Mr. Robert R. Dorsey  
Environmental Engineer  
Solid Waste Management Division  
Arkansas Department of Pollution Control and Ecology  
8001 National Drive  
Little Rock, Arkansas  72209

Dear Mr. Dorsey:

As requested in your letter January 29, 1980, we are submitting herewith three copies of soil tests and two additional sets of the plans previously submitted to request a change to the area of our Solid Waste Landfill Permit S-0132.

If additional information is needed, please contact Mr. Donald Faust at 541-3239.

Sincerely,

[Signature]

JOHN H. DOLIER, JR., P.E.  
Ch., Engineering Plans & Svcs Div  
Directorate for Facilities Engineering

[Stamp: Received Apr 1980]
REPORT OF SUBSURFACE INVESTIGATION
SANITARY LANDFILL EXTENSION
PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS

Reported to
Commander
Pine Bluff Arsenal
Pine Bluff, Arkansas

Prepared by
Southwestern Laboratories
Soils Engineering Division
Little Rock, Arkansas

80036 S
April, 1980
April 10, 1980

Commander
Pine Bluff Arsenal
Pine Bluff, Arkansas  71611

Attention: Procurement Division

Subject:  Report of Subsurface Investigation
Pine Bluff Arsenal
Sanitary Landfill Extension
Near Pine Bluff, Arkansas
P.O. No. DAAA03-80-M-0059
SWL Job No. 80036 S

Gentlemen:

Southwestern Laboratories has completed the subsurface investigation authorized by Pine Bluff Arsenal Purchase Order No. DAAA03-80-M-0059. All work was coordinated with Mr. Donald Faust of the Engineering Management Division.

The purpose of this investigation was to drill two test borings in general areas selected by Pine Bluff Arsenal personnel and to perform laboratory tests to determine the Atterberg limits and permeability characteristics of representative soils. This report contains brief descriptions of the site and subsurface conditions and testing procedures, all field and laboratory test data, and some general comments regarding soil permeability.

FIELD TESTING PROCEDURES

Boring Locations: Mr. David Kraft, driller for Southwestern Laboratories, met with Mr. Donald Faust of the Pine Bluff Arsenal on March 24, 1980. At that time, Mr. Kraft was taken to the proposed landfill extension area and shown two approximate areas to drill the test borings.

Soil Borings: Two soil borings were made at the locations shown on the attached Boring Plan. The borings were advanced by wash drilling procedures which utilize a drilling fluid to stabilize the sides of the borehole while drilling and wash the cuttings to the surface, and by continuous steel flight augers which rotate to bring the soil cuttings to the surface. At regular intervals throughout the borings' depths, soil samples were obtained with a three inch diameter Shelby tube in both cohesive and non-cohesive soils (where possible). Each Shelby tube was pushed about 18 inches and then removed from the borehole. The Shelby tube sampling procedure is in basic accordance with ASTM Designation D 1587. The Shelby tube sampling procedure is not normally used in granular or non-cohesive materials because they generally are not retained in the tube or they break apart when extruded. However, because intact samples were not required for strength or consolidation testing, Shelby tube samples were taken to obtain larger portions of the material than can be obtained by split spoon sampling.
Standard penetration tests obtained by driving a thick wall split tube sampler into the ground by blows of a 140 pound hammer falling 30 inches were taken at test intervals where Shelby tube samples were not recovered or in portions of borings where the granular nature of the material did not readily permit the use of the Shelby tube sampling technique. The standard penetration test method is generally described by ASTM Designation D 1586.

Representative portions of the soil samples obtained from each boring were placed in moisture tight containers and transported to our laboratory for examination by a soils engineer. Approximate Unified soil classifications were determined by visual examination and appropriate laboratory tests.

Water level readings were made in the boreholes at completion of drilling and/or prior to leaving the site. Water level measurements made at completion of wash boring do not, however, represent the actual ground-water levels.

Boring logs which show soil descriptions, stratifications, penetration resistances, and locations of Shelby tube samples are attached to this report. The water level information is also shown on the boring logs.

LABORATORY TESTING

Representative samples of the subsurface soils were tested in our laboratory to determine some of their physical and engineering properties. The analyses included determinations of the soils' natural moisture contents, Atterberg limits, grain size distributions, and permeability characteristics. All test procedures were in basic accordance with the applicable ASTM Designation or other accepted laboratory practices. Laboratory test results are attached to this report.

SITE AND SUBSURFACE CONDITIONS

The Pine Bluff Arsenal is located northwest of Pine Blyff, Arkansas on the east side of Arkansas Highway No. 365. State Highway No. 256 extends from Highway No. 365 to the arsenal. The existing landfill is oriented northwest to southeast on the northeast side of McCoy Road. The proposed landfill extension is approximately triangular in shape and is located at the northwest end of the existing landfill. The base of the triangle is approximately 300 feet wide (east-west) and its length (north-south) is approximately 560 feet.

Trees line the west side of the area and an open trench approximately 17 feet deep is parallel to the west side of the area. A paved road enters the site from the south end. The paved road changes to a dirt road inside the site. The ground surface appears to slope to the east (based on a site plan provided by Mr. Faust) and the slope steepens considerably at the eastern edge of the proposed extension area. Crushed rock fill covered the surface at the two boring areas.
Published geologic maps indicate that the Pine Bluff Arsenal is underlain by Pleistocene and Holocene age terrace and more recent alluvial deposits. These alluvially deposited soils may consist of various combinations of sands, silts, clays, and gravels.

Crushed rock is present at both borings at the ground surface. This rock is a thin veneer at Boring B-2 but is about 2.5 feet thick at Boring B-1C. (The depth of the fill layer appears variable.)

Stiff to very stiff tan and gray silty sandy clays and clayey sandy silts are present beneath the upper fill. These materials contain numerous sandy layers and lenses, and typically fall within the Unified soil classifications CL, ML, and SM. These silts and clays exhibit relatively low permeability (coefficients of permeability of $1 \times 10^{-7}$ to $1 \times 10^{-9}$ cm./sec. for the two samples tested) in the vertical direction. However, the sandy layers and lenses, if interconnected, could increase the net permeability of the soil.

More pervious, dense tan and gray silty fine sands to fine sandy silts are present at a depth of about 11 to 12 feet below existing ground surface. These silty sands are within the Unified soil classification SM/ML and appear to be about two to four feet thick. A remolded sample of soil taken from a depth of 15 feet at Boring B-1A exhibited a coefficient of permeability of $3.3 \times 10^{-5}$ cm./sec. The 12.5 foot sample of Boring B-2 appears to be sandier and should have a higher permeability (more pervious) than the sample tested.

Stiff to hard gray and tan silty sandy clays to sandy silty clays with sandy lenses and layers are present beneath the silty sand layer. These materials typically fall within the Unified soil classification CL but may fall within the SM classification when the sandy layers are encountered. The sample from a depth of 22.5 feet at Boring B-2 was tested and found to have a coefficient of permeability of $4.5 \times 10^{-8}$ cm./sec. in the vertical direction. Its horizontal permeability would be greater and, in addition, any interconnecting of the sandy lenses and layers could increase both the horizontal and vertical permeabilities. This sandy clay layer continued to boring termination at 25.5 feet at Boring B-1A and to about 23 feet below ground at Boring B-2.

Dense gray and orange silty fine sands to hard fine sandy silts are present at Boring B-2 from about 23 feet to boring termination at 25.5 feet. The bottom sample of Boring B-1A was considerably more sandy than the samples above it, which may indicate the presence of a sandier layer below boring termination similar to the layer found at the bottom of Boring B-2. The Unified soil classification for this layer is SM/ML. No permeability tests were performed on samples from this layer; however, we anticipate that these soils would exhibit coefficients of permeability of the same magnitude or higher than the sandy layer at about 12 feet below ground.

The drilling fluid levels at completion of drilling of wash borings are not representative of the actual groundwater level. The water
levels did not have time to stabilize before we left the site. The boreholes were left open and can be checked for water levels if they have not collapsed. Additional water level information can be obtained by observing for the presence of water in the existing trenches.

SOIL PERMEABILITY COMMENTS

The susceptibility of in-place soils to movement of water, either horizontally or vertically, is related to the characteristic material type, to structural defects such as fissures or cracks, and to the interlayering of the various materials. The permeability of one-sized materials generally decreases with decreasing particle size. Thusly, one-sized deposits of gravels, sands, silts, or clays become progressively less permeable in the order listed. Combinations of material types will generally have a permeability somewhere between the permeability of either individual particle type. However, well graded mixtures may have lower permeabilities than any of the individual materials.

The net permeability of the soil system is variable depending upon the direction of water flow and the uniformity of the stratification system. The effective coefficient of permeability of the soil system measured in a direction parallel (generally horizontal) to the bedding planes or strata is generally much higher than the coefficient measured in a direction perpendicular (generally vertical) to the bedding planes. This difference in the vertical and horizontal net permeabilities is due to the fact that water flows in the direction of least resistance. Therefore, water flows horizontally along more permeable strata more easily than when it must pass through all of the strata. Water also flows more easily along joints, fissures, and more granular partings or seams than it does through more uniform materials.

*    *    *    *    *

We at Southwestern Laboratories are pleased to have provided these geotechnical services for the extension of your landfill. Please contact us if we can be of further service or if you have any questions concerning this report.

Very truly yours,

SOUTHWESTERN LABORATORIES

Michael V. Korth
Soils Engineer, Registered
Arkansas 4513

Walter H. Goin
Soils Engineer, Registered
Arkansas 4237
NOTE: Boring Plan reproduced from site plan furnished by the Pine Bluff Arsenal.

BORING PLAN
PINE BLUFF ARSENAL SANITARY LANDFILL EXTENSION
PINE BLUFF, ARKANSAS
SWL JOB NO. 80036 S
SCALE: 1" = 80'
<table>
<thead>
<tr>
<th>DEPTH IN FEET</th>
<th>SYMBOL</th>
<th>CORE DATA /鲶REC/ROD</th>
<th>STANDARD PENETRATION</th>
<th>ROCK CORE</th>
<th>SAMPLE</th>
<th>LEGEND</th>
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</thead>
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<tr>
<td>-2.5</td>
<td>M/S M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>-10</td>
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</tr>
<tr>
<td>-12.5</td>
<td>M/S M</td>
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</tr>
<tr>
<td>-15</td>
<td>CL</td>
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<td>-17.5</td>
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</tr>
<tr>
<td>-20</td>
<td></td>
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<tr>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**LOG OF BORING**

**PROJECT:** PINE BLUFF ARSENAL SANITARY LANDFILL EXTENSION  
**CLIENT:** PINE BLUFF ARSENAL  
**SWL JOB NO.** 80036 S  
**BORING NO.:** B-1A,1C  
**LOCATION:** PINE BLUFF, AR.

**DATE:** 3-24, 25-80  
**TYPE:** WASH/AUGER  
**CASED TO:** 5'  
**GROUND ELEVATION:**

**WATER INFORMATION:**
B-1C had seepage at 3' while drilling, water at 9.6' at completion. Drilling fluid at 7.4' at completion of B-1A and at surface after 24 hours.

**DESCRIPTION OF STRATUM**

- **-1C**:
  - Crushed ROCK FILL (Had to set casing to keep borehole open, Borings B-1A and B-1C separated by 10'. Intermediate Boring B-1B caved to about 4' and was abandoned. Boring B-1C was drilled by auger and terminated at 10.5'.)

- **-2.5 M/S**:
  - Stiff tan and gray clayey fine sandy SILT with some sandy lenses and layers

- **-5 CL**:
  - Very stiff tan and gray sandy silty CLAY and silty sandy CLAY with sandy layers and lenses

- **-12.5 M/S**:
  - Dense gray with tan silty fine SAND to very stiff fine sandy SILT

- **-15 CL**:
  - Hard to stiff gray with tan sandy silty CLAY to silty sandy CLAY with sandy layers and lenses. (Sample at 25' was noticeably more sandy than samples above, some red mottling below about 20').

**BORING TERMINATED AT 25.5'**

SOUTHWESTERN LABORATORIES
# LOG OF BORING

**PROJECT:** PINE BLUFF ARSENAL SANITARY LANDFILL EXTENSION  
**BORING NO.:** B-2  
**CLIENT:** PINE BLUFF ARSENAL  
**LOCATION:** PINE BLUFF, AR.  
**DATE:** 3-25-80  
**TYPE:** WASH  
**SWL JOB NO.:** 80036 S

---

**DEPTH IN FEET** | **SYMBOL** | **SAMPLE** | **STANDARD PENETRATION BLOWS/FT.** | **CORE DATA (REC/ROD)** | **LEGEND:** NR= NO RECOVERY  
--- | --- | --- | --- | --- | ---  
0 |  |  |  |  |  
2.5 |  |  |  |  |  
5 |  |  |  |  |  
7.5 |  |  |  |  |  
10 |  |  |  |  |  
12.5 | SMML | NR | 25 |  |  
15 |  |  |  |  |  
17.5 |  |  |  |  |  
20 |  |  |  |  |  
22.5 | SM/ML | NR | 45 |  |  
25 |  |  |  |  |  

---

**WATER INFORMATION**  
Drilling fluid at 1.7' at completion and at 2' after 2 hours.

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**DESCRIPTION OF STRATUM**

- **2.5'**  
  Crushed ROCK VENEER  
  Stiff tan and brownish gray silty fine sandy CLAY with sandy layers

- **5'**  
  Stiff to very stiff tan and gray silty fine sandy CLAY and sandy very silty CLAY with sandy layers and lenses

- **12.5'**  
  Very firm tan and gray silty fine SAND to very stiff fine sandy SILT

- **15'**  
  Stiff to very stiff gray and tan silty sandy CLAY with sandy layers and lenses (some red mottling below about 20')

- **25'**  
  Dense gray and orange silty fine SAND to hard fine sandy SILT.

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**BORING TERMINATED AT 25.5'**  
**SOUTHWESTERN LABORATORIES**
### SUMMARY OF LABORATORY TEST DATA

**PROJECT**
PINE BLUFF ARSENAL SANITARY LANDFILL EXTENSION
PINE BLUFF, ARKANSAS
SWL JOB NO. 80036 S

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>DEPTH IN FEET</th>
<th>TYPE OF MATERIAL (SEE LOG OF BORING)</th>
<th>MOISTURE CONTENT %</th>
<th>DRY DENSITY DCF</th>
<th>ATTERBERG LIMITS LL</th>
<th>STRAIN %</th>
<th>LATERAL Pressures psi</th>
<th>COMPRESSION TESTS</th>
<th>OTHER TESTS</th>
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<td>21.5</td>
<td>24.6</td>
<td>21</td>
<td>19</td>
<td>2</td>
<td></td>
<td>See PERMEABILITY 82.1% Pass No. 200</td>
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<td>9-10.5</td>
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<td></td>
<td>16.7</td>
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<td>17</td>
<td>29</td>
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<td>B-1A</td>
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<td></td>
<td></td>
<td>16.6</td>
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<td>55.6% Pass No. 200</td>
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<td>14-15.5</td>
<td>(REMOLED)</td>
<td>21.8</td>
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<td>10.4</td>
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<td>19</td>
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<td>18.1</td>
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<td>24-25.5</td>
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SOUTHWESTERN LABORATORIES
# REPORT OF CONSTANT HEAD PERMEABILITY TESTS

**PINE BLUFF ARSENAL SANITARY LANDFILL EXTENSION**

**PINE BLUFF, ARKANSAS**

**SWL JOB NO. 80036 S**

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>DEPTH (FEET)</th>
<th>MOISTURE (PERCENT)</th>
<th>DRY DENSITY (PCF)</th>
<th>PRESSURE (PSI)</th>
<th>COEFFICIENT OF PERMEABILITY (CM./SEC.)</th>
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<tbody>
<tr>
<td>B-1C</td>
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<td>95.3</td>
<td>20</td>
<td>5.9 x 10^{-9}</td>
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<td>B-1A (REMOLED)</td>
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<td>21.8</td>
<td>101.0</td>
<td>2</td>
<td>3.3 x 10^{-5}</td>
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<td>B-2</td>
<td>9-10.5</td>
<td>10.4</td>
<td>110.3</td>
<td>10</td>
<td>2.7 x 10^{-7}</td>
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<td>21.5-23</td>
<td>18.1</td>
<td>102.4</td>
<td>30</td>
<td>4.5 x 10^{-8}</td>
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</table>

PERMEABILITY TESTS PERFORMED BY SOUTHWESTERN LABORATORIES' ARLINGTON, TEXAS OFFICE