PETROLEUM VAPOR PROBLEM
AT MILLER, SOUTH DAKOTA

by
Dean E. Holly

Science Center
University of South Dakota
Vermillion, South Dakota
1986
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>GEOLOGY</td>
<td>1</td>
</tr>
<tr>
<td>INITIAL ASSESSMENT</td>
<td>3</td>
</tr>
<tr>
<td>DRILLING AND OBSERVED CONTAMINATION</td>
<td>4</td>
</tr>
<tr>
<td>OBSERVATION-WELL NETWORK</td>
<td>8</td>
</tr>
<tr>
<td>WATER-LEVEL MEASUREMENTS</td>
<td>11</td>
</tr>
<tr>
<td>WATER SAMPLING AND ANALYSES</td>
<td>11</td>
</tr>
<tr>
<td>SUMMARY</td>
<td>15</td>
</tr>
<tr>
<td>CONCLUSIONS</td>
<td>17</td>
</tr>
<tr>
<td>RECOMMENDATIONS</td>
<td>20</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>21</td>
</tr>
</tbody>
</table>

## FIGURES

1. Location of study area .......................... 2  
2. Location of reported petroleum vapor problems and potential sources of petroleum contamination .............. 5  
3. Location of observation wells, test holes, and selected sanitary sewer manholes ........................ 7  
4. Location of observation wells with contaminated sediment and free petroleum product ....................... 9  
5. Typical observation well construction ............. 10  
6. Water-level altitudes in observation wells and selected sanitary sewer manholes, May 21-22, 1985 ........ 14  
7. Volatile hydrocarbon concentrations in observation wells and selected sanitary sewer manholes, May 21-22, 1985 ......... 18  
8. Volatile hydrocarbon concentrations in selected sanitary sewer manholes, June 26, 1985 ........... 19
TABLES

1. Reported petroleum vapor problems in buildings ........ 1
2. Inventory of potential sources of petroleum contamination .................. 6
3. Observation-well altitudes and water-level measurements .................. 12
4. Sanitary sewer manhole altitudes and water-level measurements .............. 13
5. Volatile hydrocarbon analysis of water samples from observation wells ........ 16
6. Volatile hydrocarbon analysis of water samples from sanitary sewer manholes 17

APPENDIX

A. Logs of test holes and observation wells ............. 22
INTRODUCTION

During the past several years, the City of Miller has experienced intermittent petroleum vapors in the basements of several houses, the basement of the High School, in the Hand County Library, and in the sanitary sewer system. In April, 1985, explosive levels of combustible gases were measured by the Deputy State Fire Marshall in a residential basement on the north side of town. Subsequently, the City requested assistance and entered into a contract with the South Dakota Geological Survey to conduct a study to determine the origin and/or occurrence of the petroleum vapors.

The study was financed by the South Dakota Geological Survey and the City of Miller. The tremendous cooperation and assistance afforded by city officials and service station owners during the course of the investigation are gratefully acknowledged. Their assistance was invaluable to the successful completion of the study. Special thanks to Mayor Siik, City Auditor Dave Blachford, Deputy State Fire Marshall Art Manning, Assistant City Fire Chief Keith Stobb, Utility and Water Department personnel Merle Dickerson, Don Holley, and Cliff Peterson, and all the service stations owners.

The study began on April 22, 1985. Fifteen potential sources of contamination were identified and 35 test holes were drilled around the potential sources. Observation wells were installed in 32 of the test holes. Water levels were measured on five separate occasions and water samples were collected for volatile hydrocarbon analysis from the 32 observation wells, a private observation well, and 17 sanitary sewer manholes. Reference petroleum samples were collected from the active service stations for identification. The basement of houses and sanitary sewer manholes were monitored for the presence of combustible gases.

This report contains the findings, conclusions, and recommendations of the investigation.

GEOLY

The City of Miller (fig. 1) is underlain by approximately 250 to 300 feet of late Wisconsin age (7,000 to 25,000 years before present) glacial drift (Hedges and others, 1982). Glacial drift is defined as all rock material transported and deposited by glacial processes. There are two types of drift in the Miller area, till and outwash. Till is deposited directly from glacial ice and consists of poorly-sorted sediments ranging in size from clay to boulders. Outwash is deposited by meltwater streams from the ice and consists mainly of sand and gravel with minor amounts of silt and clay (Flint, 1971).

Till typically transmits water very slowly and hence does not make a good aquifer. Outwash, on the other hand, usually transmits water readily and typically does make a good aquifer. An
Figure 1. Location of study area.
outwash deposit called the Tulare Aquifer is present beneath the City of Miller and ranges in saturated thickness from 6 to 25 feet. The top of the aquifer is located at depths ranging from 134 to 157 feet. Several isolated sand and gravel lenses also occur at shallower depths (in the 50- to 70-foot range) but apparently are very limited in areal extent (Rothrock, 1941; Christensen, 1962; Koch, 1980).

The bedrock units occurring beneath the glacial drift in descending order include the Pierre Shale, Niobrara Formation, Carlile Shale, Grennhorn Limestone, Graneros Shale, and the Dakota Formation, followed by the Precambrian basement complex.

INITIAL ASSESSMENT

The initial step was to determine the immediate threat to life and property imposed by the reported explosive levels of combustible gases. A total of seven houses and buildings (table 1, fig. 2) had reported petroleum vapor problems for the past several years. Vapors were also reported in the main line of the sanitary sewer system underlying Broadway. The residences, buildings, and sanitary sewer system manholes were tested with a combustible-gas indicator on several different occasions during the investigation. Explosive levels of combustible gases were never found. However, prior to the inspection with the combustible gas indicator, the main stem of the sanitary sewer system under Broadway had been cleaned as a result of regularly scheduled maintenance. This probably reduced the levels of combustible gases that were present in the sanitary sewer system.

Having found no immediate threat to life or property as a result of combustible gases, a systematic program to identify the affected areas and locate the potential sources of contamination was begun. An inventory of potential sources identified 15 current and past service station locations (table 2, fig. 2). Service station owners acknowledged losses of petroleum product at several locations. Niederauer Northside (north Standard) reported a loss of 4,000 to 5,000 gallons of Amoco regular (leaded) from a leaky tank around 1970. The leaky tank was replaced but none of the gasoline was recovered. Niederauer Oil and Gas Company (south Standard) replaced a leaky tank in the fall of 1984; however, the amount of loss was not known. Hargens APCD Station replaced both its tanks 7 to 10 years ago but no losses were reported. No losses were reported by other service station owners in Miller.

Since the shallowest glacial aquifer occurs at a depth of 50 to 70 feet below the land surface, there was no apparent danger of shallow well contamination. The city wells are located outside the problem area and are developed in the Dakota Formation at depths of approximately 1,200 feet. As a result, there was no apparent threat to the city water supply. Therefore, the greatest potential threat was from petroleum vapors in the area.
TABLE 1

Reported petroleum vapor problems in buildings

<table>
<thead>
<tr>
<th>Map Location Number</th>
<th>Building Affected</th>
<th>Area of Building Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>L. Heitzman residence</td>
<td>Basement (floor drain)</td>
</tr>
<tr>
<td>B</td>
<td>C. Klages residence</td>
<td>Basement (floor drain)</td>
</tr>
<tr>
<td>C</td>
<td>R. Moser residence</td>
<td>Basement (floor drain)</td>
</tr>
<tr>
<td>D</td>
<td>E. Lewis residence</td>
<td>Basement (floor drain)</td>
</tr>
<tr>
<td>E</td>
<td>High School</td>
<td>Basement</td>
</tr>
<tr>
<td>F</td>
<td>Hand County Library</td>
<td>Restrooms (no basement)</td>
</tr>
<tr>
<td>G</td>
<td>J. Meyer residence</td>
<td>Basement (floor drain)</td>
</tr>
</tbody>
</table>

* Refer to figure 2 for location.

Perhaps the most important task in providing a solution to petroleum contamination incidences is to adequately assess the areal extent and magnitude of the contamination. Without adequate assessment, a proper program for abatement/recovery operations cannot be developed.

To determine the areal extent and magnitude of the contamination in the ground, test holes were drilled and an observation well network was installed to monitor the ground water. Water samples were collected and analyzed for total volatile hydrocarbons present.

**DRILLING AND OBSERVED CONTAMINATION**

Test holes near the affected areas and potential sources were drilled with a 5-inch diameter flight auger (fig. 3, and app. A). Three of the holes were drilled outside the affected area for hydrogeological control at map locations (ML) 11, 16, 21 (fig. 3).

The drilling indicated that a weathered (oxidized) till occurs directly beneath the surface and ranges in thickness from 13 feet (ML 2, fig. 3) to 49 feet (ML 11, fig. 3) in the area. The average thickness of the weathered till is 31 feet. This is
Figure 2. Location of reported petroleum vapor problems and potential sources of petroleum contamination.

- Building that experienced petroleum vapors.
- Buried tanks currently in use.
- Buried tanks removed or abandoned.

Letters refer to Table 1 and numbers refer to Table 2.
<table>
<thead>
<tr>
<th>Map Location Number</th>
<th>Source</th>
<th>Buried Tanks (Gasoline and Diesel) Number In Use Removed (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Niederauer Northside</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>OK Tire Store</td>
<td>7     0     Yes (1978)</td>
</tr>
<tr>
<td>3</td>
<td>Lil' Feller Store</td>
<td>4     4     4</td>
</tr>
<tr>
<td>4</td>
<td>High School</td>
<td>1     0     Yes (unknown)</td>
</tr>
<tr>
<td>5</td>
<td>Old Coop</td>
<td>Unknown 1</td>
</tr>
<tr>
<td>6</td>
<td>Past Station Site</td>
<td>Unknown 0    Unknown</td>
</tr>
<tr>
<td>7</td>
<td>Past Station Site</td>
<td>Unknown 0    Unknown</td>
</tr>
<tr>
<td>8</td>
<td>Past Station Site</td>
<td>Unknown 0    Unknown</td>
</tr>
<tr>
<td>9</td>
<td>Past Station Site</td>
<td>Unknown 0    Unknown</td>
</tr>
<tr>
<td>10</td>
<td>Niederauer Oil &amp; Gas Company</td>
<td>3     3</td>
</tr>
<tr>
<td>11</td>
<td>Past Station Site</td>
<td>Unknown 0    Unknown</td>
</tr>
<tr>
<td>12</td>
<td>Hargens APCO</td>
<td>2     2</td>
</tr>
<tr>
<td>13</td>
<td>Old Mobil Station</td>
<td>Unknown 0    Yes (unknown)</td>
</tr>
<tr>
<td>14</td>
<td>Old Ford Garage</td>
<td>2     0     No</td>
</tr>
<tr>
<td>15</td>
<td>Stobbs Sales, Inc.</td>
<td>4     4</td>
</tr>
</tbody>
</table>

*Refer to figure 2 for location

significant because the weathered till will have a much greater hydraulic conductivity than the underlying unweathered till due to the presence of fractures. Hence, the unweathered till will retard product movement and will for all practical purposes limit vertical movement of petroleum product. Horizontal and vertical product movement, however, can be expected in the weathered till.
Figure 3. Location of observation wells, test holes and selected sanitary sewer manholes.

Numbers are map location numbers.

For logs of observation wells and test holes see Appendix A.

- Test hole
- Observation well
- PW Private observation well
- MH Sanitary sewer manhole
Drill cuttings from the test holes were examined for evidence of petroleum contamination including sediment discoloration and the presence of petroleum odors or free petroleum product in the ground. Locations of petroleum-contaminated sediment are shown on figure 4. The average depth of contaminated sediment was found from 5 to 12 feet below the land surface. The usual indication of petroleum-contaminated sediment was the change in color from brown (uncontaminated) to blue-gray (contaminated zone). See appendix A for examples of test holes with contaminated sediment. The color change results from bacterial action on the petroleum product in the sediment. The bacteria present in the shallow sediments are aerobic (i.e., utilize free oxygen) and use the petroleum as a food source. As they continually feed on the petroleum product, dissolved oxygen is depleted resulting in a reducing environment (oxygen deficient). The reducing environment causes the sediment to change from brown to blue-gray. Petroleum odors were commonly found in association with the contaminated sediment but no free product was encountered in any of the test holes.

**OBSERVATION—WELL NETWORK**

Observation wells were installed in 32 of the 35 test holes that were drilled. The locations are shown in figure 3. These observations wells provide the opportunity to measure the depth to water (to determine ground-water flow direction) and to collect water samples for chemical analyses (to determine degree of contamination). The observation wells were installed to provide for both short- and long-term monitoring of the ground water in the affected areas.

The general construction of the observation wells is shown in figure 5. The wells consist of 2-inch diameter schedule 40 polyvinyl chloride (PVC) casing and screen installed in the 5-inch diameter auger holes. The casing is joined with glued slip-fit couplings. A manufactured 10-foot screen, which consisted of 0.020-inch horizontal slotted casing and a capped bottom, was typically placed in the interval from 4 to 14 feet below the land surface. The screen was purposely located at this interval to place the screen 5 feet above and 5 feet below the mean water table to allow for seasonal fluctuations. This also enables any free petroleum product that reaches the water table to enter the observation well, since petroleum products are lighter and float on water. The wells were gravel packed from the bottom to within 1 foot above the screen and the remaining hole was sealed with granular bentonite. A vented, threaded cap was placed on top to complete the well.

The water in the observation wells was evacuated several days after installation with a bailer to remove sediments and muddy water resulting from the drilling operation. They were then left undisturbed to allow the water to reach its static level. The altitude of the casing tops were surveyed to the nearest 0.01 foot.
Figure 4. Location of observation wells with contaminated sediment and free petroleum product.
Figure 5. Typical observation well construction.
WATER-LEVEL MEASUREMENTS

The depth to water in the observation wells was measured on five separate occasions as shown on Table 3. On July 27, 1985, the depth to water ranged from 3.00 feet to 10.40 feet below the land surface (ML 25 and 15, respectively, fig. 3). The mean depth to water was 6.52 feet below the land surface.

Water levels were also measured in selected sanitary sewer manholes to determine the degree of connection between the ground water and water in the sewer. These values are shown on Table 4. On June 16, 1985, the depth to water ranged from 4.05 feet to 11.05 feet (MH 14 and MH 6, respectively, fig. 3). The mean depth to water was 7.81 feet below the land surface.

A plot of the water-level altitudes (casing-top altitude minus depth to water) from the observation wells and selected sanitary sewer manholes is shown on Figure 6. This figure shows that in general the ground-water gradient and hence ground-water flow direction is to the northeast. Also of interest is that the sanitary sewer water-level altitudes are lower than the water-table altitudes indicating ground-water flow into the sanitary sewer system. This demonstrates that petroleum contaminated ground water could enter the sanitary sewer system.

WATER SAMPLING AND ANALYSES

The observation wells were sampled with a product sampler to ascertain the presence of free petroleum product floating on the water table. Locations of observation wells containing free petroleum product are shown on Figure 4. All observation wells were sampled for free product on May 1, May 21, and June 27, 1985. The Niedarau Oil and Gas Company observation well PW1 (fig. 3) contained one-sixteenth of an inch of free gasoline on May 1 and May 21 and 4 inches on June 21. At Hargens APCD Station, observation well ML 25 (fig. 3) contained one-sixteenth of an inch of free gasoline on May 1, but none was found on subsequent sampling dates. Stobbs Sales, Inc. observation well ML 23 (fig. 3) contained 2.25 inches of free diesel on May 1 and 12 inches plus on June 27.

Sampling on June 27 was done with a manufactured product sampler while the previous sampling was done with a homemade product sampler. This may account for the increase in product found on June 27. It is assumed that the manufactured product sampler provided a more representative sample of free product present on the water table.

Water samples were collected from all observation wells on May 21, 1985, and selected sanitary sewer manholes on May 22, 1985. A second set of samples was collected on June 28, 1985.
### TABLE 3
Observation well altitudes and water-level measurements

<table>
<thead>
<tr>
<th>No.*</th>
<th>in feet</th>
<th>Date</th>
<th>4-26-85</th>
<th>5-1-85</th>
<th>5-8-85</th>
<th>5-21-85</th>
<th>6-27-85</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1573.40</td>
<td>4-23-85</td>
<td>8.20</td>
<td>8.23</td>
<td>8.07</td>
<td>8.10</td>
<td>8.05</td>
</tr>
<tr>
<td>2</td>
<td>1571.85</td>
<td>5-02-85</td>
<td>----</td>
<td>----</td>
<td>8.38</td>
<td>8.75</td>
<td>9.05</td>
</tr>
<tr>
<td>4</td>
<td>1574.82</td>
<td>4-23-85</td>
<td>13.10</td>
<td>6.95</td>
<td>8.18</td>
<td>8.98</td>
<td>10.14</td>
</tr>
<tr>
<td>5</td>
<td>1572.59</td>
<td>4-24-85</td>
<td>9.00</td>
<td>5.55</td>
<td>7.93</td>
<td>8.31</td>
<td>8.36</td>
</tr>
<tr>
<td>6</td>
<td>1574.86</td>
<td>4-24-85</td>
<td>8.85</td>
<td>8.81</td>
<td>8.82</td>
<td>8.67</td>
<td>8.42</td>
</tr>
<tr>
<td>7</td>
<td>1573.37</td>
<td>4-25-85</td>
<td>Dry</td>
<td>Dry</td>
<td>14.76</td>
<td>12.26</td>
<td>8.90</td>
</tr>
<tr>
<td>8</td>
<td>1572.54</td>
<td>5-02-85</td>
<td>----</td>
<td>Dry</td>
<td>Dry</td>
<td>Dry</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1573.99</td>
<td>4-24-85</td>
<td>8.50</td>
<td>8.49</td>
<td>8.32</td>
<td>6.29</td>
<td>7.87</td>
</tr>
<tr>
<td>10</td>
<td>1573.87</td>
<td>4-24-85</td>
<td>8.15</td>
<td>8.06</td>
<td>7.86</td>
<td>8.20</td>
<td>8.32</td>
</tr>
<tr>
<td>11</td>
<td>1575.59</td>
<td>4-25-85</td>
<td>6.25</td>
<td>10.60</td>
<td>10.66</td>
<td>10.81</td>
<td>11.11</td>
</tr>
<tr>
<td>12</td>
<td>1574.51</td>
<td>4-24-85</td>
<td>10.40</td>
<td>8.17</td>
<td>8.14</td>
<td>8.37</td>
<td>7.74</td>
</tr>
<tr>
<td>13</td>
<td>1577.90</td>
<td>4-25-85</td>
<td>Dry</td>
<td>12.76</td>
<td>11.58</td>
<td>11.87</td>
<td>10.98</td>
</tr>
<tr>
<td>14</td>
<td>1576.86</td>
<td>4-24-85</td>
<td>Dry</td>
<td>12.68</td>
<td>11.51</td>
<td>11.32</td>
<td>12.10</td>
</tr>
<tr>
<td>15</td>
<td>1576.16</td>
<td>4-25-85</td>
<td>Dry</td>
<td>10.32</td>
<td>9.52</td>
<td>9.16</td>
<td>9.12</td>
</tr>
<tr>
<td>16</td>
<td>1573.82</td>
<td>4-24-85</td>
<td>12.50</td>
<td>9.25</td>
<td>7.34</td>
<td>6.84</td>
<td>6.97</td>
</tr>
<tr>
<td>17</td>
<td>1574.46</td>
<td>4-24-85</td>
<td>Dry</td>
<td>9.86</td>
<td>8.40</td>
<td>8.86</td>
<td>9.42</td>
</tr>
<tr>
<td>18</td>
<td>1574.85</td>
<td>4-24-85</td>
<td>7.00</td>
<td>6.96</td>
<td>6.74</td>
<td>6.84</td>
<td>6.87</td>
</tr>
<tr>
<td>19</td>
<td>1576.51</td>
<td>4-25-85</td>
<td>8.85</td>
<td>8.80</td>
<td>9.01</td>
<td>9.34</td>
<td>8.93</td>
</tr>
<tr>
<td>20</td>
<td>1573.88</td>
<td>4-25-85</td>
<td>8.60</td>
<td>8.65</td>
<td>8.21</td>
<td>8.29</td>
<td>8.02</td>
</tr>
<tr>
<td>21</td>
<td>1574.12</td>
<td>4-25-85</td>
<td>Dry</td>
<td>14.20</td>
<td>9.72</td>
<td>7.93</td>
<td>6.70</td>
</tr>
<tr>
<td>22</td>
<td>1570.93</td>
<td>5-02-85</td>
<td>----</td>
<td>----</td>
<td>5.14</td>
<td>5.17</td>
<td>4.98</td>
</tr>
<tr>
<td>23</td>
<td>1574.68</td>
<td>4-26-85</td>
<td>12.60</td>
<td>7.30</td>
<td>6.83</td>
<td>6.72</td>
<td>6.45</td>
</tr>
<tr>
<td>24</td>
<td>1574.44</td>
<td>4-24-85</td>
<td>6.00</td>
<td>6.20</td>
<td>5.97</td>
<td>5.92</td>
<td>5.00</td>
</tr>
<tr>
<td>25</td>
<td>1574.64</td>
<td>4-24-85</td>
<td>7.12</td>
<td>7.20</td>
<td>7.14</td>
<td>7.52</td>
<td>7.66</td>
</tr>
<tr>
<td>26</td>
<td>1574.97</td>
<td>4-25-85</td>
<td>Dry</td>
<td>9.80</td>
<td>8.80</td>
<td>9.05</td>
<td>10.12</td>
</tr>
<tr>
<td>27</td>
<td>1581.02</td>
<td>4-24-85</td>
<td>8.25</td>
<td>8.80</td>
<td>8.69</td>
<td>8.72</td>
<td>7.90</td>
</tr>
<tr>
<td>28</td>
<td>1579.28</td>
<td>4-24-85</td>
<td>10.30</td>
<td>7.95</td>
<td>7.95</td>
<td>7.89</td>
<td>8.10</td>
</tr>
<tr>
<td>29</td>
<td>1579.36</td>
<td>4-24-85</td>
<td>9.80</td>
<td>8.94</td>
<td>8.73</td>
<td>8.58</td>
<td>8.35</td>
</tr>
<tr>
<td>30</td>
<td>1578.57</td>
<td>4-25-85</td>
<td>Dry</td>
<td>11.00</td>
<td>9.10</td>
<td>9.02</td>
<td>9.11</td>
</tr>
<tr>
<td>31</td>
<td>1579.99</td>
<td>4-25-85</td>
<td>7.75</td>
<td>7.80</td>
<td>7.85</td>
<td>7.88</td>
<td>7.66</td>
</tr>
<tr>
<td>32</td>
<td>1578.91</td>
<td>4-25-65</td>
<td>8.00</td>
<td>7.90</td>
<td>7.72</td>
<td>7.77</td>
<td>7.69</td>
</tr>
</tbody>
</table>

* Refer to figure 3 for location
<table>
<thead>
<tr>
<th>Map Location Number</th>
<th>Altitude of Measuring Point (in feet)</th>
<th>Depth to Water from Measuring Point (in feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH 1</td>
<td>1570.40</td>
<td>6.77 6.73 6.87 6.77</td>
</tr>
<tr>
<td>MH 2</td>
<td>1572.74</td>
<td>8.71 8.70 8.88 8.78</td>
</tr>
<tr>
<td>MH 3</td>
<td>1573.45</td>
<td>8.65 8.67 8.59 8.70</td>
</tr>
<tr>
<td>MH 4</td>
<td>1574.52</td>
<td>9.74 9.67 9.70 9.70</td>
</tr>
<tr>
<td>MH 5</td>
<td>1575.84</td>
<td>9.35 9.30 9.40 9.42</td>
</tr>
<tr>
<td>MH 6</td>
<td>1577.36</td>
<td>10.07 10.99 11.06 11.05</td>
</tr>
<tr>
<td>MH 7</td>
<td>1577.36</td>
<td>10.56 10.64 10.71</td>
</tr>
<tr>
<td>MH 8</td>
<td>1572.90</td>
<td>6.30 6.30 6.38 6.38</td>
</tr>
<tr>
<td>MH 9</td>
<td>1576.91</td>
<td>---- ---- 9.41 9.29</td>
</tr>
<tr>
<td>MH10</td>
<td>1572.94</td>
<td>---- ---- 5.63 5.40</td>
</tr>
<tr>
<td>MH11</td>
<td>1571.73</td>
<td>6.23 6.10 6.20 6.20</td>
</tr>
<tr>
<td>MH12</td>
<td>1572.85</td>
<td>6.65 6.90 6.93 6.82</td>
</tr>
<tr>
<td>MH13</td>
<td>----</td>
<td>---- ---- ---- 8.35</td>
</tr>
<tr>
<td>MH14</td>
<td>----</td>
<td>---- ---- ---- 4.05</td>
</tr>
<tr>
<td>MH15</td>
<td>----</td>
<td>---- ---- ---- 5.05</td>
</tr>
<tr>
<td>MH16</td>
<td>----</td>
<td>---- ---- ---- 8.65</td>
</tr>
<tr>
<td>MH17</td>
<td>----</td>
<td>---- ---- ---- 8.18</td>
</tr>
</tbody>
</table>

* Refer to figure 3 for location
Figure 6. Water-level altitudes in observation wells and selected sanitary sewer manholes, May 21-22, 1985.

Numbers are altitude of water level, in feet, above datum. Datum is 1,500 feet above mean sea level.

- Observation well
- Private observation well
- Sanitary sewer manhole
A bailer was used to collect water samples from the observation wells, while a quart jar tied to a rod was used in collecting samples from the sewer manholes. The samples were collected in pint glass jars, filled level full, with a Saran Wrap seal placed between the sample and the lid. To retard chemical and biological activity, all samples were iced and then taken to the State Health Laboratory in Pierre for volatile hydrocarbon analysis. The results of the analyses are shown on tables 5 and 6 and figures 7 and 8.

Dissolved gasoline and petroleum mixtures in excess of 100 parts per million (ppm) were found in observation wells located around the Niederauer Northside, Lil' Feller Store, old Mobil Station, and Hargens APCO Station. Samples from the sanitary sewer system ranged from non-detectable to 12 ppm of mostly gasoline except for MH4 (figs. 3 and 7) which contained 100 ppm gasoline. This prompted another set of sanitary sewer samples to be taken on June 26, 1985. The results are shown on figure 8. Additional sewer manholes were also sampled at this time. The previously high value found at MH4 had reduced to 15 to 22 ppm of gasoline. However, MH17 showed 100 ppm of gasoline. The high concentrations of dissolved petroleum in both the observation wells and sanitary sewer system indicate a constant source of petroleum contamination.

SUMMARY

The investigation to determine the origin and/or occurrence of petroleum vapors in residential basements and buildings included:

1. Identification of problem areas and potential sources of contamination;
2. Drilling of test holes and installation of observation wells, and
3. Measurements of water levels and collection of water samples.

Petroleum-contaminated sediment was found around the Niederauer Northside, OK Tire Store, Lil' Feller Store, old CDOR, Niederauer Oil and Gas Company, old Mobil, old Ford Garage, Hargens APCO, and Stobbs Sales, Inc. Ground-water flow is to the north in the general area and at a higher altitude relative to the sanitary sewer indicating that ground water may flow into the sanitary sewer. Significant dissolved petroleum product occurred at points in the sanitary sewer system and in the ground water around the Niederauer Northside, lil' Feller Store, Niederauer Oil and Gas Company, old Mobil, and Hargens APCO. Free petroleum product occurred in observation wells at the Niederauer Oil and Gas Company (4 inches of gasoline), Stobbs Sales, Inc. (12 inches plus of diesel fuel), and initially at the Hargens APCO (one-sixteenth of an inch gasoline). However, subsequent sampling at Hargens APCO did not show any free product.
<table>
<thead>
<tr>
<th>Map Location Number *</th>
<th>5-21-85</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ND</td>
</tr>
<tr>
<td>2</td>
<td>ND</td>
</tr>
<tr>
<td>3</td>
<td>&gt; 20 G</td>
</tr>
<tr>
<td>4</td>
<td>&gt; 100 D,G(S?)</td>
</tr>
<tr>
<td>5</td>
<td>2 M</td>
</tr>
<tr>
<td>6</td>
<td>2 S</td>
</tr>
<tr>
<td>7</td>
<td>15 G</td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>&gt; 100 G</td>
</tr>
<tr>
<td>10</td>
<td>ND</td>
</tr>
<tr>
<td>11</td>
<td>ND</td>
</tr>
<tr>
<td>13</td>
<td>55</td>
</tr>
<tr>
<td>14</td>
<td>&lt; 1 S</td>
</tr>
<tr>
<td>15</td>
<td>ND</td>
</tr>
<tr>
<td>16</td>
<td>ND</td>
</tr>
<tr>
<td>18</td>
<td>ND</td>
</tr>
<tr>
<td>19</td>
<td>ND</td>
</tr>
<tr>
<td>20</td>
<td>&lt; 1 G</td>
</tr>
<tr>
<td>21</td>
<td>ND</td>
</tr>
<tr>
<td>22</td>
<td>&lt; 5 G,D</td>
</tr>
<tr>
<td>23</td>
<td>Saturated diesel</td>
</tr>
<tr>
<td>24</td>
<td>&lt; 5 D</td>
</tr>
<tr>
<td>25</td>
<td>&gt; 100 G</td>
</tr>
<tr>
<td>26</td>
<td>&gt; 100 G</td>
</tr>
<tr>
<td>27</td>
<td>2 D</td>
</tr>
<tr>
<td>29</td>
<td>&gt; 100 G</td>
</tr>
<tr>
<td>30</td>
<td>50 D</td>
</tr>
<tr>
<td>31</td>
<td>Trace D</td>
</tr>
<tr>
<td>32</td>
<td>ND</td>
</tr>
<tr>
<td>33</td>
<td>&lt; 5 D,G</td>
</tr>
<tr>
<td>34</td>
<td>&gt; 100 M</td>
</tr>
<tr>
<td>35</td>
<td>100 D,G</td>
</tr>
<tr>
<td>PW1</td>
<td>Saturated gasoline</td>
</tr>
</tbody>
</table>

* Refer to figure 3 for location

ND = Not detected (detection limit 0.1 ppm)
G = Gasoline
D = Diesel
M = Petroleum mixture or light solvent
S = Light solvent
### Table 6

Volatile hydrocarbon analysis of water samples from sanitary sewer manholes

<table>
<thead>
<tr>
<th>Map Location Number</th>
<th>5-22-85</th>
<th>6-22-85</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH 1</td>
<td>7 G</td>
<td>5 G</td>
</tr>
<tr>
<td>MH 2</td>
<td>8 G</td>
<td>5 G</td>
</tr>
<tr>
<td>MH 3</td>
<td>10 G</td>
<td>10-12 G</td>
</tr>
<tr>
<td>MH 4</td>
<td>100 G</td>
<td>15-20 G</td>
</tr>
<tr>
<td>MH 5</td>
<td>12 G</td>
<td>10-12 G</td>
</tr>
<tr>
<td>MH 6</td>
<td>10 G</td>
<td>12 G, D</td>
</tr>
<tr>
<td>MH 7</td>
<td>ND</td>
<td>5 G</td>
</tr>
<tr>
<td>MH 8</td>
<td>~ 2 D</td>
<td>2 G, G</td>
</tr>
<tr>
<td>MH 9</td>
<td>ND</td>
<td>1 D</td>
</tr>
<tr>
<td>MH10</td>
<td>~ 1 D</td>
<td>1 D</td>
</tr>
<tr>
<td>MH11</td>
<td>7 G</td>
<td>10 G, G</td>
</tr>
<tr>
<td>MH12</td>
<td>ND</td>
<td>2 G, G</td>
</tr>
<tr>
<td>MH13</td>
<td>~</td>
<td>6 G, D</td>
</tr>
<tr>
<td>MH14</td>
<td>~</td>
<td>4 G, 1 D</td>
</tr>
<tr>
<td>MH15</td>
<td>~</td>
<td>1 G</td>
</tr>
<tr>
<td>MH16</td>
<td>~</td>
<td>12 G</td>
</tr>
<tr>
<td>MH17</td>
<td>~</td>
<td>&gt;100 G</td>
</tr>
</tbody>
</table>

* Refer to figure 3 for location

ND = Not detected (detection limit 0.1 ppm)
G = Gasoline
D = Diesel
M = Petroleum mixture or light solvent
S = Light solvent

### Conclusions

The petroleum vapors experienced in basements, buildings, and sanitary sewer systems are the result of petroleum products (free and dissolved) entering the sanitary sewer system (via ground water) from leaking underground petroleum storage tanks. Data indicated that the Niederauer Oil and Gas Company, Hargens RCC and Stobbs Sales, Inc. as probable sources of free and dissolved product contamination while the Li'l Feller Store, Niederauer Northside, and old Mobil Station may be contributing dissolved product. Petroleum product and vapors migrate down gradient (to the north) in the sanitary sewer and petroleum vapors enter residences with faulty or nonexistent sewer traps.
**Figure 7.** Volatile hydrocarbon concentrations in observation wells and selected sanitary sewer manholes, May 21-22, 1985.
Figure 8. Volatile hydrocarbon concentrations in selected sanitary sewer manholes, June 26, 1985.
RECOMMENDATIONS

For the immediate protection of the public from the occurrence of petroleum vapors in the sanitary sewer system, the following actions are suggested:

1. Monitoring of petroleum vapors should be conducted at regular intervals in the affected area for early detection of explosive levels of petroleum vapors.

2. Repair or replace the sanitary sewer traps in buildings experiencing petroleum vapors to prohibit the migration of sewer vapors from the sanitary sewer into the buildings.

3. If explosive levels of petroleum vapors persist in the sanitary sewer system, periodic flushing of the sewer with water may reduce the concentrations below explosive levels. A venting system may also be required to draw petroleum vapors from the sewer system.

The above measures will treat the symptoms of the problem but will not solve the problem. Further recommended remedial actions necessary for petroleum product/vapors abatement are listed below.

1. Eliminate the source of petroleum contamination. This may require testing of underground storage tanks to determine which tanks may be leaking. Replace leaking tanks.

2. Initiate recovery operations at Niederauer Oil and Gas Company and Stobbs Sales, Inc. to remove free petroleum product that occurs in the ground. Consult with or contact companies specializing in fuel recovery for assistance. Once the free product is removed and the sources eliminated (leaky tanks), the dilution of dissolved product in the ground water will gradually reduce the levels of petroleum product/vapors entering the sanitary sewer system. Recovery and disposal plans should be submitted in writing to Leland Baron, Office of Water Quality, Joe Foss Building, Pierre, SD 57501, as soon as possible for approval.

3. Insure stronger inventory control practices as a first line of defense for indicating when petroleum product losses occur.

4. Continue monitoring of observations wells placed near buried tanks for early indication of spills or leaky tanks.
REFERENCES


APPENDIX A

Logs of test holes and observation wells

MAP LOCATION (ML)

A number which is assigned to the log according to the order in which it is listed (see LEGAL LOCATION and LOCATION). This number corresponds to the numbers shown on figure 3.

LEGAL LOCATION and LOCATION

The logs are listed by smallest township number, then the smallest range number, the smallest section number, and ther. by quarter section: NE = A; NW = B; SW = C; SE = D. A comparison of LEGAL LOCATION and LOCATION is as follows. A LEGAL LOCATION of NW SE NE SW sec. 30, T. 99 N., R. 64 W. is the same as a LOCATION of 099N-64W-30CAB.

LATITUDE and LONGITUDE

The format is DD.MMSS where D is degrees, M is minutes, and S is seconds.

DRILLING COMPANY

SDGS is an abbreviation for South Dakota Geological Survey.

TOTAL DRILL HOLE DEPTH and SCREEN LENGTH

The numbers are presented in feet.

SCREEN TYPE and CASING TYPE

PVC - polyvinyl chloride

CASING TOP ELEVATION and GROUND SURFACE ELEVATION

The numbers are presented in feet above mean sea level. The elevations were surveyed to the nearest 0.01 foot with an automatic level.

CASING DIAMETER

The numbers are presented in inches.
COUNTY: HANDEL LOCATION: 112N-68W-10ACDA 1
MAP LOCATION: 1
LEGAL LOCATION: NE SE SW NE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.1226 LONGITUDE: 98.5913
LANDOWNER: MILLER PETROLEUM SPILL
DRILLING COMPANY: SGDS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-23-1985
GROUND SURFACE ELEVATION: 1571.30 I
TOTAL DRILL HOLE DEPTH: 28
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-1
OTHER WELL NAME: A1-85-1
AQUIFER: TILL
BASE: JAMES
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFS.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1573.40 I
CASING STICK-UP: 2.10
TOTAL CASING AND SCREEN: 16.0
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL:
NATURAL GAMMA:
SAMPLES:
WELL WAS GRAVEL Packed. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 8.07 FEET AND FIELD CONDUCTIVITY WAS 3800 MICROMHDS PER CENTIMETER ON 05-08-1985.
0 - 10 CLAY, LIGHT-TO MEDIUM-BROWN, VERY SILTY, SANDY, SLIGHTLY PEBBLY; DRY (TILL)
10 - 15 CLAY, LIGHT-BROWN, VERY SILTY, SLIGHTLY SANDY AND PEBBLY; DAMP (TILL)
15 - 20 CLAY, DARK-BROWN, SILTY; MOIST (TILL)
20 - 28 CLAY, GRAY, SILTY, SLIGHTY SANDY AND PEBBLY; MOIST (TILL)

COUNTY: HANDEL LOCATION: 112N-68W-10ACDA 2
MAP LOCATION: 2
LEGAL LOCATION: NE SE SW NE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3126 LONGITUDE: 98.5921
LANDOWNER: MILLER PETROLEUM SPILL
DRILLING COMPANY: SGDS
DRILLER: L. FRYMAN
DRILLER'S LOG: X
GEOLOGIST: D. HOLLY
GEOLOGIST'S LOG: X
DATE DRILLED: 05-02-1985
GROUND SURFACE ELEVATION: 1569.75 I
TOTAL DRILL HOLE DEPTH: 15
WATER RIGHTS WELL: A1-85-42
OTHER WELL NAME: A1-85-42
BASEIN JAMES
AQUIFER: TILL
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1571.85 I
CASING STICK-UP: 2.10
TOTAL CASING AND SCREEN: 16.9
WELL MAINTENANCE DATE: 05-02-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY: EXTRA:
NATURAL GAMMA: SAMPLES:
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 8.38 FEET AND FIELD
CONDUCTIVITY WAS 3600 MICROMOHS PER CENTIMETER
ON 05-08-1985.
0 - 4 TOPSOIL, BLACK
4 - 7 SAND, BROWN, COARSE, CLAYEY
7 - 13 CLAY, BROWN, SILTY, SANDY, PEBBLY; MOIST
(TILL)
13 - 15 CLAY, OLIVE-GRAY, SILTY, SANDY, PEBBLY;
MOIST (TILL)

COUNTY: HANF
MAP LOCATION: 3
LEGAL LOCATION: SE SE SW NE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3125
LONGITUDE: 98.5321
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-23-1985
GROUND SURFACE ELEVATION: 1570.50 I
TOTAL DRILL HOLE DEPTH: 15
WATER RIGHTS WELL: A1-85-2
OTHER WELL NAME:
BASEIN JAMES
AQUIFER: TILL
LOCATION: 112N-68W-10ACDD 1
WELL WAS GRAVEL PACKED, BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 3.41 FEET AND FIELD CONDUCTIVITY WAS 4100 MICROMOHMS PER CENTIMETER ON 05-08-1985.

0 - 2 TOPSOIL, BROWN; ORGANIC
2 - 5 CLAY, BROWN
5 - 7 SAND, BROWN, FINE TO MEDIUM; SATURATED
7 - 9 SAND, GRAY, FINE TO MEDIUM; SATURATED, GASOLINE ODOR
9 - 11 SAND, BROWN, FINE TO MEDIUM; SATURATED
11 - 15 CLAY, GRAY-BROWN, SILTY, SANDY (TILL)

LOCATION: 112N-68W-10ACDD 8
LEGAL LOCATION: SE SE SW NE SEC. 10, T. 112 N., R. 68 W.
LAND OWNER: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-23-1985
GROUND SURFACE ELEVATION: 1573.00 I
TOTAL DRILL HOLE DEPTH: 18
TEST HOLE NUMBER: A1-85-3
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-3
OTHER WELL NAME:
BASIN: JAMES
AQUIFER: TILL
COUNTY: HAND
LOCATION: 112N-68W-10ACDD 8
LEGAL LOCATION: SE SE SW NE SEC. 10, T. 112 N., R. 68 W.
LAND OWNER: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-23-1985
GROUND SURFACE ELEVATION: 1573.00 I
TOTAL DRILL HOLE DEPTH: 18
TEST HOLE NUMBER: A1-85-3
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-3
OTHER WELL NAME:
BASIN: JAMES
AQUIFER: TILL
COUNTY: HAND
LOCATION: 112N-68W-10ACDD 8
LEGAL LOCATION: SE SE SW NE SEC. 10, T. 112 N., R. 68 W.
LAND OWNER: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-23-1985
GROUND SURFACE ELEVATION: 1573.00 I
TOTAL DRILL HOLE DEPTH: 18
TEST HOLE NUMBER: A1-85-3
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-3
OTHER WELL NAME:
BASIN: JAMES
AQUIFER: TILL
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY: EXTRA:
NATURAL GAMMA: EXTR:
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 8.18 FEET AND FIELD
CONDUCTIVITY WAS 7500 MICROHMOS PER CENTIMETER
ON 05-08-1985.

0 - 11 CLAY, LIGHT-BROWN, SILTY, SLIGHTLY SANDY,
SLIGHTLY PEBBLY; DAMP, MAY HAVE DARK-
BROWN-GRAY FRACTURE ZONE FROM 8 TO 11
FEET (TILL)

11 - 18 CLAY, DARK-BROWN, SILTY, SANDY; FEW
PEBBLES, MOIST (TILL)

***
COUNTY: Hand LOCATION: 112N-68W-10ACDD 3
MAP LOCATION: 5. LATITUDE: 44.3123
LEGAL LOCATION: SE SE SW NE SEC. 10, T. 112 N., R. 68 W.
LAND OWNER: GEOLoGIST: D. HOLLY
PROJECT: MILLER PETROLEUM SPILL DATE DRILLED: 04-24-1985
DRILLING COMPANY: SDGS DRILLER'S LOG:
DRILLER: M. JARRETT GEOLOGIST'S LOG: X
GROUND SURFACE ELEVATION: 1570.49 I TOTAL DRILL HOLE DEPTH: 18
DRILLING METHOD: RUBER TEST HOLE NUMBER: A1-85-4
WATER RIGHTS WELL: 18.2 SDGS WELL NAME: A1-85-4
OTHER WELL NAME: AQUIFER: TILL
BASIN: JAMES
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG. SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40 CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1572.59 I CASING STICK-UP: 2.10 TOTAL CASING AND SCREEN: 16.2
WELL MAINTENANCE DATE: 04-26-1985 USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY: EXTRA:
NATURAL GAMMA: EXTR:
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 7.93 FEET AND FIELD
CONDUCTIVITY WAS 5000 MICROHMOS PER CENTIMETER

26
**ON 05-08-1985.**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>TOPSOIL, BROWN; ORGANIC</td>
</tr>
<tr>
<td>1</td>
<td>CLAY, LIGHT-TAN-BROWN, SILTY, PEBBLY, SANDY; DAMP (TILL)</td>
</tr>
<tr>
<td>4</td>
<td>CLAY, BROWN, VERY SILTY, SANDY; FEW PEBBLES, MOIST (TILL)</td>
</tr>
</tbody>
</table>

**COUNTY: Hand**
**LOCATION: 112N-68W-10ACDD 4**

**LEGAL LOCATION: SE SE SW NE SEC. 10, T. 112 N., R. 68 W.**
**LONGITUDE: 98.5919**

**LAND OWNER:**

**PROJECT: MILLER PETROLEUM SPILL**

**DRILLING COMPANY: SDGS**

**GEOLeT: D. HOLLY**

**DATE DRILLED: 04-24-1985**

**GROUND SURFACE ELEVATION: 1572.96 I**

**TOTAL DRILL HOLE DEPTH: 18**

**WATER RIGHTS WELL: SDGS WELL NAME: A1-85-5**

**OTHER WELL NAME:**

**BASIN: JAMES**

**AQUIFER: TILL**

**MANAGEMENT UNIT:**

**SCREEN TYPE: PVC, MFG.**

**SCREEN LENGTH: 10.0**

**CASING TYPE: PVC, SCH. 40**

**CASING DIAMETER: 2.0**

**CASING TOP ELEVATION: 1574.26 I**

**CASING STICK-UP: 1.30**

**TOTAL CASING AND SCREEN: 15.6**

**WELL MAINTENANCE DATE: 04-26-1985**

**USGS HYDROLOGICAL UNIT CODE: 10160009**

**ELECTRIC LOG INFORMATION:**

**SPONTANEOUS POTENTIAL:**

**NATURAL GAMMA:**

**SAMPLES:**

**WELL WAS GRAVEL Packed. BENTONITE SEAL FROM 0 TO 3 FEET, DEPTH TO WATER WAS 8.62 FEET AND FIELD CONDUCTIVITY WAS 4400 MICROHMOS PER CENTIMETER ON 05-08-1985.**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>TOPSOIL, BROWN; DAMP</td>
</tr>
<tr>
<td>2</td>
<td>CLAY, TAN, SILTY, SLIGHTLY PEBBLY, SANDY; MOIST (TILL)</td>
</tr>
<tr>
<td>6</td>
<td>CLAY, BROWN, SILTY, SANDY, PEBBLY; MOIST (TILL)</td>
</tr>
<tr>
<td>14</td>
<td>CLAY, LIGHT-TAN-BROWN, VERY SANDY, SILTY;</td>
</tr>
</tbody>
</table>
FEW PEBBLES, SATURATED AT 14 FEET (TILL)

* * * *

COUNTY: HARD
LOCATION: 112N-68W-10GCD 5
MAP LOCATION: 7
LEGAL LOCATION: SE SE SW NE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3125
LONGITUDE: 98.5319
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-25-1985
GROUND SURFACE ELEVATION: 1571.37 I
TOTAL DRILL HOLE DEPTH: 15
TEST HOLE NUMBER: A1-85-28
WATER RIGHTS WELL:
SDGS WELL NAME: A1-85-28
OTHER WELL NAME:
BASE: JAMES
AQUIFER: TILL
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1573.37 I
CASING STICK-UP: 2.00
TOTAL CASING AND SCREEN: 16.1
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL:
SINGLE POINT RESISTIVITY:
NATURAL GAMMA:
EXTRA:
SAMPLES:

WELL WAS GRAVEL PACKED, BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 14.76 FEET AND FIELD
CONDUCTIVITY WAS 7000 MICROHODS PER CENTIMETER
ON 05-08-1985.

0 - 1 ROADFILL
1 - 2 CLAY, BROWN, SILTY; LITTLE SAND AND
    PEBBLES, MOIST; GASOLINE ODOR (TILL)
2 - 4 CLAY, DARK-BLUE-GRAY, SILTY, SLIGHTLY
    SANDY AND PEBBLY; MOIST, GASOLINE ODOR
    (TILL)
4 - 9 CLAY, GRAY-BROWN, SILTY, PEBBLY, SLIGHTLY
    SANDY; MOIST, STRONG GASOLINE ODOR
    (TILL)
9 - 15 SAND; MOIST, DECREASING GASOLINE ODOR
    WITH DEPTH, GONE BY 12 FEET (TILL)
** **

COUNTY: HAND
MAP LOCATION: 8
LEGAL LOCATION: SE SE NW NE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3125
LONGITUDE: 98.5924
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. YESKE
GEOLOGIST: D. HOLLY
DRILLER'S LOG:
GEOLOGIST'S LOG: X
DATE DRILLED: 05-02-1985
DRILLING METHOD: AUGER
GROUND SURFACE ELEVATION: 1569.94 I
TOTAL DRILL HOLE DEPTH: 15
TEST HOLE NUMBER: A1-85-43
WATER RIGHTS WELL:
SDGS WELL NAME: A1-85-43
OTHER WELL NAME:
BASE: JAMES
AQUIFER: TILL
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MS.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1572.54 I
CASING STICK-UP: 2.60
TOTAL CASING AND SCREEN: 16.7
WELL MAINTENANCE DATE: 05-02-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL:
SINGLE POINT RESISTIVITY:
NATURAL GAMMA:
EXTRA:
SAMPLES:
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. WELL WAS DRY ON 05-08-1985.

0 - 3 CLAY, DARK-BROWN, SILTY (TOPSOIL)
3 - 5 SAND, BROWN, MEDIUM TO COARSE, CLAYEY;
DRY
5 - 15 CLAY, DARK-BROWN, SILTY, SANDY, PEBBLY;
DRY, OXIDIZED (TILL)

** **

COUNTY: HAND
MAP LOCATION: 9
LEGAL LOCATION: SE SW SE NE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3122
LONGITUDE: 98.5913
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
DRILLER'S LOG:
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM C TO 3 FEET. DEPTH TO WATER WAS 8.32 FEET AND FIELD CONDUCTIVITY WAS 2400 MICROHMS PER CENTIMETER ON 05-08-1985.

0 - 1 CLAY, TAN, SILTY, SANDY (TILL)
1 - 4 CLAY, DARK-BROWN, GRAY, SILTY, SANDY; FEW PEBBLES, MOIST (TILL)
4 - 6 CLAY, BROWN, SILTY, SANDY; SOME PEBBLES, MOIST (TILL)
6 - 14 CLAY, BLUE-GRAY, SANDY, SILTY; FEW PEBBLES, SATURATED AT 7 FEET, GASOLINE ODOR (TILL)
14 - 18 CLAY, BROWN, SILTY, SANDY, PEBBLY; MOIST (TILL)

** ** **
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-7
OTHER WELL NAME: AQUIFER:
BASIN: JAMES
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG. SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40 CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1573.87 TOTAL CASING AND SCREEN: 15.6
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 7.86 FEET AND FIELD
CONDUCTIVITY WAS 3800 MICROMOS PER CENTIMETER
ON 05-08-1985.

0 - 1 TOPSOIL, LIGHT-BROWN; DRY
1 - 5 CLAY, LIGHT-BROWN TO BROWN, SILTY, SANDY;
   FEW PEBBLES (TILL)
5 - 10 CLAY, BROWNISH-GRAY TO GRAY, SILTY,
   SANDY; FEW PEBBLES, MOIST, GASOLINE
   ODD (TILL)
10 - 15 CLAY, LIGHT-TAN-BROWN TO BROWN, SILTY,
   SANDY; SATURATED (TILL)
15 - 18 CLAY, LIGHT-TAN-BROWN, VERY SANDY;
   SATURATED

***

COUNTY: HARD LOCATION: 112N-68W-10DAAA
MAP LOCATION: NE NE NE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3120 LONGITUDE: 98.5904
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-25-1985
GROUND SURFACE ELEVATION: 1573.69 I
TOTAL DRILL HOLE DEPTH: 53 TEST HOLE NUMBER: A1-85-31
WATER RIGHTS WELL:
OTHER WELL NAME:
BASIN: JAMES AQUIFER: TILL
MANAGEMENT UNIT:

AQUIFER: TILL
 SCREEN TYPE: PVC, MFG. SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40 CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1575.591 TOTAL CASING AND SCREEN: 14.4
CASING STICK-UP: 1.90 WELL MAINTENANCE DATE: 04-25-1985
USGS HYDROLOGICAL UNIT CODE: 10160009 ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 10.66 FEET AND FIELD
CONDUCTIVITY WAS 6400 MICROMOS PER CENTIMETER
ON 05-08-1985.

0 - 17 CLAY, YELLOW-BROWN, SILTY, SLIGHTLY
SANDY AND PEBBLY; MOIST (TILL)
17 - 44 CLAY, BROWN, SILTY, SLIGHTLY SANDY AND
PEBBLY; MOIST (TILL)
44 - 49 SILT, LIGHT-BROWN, SANDY; SATURATED
(LOESS?)
49 - 53 CLAY, GRAY, SILTY, SANDY, PEBBLY; MOIST
(TILL)

***

COUNTRY: HAND LOCATION: 112N-68W-100ABC 1
MAP LOCATION: 12 LEGAL LOCATION: SW NW NE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.317 LONGITUDE: 98.5918
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDSS
DRILLER: M. JARRETT DRILLER’S LOG:
GEOLOGIST: D. HOLLY GEOLOGIST’S LOG: X
DATE DRILLED: 04-24-1985 DRILLING METHOD: AUGER
GROUND SURFACE ELEVATION: 1574.00 T TOTAL DRILL HOLE DEPTH: 20 TEST HOLE NUMBER: A1-85-12
USGS HYDROLOGICAL UNIT CODE: 10160009 ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

HOLE WAS BACKFILLED WITH CUTTINGS.

0 - 20 CLAY, LIGHT-BROWN TO DARK-BROWN, SILTY,
SANDY, PEBBLY; OXIDIZED, DAMP (TILL)

***

COUNTY: HANF
MAP LOCATION: 13
LEGAL LOCATION: SW NW NE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3116
LONGITUDE: 98.5918
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL DRILLING COMPANY: SDGS
DRILLER: M. JARRATT

DRILLER'S LOG:

DRILLING COMPANY: SDGS
GEOLGIST: D. HOLLY

DATE DRILLED: 04-24-1985
GROUND SURFACE ELEVATION: 1652.09
TOTAL DRILL HOLE DEPTH: 15
TEST HOLE NUMBER: A1-85-13
WATER RIGHTS WELL:
SDGS WELL NAME: A1-85-13
OTHER WELL NAME:

AQUIFER: TILL

MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG.
Casing Type: PVC, SCH. 40
CASING TOPELEVATION: 1574.51
Casing STICK-UP: 1.80
TOTAL CASING AND SCREEN: 16.3
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA:
EXTRA:
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH 70 WATER WAS 8.14 FEET AND FIELD CONDUCTIVITY WAS 7100 MICROMHOES PER CENTIMETER ON 05-08-1985.

0 = 1 CLAY, SANDY (TILL)
1 = 15 CLAY, BROWN, SANDY, SILTY, PEBBLY; OXIDIZED, MOIST (TILL)

***

COUNTY: HANF
MAP LOCATION: 14
LEGAL LOCATION: SW NW NE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3116
LONGITUDE: 98.5915
LAND OWNER:

33
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLL
DATE DRILLED: 04-25-1985
GROUND SURFACE ELEVATION: 1576.00
TOTAL DRILL HOLE DEPTH: 15
WATER RIGHTS WELL:
OTHER WELL NAME:
BASIN: JAMES
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG.
CAGING TYPE: PVC, SCH. 40
CAGING TOP ELEVATION: 1577.90
CAGING STICK-UP: 1.90
TOTAL CASING AND SCREEN: 16.1
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 1016009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL:
NATURAL GAMMA:
SAMPLES:
WELL WAS GRAVEL PACKED, BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 1.58 FEET AND FIELD CONDUCTIVITY WAS 7000 MICROMOHS PER CENTIMETER ON 05-08-1985.
0 - 15 CLAY, BROWN, SITLY; LITTLE SAND AND PEBBLES, MOIST (TILL)

COUNTY: HARD
MAP LOCATION: 15
LEGAL LOCATION: SW SW NE SE SEC. 10, T. 11 R N., R. 68 W.
LATITUDE: 44.3110
LONGITUDE: 98.5918
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLL
DATE DRILLED: 04-25-1985
GROUND SURFACE ELEVATION: 1575.16
TOTAL DRILL HOLE DEPTH: 15
WATER RIGHTS WELL:
OTHER WELL NAME:
BASIN: JAMES
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING TOP ELEVATION: 1576.86
CASING STICK-UP: 1.70
TOTAL CASING AND SCREEN: 15.9
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

WELL WAS GRAVEL PACKED, BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 11.51 FEET AND FIELD CONDUCTIVITY WAS 11,200 MICROAMPS PER CENTIMETER ON 05-08-1985.

0 - 15 CLAY, BROWN, SILTY; SOME SAND AND PEBBLES, OXIDIZED, MOIST (TILL)

** * *

COUNTY: HAND
LOCATION: 112N-68W-10DBB

MAP LOCATION: 16
LEGAL LOCATION: NW NE NW SE SEC. 10, T. 112 N., R. 68 W.

LATITUDE: 44.3120
LONGITUDE: 98.5926

LAND OWNER: MILLER PETROLEUM SPILL

DRILLER: M. JARRETT

GEOLOGIST: D. HOLLY

DATE DRILLED: 04-25-1985

GROUND SURFACE ELEVATION: 1574.26

TOTAL DRILL HOLE DEPTH: 48

WATER RIGHTS WELL:

SDGS WELL NAME: A1-85-29

OTHER WELL NAME:

BASIN: JAMES

AQUIFER: TILL

MANAGEMENT UNIT:

SCREEN TYPE: PVC, MFS.

SCREEN LENGTH: 10.0

CASING TYPE: PVC, SCH. 40

CASING DIAMETER: 2.0

CASING STICK-UP: 1.90

TOTAL CASING AND SCREEN: 16.0

WELL MAINTENANCE DATE: 04-26-1985

USGS HYDROLOGICAL UNIT CODE: 10160009

ELECTRIC LOG INFORMATION:

SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:

NATURAL GAMMA: EXTRA:

SAMPLES:

WELL WAS GRAVEL PACKED, BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 9.52 FEET AND FIELD
CONDUCTIVITY WAS 9400 MICROHMS PER CENTIMETER ON 05-06-1985.

0 - 5 CLAY, LIGHT-BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, OXIDIZED (TILL)

5 - 44 CLAY, CHOCOLATE-BROWN, SILTY; FEW PEBBLES, LITTLE SAND, MOIST, OXIDIZED (TILL)

44 - 48 CLAY, GRAY, SILTY, SANDY, PEBBLY; MOIST, UNOXIDIZED (TILL)

* * *

COUNTY: HANE LOCATION: 112N-68W-100DBAD 1
MAP LOCATION: 17
LEGAL LOCATION: SE NE NW SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3117 LONGITUDE: 98.5919
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDSG
DRILLER: M. JARRE
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-24-1985
GROUND SURFACE ELEVATION: 1574.00 T
TOTAL DRILL HOLE DEPTH: 15
TEST HOLE NUMBER: A1-85-8
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:
HOLE WAS BACKFILLED WITH CUTTINGS.

0 - 15 CLAY, LIGHT-BROWN TO BROWN, SILTY; LITTLE SAND AND FEW PEBBLES, DRY TO DAMP (TILL)

* * *

COUNTY: HANE LOCATION: 112N-68W-100DBAD 2
MAP LOCATION: 18
LEGAL LOCATION: SE NE NW SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.1315 LONGITUDE: 98.5919
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDSG

36
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-24-1985
GROUND SURFACE ELEVATION: 1573.42 I
TOTAL DRILL HOLE DEPTH: 15
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-9
OTHER WELL NAME:
BASIN: JAMES
AQUIFER: TILL
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG. SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40 CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1573.82 I TOTAL CASING AND SCREEN: 15.6
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY: 1.08
NATURAL GAMA: EXTRA:
SAMPLES:
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 7.34 FEET AND FIELD
CONDUCTIVITY WAS 5200 MICROMOHS PER CENTIMETER
ON 05-08-1985.
0 - 15 CLAY, LIGHT-TAN TO BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; DRY TO MOIST (TILL)

***
COUNTY: HANCO
LOCATION: 112N-68W-10DBAD 3
LEGAL LOCATION: SE NE NW SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3116 LONGITUDE: 98.5921
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT DRILLER'S LOG: X
GEOLOGIST: D. HOLLY GEOLOGIST'S LOG: X
DATE DRILLED: 04-24-1985 DRILLING METHOD: AUGER
GROUND SURFACE ELEVATION: 1572.66 I TOTAL DRILL HOLE DEPTH: 15
TEST HOLE NUMBER: A1-85-11
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-11
OTHER WELL NAME:
BASIN: JAMES AQUIFER: TILL
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG. SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40 CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1574.46 I
Casing Stick-Up: 1.80  Total Casing and Screen: 16.0

WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009

ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY: EXTRAS:
NATURAL GAMMA: 
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0° TO
3 FEET DEPTH TO WATER WAS 8.40 FEET AND FIELD
CONDUCTIVITY WAS 11,200 MICROMHRS PER CENTIMETER
ON 05-08-1985.

0 - 15 CLAY, BROWN, SILTY, SLIGHTLY SANDY AND
PEBBLY; DRY TO MOIST, OXIDIZED (TILL)

***

COUNTY: HARD  LOCATION: 112N-68W-10DB09
MAP LOCATION: NE SE NW SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3114  LONGITUDE: 90.5920
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL

DRILLING COMPANY: SDGS
DRILLER: M. JARRETT  DRILLER'S LOG:
GEOLOGIST: D. HOLLY  GEOLOGIST'S LOG: X
DATE DRILLED: 04-24-1985  DRILLING METHOD: AUGER
GROUND SURFACE ELEVATION: 1572.85  TOTAL DRILL HOLE DEPTH: 18
GROUND WATER MINT HOLE: 18  TEST HOLE NUMBER: A1-85-10
WATER RIGHTS WELL: SDGS WELL NUMBER: A1-85-10
OTHER WELL NAME:

GAIN: JAMES  AQUIFER: TILL

MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 8.0
CASING TOP ELEVATION: 1574.85 I
Casing Stick-Up: 2.00  Total Casing and Screen: 17.0
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY: EXTRAS:
NATURAL GAMMA: 
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 6.74 FEET AND FIELD
CONDUCTIVITY WAS 5000 MICROMHRS PER CENTIMETER
ON 05-08-1985.
0 - 4 CLAY, BROWN TO BROWNISH-GRAY, SILTY, SANDY; FEW PEBBLES, DAMP, GASOLINE ODOR (TILL)  
4 - 6 CLAY, BROWNISH-GRAY, SILTY, SANDY; FEW PEBBLES, MOIST, STRONG GASOLINE ODOR (TILL)  
6 - 11 CLAY, BROWN TO BROWNISH-GRAY, SILTY, SANDY; FEW PEBBLES, MOIST, SLIGHT GASOLINE ODOR (TILL)  
11 - 16 CLAY, GRAY-BLUE, SILTY, VERY SANDY; MOIST TO SATURATED, STRONG GASOLINE ODOR (TILL?)  
16 - 18 CLAY, BROWN, SILTY, SANDY, PEBBLY; MOIST (TILL)

***

COUNTY: Hard  
LOCATION: 112N-68W-10DCDB  
MAP LOCATION: 21  
LEGAL LOCATION: NW SE SW SE Sec. 10, T. 112 N., R. 68 W.  
LATITUDE: 44.3101  
LONGITUDE: 98.5924  
LAND OWNER:  
PROJECT: MILLER PETROLEUM SPILL  
DRILLING COMPANY: SDGS  
DRILLER: M. Jarrett  
GEOLOGIST: D. Holly  
DATE DRILLED: 04-25-1985  
GROUND SURFACE ELEVATION: 1576.61 I  
TOTAL DRILL HOLE DEPTH: 33  
TEST HOLE NUMBER: A1-85-30  
WATER RIGHTS WELL:  
SDGS WELL NAME: A1-85-30  
OTHER WELL NAME:  
MANAGEMENT UNIT:  
SCREEN TYPE: PVC, MFG.  
SCREEN LENGTH: 10.0  
CASING TYPE: PVC, SCH. 40  
CASING DIAMETER: 2.0  
CASING TOP ELEVATION: 1578.51 I  
CASING STICK-UP: 1.90  
TOTAL CASING AND SCREEN: 16.1  
WELL MAINTENANCE DATE: 04-26-1985  
USGS HYDROLOGICAL UNIT CODE: 10160009  
ELECTRIC LOG INFORMATION:  
SPONTANEOUS POTENTIAL:  
NATURAL GAMMA:  
SAMPLES:  
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 9.01 FEET AND FIELD CONDUCTIVITY WAS 3600 MICROMHANS PER CENTIMETER ON 05-08-1985.
0 - 20 CLAY, BROWN, SILTY, SLIGHTLY SANDY AND
PEBBLY; MOIST, OXIDIZED (TILL)

20 - 27 CLAY, DARK-BROWN, SILTY, SLIGHTLY SANDY
AND PEBBLY; MOIST, PARTIALLY OXIDIZED
(TILL)

27 - 33 CLAY, GRAY, SILTY, PEBBLY, SANDY; MOIST,
UNOXIDIZED (TILL)

***

COUNTY: HAND
LOCATION: 112N-68W-10DDAC 1

LEGAL LOCATION: SW NE SE SE SEC. 10, T. 112 N., R. 68 W.

LATITUDE: 44.3305
LONGITUDE: 98.5305

LAND OWNER:

PROJECT: MILLER PETROLEUM SPILL

DRILLING COMPANY: SDGS

DRILLER: M. JARRETT

GEOLOGIST: D. HOLLY

DATE DRILLED: 04-25-1985

DRILLING METHOD: AUGER

GROUND SURFACE ELEVATION: 1571.68

TOTAL DRILL HOLE DEPTH: 15

TEST HOLE NUMBER: A1-85-23

WATER RIGHTS WELL:

OTHER WELL NAME:

AQUIFER: TILL

BASIN: JAMES

MANAGEMENT UNIT:

SCREEN TYPE: PVC, MFG.

SCREEN LENGTH: 10.0

CASING TYPE: PVC, SCH. 40

CASING DIAMETER: 2.0

CASING TOP ELEVATION: 1573.68

CASING STICK-UP: 2.20

WELL MAINTENANCE DATE: 04-26-1985

USGS HYDROLOGICAL UNIT CODE: 1016009

ELECTRIC LOG INFORMATION:

SPONTANEOUS POTENTIAL:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 8.21 FEET AND FIELD
CONDUCTIVITY WAS 3800 MICROHMS PER CENTIMETER
ON 05-08-1985.

0 - 8 CLAY, BROWN, SILTY, SLIGHTLY SANDY AND
PEBBLY; MOIST

8 - 10 CLAY, GRAY, SILTY, SLIGHTLY SANDY AND
PEBBLY; MOIST, OLD GASOLINE ODOR
(TILL)
10 - 11 CLAY, GRAYISH-BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, SLIGHT GASOLINE ODOR (TILL)

11 - 15 CLAY, BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST (TILL)

COUNTY: HAND

LOCATION: 118N-68W-10DDAC 2

LEGAL LOCATION: SW NE SE SEC. 10, T. 112 N., R. 68 W.

MAP LOCATION: 23

LATITUDE: 44.3104

LONGITUDE: 98.5904

LAND OWNER:

PROJECT: MILLER PETROLEUM SPILL

DRILLING COMPANY: SDDS

DRILLER: M. HARRETT

GEOLOGIST: D. HOLLY

DATE DRILLED: 04-25-1985

DRILLING METHOD: AUGER

GROUND SURFACE ELEVATION: 1572.72 I

TOTAL DRILL HOLE DEPTH: 15

TEST HOLE NUMBER: A1-85-24

WATER RIGHTS WELL:

SDGS WELL NAME: A1-85-24

OTHER WELL NAME:

BASIN: JAMES

AQUIFER: TILL

MANAGEMENT UNIT:

SCREEN TYPE: PVC, MFS

SCREEN LENGTH: 10.0

CASING TYPE: PVC, SCH. 40

CASING DIAMETER: 2.0

CASING TOP ELEVATION: 1574.12 I

CASING STICK-UP: 2.40

TOTAL CASING AND SCREEN: 16.2

WELL MAINTENANCE DATE: 04-26-1985

USGS HYDROLOGICAL UNIT CODE: 10160009

ELECTRIC LOG INFORMATION:

SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:

NATURAL GAMMA: EXTRA:

SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 9.72 FEET ON 03-08-1985. WELL CONTAINED 2.25 INCHES OF FREE DIESEL FUEL WHEN SAMPLED ON 05-01-1985.

0 - 6 CLAY, BROWN TO DARK-BROWN, SILTY; LITTLE SAND, FEW PEBBLES, MOIST

6 - 12 CLAY, BLUE-GRAY, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, GASOLINE ODOR (TILL)

12 - 13 CLAY, GRAYISH-BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, SLIGHT GASOLINE ODOR (TILL)

13 - 15 CLAY, BROWN, SILTY; LITTLE SAND AND
COUNTY: HARD

LOCATION: 112N-68W-10DDAC 3

LEGAL LOCATION: SW NE SE SE SEC. 10, T. 112 N., R. 68 W.

LATITUDE: 44.3104

LONGITUDE: 98.5905

LANDowner:

PROJECT: MILLER PETROLEUM SPILL

DRILLING COMPANY: SDGS

DRILLER: M. YEBKE

GEOLOGIST: D. HOLLY

DATE DRILLED: 05-02-1985

GROUND SURFACE ELEVATION: 1571.231

TOTAL DRILL HOLE DEPTH: 15

TEST HOLE NUMBER: A1-85-41

WATER RIGHTS WELL:

SDGS WELL NAME: A1-85-41

OTHER WELL NAME:

BASIN: JAMES

AQUIFER: TILL

MANAGEMENT UNIT:

SCREEN TYPE: PVC, MFG.

SCREEN LENGTH: 10.0

CASING TYPE: PVC, SCH. 40

CASING DIAMETER: 2.0

CASING TOP ELEVATION: 1570.931

CASING STICK-UP:

TOTAL CASING AND SCREEN: 13.1

WELL MAINTENANCE DATE: 05-06-1985

USGS HYDROLOGICAL UNIT CODE: 10160009

ELECTRIC LOG INFORMATION:

SPONTANEOUS POTENTIAL:

SINGLE POINT RESISTIVITY:

NATURAL GAMMA:

EXTRA:

SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 5.14 FEET AND FIELD CONDUCTIVITY WAS 6200 MICROMHMS PER CENTIMETER ON 05-08-1985. STICK-UP: -0.3.

0 - 2 CLAY, DARK-GRAY, SILTY, SANDY, VERY PEBBLY; DISCOLORATION DUE TO CONTAMINATION (ROADFILL)

2 - 12 CLAY, LIGHT-GRAY, SILTY, SANDY, PEBBLY; MOIST, CONTAMINATED

12 - 15 CLAY, LIGHT-BROWN, SILTY, SANDY, PEBBLY; MOIST, OXIDIZED, SLIGHT CONTAMINATION (TILL)

***

42
COUNTY: HARD
LOCATION: 112N-68W-100DBA 1
MAP LOCATION: 25
LEGAL LOCATION: NE NW SE SE Sec. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3106
LONGITUDE: 98.5911
LAND OWNER: MILLER PETROLEUM SPILL
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DRILLER’S LOG: GEOLOGIST’S LOG: X
DATE DRILLED: 04-26-1985
GROUND SURFACE ELEVATION: 1572.68 I
TOTAL Drill HOLE DEPTH: 15
WATER RIGHTS WELL: TEST HOLE NUMBER: A1-85-18
OTHER WELL NAME: SDGS WELL NAME: A1-85-18
BASE: JAMES
AQUIFER: TILL
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING 100 ELEVATION: 1574.68 I
CASING STICK-UP: 2.00
TOTAL CASING AND SCREEN: 16.1
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL:
SINGLE POINT RESISTIVITY:
NATURAL GAMMA:
SAMPLES:
WELL WAS GRAVEL PACKED, BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 6.63 FEET AND FIELD CONDUCTIVITY WAS 2800 MICROHMOS PER CENTIMETER ON 05-08-1985.
0 - 1 ROADFILL
1 - 5 CLAY, BLUE-GRAY, SILTY, SLIGHTLY SANDY, SLIGHTLY PEBBLY; MOIST, STRONG GASOLINE ODOR (TILL)
5 - 15 CLAY, BROWNISH-GRAY TO BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, SLIGHT GASOLINE ODOR

COUNTY: HAND
LOCATION: 112N-68W-100DBA 2
MAP LOCATION: 26
LEGAL LOCATION: NE NW SE SE Sec. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3107
LONGITUDE: 98.5911
LAND OWNER: MILLER PETROLEUM SPILL
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
DRILLER'S LOG:

GEOLOGIST: D. HOLLY
GEOLOGIST'S LOG: X

DATE DRILLED: 04-24-1985
DRILLING METHOD: AUGER

GROUND SURFACE ELEVATION: 1572.44 I
TOTAL DRILL HOLE DEPTH: 18

WATER RIGHTS WELL: SDGS WELL NAME: A1-85-19
OTHER WELL NAME: JAMES
AQUIFER: TILL

MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG.
SCREEN LENGTH: 2.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1574.44 I
CASING STICK-UP: 2.00
TOTAL CASING AND SCREEN: 13.5
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009

ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL:
SINGLE POINT RESISTIVITY:
NATURAL GAMMA:
EXTRA:
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 5.97 FEET AND FIELD CONDUCTIVITY WAS 1200 MICROMhos PER CENTIMETER ON 05-08-1985.

0 - 1 TOPSOIL, DAMK-BROWN; ORGANIC, MOIST
1 - 5 CLAY, CHOCOLATE-BROWN, SLIGHTLY SANDY AND PEBBLY; MOIST (TILL)
5 - 8 CLAY, BROWN-GRAY, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, FRESH GASOLINE ODOR FROM 5 TO 8 FEET (TILL)
8 - 11 CLAY, GRAY, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, OLD GASOLINE ODOR (TILL)
11 - 16 CLAY, DARK-BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, SLIGHT GASOLINE ODOR, ODOR DECREASES WITH DEPTH, GONE BY 17 FEET (TILL)

* * * *

COUNTY: HAN
LOCATION: 112N-66W-100DBA 3

LEGAL LOCATION: NE NW SE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3107
LONGITUDE: 98.5310

LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS

DRILLER: M. JARRETT
DRILLER'S LOG: 44
GEOLeST: D. HOLLY
DATE DRILLED: 06-24-1985
GROUND SURFACE ELEVATION: 1572.42
TOTAL DRILL HOLE DEPTH: 15
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-20
OTHER WELL NAME:
BASIN: JAMES
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG. 40
Casing Type: PVC, SCH. 40
Casing Top Elevation: 1574.64
Casing Stick-Up: 2.20
WELL MAINTENANCE DATE: 04-26-1985
U.S. Hydrological Unit Code: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL:
NATURAL GAMMA:
SAMPLES:
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 7.14 FEET AND FIELD
CONDUCTIVITY WAS 2400 MICROMhos PER CENTIMETER
ON 05-08-1985.

0 - 1 TOPSOIL, BROWN; ORGANIC
1 - 4 CLAY, DARK-GRAY-BLUE, SILTY, SLIGHTLY
SANDY, SLIGHTLY PEBBLY; MOIST STRONG
GASOLINE ODOR (TILL)
4 - 9 CLAY, GRAY-BLUE, SILTY, SLIGHTLY SANDY
AND PEBBLY; MOIST, OLD GASOLINE ODOR
(TILL)
9 - 13 CLAY, GRAY-BROWN, SILTY, SANDY, SLIGHTLY
PEBBLY; MOIST, SLIGHT GASOLINE ODOR
(TILL)
13 - 15 CLAY, BROWN, SILTY, SANDY, SLIGHTLY
PEBBLY; MOIST, VERY SLIGHT GASOLINE
ODOR (TILL)

COUNTY: HAND
MAP LOCATION: 28
LEGAL LOCATION: NE NW SE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3106
LONGITUDE: 98.5910
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLeST: D. HOLLY

LOCATION: 112N-68W-100DBA 4

Driller's Log: C

Geologist's Log: X
DATE DRILLED: 04-24-1985        DRILLING METHOD: AUGER
GROUND SURFACE ELEVATION: 1575.00 T
TOTAL DRILL HOLE DEPTH: TEST HOLE NUMBER: A1-85-21
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

HOLE WAS BACKFILLED WITH CUTTINGS.

0 - 15 CLAY, BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; DRY TO 10 FEET, MOIST AFTER 10 FEET (TILL)

* * * *

COUNTY: HAND
MAP LOCATION: 29
LEGAL LOCATION: NE NW SE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3104 LONGITUDE: 98.5910
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
GEOLOGIST’S LOG: X
DATE DRILLED: 04-25-1985
DRILLING METHOD: AUGER
GROUND SURFACE ELEVATION: 1572.77 I
TOTAL DRILL HOLE DEPTH: 15
WELL RIGHTS WELL:
SDGS WELL NAME: A1-85-22
OTHER WELL NAME:
BASE: JAMES
AQUIFER: TILL

MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1574.97 I
TOTAL CASING AND SCREEN: 15.1
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 8.80 FEET AND FIELD CONDUCTIVITY WAS 6000 MICROMS PER CENTIMETER ON 05-08-1985.
COUNTY: HANF
LOCATION: 112N-68W-10DDBB 1

LEGAL LOCATION: NW NW SE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3107
LONGITUDE: 98.5915

LAND OWNED: MILLER PETROLEUM SPILL
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-24-1985
GROUND SURFACE ELEVATION: 1579.92 I
TOTAL DRILL HOLE DEPTH: 15
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-15
OTHER WELL NAME: AQUIFER: TILL
BASE: JAMES

MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFS.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1581.02 I
CASING STICK-UP: 2.10
WELL MAINTENANCE DATE: 04-06-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL:
NATURAL GAMMA:
SAMPLES:
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATER WAS 8.69 FEET AND FIELD
CONDUCTIVITY WAS 3400 MICROMOH/US PER CENTIMETER
ON 05-08-1985.

0 - 1 TOPSOIL, BROWN; ORGANIC
1 - 8 CLAY, BROWN, SILTY, SLIGHTLY SANDY AND
PEBBLY; MOIST (TILL)
8 - 12 CLAY, BLUE-GRAY, SILTY, SLIGHTLY SANDY
AND PEBBLY; MOIST, OLD GASOLINE ODOR
(TILL)
12 - 15 CLAY, BROWNISH-GRAY, SILTY, SLIGHTLY
SANDY AND PEBBLY; MOIST, SLIGHT
GASOLINE ODOR (TILL)

0 - 5 CLAY, BROWN, PEBBLY, SANDY (TILL)
5 - 11 CLAY, GRAY-BLUE, gradually turning to
GRAY-BROWN, SILTY; SOME SAND AND
PEBBLES, MOIST, GASOLINE ODOR FROM 5 TO
8 FEET (TILL)
11 - 15 CLAY, TAN-BROWN, SILTY; SOME SAND AND PEBBLES, MOIST, FAINT GASOLINE ODOR (TILL)

** **

COUNTY: HAND LOCATION: 112N-68W-100DBB 2
MAP LOCATION: 31 LATITUDE: 44.3106
LEGAL LOCATION: NW NW SE SE SEC. 10, T. 112 N., R. 68 W. LONGITUDE: 98.5917
LAND OWNER: DRILLER'S LOG:
PROJECT: MILLER PETROLEUM SPILL GEOLOGIST'S LOG: X
DRILLING COMPANY: SDGS DRILLING METHOD: AUGER
DRILLER: M. JARRETT
GEOLeGist: D. HOLLY
DATE DRILLED: 04-26-1985
GROUND SURFACE ELEVATION: 1577.38 I
TOTAL DRILL HOLE DEPTH: 15 TEST HOLE NUMBER: A1-85-16
WATER RIGHTS: SDGS WELL NAME: A1-85-16
OTHER WELL NAME: James
AQUIFER: TILL
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFG. SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40 CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1579.28 I TOTAL CASING AND SCREEN: 16.2
CASING STICK-UP: 1.90 WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 7.95 FEET AND FIELD CONDUCTIVITY WAS 6600 MICROMHOS PER CENTIMETER ON 05-08-1985.

0 - 15 CLAY, LIGHT-TAN TO BROWN, VERY SILTY; FEW PEBBLES AND LITTLE SAND, MOIST (TILL)

** **

COUNTY: HAND LOCATION: 112N-68W-100DBB 3
MAP LOCATION: 32 LATITUDE: 44.3106
LEGAL LOCATION: NW NW SE SE SEC. 10, T. 112 N., R. 68 W. LONGITUDE: 98.5917
LAND OWNER:

PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-24-1985
GROUND SURFACE ELEVATION: 1577.26
TOTAL DRILL HOLE DEPTH: 15
WATER RIGHTS WELL: SDGS WELL NAME: A1-85-17
OTHER WELL NAME:
BASIN: JAMES
MANAGEMENT UNIT:
SCREEN TYPE: PVC, MFS.
CASING TYPE: PVC, SCH. 40
CASING TOP ELEVATION: 1579.36
CASING DICK-UP: 2.10
WELL MAINTENANCE DATE: 04-26-1985
USR/ HYDROLOGICAL UNIT CODE: 1016009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY:
NATURAL GAMMA: EXTRA:
SAMPLES:

WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 8.73 FEET AND FIELD CONDUCTIVITY WAS 5000 MICRHMS PER CENTIMETER ON 05-06-1985.

0 - 15 CLAY, TAN TO DARK-BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, SLIGHT GASOLINE ODOR FROM 10 TO 12 FEET; VERY SLIGHT ODOR FROM 12 TO 15 FEET (TILL)

***

COUNTY: HAND
LOCATION: 112N-68W-10DDBC 1
MAP LOCATION: 33
LEGAL LOCATION: SW NW SE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3104
LONGITUDE: 98.5914
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDGS
DRILLER: M. JARRETT
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-25-1985
GROUND SURFACE ELEVATION: 1576.77
TOTAL DRILL HOLE DEPTH: 15
WATER RIGHTS WELL:
OTHER WELL NAME: SDGS WELL NAME: A1-85-25

49
BASIN: JAMES
MANAGEMENT UNIT: Aquifer: Till
SCREEN TYPE: PVC, MFG.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1578.57
CASING STICK-UP: 1.80
TOTAL CASING AND SCREEN: 15.9
WELL MAINTENANCE DATE: 04-26-1985
USGS HYDROLOGICAL UNIT CODE: 10160009
ELECTRIC LOG INFORMATION:
SPONTANEOUS POTENTIAL: SINGLE POINT RESISTIVITY: EXTRA:
NATURAL GAMMA:
SAMPLES:
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 9.10 FEET AND FIELD CONDUCTIVITY WAS 5600 MICROMHMS PER CENTIMETER ON 05-08-1985.
0 - 6 CLAY, BROWN, SILTY; FEW PEBBLES, LITTLE SAND, MOIST (TILL)
6 - 8 CLAY, GRAYISH-BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, SLIGHT GASOLINE ODOR (TILL)
8 - 15 CLAY, BROWN, SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST (TILL)

COUNTY: Hand LOCATION: 112N-68W-10DD8C 2
MAP LOCATION: 34 LEGAL LOCATION: SW NW BE SE SEC. 10, T. 112 N., R. 68 W.
LATITUDE: 44.3103 LONGITUDE: 98.5917
LAND OWNER:
PROJECT: MILLER PETROLEUM SPILL
DRILLING COMPANY: SDS
DRILLER: L. FRYKMAN
GEOLOGIST: D. HOLLY
DATE DRILLED: 04-25-1985
GROUND SURFACE ELEVATION: 1577.09
TOTAL DRILL HOLE DEPTH: 18
TEST HOLE NUMBER: A1-85-26
WATER RIGHTS WELL:
OTHER WELL NAME:
BASIN: JAMES MANAGEMENT UNIT: Aquifer: Till
SCREEN TYPE: PVC, MFG.
SCREEN LENGTH: 10.0
CASING TYPE: PVC, SCH. 40
CASING DIAMETER: 2.0
CASING TOP ELEVATION: 1579.09
CASING STICK-UP: 2.00
TOTAL CASING AND SCREEN: 12.9
WELL MAINTENANCE DATE: 04-26-1985
WELL WAS GRAVEL PACKED, BENTONITE SEAL FROM 0 TO
3 FEET. DEPTH TO WATERS WAS 7.05 FEET AND FIELD
CONDUCTIVITY WAS 1600 MICROMOHRS PER CENTIMETER
ON 05-08-1985.

0 - 5  SAND, BROWN, MEDIUM TO COARSE, SILTY;
       SOME CLAY, MOIST AT 5 FEET (ROADFILL)

5 - 9  SAND, GRAY, MEDIUM TO COARSE; LITTLE
       CLAY, SATURATED, GASOLINE ODOR
       (ROADFILL)

9 - 15 SAND, DARK-BROWN, COARSE; SATURATED,
     GASOLINE ODOR (ROADFILL)

15 - 18 CLAY, BROWN, SILTY, SLIGHTLY SANDY AND
      PEBBLY; MOIST

* * *

COUNTY: HARD

MAF LOCATION: 35

LEGAL LOCATION: SW NW SE SE SEC. 10, T. 112 N., R. 68 W.

LATITUDE: 44.3103

LONGITUDE: 98.5917

LAND OWNER:

PROJECT: MILLER PETROLEUM SPILL

DRILLING COMPANY: SDGS

DRILLER: L. FRYKMAN

GEOLoGIST: D. HOLLY

DATE DRILLED: 04-25-1985

GROUND SURFACE ELEVATION: 1576.91

TOTAL DRILL HOLE DEPTH: 16

WATER RIGHTS WELL:

SDGS WELL NAME: A1-85-27

OTHER WELL NAME:

AQUIFER: TILL

MANAGEMENT UNIT:

SCREEN TYPE: PVC, MFG. 40

Casing Type: PVC, SCH. 40

Casing Top Elevation: 1578.91

Casing Stick-Up: 2.00

WELL MAINTENANCE DATE: 04-26-1985

USGS HYDROLOGICAL UNIT CODE: 10160009

ELECTRIC LOG INFORMATION:

SPONTANEOUS POTENTIAL:

SINGLE POINT RESISTIVITY:

NATURAL GAMMA:

SAMPLES:

EXTRA:

**
WELL WAS GRAVEL PACKED. BENTONITE SEAL FROM 0 TO 3 FEET. DEPTH TO WATER WAS 7.72 FEET AND FIELD CONDUCTIVITY WAS 3800 MICROMHRS PER CENTIMETER ON 05-08-1985.

0 – 5 CLAY, OLIVE-BROWN, SILTY, SLIGHTLY SANDY, PEBBLY; MOIST, FRESH GASOLINE ODOR (TILL)

5 – 9 CLAY, OLIVE-GRAY TO GRAY, VERY SILTY, SLIGHTLY SANDY, PEBBLY; MOIST, GASOLINE ODOR (TILL)

9 – 16 CLAY, OLIVE-GRAY TO BROWN, VERY SILTY, SLIGHTLY SANDY AND PEBBLY; MOIST, SLIGHT GASOLINE ODOR (TILL)

* * * *