
<td>Steve Gilmore</td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td>1400 Independence Avenue, SW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>Washington</td>
<td>State</td>
<td>DC</td>
<td>Zip</td>
</tr>
<tr>
<td>Phone</td>
<td>(402) 471-2363</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. a. Contractor’s License No</td>
<td>89019</td>
<td>Contractor’s Name</td>
<td>Deann J. Anderson</td>
<td></td>
</tr>
<tr>
<td>b. Drilling Firm Name</td>
<td>Thiele Geotech, Inc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td>13478 Chandler Road</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>Omaha</td>
<td>State</td>
<td>NE</td>
<td>Zip</td>
</tr>
<tr>
<td>Phone</td>
<td>(402) 556-2171</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. a. Well location:</td>
<td>SE ¼ of the SW ¼ of Section 10</td>
<td>Township</td>
<td>11</td>
<td>North, Range 10E East/West</td>
</tr>
<tr>
<td>b. Natural Resources District</td>
<td>Lower Platte South</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. The well is</td>
<td>512 ft from the (□ North/South) section line and 2,028 ft from the (□ East/West) section line.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>or Latitude Degree</td>
<td>40</td>
<td>Second</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Longitude Degree</td>
<td>96</td>
<td>Minute</td>
<td>17</td>
<td>Second</td>
</tr>
<tr>
<td>d. Street address and subdriller, if applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Permits</td>
<td>None</td>
<td>Surface Water Permit Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management Area Permit Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geothermal Permit Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Municipal Permit Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Spacing Permit Number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEPD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Purpose of well (indicate one):</td>
<td>Aquaculture</td>
<td>Commercial/Industrial</td>
<td>Dewatering (over 90 days)</td>
<td></td>
</tr>
<tr>
<td>Domestic</td>
<td>Ground Heat Exchanger</td>
<td>Groundwater Source Heat Pump</td>
<td>Irrigation Injection</td>
<td></td>
</tr>
<tr>
<td>Livestock</td>
<td>X</td>
<td>Monitoring Observation</td>
<td>Public Water Supply (with metering 04-05)</td>
<td></td>
</tr>
<tr>
<td>Public Water Supply (without metering)</td>
<td>Recovery</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Wells in a series</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Is this well a part of a series?</td>
<td>X</td>
<td>Yes, go to part b of this section.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. If one or more of the wells in the series is currently registered, give the well registration number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. How many wells in the series are you registering at this time?</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Replacement and abandoned well information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Is this well a replacement well?</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Replacement number of abandoned well</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Original well in</td>
<td>feet from abandoned well</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Abandoned well last operated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Original well pump column size</td>
<td>inches</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Completion of original well abandonment on</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Location of water use of abandoned well:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From provided by Ferrus-On-A-Disk, Inc. - Dallas, Texas - (214) 340-0429
8. Pump Information
   a. Is pump installed at this time? Yes No
   b. Is pump installed by well owner in section 9? Yes No
   c. If pump installed by pump installer, please fill out license number below.
   d. Pump Installer’s License No.
   e. Pump Installer’s Name
   f. Pump Installer’s Firm Name
   g. Pump Installer’s Firm Address
   h. Pump Installer’s Firm Email Address
   i. City State Zip Telephone
   j. Pumping Rate gallons per minute Measured Estimated
   k. Drop pipe diameter inches
   l. Length of drop pipe feet
   m. Pumping equipment installed (yes/no)
   n. Pump Brand
   o. This well is designed and constructed to pump less than 50 gpm Yes No

9. Well Construction Information.
   a. Total well depth: 15 feet.
   b. Static water level: feet.
   c. Pumping water level: feet.
   d. Well Construction began (mm/dd/yyyy) 04/28/05
   e. Well Construction completed (mm/dd/yyyy) 04/28/05
   f. Bore hole diameter in inches Top 8 Bottom 8
   g. Casing and Screen Joints are Welded Glued Threaded Other

10. Well Construction (Casing & Screen) - c. d. e. & g. measurements should be in inches to three decimal places
    a. Placement Depth in Feet
       b. Casing or Screen
       c. Inside Diameter
       d. Outside Diameter
       e. Wall Thickness
       f. Screen Slot Size
       g. Type of Material
       h. Trade Name

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Casing</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>11</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
<td>EMI</td>
</tr>
<tr>
<td>11</td>
<td>15</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
<td>EMI</td>
</tr>
</tbody>
</table>

11. Grout and Gravel Pack
    a. Placement Depth in Feet
       b. Grout or Gravel Pack
       c. Material Description

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>Bentonite Seal</td>
<td>WyoBen Environplug Bentonite Chips</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
<td>Sand/Gravel Pack</td>
<td>10/20 Washed Silica Sand</td>
</tr>
</tbody>
</table>

12. Geologic Materials Logged
    a. Depth in Feet
       b. Description
       c. From | To |

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>dark brown silty clay</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>tan/gray silty clay</td>
</tr>
<tr>
<td>10</td>
<td>15</td>
<td>tan/gray silty clay with sand</td>
</tr>
</tbody>
</table>

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

Water Well Contractor’s Signature: [Signature]  Date: 8/24/05
Well Owner’s Signature: [Signature]  Date: [Signature]  Date:

Form provided by Forms-On-A-Disk · (214) 340-8429 · FormsOnADisk.com
STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
WATER WELL REGISTRATION

FOR DEPARTMENT USE ONLY

<table>
<thead>
<tr>
<th>Registration Date</th>
<th>Sequence No.</th>
<th>Registration No.</th>
<th>Owner Code No.</th>
<th>Receipt No.</th>
<th>NRD</th>
</tr>
</thead>
</table>

1. a. Well Owner’s First Name -- Last Name --
   b. Company Name USDA CEPD FSA/CCC
   c. Correspondent Name -- Attention Steve Gilmore
      Address 1400 Independence Avenue, SW
      City Washington State DC Zip 29250-8513 Telephone 262.720.5104

2. a. Contractor’s License No 89019 Contractor’s Name Dennis J. Anderson
    b. Drilling Firm Name Thiele Geotech, Inc.
       Address 13478 Chandler Road
       City Omaha State NE Zip 68138 Telephone (402) 556-2171
       Drilling Firm’s Email Address www.thielegeotech.com

3. a. Well location: SE ¼ of the SW ¼ of Section 10 Township 11 North, Range 10E East/West Cass County
   b. Natural Resources District Lower Platte South
   c. The well is 512 feet from the ( ) North(South) section line and 2,018 feet from the ( ) East(West) section line.
      or Latitude Degree 40 Minute 55 Second 48
      Longitude Degree 96 Minute 17 Second 10.02
   d. Street address and subdivision, if applicable --
      Block -- Lot --
   e. Location of water use, if applicable (give legal descriptions) --
   f. If for irrigation, the land to be irrigated is -- acres.
   g. Well reference letter(s), if applicable: PMW-9D HHSS PWSID

4. Permits None
   Management Area Permit Number
   Geothermal Permit Number
   Municipal Permit Number
   Well Spacing Permit Number
   HHSS
   Industrial Permit Number
   Transfer Out-of-State Permit Number
   Conduct Permit Number
   Other Permit Number
   NDEQ

5. Purpose of well (indicate one): Aquaculture Commercial/Industrial Dewatering (over 90 days)
   Domestic Ground Heat Exchanger Groundwater Source Heat Pump Irrigation Injection
   Livestock X Monitoring Observation Public Water Supply (with spacing <600
   Public Water Supply (without spacing) Recovery Other
   (Specify use)

6. Wells in a Series
   a. Is this well a part of a series? X Yes; go to part b of this section. No; go to part 7 of this application
   b. If one or more of the wells in the series is currently registered, give the well registration number --
   c. How many wells in the series are you registering at this time? 15

7. Replacement and abandoned well information.
   a. Is this well a replacement well? X Yes No
   b. Registration number of abandoned well If not registered, date abandoned well was constructed: (mm/dd/yy)
   c. Replacement well is _______ feet from abandoned well. d. Abandoned well last operated (mm/dd/yy)
   e. Original well pump column size: _______ inches f. Completion of original well abandonment on (mm/dd/yy)
   g. Location of water use of abandoned well: 

Form provided by Forms-On-A-Click, Inc. • Dallas, Texas • (214) 345-8429
8. Pump Information
a. Is pump installed at this time? Yes X No
b. Pump Installer’s License No. _______________________
c. Pump Installer’s Name ____________________________
d. Pump Installer’s SIC No. _________________________
e. Pump Installer’s Firm Name _______________________
f. Pump Installer’s Firm Address _____________________

9. Well Construction Information.
a. Total well depth: 32 feet. b. Static water level: ___________ feet.
c. Pumping water level: ___________ feet. d. Well Construction began: ___________.
d. Well Construction completed: ___________.
e. Bore hole diameter in inches: Top 8, Bottom 8

10. Well Construction (Casing & Screen). All measurements should be in inches to three decimal places.

<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Casing or Screen</th>
<th>Inside Diameter</th>
<th>Outside Diameter</th>
<th>Wall Thickness</th>
<th>Screen Slot Size</th>
<th>Type of Material</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Casing</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>N/A</td>
<td>PVC</td>
<td>EM1</td>
</tr>
<tr>
<td>19.5</td>
<td>Screen</td>
<td>2.00</td>
<td>2.375</td>
<td>0.1875</td>
<td>0.010</td>
<td>PVC</td>
<td>EM1</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Placement Depth in Feet</th>
<th>Grout or Gravel Pack</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>17.6</td>
<td>Bentonite Seal</td>
</tr>
<tr>
<td>17.6</td>
<td>32</td>
<td>Sand/Gravel Pack</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>dark brown silty clay</td>
<td>23</td>
<td>tan, muddy fine/medium sand</td>
</tr>
<tr>
<td>5</td>
<td>tan/gray silty clay</td>
<td>32</td>
<td>tan, muddy fine/medium sand</td>
</tr>
<tr>
<td>10</td>
<td>tan/gray silty clay with sand</td>
<td></td>
<td>tan, muddy fine/medium sand</td>
</tr>
<tr>
<td>15</td>
<td>tan clayey sand</td>
<td></td>
<td>tan, muddy fine/medium sand</td>
</tr>
</tbody>
</table>

(Additional sheets may be submitted)

13. I am familiar with the information submitted on this registration, and to the best of my knowledge it is true.

[Signature] 8/29/05
Appendix B:

Nebraska Department of Environmental Quality
Discharge Requirements for the
Murdock Groundwater Treatment System
DISCHARGE REQUIREMENTS
For Treated Ground Water from a Remediation Project
carried out by USDA under the Superfund Regulations

Pursuant to Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), 42 U.S.C. §9601 et seq. and 40 Code of Federal Regulations (CFR) Part 300.400, Title 40, Rules and Regulations Pertaining to the Issuance of Permits Under the National Pollutant Discharge Elimination System, constitute applicable requirements for the Murdock Ground Water Treatment System as described on this page. These discharge requirements were developed to meet the substantive requirements that apply to Superfund sites. The Accountable Party identified on this page is responsible for ensuring compliance with the conditions set forth herein.

NPDES Tracking Number: NE0137464
NPS File Number: 71956-P
Accountable Party: United States Department of Agriculture - Farm Service Agency
Facility Name: Murdock Ground Water Treatment System
Facility Location: NE%, NW%, Section 15, Township 11 North, Range 10 E., Cass County
Also Known as: Fourth and Wyoming Streets, Murdock, Nebraska 68407
Receiving Water: This is a head application using sprinkler system.
Date Prepared: April 4, 2005
Discharge Authorization: The authorization to discharge becomes effective on the date signed and remains in effect until terminated pursuant to the conditions set forth herein.

Pursuant to the Delegation Memorandum dated January 29, 1999 and signed by the Director, the undersigned hereby executes this document on the behalf of the Director.

Signed this ______ day of ________________________- ________

- Patrick W. Rice
  Assistant Director
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This authorization contains discharge limitations, management practices, and requirements for monitoring, record keeping and reporting. See pertinent sections in Parts I, II, III, and Appendix A of this document
### Part I. Discharge Description

This document specifically authorizes the discharge from the following outfall identified and described herein. The discharge characteristics need to be consistent with those described in the application and supplemental information submitted with it. Departmental approval is required for any alterations. This discharge consists of contaminated ground water from Outfall 001 to a pressurized spray irrigation system. The discharge shall be monitored and subject to the discharge monitoring requirements set forth in the following table.

### Part II. Discharge Limitations and Monitoring Requirements

#### A. Requirements for Outfall 001

The discharge of contaminated ground water from Outfall 001 to a pressurized spray irrigation system is authorized and shall be monitored and limited as specified in the following table. Monitoring shall be conducted by after leaving the pressurized spray irrigation system. The Department may specify an alternative or more specific sampling point.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Storet #</th>
<th>Units</th>
<th>Discharge Limitations</th>
<th>Sample Type</th>
<th>Monitoring Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Average</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow</td>
<td>50050</td>
<td>MGD</td>
<td>Report</td>
<td>Quarterly</td>
<td>Measured or Calculated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Maximum</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>32102</td>
<td>µg/L</td>
<td>Report</td>
<td>Quarterly</td>
<td>Grab</td>
</tr>
<tr>
<td>Chloroform</td>
<td>32106</td>
<td>µg/L</td>
<td>Report</td>
<td>Quarterly</td>
<td>Grab</td>
</tr>
<tr>
<td>Other Parameter</td>
<td></td>
<td></td>
<td><strong>Minimum</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>00400</td>
<td>Standard Units</td>
<td>6.5</td>
<td>Quarterly</td>
<td>Grab</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Maximum</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviations:**
- MGD - million gallons per day
- µg/L - micrograms per liter
Part III. Other Conditions and Requirements

A. Narrative Limits

Discharges authorized under this permit:

1. Shall not be toxic to aquatic life in surface waters of the State outside the mixing zones allowed in NDEQ Title 117 - Nebraska Surface Water Quality Standard;
2. Shall not contain pollutants at concentrations or levels that produce objectionable films, colors, turbidity, deposits, or noxious odors in the receiving stream or waterway;
3. Shall not contain or produce any hydrocarbon sheens; and/or
4. Shall not contain pollutants at concentrations or levels that cause the occurrence of undesirable or nuisance aquatic life in the receiving stream.

B. Additional Monitoring

The Department may require increases in the monitoring frequencies set forth in this permit to address new information concerning a discharge, evidence of potential non-compliance, suspect water quality in a discharge, evidence of water quality impacts in the receiving stream or waterway, or other similar concerns.

C. Modifications

1. The basis for modification are set forth in NDEQ Title 119 - Rules and Regulations Pertaining to the Issuance of Permits Under the National Pollutant Discharge Elimination System. This authorization may be modified pursuant to this regulation.
Appendix A - Standard Conditions that Apply Regulated Discharges

These general conditions are applicable to all regulated discharges under Title 119. These conditions shall not preempt any more stringent requirements found elsewhere in this permit.

A. General Conditions

1. Information Available
   All permit applications, fact sheets, permits, discharge data, monitoring reports, and any public comments concerning such shall be available to the public for inspection and copying, unless such information about methods or processes is entitled to protection as trade secrets of the owner or operator under Neb. Rev. Stat. §81-1527, (Cum. Supp. 1992) and Title 115, Chapter 4.

2. Duty to Comply
   All authorized discharges shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit.
   The permittee shall comply with all conditions of this permit. Failure to comply with these conditions may be grounds for administrative action or enforcement proceedings including injunctive relief and civil or criminal penalties.
   The filing of a request by the permittee for a permit modification, revocation and re-issuance, termination or a notification of planned changes or anticipated non-compliance does not stay any permit condition.

3. Duty to Mitigate
   The permittee shall take all reasonable steps to minimize, prevent or correct any adverse impact to the environment resulting from noncompliance with this permit, including such accelerated or additional monitoring as required by the NDEQ to determine the nature and impact of the noncompliant discharge.

4. Toxic Pollutants
   The permittee shall not discharge pollutants to waters of the State that cause a violation of the standards established in NDEQ Titles 117, 118 or 121. All discharges to surface waters of the State shall be free of toxic (acute or chronic) substances which alone or in combination with other substances, create conditions unsuitable for aquatic life outside the appropriate mixing zone.

5. Oil and Hazardous Substances/Spill Notification
   Nothing in this permit shall preclude the initiation of any legal action or relieve the permittee from any responsibilities, liabilities or penalties under Section 311 of the Clean Water Act. The permittee shall conform to the provisions set forth in NDEQ Title 126, Rules and Regulations Pertaining to the Management of Wastes. If the permittee knows, or has reason to believe, that oil or hazardous substances were released at the facility and could enter waters of the State or any of the outfall discharges authorized in this permit, the permittee shall immediately notify the Department of a release of oil or hazardous substances. During Department office hours (i.e., 8:00 a.m. to 5:00 p.m., Monday through Friday, except holidays), notification shall be made to the Nebraska Department of Environmental Quality at telephone numbers (402) 471-2186 or (877) 253-2603 (toll free). When NDEQ cannot be contacted, the permittee shall report to the Nebraska State Patrol for referral to the NDEQ Emergency Response Team at telephone number (402) 471-4545. It shall be the permittee's responsibility to maintain current telephone numbers necessary to carry out the notification requirements set forth in this paragraph.

6. Property Rights
   The issuance of this permit does not convey any property rights of any sort or any exclusive privileges nor does it authorize any damage to private property or neither any invasion of personal rights nor any infringement of federal, state or local laws or regulations.

7. Other Rules and Regulations Liability
   The issuance of this permit in no way relieves the obligation of the permittee to comply with other rules and regulations of the Department.

8. Inspection and Entry
   The permittee shall allow the Director or his authorized representative, upon the presentation of his identification and at a reasonable time:
a. To enter upon the permittee's premises where a regulated facility or activity is located or conducted, or records are required to be kept under the terms and conditions of the permit,

b. To have access to and copy any records required to be kept under the terms and conditions of the permit,

c. To inspect any facilities, equipment (including monitoring and control), practices or operations regulated or required in the permit, and

d. To sample or monitor any substances or parameters at any location.

B. Management Requirements

1. Duty to Provide Information

The permittee shall furnish to the Department within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit; or to determine compliance with this permit. The permittee shall also furnish to the Department upon request, copies of records retained as a requirement of this permit.

2. Signatory Requirements

All reports and applications required by this permit or submitted to maintain compliance with this permit shall be signed and certified as set forth in this section.

a. Permit applications shall be signed by a cognizant official who meets the following criteria:

1) For a corporation: by a principal executive officer of at least the level of vice-president,

2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively, or

3) For a municipality, state, federal or other public facility: by either a principal executive officer or highest ranking elected official.

b. Discharge monitoring reports and other information shall be signed by the cognizant official or by an authorized representative.

c. An authorized representative is designated by the cognizant official. The authorized representative is responsible for the overall operation of the facility (i.e., a plant manager, a well field operator or a wastewater treatment plant superintendent).

d. Any change in the signatories shall be submitted to the Department, in writing, within 30 days after the change.

e. Certification. All applications, reports and information submitted as a requirement of this permit, shall contain the following certification statement:

"I certify, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations."

C. Monitoring and Records

1. Representative Sampling

Samples and measurements taken as required within this permit shall be representative of the discharge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water or substance. Monitoring points shall not be changed without notification to the Department and with the written approval of the Director.

a. Composite sampling shall be conducted in one of the following manners:

1) Continuous discharge - a minimum of one discrete aliquot collected every three hours,

2) Less than 24 hours - a minimum of hourly discrete aliquots or a continuously drawn sample shall be collected during the discharge, or

3) Batch discharge - a minimum of three discrete aliquots shall be collected during each discharge.
b. Composite samples shall be collected in one of the following manners:
   1) The volume of each aliquot must be proportional to either the waste stream flow at the time of
      sampling or the total waste stream flow since collection of the previous aliquot,
   2) A number of equal volume aliquots taken at varying time intervals in proportion to flow,
   3) A sample continuously collected in proportion to flow, and
   4) If it is infeasible or non-representative of the pollutant loadings to conduct flow proportional
      sampling, the Department may approve the use of time composite samples.

   c. Grab samples shall consist of a single aliquot collected over a time period not exceeding 15 minutes.
      1) All sample preservation techniques shall conform to the methods adopted in NDEQ regulations.

2. Flow Measurements
Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be
used to insure the accuracy and reliability of measurements. The accuracy of the measurement devices
shall be calibrated and maintained to insure that they are consistent with the accepted capability of that
type of device. Devices selected shall be capable of measuring flows with a maximum deviation of +/-
10% from the true discharge rates throughout the range of expected discharge volumes. Guidance in
selection, installation, calibration and operation of acceptable flow measurement devices can be obtained
from the following references:
      Revised Reprint, 2001, 327 pp. This document is available from the National Technical Information
      Services (NTIS).
   b. "NPDES Compliance Inspection Manual," U. S. Environmental Protection Agency, Office of
      Enforcement and Compliance Assurance, Publication EPA 300-B-94-014 September 1994. This
document is available from the National Technical Information Services (NTIS).

3. Test Procedures
Test procedures used for monitoring required by this permit, shall conform to the methods adopted in
NDEQ regulations.

4. Averaging of Measurements
Averages shall be calculated as an arithmetic mean except:
   a. Bacterial counts which shall be calculated as a geometric mean, or
   b. Where otherwise specified by the Department.

5. Retention of Records
The accountable party shall retain records of all monitoring activities for a period of at least three years
as set forth in NDEQ Titles 119. The types of records that must be retained include, but are not limited
to:
   a. Calibration and maintenance records,
   b. Original strip chart recordings,
   c. Copies of all reports required by this permit,
   d. Monitoring records and information, and
   e. Electronically readable data.

6. Record Contents
Records of sampling or monitoring information shall include:
   a. The date(s), exact place, time and methods of sampling or measurements,
   b. The name(s) of the individual(s), who performed the sampling or measurements,
   c. The date(s) the analyses were performed,
   d. The individual(s) who performed the analyses,
   e. The analytical techniques or methods used,
   f. The results of such analyses, and
   g. Laboratory data, bench sheets and other required information.
D. Reporting Requirements

1. 24-Hour Reporting:
   The accountable party shall report to the NDEQ, within 24 hours of becoming aware of:
   a. Any noncompliance that may endanger the environment or human health or welfare,
   b. Any unanticipated bypass as set forth in NDEQ Titles 119 and/or 127,  
      All upsets as set forth in NDEQ Titles 119 and/or 127,
   c. Any discharge to a POTW that causes a violation of the prohibited discharge standards set forth in  
      NDEQ Title 119 or
   d. Any noncompliance of an effluent limitation in this permit.
   Initial notification may be verbal. A written noncompliance notification shall be submitted as set forth in  
   Section D 3 of this permit.

2. Written Noncompliance Notification:
   a. The accountable party shall submit a written noncompliance report to the NDEQ:
      1) Within five days of becoming aware of any noncompliance with the:
         a) NPDES toxic pollutant effluent limitations or requirements set forth in this permit.
         2) Within seven days of becoming aware of any other noncompliance with the NPDES requirements  
            and/or effluent limitations set forth in this permit.
   b. The written notification shall be submitted on a noncompliance form supplied by the Department and  
      shall include:
      1) A description of the discharge and cause of noncompliance,
      2) The period of noncompliance, including exact dates and times, or if not corrected, the anticipated 
         time the noncompliance is expected to continue, and
      3) The steps taken to reduce, eliminate, and prevent the reoccurrence of the noncompliance.
      The submittal of a written noncompliance report does not relieve the permittee of any liability from  
      enforcement proceedings that may result from the violation of permit or regulatory requirements.

3. Quarterly Discharge Monitoring Reports (DMRs):
   The permittee shall report the monitoring results required by this permit on a DMR form supplied or  
   approved by the Department. Monitoring results shall be submitted on a quarterly basis using the  
   reporting schedule set forth below, unless otherwise specified in this permit or by the Department.
   
<table>
<thead>
<tr>
<th>Monitoring Quarters</th>
<th>DMR Reporting Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>January - March</td>
<td>April 28</td>
</tr>
<tr>
<td>April – June</td>
<td>July 28</td>
</tr>
<tr>
<td>July - September</td>
<td>October 28</td>
</tr>
<tr>
<td>October - December</td>
<td>January 28</td>
</tr>
</tbody>
</table>

   If the permittee monitors any pollutant more frequently than required by this permit, using procedures  
   specified in this permit, the results of this monitoring shall be included in the calculation and reporting of  
   the data submitted on the DMR. The frequency of the analysis shall also be reported on the DMR.

4. Changes in Discharge:
   Any facility expansion, production increases or process modifications which will result in new or  
   substantially increased discharges of pollutants or a change in the nature of the discharge of pollutants  
   must be reported by the permittee 180 days prior to the expansion, increases or modifications, either by  
   amending his original application or by submitting a new application. This permit may be modified or  
   revoked and reissued as a result of this notification to maintain compliance with applicable state or federal  
   regulations.
E. Operation and Maintenance

1. Proper Operation and Maintenance

The permittee shall, at all times, maintain in good working order and operate as efficiently as possible, any facilities or systems of control installed by the permittee in order to achieve compliance with the terms and conditions of this permit. This would include, but not be limited to, effective performance based on designed facility removals, effective management, adequate operator staffing and training, adequate laboratory and process controls, and adequate funding that reflects proper user fee schedules.

2. Treatment System Failure and Upset

An upset is an affirmative defense to an enforcement action brought for noncompliance with technology-based permit effluent limitations if the permittee can demonstrate, through properly signed, operating logs or other relevant evidence, that:

a. An upset occurred and the specific cause was identified,

b. That the facility was properly operated and maintained at such time,

c. The Department was notified within 24 hours of the permittee becoming aware of the upset, and

d. The accountable party took action to reduce, eliminate and prevent a reoccurrence of upset, including minimizing adverse impact to waters of the state.

Removed Substances

Solids, sludge, filter backwash or other pollutants removed in the course of treatment or control of wastewater shall be disposed of at a site and in a manner approved by the Nebraska Department of Environmental Quality. The disposal of non-hazardous industrial sludges shall conform to the standards established in or to the regulations established pursuant to 40 CFR, Part 257. If solids are disposed of in a licensed sanitary landfill, the disposal of solids shall conform to the standards established in Title 132.

F. Definitions
Monitoring Plan for Murdock, Nebraska
Version 00, 11/11/05

**Murdock Ground Water Treatment System**  
NPDES Tracking Number NE0137464  
April 4, 2005  
Page 10 of 11

**Administrator:** The Administrator of the USEPA.

**Aliquot:** An individual sample having a minimum volume of 100 milliliters that is collected either manually or in an automatic sampling device.

**Biweekly:** Once every other week.

**Bimonthly:** Once every other month.

**Bypass:** The intentional diversion of wastes from any portion of a treatment facility.

**Daily Average:** An effluent limitation that cannot be exceeded and is calculated by averaging the monitoring results for any given pollutant parameter obtained during a 24-hour day.

**Department:** Nebraska Department of Environmental Quality.

**Director:** The Director of the Nebraska Department of Environmental Quality.

**Industrial User:** A source of indirect discharge (a pretreatment facility).

**Monthly Average:** An effluent limitation that cannot be exceeded, calculated by averaging the monitoring results for any given pollutant parameter obtained during a calendar month.

**Publicly Owned Treatment Works (POTW):** A treatment works as defined by Section 212 of the Clean Water Act (Public Law 106-4) which is owned by the state or municipality, excluding any sewers or other conveyances not leading to a facility providing treatment.

**30-Day Average:** An effluent limitation that cannot be exceeded, calculated by averaging the monitoring results for any given pollutant parameter obtained during a calendar month.

**Total Toxic Organics (TTO):** The summation of all quantifiable values greater than 0.01 milligrams per liter (mg/l) for toxic organic compounds that may be identified elsewhere in this permit. (If this term has application in this permit, the list of toxic organic compounds will be identified; typically in the Limitations and Monitoring Section(s) or in an additional Appendix to this permit.)

**Toxic Pollutant:** Those pollutants or combination of pollutants, including disease causing agents, after discharge and upon exposure, ingestion, inhalation or assimilation into an organism, either directly from the environment or indirectly by ingestion through food chains will, on the basis of information available to the administrator, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunction (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring.

**Upset:** An exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee, excluding such factors as operational error, improperly designed or inadequate treatment facilities or improper operation and maintenance or lack thereof.

**Volatile Organic Compounds (VOC):** The summation of all quantifiable values greater than 0.01 milligrams per liter (mg/l) for volatile, toxic organic compounds that may be identified elsewhere in this permit. (See the definition for Total Toxic Organics above. In many instances, VOCs are defined as the volatile fraction of the TTO parameter. If the term “VOC” has application in this permit, the list of toxic organic compounds will be identified; typically in the Limitations and Monitoring Section(s) or in an additional Appendix to this permit.)

**Weekly Average:** An effluent limitation that cannot be exceeded, calculated by averaging the monitoring results for any given pollutant parameter obtained during a fixed calendar week. The permittee may start their week on any weekday but the weekday must remain fixed unless a change is approved by the Department.

"X" Day Average: An effluent limitation defined as the maximum allowable "X" day average of consecutive monitoring results during any monitoring period where "X" is a number in the range of one to seven days.
G. Abbreviations

CFR: Code of Federal Regulations
kg/Day: Kilograms per Day
MGD: Million Gallons per Day
mg/L: Milligrams per Liter
NDEQ: Nebraska Department of Environmental Quality
NDEQ Title 115: Rules of Practice and Procedure
NDEQ Title 117: Nebraska Surface Water Quality Standards
NDEQ Title 118: Ground Water Quality Standards and Use Classification
NDEQ Title 119: Rules and Regulations Pertaining to the Issuance of Permits Under the National Pollutant Discharge Elimination System
NDEQ Title 121: Effluent Guidelines and Standards
NDEQ Title 126: Rules and Regulations Pertaining to the Management of Wastes
NDEQ Title 127: Rules and Regulations Governing the Nebraska Pretreatment Program
NDEQ Title 132: Rules and Regulations Pertaining to Solid Waste Management
NPDES: National Pollutant Discharge Elimination System
POTW: Publicly Owned Treatment Works
µg/L: Micrograms per Liter
WWTF: Wastewater Treatment Facility