NSP SHERBURNE COUNTY GENERATING PLANT

BOTTOM ASH POND REVISIONS

BECKER, MINNESOTA

LABORATORY #9-1357
December 22, 1982

Northern States Power Company
Attn: Roger B Anderson
414 Nicollet Mall
7th Floor - Plant Eng & Const
Minneapolis, MN  55401

Gentlemen:

Subj: NSP Sherburne County Generating Plant
      Bottom Ash Pond Revisions
      Becker, Minnesota
      Laboratory #9-1357

We have completed our testing work for the Bottom Ash Pond Revisions.
Our final report is attached. Copies of the report are being sent as
noted below. This work was performed under your Purchase Order
#A82926CT.

We appreciate having had the opportunity to work with you on
this project. If you have any questions, please contact us.

Very truly yours,

Dale Britzies,
Civil Engineer

Thomas B Flick, P.E.
Manager, Soils & Geology Dept

DB/TBF/fm
cc: 1-Black & Veatch Consulting Eng
    Attn: Larry Almaleh
OBSERVATIONS AND TEST PROGRAM
BOTTOM ASH POND REVISION
SHERBURN COUNTY GENERATING PLANT
BECKER, MINNESOTA
LABORATORY #9-1357

INTRODUCTION

This report concerns the observations and testing we performed during the recent revisions to the bottom ash pond at Northern States Power Company's Sherburne County Generating Plant in Becker, Minnesota. Our work was performed in accordance with your Purchase Order No A82926CT.

The scope of our recent involvement consisted of:

1. Performing field observations at the borrow area and laboratory testing to judge if the imported cohesive fill materials were in compliance with the project specifications.

2. Performing field observations and compaction testing to document that the embankment and clay core fill materials were placed in accordance with the project specifications.

3. Performing laboratory testing to determine the permeability of undisturbed samples removed from the compacted clay core.

4. Performing laboratory testing to determine if the Type I filter material was in compliance with the project specifications.
PROJECT INFORMATION

The recent construction consisted of completing the northeast portion of the dike around the existing bottom ash pond. This portion of the dike was originally left at a lower elevation than the remainder of the dike around the pond. Final top of dike elevation in this area will be at elevation 1000'. The lowest portion of the existing dike was approximately elevation 975' prior to the start of the recent construction.

The central core of the dike extension will consist of an impervious clay core having a minimum thickness of 10'. The project specifications require that the material used to construct the clay core consist of a material classified as either a CL, CL-SC or an SC-CL. The cohesive material is to be compacted to at least 90% of ASTM:D1557 (Modified Proctor). The moisture content of the cohesive fill at the time of placement must be in the range of 0-5% over optimum moisture content. The clay is to be obtained from an off-site borrow source designated by Northern States Power Company.

The remainder of the dike is to consist primarily of on-site granular fill materials. These sand fill materials are to be compacted to at least 95% of ASTM:D1557 (Modified Proctor).

There is an existing filter blanket present beneath the outer half of the existing dike. Since the revisions in the northeast portion of the dike will include increasing the width of the dike base, the filter blanket will also be extended outward to the toe of the new embankment. The filter blanket material is to consist of Type I material with a minimum thickness of 1 1/2'. The filter material present at the very toe of the embankment is to consist of Type II filter material.

Parallel to the toe of the new embankment, a drainage ditch is to be constructed. This ditch is to be lined with an 18" impervious blanket consisting of material similar to that used for the clay core, although an SC material could also be used in this area. The impervious blanket in the drainage ditch is to be compacted to at least 100% of the Modified Proctor density.
OBSERVATION METHODS AND RESULTS

Initial Preparation
Between August 13 and October 15, 1982, we were present at the site on a full-time basis to observe and monitor construction operations during the dike revision. Initially, we documented that the contractor removed all surficial vegetation from the embankment, and also all granular materials and the remains of a roadway from above the existing impervious clay core. The surface of the existing clay core was subsequently scarified and re-compacted using a large sheepfoot compactor. Listed below are the elevations at which the impervious clay core was exposed at representative locations prior to the start of recent fill placement:

<table>
<thead>
<tr>
<th>Location</th>
<th>Top of Existing Clay Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>East dike-coordinate 865, 700</td>
<td>Elevation 985'</td>
</tr>
<tr>
<td>East dike-coordinate 865, 600</td>
<td>Elevation 993'</td>
</tr>
<tr>
<td>East dike-coordinate 865, 800</td>
<td>Elevation 974'</td>
</tr>
<tr>
<td>North dike-coordinate 2, 028, 900</td>
<td>Elevation 978'</td>
</tr>
<tr>
<td>North dike-coordinate 2, 028, 800</td>
<td>Elevation 984'</td>
</tr>
<tr>
<td>North dike-coordinate 2, 028, 700</td>
<td>Elevation 991'</td>
</tr>
</tbody>
</table>

After completion of the preparatory operations, we observed that the width of the existing clay core was approximately 13' to 15'. The existing core was generally centered along the centerline of the dike. However, on the east dike near coordinate 865, 700, the existing clay core was off-set about 3 1/2' east from the centerline of the dike.

Cohesive Fill Importation
The contractor elected to import and construct an on-site stockpile of the clay fill material needed for the impervious clay core early in the job. During excavation of cohesive material, we provided an engineer at the borrow pit to visually and manually classify the soil and provide judgements regarding the material's suitability. Those materials classified as either CL, SC-CL, or CL-SC were approved for importation to the site.
OBSERVATION METHODS AND RESULTS

(Cont.)

To assist NSP's field engineers in their determination of material quantities, we performed random field density tests of the undisturbed clay borrow materials. The densities averaged 100pcf. In addition, we performed field density tests in the materials stockpiled at the project site to obtain data regarding the field density in a loose stockpiled condition, similar to the density the soil would have in a truck. The densities of the material in the loose condition averaged 77 pcf. We have attached a data sheet summarizing our field density tests in the borrow and stockpile areas.

Impervious Core Construction

During placement of the cohesive fill materials within the impervious core, we performed observations and documented that no granular fill materials became trapped within the new clay core. We also documented that those portions of the cohesive fill which became unacceptably dry were removed from the core area prior to placement of the succeeding lifts of cohesive fill. We observed that the cohesive fill was placed in maximum 8" thick layers, and that a large sheepfoot compactor was utilized to thoroughly compact these materials prior to placement of additional fill. We documented that the width of the new core was at least 10'-12'.

During compaction of the cohesive fill materials, a series of field density tests were performed. These tests were performed at about 2' vertical intervals at representative locations within the new construction. The tests were performed utilizing the sand cone method, and the field density results were evaluated on the basis of ASTM:D1557 (Modified Proctor). Attached to this report are data sheets regarding each of the field compaction tests, as well as summary sheets including pertinent information about these density tests.

Based on the results of our recent testing, it is our opinion the clay core fill materials were placed and compacted in compliance with the project specifications.
OBSERVATION METHODS AND RESULTS
(Cont.)

Embarkment Fill Construction
We were also present at the site on a full-time basis during the compaction and placement of the embankment fill materials adjacent to the clay core. Prior to fill placement, we observed that all surficial vegetation was removed from the existing embankments, and that the exposed granular materials were surface compacted. The existing embankment consisted primarily of sands and silty sands which would be classified as either SM or SP-SM. During placement of the new fill materials, we documented that the existing embankment face was terraced so that the new fill materials could be placed in relatively horizontal lifts.

During placement of the embankment fill materials, we performed a series of field density tests to document the effectiveness of the compaction procedures. Again, the compaction tests were evaluated on the basis of ASTM:D1557. Most of the on-site sands were very dry. It was necessary for the contractor to wet down these soils prior to compacting them in order to obtain the specified density.

Data sheets regarding each of the field density tests as well as a summary sheet indicating pertinent information regarding our tests of the granular embankment fill materials are attached. Based on this data, it is our opinion the embankment fill materials were placed and compacted in general compliance with the project specifications.

Permeability Testing
During placement and compaction of the impervious clay core, we obtained four undisturbed samples of the compacted cohesive fill materials. As indicated by the project specifications, two of these undisturbed samples were obtained after approximately 15% of the cohesive fill material had been placed. The remaining two samples were obtained after approximately 80-85% of the fill materials had been placed. The remaining two samples were obtained in accordance with ASTM procedure D1587. The 3" diameter thinwall tube samples were
OBSERVATION METHODS AND RESULTS

(Cont.)

then submitted to the laboratory, where they were extruded, and subjected to Falling Head permeability tests.

The samples were subjected to a maximum test head of 10', with a confining pressure 2 psi greater than the test head. In addition, the density and plasticity index of each of the samples were determined in the laboratory. The laboratory test results are indicated on the attached data sheet.

A review of the data suggests the permeability rates vary from $10^{-6}$ to about $10^{-8}$ cm/sec. The initial two samples, which consisted of CL type material, had permeability rates of $10^{-8}$ range. The final tube samples, obtained from the upper portions of the clay core, consisted of a mixture of sandy clay and clayey sand. The permeability of this material was considerably faster, in the range of $10^{-6}$.

Filter Blanket Material
During our involvement, we also observed that the existing filter blanket beneath the outer portions of the existing embankment was extended to the toe of the new embankment prior to the placement of the embankment fill materials. The results of our laboratory gradation indicated the filter material was in compliance with the specified Type I material.

Drainage Ditch Line
At the time of our involvement terminated this fall, the drainage ditch at the toe of the embankment had not been completed and the Type II filter materials had not been placed in the specified area near the toe of the new embankment. We have observed the cohesive fill materials imported into the drainage ditch area, and it is our opinion these materials comply with the project specifications. Based on our recent conversations with Roger Anderson of NSP, we understand that no additional testing will be required in this area.
COMPACITION TESTS

CLAY CORE
**REPORT OF:** DENSITY TESTS OF COMPACTED FILL

**PROJECT:** NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN

**REPORTED TO:** Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

**DATE:** August 24, 1982

**COPY TO:**
1-C S McCrossan Inc
1-Black & Veatch Consulting Engr
Attn: Larry Almarch
P O Box 8405
Kansas City, MO 64114

**LABORATORY No.** 9-1292

<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>DATE TAKEN</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>August 17, 1982</td>
<td>Sandy clay, trace of gravel, a little gravel</td>
</tr>
<tr>
<td>C-2</td>
<td>August 17, 1982</td>
<td>Sandy clay, trace of gravel, a little gravel</td>
</tr>
<tr>
<td>C-3</td>
<td>August 17, 1982</td>
<td>Sandy clay, trace of gravel, a little gravel</td>
</tr>
<tr>
<td>C-4</td>
<td>August 17, 1982</td>
<td>Sandy clay, trace of gravel, a little gravel</td>
</tr>
</tbody>
</table>

**LOCATION:**

- East dike, existing clay core, coordinate N 866,120
- East dike, existing clay core, coordinate N 866,000
- East dike, existing clay core, coordinate N 865,800
- North dike, existing clay core, coordinate E 2,028,810

**ELEVATION OF TEST:**

- 976'
- 973'
- 974'
- 984'

**DEPTH BELOW EXISTING GRADE:**

- 6''
- 6''
- 6''
- 6''

**FIELD DENSITY DETERMINATION:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (- #4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density (pcf)</td>
<td>115 119 124 124</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>11.1 14.3 11.7 11.1</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>5 9 5 8</td>
</tr>
</tbody>
</table>

**LABORATORY MOISTURE-DENSITY RELATION OF SOIL:**

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>126.0 126.0 126.0 126.0</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>11.3 11.3 11.3 11.3</td>
</tr>
</tbody>
</table>

**COMPACTION TEST RESULTS:**

<table>
<thead>
<tr>
<th>Compaction (%)</th>
<th>Specified Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>91</td>
<td>90</td>
</tr>
<tr>
<td>94.5</td>
<td>90</td>
</tr>
<tr>
<td>99</td>
<td>90</td>
</tr>
</tbody>
</table>

**ATTENTION:** Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested. The test locations and number of tests were selected by Twin City Testing and Engineering Laboratory Inc.

Twin City Testing and Engineering Laboratory, Inc.

SG-225 (81-A)
REPORT OF:  DENSITY TESTS OF COMPACTED FILL

NSP SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
REPORTED TO:
Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: August 24, 1982
Copies To:
1-C S McCrossan Inc
1-Black & Veatch Consulting Engr
Attn: Larry Almarch
P O Box 8405
Kansas City, MO 64114

LABORATORY No. 9-1292

TEST NUMBER: C-5 C-6 C-7

DATE TAKEN: August 18, 1982 August 18, 1982 August 18, 1982

UNIFIED SOIL CLASSIFICATION:
(Sandy clay, Sandy clay, Sandy clay,
a little gravel, a little gravel, trace of gravel,
brown (SC-CL)-2 brown (SC-CL)-2 brown (SC-CL)-2

LOCATION:
East dike, East dike, East dike,
clay core, clay core, clay core,
coordinate N coordinate N coordinate N
866,100 866,000 865,850

ELEVATION OF TEST:
977.5' 975' 975.5'

DEPTH BELOW EXISTING GRADE:
6" 6" 6"

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)
Dry Density (pcf) 115 115 115
Moisture Content (%) 14.0 12.4 13.0
Plut #4 Material (%) 8 6 4

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 126.0 126.0 126.0
Optimum Moisture (%) 11.3 11.3 11.3

COMPACATION TEST RESULTS:
Compaction (%) 91 91 91
Specified Compaction (%) 90 90 90

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested. The test
locations and number of tests were selected by Twin City Testing and
Engineering Laboratory Inc.

SG-225 (81-A)
REPORT OF: DENSITY TESTS OF COMPACTED FILL

NSP SHERBINE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN

REPORTED TO:
Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE:
August 24, 1982

DIRECT TO:
I-C S McCrossan Inc
1-Black & Veatch Consulting Engr
P O Box 8405
Kansas City, MO 64114

LABORATORY No. 9-1292

TEST NUMBER:
C-8 C-9 C-10 C-11

DATE TAKEN:
August 19, 1982 August 19, 1982 August 19, 1982 August 19, 1982

UNIFIED SOIL CLASSIFICATION:
Sandy clay, Sandy clay, Sandy clay, Sandy clay, trace of gravel, trace of gravel, trace of gravel, trace of gravel, brown (SC)-4 brown (SC)-4 brown (SC)-4 brown (SC)-4

(Moisture-Density Sample Number)

LOCATION:
East dike, East dike, East dike, East dike, clay core, clay core, clay core, clay core, coordinate N coordinate N coordinate N coordinate N 866,130 866,050 865,850 865,700

ELEVATION OF TEST:
979' 979' 976.5' 988.5'

DEPTH BELOW EXISTING GRADE:
1' 1' 1' 1'

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (+ #4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density (pcf)</td>
<td>116 123 123 117</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>14.3 12.4 12.3 13.3</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>5 4 3 4</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>123.9 123.9 123.9 123.9</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>11.2 11.2 11.2 11.2</td>
</tr>
</tbody>
</table>

COMPACATION TEST RESULTS:

| Compaction (%) | 93.5 99 99 94.5 |
| Specified Compaction (%) | 90 90 90 |

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested. The test locations and number of tests were selected by Twin City Testing and Engineering Laboratory Inc.

Twin City Testing and Engineering Laboratory, Inc.

By D.

SG-225 (81-A)
REPORT OF:  DENSITY TESTS OF COMPACTED FILL
NSP SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN

REPORTED TO:  Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE:  August 24, 1982
COPIES TO:  1-C S McCrossan Inc
            1-Black & Veatch Consulting Engr
            Attn: Larry Almack
            P O Box 8405
            Kansas City, MO 64114

LABORATORY No.  9-1292

TEST NUMBER:  C-12  C-13

DATE TAKEN:  August 19, 1982  August 19, 1982

UNIFIED SOIL CLASSIFICATION:  Sandy clay, a little gravel,
(Moisture-Density Sample Number)  brown (SC)-4  Sandy clay, a little gravel,
                                      brown (SC)-4

LOCATION:  North dike, clay core,
coordinate E 2,028,950  North dike, clay core,
coordinate E 028,800

ELEVATION OF TEST:  979'  985'

DEPTH BELOW EXISTING GRADE:  10''  10''

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density In Place by Sand-Cone Method, ASTM: D1556-64 (-%4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>(pcf)  120  123</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>(% )  11.7  11.7</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>(% )  7   6</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density</td>
<td>(pcf) 123.9  123.9</td>
</tr>
<tr>
<td>Optimum Moisture</td>
<td>(% )  11.2  11.2</td>
</tr>
</tbody>
</table>

COMPACTION TEST RESULTS:

| Compaction | 97  99                        |
| Specified Compaction | 90  90                      |

ATTENTION:  Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested.

Twin City Testing and Engineering Laboratory, Inc.

By  Dale Perlman

SG-225 (81-A)
# REPORT OF: DENSITY TESTS OF COMPACTED FILL

**PROJECT:** SHERBURN COUNTY GENERATING PLANT
**BOTTOM ASH POND REVISIONS**
**BECKER, MN**

**REPORTED TO:** Northern States Power Co
**Attn:** Roger Anderson
**414 Nicollet Mall**
**Minneapolis, MN 55401**

**DATE:** August 31, 1982
**COPIES TO:**
1-C S McCrossan Inc
Attn: Larry Almarch
P O Box 8405
Kansas City, MO 64114

**LABORATORY No.** 9-1292

<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>C-14</th>
<th>C-15</th>
<th>C-16</th>
<th>C-17</th>
</tr>
</thead>
</table>

**DATE TAKEN:**
August 26, 1982

**UNIFIED SOIL CLASSIFICATION:**
Sandy clay, Sandy clay, Sandy clay, Sandy clay,
trace of gravel, a little gravel, trace of gravel, trace of gravel,
brown (SC-CL)-4 brown (SC-CL)-4 brown (SC-CL)-4 brown (SC-CL)-4

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>East dike, clay core, coordinate N865,900</th>
<th>East dike, clay core, coordinate N866,000</th>
<th>North dike, clay core, coordinate E2,028,900</th>
<th>North dike, clay core, coordinate E2,028,800</th>
</tr>
</thead>
</table>

**ELEVATION OF TEST:**
980' 980.5' 981.5' 984'

**DEPTH BELOW EXISTING GRADE:**
8" 8" 8" 8"

**FIELD DENSITY DETERMINATION:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density (pcf)</td>
<td>124</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>10.8</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>5</td>
</tr>
</tbody>
</table>

**LABORATORY MOISTURE-DENSITY RELATION OF SOIL:**

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>123.9</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>11.2</td>
</tr>
</tbody>
</table>

**COMPACITION TEST RESULTS:**

| Compaction (%) | 100 | 91.5 | 101 | 99 |
| Specified Compaction (%) | 90 | 90 | 90 | 90 |

**ATTENTION:** Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: September 2, 1982

DATE TAKEN: August 30, 1982

UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Sandy clay, Sandy clay, Sandy clay, Sandy clay,
a little gravel, trace of gravel, a little gravel, trace of gravel,
brown (SC-CL)-4 brown (SC-CL)-4 brown (SC-CL)-4 brown (SC-CL)-4

LOCATION:
East dike,
clay core,
coordinate
N865,900

982.0'

1'

FIELD DENSITY DETERMINATION:

Method Density in Place by Sand-Cone Method, ASTM: D1556:64 (-# Basis)
Dry Density (pcf) 116 117 122 115
Moisture Content (%) 13.0 12.7 13.0 12.7
Plus #4 Material (%) 9 4 10 4

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 123.9 123.9 123.9 123.9
Optimum Moisture (%) 11.2 11.2 11.2 11.2

COMPACATION TEST RESULTS:
Compaction (%) 94 95 99 93
Specified Compaction (%) 90 90 90 90

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested.

Twin City Testing and Engineering Laboratory, Inc.
By Dale Britton

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**REPORT OF:** DENSITY TESTS OF COMPACTED FILL

**PROJECT:** NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

**REPORTED TO:** Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

**DATE:** October 11, 1982
**COPIES TO:** 1-C S McCrossan
1-Black & Veatch Consulting Eng
Attn: Larry Almalch

---

**LABORATORY No.** 9-1357

**TEST NUMBER:**
- C-22
- C-23
- C-24
- C-25

**DATE TAKEN:**
- Sept 10,1982
- Sept 10,1982
- Sept 10,1982
- Sept 10,1982

**UNIFIED SOIL CLASSIFICATION:**
- Sandy clay, trace of gravel, brown (SC-CL)-4
- Sandy clay, trace of gravel, brown (SC-CL)-4
- Sandy clay, trace of gravel, brown (SC-CL)-4
- Sandy clay, trace of gravel, brown (SC-CL)-4

**LOCATION:**
- East dike coordinate
  - N865,850
- East dike coordinate
  - N866,000
- North dike coordinate
  - E2,029,010
- North dike coordinate
  - E2,028,700

**ELEVATION OF TEST:**
- 984.5'
- 985.5'
- 986'
- 987'

**DEPTH BELOW EXISTING GRADE:**
- 1'
- 1'
- 1'
- 1'

**FIELD DENSITY DETERMINATION:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density (pcf)</td>
<td>123</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>12.4</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>128</td>
</tr>
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<td>14.3</td>
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<tr>
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<td>7</td>
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<td></td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

**LABORATORY MOISTURE-DENSITY RELATION OF SOIL:**

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>123.9</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>123.9</td>
</tr>
<tr>
<td></td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>128.3</td>
</tr>
<tr>
<td></td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>128.3</td>
</tr>
<tr>
<td></td>
<td>11.0</td>
</tr>
</tbody>
</table>

**COMPACATION TEST RESULTS:**

| Compaction (%) | 99 |
| Specified Compaction (%) | 90 |
|                   | 94.5 |
|                   | 99.5 |

**ATTENTION:** Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.

---

**AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL**

---

Twin City Testing and Engineering Laboratory, Inc.

By [Signature]
REPORT OF:  DENSITY TESTS OF COMPACTED FILL  

NSP SHERBURNE COUNTY GENERATING PLANT  
BOTTOM ASH POND REVISIONS  
BECKER, MINNESOTA  

REPORTED TO:  Northern States Power Co  
Attn: Roger Anderson  
414 Nicollet Mall  
Minneapolis, MN 55401  

DATE:  October 11, 1982  

DATE TAKEN:  
Sept 16, 1982  
Sept 16, 1982  
Sept 16, 1982  
Sept 17, 1982  

UNIFIED SOIL CLASSIFICATION:  
(Moisture-Density Sample Number)  
Sandy clay,  
trace of gravel, brown  
(SC-CL)-4  
Sandy clay,  
trace of gravel, brown  
(SC-CL)-4  
Sandy clay,  
a little gravel, brown  
(SC-CL)-4  
Sandy clay,  
trace of gravel, brown  
(SC-CL)-4  

LOCATION:  
East dike coordinate  
N865,850  
East dike coordinate  
N866,000  
East dike coordinate  
N865,900  
East dike coordinate  
N866,050  

ELEVATION OF TEST:  
987'  
988'  
989'  
990'  

DEPTH BELOW EXISTING GRADE:  
1'  
1'  
1'  
1'  

FIELD DENSITY DETERMINATION:  

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (-4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>124</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>12.4</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>112.5</td>
</tr>
<tr>
<td></td>
<td>124</td>
</tr>
<tr>
<td></td>
<td>5</td>
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<td>7</td>
</tr>
<tr>
<td></td>
<td>115</td>
</tr>
<tr>
<td></td>
<td>124</td>
</tr>
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<td></td>
<td>11.1</td>
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<td></td>
<td>12.4</td>
</tr>
<tr>
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<td>7</td>
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<td>11.7</td>
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<td>123.9</td>
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</tr>
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</tr>
<tr>
<td></td>
<td>11.2</td>
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<td></td>
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<td></td>
<td>11.2</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:  

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>123.9</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>11.2</td>
</tr>
</tbody>
</table>

COMPACCTION TEST RESULTS:  

| Compaction (%) | 100 |
| Specified Compaction (%) | 90 |

ATTENTION:  Density tests are valid at the location and elevation of the test only.  No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.

Twin City Testing and Engineering Laboratory, Inc.

By  [Signature]
**REPORT OF:** DENSITY TESTS OF COMPACTED FILL

**PROJECT:** NSP SHERBURRE COUNTY GENERATING PLANT BOTTOM ASH POND REVISIONS BECKER, MINNESOTA

**REPORTED TO:** Northern States Power Co Attn: Roger Anderson 414 Nicollet Mall Minneapolis, MN 55401

**DATE:** October 11, 1982

**COPIES TO:** 1-C S McCrossan 1-Black & Veatch Consulting Eng Attn: Larry Almalich

**LABORATORY No.:** 9-1357

<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>C-30</th>
<th>C-31</th>
<th>C-32</th>
<th>C-33</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIFIED SOIL CLASSIFICATION</td>
<td>Sandy clay, a little gravel, brown (SC-CL)-4</td>
<td>Sandy clay, a little gravel, brown (CL)-1</td>
<td>Sandy clay, a little gravel, brown (SC-CL)-4</td>
<td>Sandy clay, a little gravel, brown (SC-CL)-4</td>
</tr>
<tr>
<td>LOCATION</td>
<td>North dike coordinate</td>
<td>North dike coordinate</td>
<td>East dike coordinate</td>
<td>East dike coordinate</td>
</tr>
<tr>
<td>Elevation</td>
<td>987'</td>
<td>988'</td>
<td>991'</td>
<td>992'</td>
</tr>
<tr>
<td>Depth Below Existing Grade</td>
<td>1'</td>
<td>1'</td>
<td>1'</td>
<td>1'</td>
</tr>
<tr>
<td>FIELD DENSITY DETERMINATION</td>
<td>Density in Place by Sand-Cone Method, ASTM: D1556-64 (- #4 Basis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Density (pcf)</td>
<td>116</td>
<td>125</td>
<td>116</td>
<td>123</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>14.5</td>
<td>14.5</td>
<td>13.3</td>
<td>14.3</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>LABORATORY MOISTURE-DENSITY RELATION OF SOIL: ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>123.9</td>
<td>128.3</td>
<td>123.9</td>
<td>123.9</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>11.2</td>
<td>11.0</td>
<td>11.2</td>
<td>11.2</td>
</tr>
<tr>
<td>COMPACTION TEST RESULTS:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compaction (%)</td>
<td>94</td>
<td>95</td>
<td>94</td>
<td>99</td>
</tr>
<tr>
<td>Specified Compaction (%)</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
</tbody>
</table>

**ATTENTION:** Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: October 11, 1982
COPIES TO: 1-C S McCrossan
1-Black & Veatch Consulting Eng
Attn: Larry Almalch

LABORATORY No. 9-1357

TEST NUMBER: C-34 C-35 C-36 C-37


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Sandy clay, Sandy clay, Sandy clay, Sandy clay,
a little gravel, brown a little gravel, brown a little gravel, brown a little gravel,

LOCATION:
East dike coordinate
N865,800

East dike coordinate
N866,000

East dike coordinate
N865,850

East dike coordinate
N866,000

ELEVATION OF TEST:
993' 994' 994.5' 995'

DEPTH BELOW EXISTING GRADE:
1' 1' 1' 1'

FIELD DENSITY DETERMINATION:

Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (- #4 Basis)
Dry Density (pcf) 122 115 121.5 114
Moisture Content (%) 13.0 11.1 13.3 13.0
Plus #4 Material (%) 8 6 8

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 123.9 123.9 123.9 123.9
Optimum Moisture (%) 11.2 11.2 11.2 11.2

COMPACTION TEST RESULTS:

Compaction (%) 98.5 93 98 92.5
Specified Compaction (%) 90 90 90 90

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested.
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURNE COUNTY GENERATING PLANT BOTTOM ASH POND REVISIONS BECKER, MINNESOTA

REPORTED TO: Northern States Power Co Attn: Roger Anderson 414 Nicollet Mall Minneapolis, MN 55401

DATE: October 11, 1982

LABORATORY No. 9-1357

TEST NUMBER: C-38 C-39

DATE TAKEN: Sept 21, 1982 Sept 21, 1982

UNIFIED SOIL CLASSIFICATION: Sandy clay, Sandy clay,
a little gravel, a little gravel,
brown (CL)-2 brown (CL)-2

LOCATION: North dike coordinate North dike coordinate
E2,028,880 E2,029,000

ELEVATION OF TEST: 989.5' 991'

DEPTH BELOW EXISTING GRADE: 1' 1'

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (pcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>124</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>12.7</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density</td>
<td>126.0</td>
</tr>
<tr>
<td>Optimum Moisture</td>
<td>11.3</td>
</tr>
</tbody>
</table>

COMPACITION TEST RESULTS:

<table>
<thead>
<tr>
<th>Compaction (%)</th>
<th>Specified Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>98.5</td>
<td>96</td>
</tr>
<tr>
<td>90</td>
<td>90</td>
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</tbody>
</table>

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SG-225 (81-A)
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: October 11, 1982

LABORATORY No. 9-1357

TEST NUMBER: C-40 C-41 C-42 C-43


UNIFIED SOIL CLASSIFICATION:
(Sandy clay, Sandy clay, Sandy clay, Sandy clay,
trace of gravel, brown trace of gravel, brown trace of gravel, brown trace of gravel,

LOCATION:
East dike East dike East dike East dike
coordinate coordinate coordinate coordinate
N866,120 N866,000 N865,850 N865,800

ELEVATION OF TEST:
994' 994' 995' 996'

DEPTH BELOW EXISTING GRADE:
1' 1' 1' 1'

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>112.5</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>13.0</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>122</td>
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<td>123</td>
</tr>
<tr>
<td></td>
<td>12.7</td>
</tr>
<tr>
<td></td>
<td>12.4</td>
</tr>
<tr>
<td></td>
<td>12.7</td>
</tr>
<tr>
<td></td>
<td>6</td>
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<tr>
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<td>1</td>
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<td>1</td>
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<td>1</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density</td>
<td>123.9</td>
</tr>
<tr>
<td>Optimum Moisture</td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>123.9</td>
</tr>
<tr>
<td></td>
<td>123.9</td>
</tr>
<tr>
<td></td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>11.2</td>
</tr>
</tbody>
</table>

COMPACATION TEST RESULTS:

| Compaction (%) | 91      | 90.5   | 99     | 98.5  |
| Specified Compaction (%) | 90     | 90     | 90     | 90    |

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
# REPORT OF: DENSITY TESTS OF COMPACTED FILL

**PROJECT:** NSP SHERBURNE COUNTY GENERATING PLANT  
**LOCATION:** BECKER, MINNESOTA  
**REPORTED TO:** Northern States Power Co  
**DATE:** October 11, 1982  
**copies to:** 1-C S McCrossan  
**Attn:** Roger Anderson  
**Copies to:** 1-Black & Veatch Consulting Eng  
**414 Nicollel Mall**  
**Attn:** Larry Almarch  
**Minneapolis, MN 55401**

<table>
<thead>
<tr>
<th>LABORATORY No.</th>
<th>9-1357</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TEST NUMBER:</strong></td>
<td>C-44, C-45, C-46, C-47</td>
</tr>
<tr>
<td><strong>UNIFIED SOIL CLASSIFICATION:</strong></td>
<td>Sandy clay, a little gravel, brown (SC-CL)-4, Sandy clay, a little gravel, brown (SC-CL)-4, Sandy clay, a little gravel, brown (SC-CL)-4, Sandy clay, a little gravel, brown (SC-CL)-4</td>
</tr>
<tr>
<td><strong>LOCATION:</strong></td>
<td>East dike coordinate, East dike coordinate, East dike coordinate, North dike coordinate</td>
</tr>
<tr>
<td><strong>ELEVATION OF TEST:</strong></td>
<td>997', 997', 995', 993'</td>
</tr>
<tr>
<td><strong>DEPTH BELOW EXISTING GRADE:</strong></td>
<td>1', 1', 1', 1'</td>
</tr>
<tr>
<td><strong>FIELD DENSITY DETERMINATION:</strong></td>
<td>Density in Place by Sand-Conc Method, ASTM: D1556-64 (-#4 Basis)</td>
</tr>
<tr>
<td><strong>Dry Density (pcf)</strong></td>
<td>120, 119, 117, 112</td>
</tr>
<tr>
<td><strong>Moisture Content (%)</strong></td>
<td>12.4, 12.4, 11.1, 12.4</td>
</tr>
<tr>
<td><strong>Plus #4 Material (%)</strong></td>
<td>6, 10, 9, 7</td>
</tr>
<tr>
<td><strong>LABORATORY MOISTURE-DENSITY RELATION OF SOIL:</strong></td>
<td>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</td>
</tr>
<tr>
<td><strong>Maximum Dry Density (pcf)</strong></td>
<td>123.9, 123.9, 123.9, 123.9</td>
</tr>
<tr>
<td><strong>Optimum Moisture (%)</strong></td>
<td>11.2, 11.2, 11.2, 11.2</td>
</tr>
<tr>
<td><strong>COMPACION TEST RESULTS:</strong></td>
<td>Compaction, Specified Compaction</td>
</tr>
<tr>
<td><strong>Compaction (%)</strong></td>
<td>97, 96, 94.5, 90.5</td>
</tr>
<tr>
<td><strong>Specified Compaction (%)</strong></td>
<td>90, 90, 90, 90</td>
</tr>
</tbody>
</table>

**ATTENTION:** Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.

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Twin City Testing and Engineering Laboratory, Inc.

SG-225 (81-A)
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

DATE: October 11, 1982

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

LABORATORY No. 9-1357

TEST NUMBER: C-48
C-49

DATE TAKEN: Sept 24, 1982
Sept 24, 1982

UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Sandy clay,
a little gravel,
brown (SC-CL)-4
Sandy clay,
a little gravel,
brown (SC-CL)-4

LOCATION:
North dike
coordinate
E2,029,000
North dike
cordinate
E2,028,800

ELEVATION OF TEST: 994.5'
996'

DEPTH BELOW EXISTING GRADE: 1'
1'

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density (pcf)</td>
<td>118.5</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>14.3</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>120.5</td>
</tr>
<tr>
<td></td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>123.9</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
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</tr>
<tr>
<td></td>
<td>123.9</td>
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<tr>
<td></td>
<td>11.2</td>
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</tbody>
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COMPACATION TEST RESULTS:

<table>
<thead>
<tr>
<th>Compaction (%)</th>
<th>96</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specified Compaction (%)</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>97.7</td>
</tr>
</tbody>
</table>

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
COMPACTION TESTS

EMBANKMENT
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURNE COUNTY GENERATING PLANT
          BOTTOM ASH POND REVISIONS
          BECKER, MN

REPORTED TO: Northern States Power Co
             Attn: Roger Anderson
             414 Nicollet Mall
             Minneapolis, MN 55401

DATE: August 24, 1982

COPIES TO: 1-C S McCrossan Inc
            Attn: Larry Almalich
            P O Box 8405
            Kansas City, MO 64114

LABORATORY No. 9-1292

TEST NUMBER: E-1 E-2 E-3 E-4

DATE TAKEN: August 20, 1982 August 20, 1982 August 20, 1982 August 20, 1982

UNIFIED SOIL CLASSIFICATION:
(Soil Classification Sample Number)
Silty sand, mostly fine
Silty sand, mostly fine
Silty sand, mostly fine
Silty sand, mostly fine
grained, trace of gravel,
dark brown
(SM)-5

LOCATION:
East dike, W embankment,
coordinate N 865,900

ELEVATION OF TEST:
976.5'

DEPTH BELOW EXISTING GRADE:
1'

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)
Dry Density (pcf) 119 111 122 112
Moisture Content (%) 7.0 8.7 8.1 5.3
Plus #4 Material (%) 3 15 9 6

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM: D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 125.0 125.0 125.0 125.0
Optimum Moisture (%) 11.1 11.1 11.1 11.1

COMPACATION TEST RESULTS:
Compaction (%) 95.5 89 97.5 90
Specified Compaction (%) 95 95 95 95

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested. The test
locations and number of tests were selected by Twin City Testing and
Engineering Laboratory Inc.

Twin City Testing and Engineering Laboratory, Inc.

By Dale J. 1/24/83
REPORT OF: DENSITY TESTS OF COMPACTED.FILL.

NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN

REPORTED TO: Northern States Power Co
Atttn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: August 24, 1982

COPIES TO: 1-C S McCrossan Inc
1-Black & Veatch Consulting Engr
Attn: Larry Almalch
P O Box 8405
Kansas City, MO 64114

LABORATORY No. 9-1292

TEST NUMBER: E-5 E-6

DATE TAKEN: August 20, 1982 August 20, 1982

UNIFIED SOIL CLASSIFICATION: Silty sand, mostly fine grained, a little gravel, brown (SM)-5
(Moisture-Density Sample Number)
Silty sand, mostly fine grained, trace of gravel, brown (SM)-5

LOCATION: North dike, N embankment, coordinate E2, 029, 010
East dike, E embankment, coordinate N866, 090

ELEVATION OF TEST: 975' 978'

DEPTH BELOW EXISTING GRADE: 1' 1'

FIELD DENSITY DETERMINATION:

Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)
Dry Density (pcf) 125 118.5
Moisture Content (%) 4.3 4.7
Plus #4 Material (%) 7 2

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 125.0 125.0
Optimum Moisture (%) 11.1 11.1

COMPACATION TEST RESULTS:

Compaction (%) 100 95
Specified Compaction (%) 95 95

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested. The test locations and number of tests were selected by Twin City Testing and Engineering Laboratory Inc.

Twin City Testing and Engineering Laboratory, Inc.

SG-225 (81-A)
REPORT OF: DENSITY TESTS OF COMPACTED FILL
NSP: SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
REPORTED TO:
Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: September 2, 1982
COPIES TO:
1-C S McCrossan
1-Black & Veatch Consulting Engr
Attn: Larry Almalich
P O Box 8405
Kansas City, MO 64114

LABORATORY No. 9-1292

TEST NUMBER: E-7 E-8 E-9 E-10


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Silty sand, mostly fine
grained, a little gravel,
dark brown (SM)-5
Silty sand, mostly fine
grain, trace of gravel,
dark brown (SM)-5
Silty sand, mostly fine
grain, dark brown
(SM)-5
Silty sand, mostly fine
grain, dark brown
(SM)-5

LOCATION:
East dike, East dike, East dike, East dike,
E embankment, W embankment, W embankment, W embankment,
coordinate coordinate coordinate coordinate
N865,900 N865,900 N866,065 N865,950
(retest of #E-4)(retest of #E-2)

ELEVATION OF TEST: .977.5' 977.5' 980' 980'
DEPTH BELOW EXISTING GRADE: 1' 1' 1' 1'

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (#4 Basis)
Dry Density (pcf) 128 125.5 117 110
Moisture Content (%) 7.2 7.0 6.4 7.0
Plus #4 Material (%) 6 4 0 0

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 125.0 125.0 125.0 125.0
Optimum Moisture (%) 11.1 11.1 11 11

COMPACtion TEST RESULTS:
Compaction (%) 102.5 100.5 93.5 88
Specified Compaction (%) 95 95 95 95

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested.

Twin City Testing and Engineering Laboratory, Inc.

By (Signature)
# Twin City Testing and Engineering Laboratory, Inc.

**Report of:** Density Tests of Compacted Fill  
**Project:** NSP Sherburne County Generating Plant  
**Bottom Ash Pond Revisions**  
**Becker, MN**  
**Reported To:** Northern States Power Co  
Attn: Roger Anderson  
414 Nicollet Mall  
Minneapolis, MN 55401  
**Date:** September 2, 1982  
**Copies To:** 1-C S McCrossan  
1-Black & Veatch Consulting Engr  
Attn: Larry Almalch  
P O Box 8405  
Kansas City, MO 64114

**Laboratory No.:** 9-1292

**Test Number:**  
- E-11  
- E-12  
- E-13  
- E-14

**Date Taken:**  
- August 24, 1982  
- August 24, 1982  
- August 24, 1982  
- August 24, 1982

**Unified Soil Classification:**  
- Silty sand, mostly fine grained, trace of gravel, dark brown (SM)-5  
- Silty sand, mostly fine grained, trace of gravel, dark brown (SM)-5  
- Sand, fine to medium grained, medium gravel, trace of gravel, brown (SP)-6  
- Sand, fine to medium grained, medium gravel, trace of gravel, brown (SP)-6

**Location:**  
- East dike, W embankment, coordinate N866,065 (retest of E-9)  
- East dike, W embankment, coordinate N865,950 (retest of E-10)  
- East dike, toe ditch fill area, coordinate N865,900  
- East dike, toe ditch fill area, coordinate N866,100

**Elevation of Test:**  
- 980'  
- 980'  
- 960'  
- 960'

**Depth Below Existing Grade:**  
- 1'  
- 1'  
- 10"  
- 10"

**Field Density Determination:**  
- Method: Density in Place by Sand-Cone Method, ASTM: D1556-64 (#4 Basis)  
- Dry Density (pcf): 121  
- Moisture Content (%): 7.2  
- Plus #4 Material (%): 1

**Laboratory Moisture-Density Relation of Soil:**  
- Maximum Dry Density (pcf): 125.0  
- Optimum Moisture (%): 11.1

**Compaction Test Results:**  
- Compaction (%): 97  
- Specified Compaction (%): 95

**Attention:**  
Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.

---

As a mutual protection to clients, the public and ourselves all reports are submitted as the confidential property of clients, and authorization for publication of statements conclusions or extracts from or regarding our reports is reserved pending our written approval.
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: September 2, 1982
COPIES TO: I-C S McCrossan
I-Black & Veatch Consulting Engr
Attn: Larry Almalch
P O Box 8405
Kansas City, MO 64114

LABORATORY No. 9-1292

TEST NUMBER: E-15 E-16 E-17 E-18


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Sand, mostly fine grained, mostly fine trace of gravel,grained, a
Silty sand, mostly fine grained, a trace of gravel,trace of gravel,
brown (SP-SM)-7 little gravel, brown (SP)-6 brown (SP-SM)-7 dark brown
(SM)-5

LOCATION:
North dike, North dike, East dike, East dike,
S embankment, N embankment, E embankment, W embankment,
coordinate coordinate coordinate coordinate
E2,028,750 E2,028,750 N865,750 N865,750

ELEVATION OF TEST: 986' 986' 979' 981'

DEPTH BELOW EXISTING GRADE: 10" 10" 8" 8"

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (4 Basis)
Dry Density (pcf) 114 119 111 114
Moisture Content (%) 3.6 6.4 2.8 3.4
Plus #4 Material (%) 1 10 5 2

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 120.0 125.0 115.4 120.0
Optimum Moisture (%) 10.5 11.1 11.9 10.5

COMPACATION TEST RESULTS:
Compaction (%) 95 95.5 96.5 95
Specified Compaction (%) 95 95 95 95

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURNE COUNTY GENERATING PLANT
           BOTTOM ASH POND REVISIONS
           BECKER, MN

REPORT TO: Northern States Power Co
           Attn: Roger Anderson
           414 Nicollet Mall
           Minneapolis, MN  55401

DATE: September 2, 1982

COPIES TO: I-C S McCrossan
           1-Black & Veatch Consulting Engr
           Attn: Larry Almalch
           P O Box 8405
           Kansas City, MO  64114

LABORATORY No. 9-1292

TEST NUMBER: E-19  E-20  E-21  E-22


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Silty sand, mostly fine
Silty sand, mostly fine
Sand, mostly fine grained, trace a little gravel, trace of gravel,
grained, trace of gravel, dark of gravel, dark brown (SM)-5
brown (SM)-5

LOCATION:
North dike, S embankment,
coordinate E2,028,900
North dike, N embankment,
coordinate E2,028,900
Toe of east dike, E embank-
ment, coordinate N865,800
Toe of east dike, E embank-
ment, coordinate 866,000

ELEVATION OF TEST:
979.5'  980.5'  961'  961'

DEPTH BELOW EXISTING GRADE:
10"  10"  8"  8"

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)
Dry Density (pcf) 111.5 125 118.5 118
Moisture Content (%) 5.8 9.3 4.2 3.4
Plus #4 Material (%) 2 3 11 4

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 125.0 125.0 120.0 120.0
Optimum Moisture (%) 11.1 11.1 10.5 10.5

COMPACATION TEST RESULTS:
Compaction (%) 89.5 100 98.5 98
Specified Compaction (%) 95 95 95 95

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested.

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RIZATION FOR PUBLICATION OF STATEMENTS CONCLUSIONS, OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL

Twin City Testing and Engineering Laboratory, Inc.
By: Dale Banister

SG-225 (81-A)
REPORT OF: DENSITY TESTS OF COMPACTED FILL
SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: August 31, 1982
COPIES TO: 1-C S McCrossan Inc
1-Black & Veatch Consulting Engr
Attn: Larry Almash
P O Box 8405
Kansas City, MO 64114

LABORATORY No. 9-1292
TEST NUMBER: E-23 E-24 E-25 E-26
UNIFIED SOIL CLASSIFICATION: Sand, fine to Sand, fine to Sand, mostly Sand, mostly
medium grained, medium grained, fine grained, fine grained,
a little gravel, trace of gravel, trace of gravel, brown (SP)-8
brown (SP)-6 brown (SP)-6 brown (SP-SM)-7

LOCATION: East dike, East dike, North dike, East dike,
W embankment, E embankment, S embankment, E embankment,
coordinate coordinate coordinate coordinate
N866,000 N866,000 E2,028,900 N866,090

ELEVATION OF TEST: 979.5' 978.5' 979.5' 978'
DEPTH BELOW EXISTING GRADE: 10" 10" 10" 10"

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)
Dry Density (pcf) 111.5 114.5 116.5 104.5
Moisture Content (%) 2.8 4.2 5.8 4.7
Plus #4 Material (%) 8 4 2 0

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 115.2 115.2 120.0 109.8
Optimum Moisture (%) 11.9 11.9 10.5 13.8

COMPACTION TEST RESULTS:
Compaction (%) 97 99.5 97 95
Specified Compaction (%) 95 95 95 95

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested.

Twin City Testing and Engineering Laboratory, Inc.
By Dale R

SG-225 (81-A)
REPORT OF:  DENSITY TESTS OF COMPACTED FILL

PROJECT:  SHERBURNE COUNTY GENERATING PLANT
           BOTTOM ASH POND REVISIONS
           BECKER, MN

REPORTED TO:  Northern States Power Co
              Attn: Roger Anderson
              414 Nicollet Mall
              Minneapolis, MN 55401

DATE:  August 31, 1982

COPIES TO:  1-C S McCrossan Inc
            1-Black & Veatch Consulting Engr
            Attn: Larry Almalich
            P O Box 8405
            Kansas City, MO 64114

LABORATORY No. 9-1292

TEST NUMBER:  E-27   E-28   E-29   E-30


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)

Sand, mostly fine grained, mostly fine trace of gravel, brown (SP-SM)-7
Silty sand, fine to medium grained, fine grained, trace of gravel, brown (SP)-6
trace of gravel, brown (SM-5)

LOCATION:

East dike, East dike, East dike, East dike,
E embankment, W embankment, E embankment, E embankment,
coordinate coordinate coordinate coordinate
N865,800  N865,750  N866,050  N865,900

ELEVATION OF TEST:

982.5'  984'  969'  971.5'

DEPTH BELOW EXISTING GRADE:

10"  10"  1'  1'

FIELD DENSITY DETERMINATION:

Method:  Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)
Dry Density (pcf)  120.5  124  120  114
Moisture Content (%)  6.7  7.2  5.5  3.6
Plus #4 Material (%)  2  7  5  2

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

Method:  ASTM:D1557-78, Method "A" , (-#4 Basis)
Maximum Dry Density (pcf)  120.0  125.0  115.2  109.8
Optimum Moisture (%)  10.5  11.1  11.9  13.8

COMPACtion TEST RESULTS:

Compaction (%)  100.5  99  104  104
Specified Compaction (%)  95  95  95  95

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Twin City Testing and Engineering Laboratory, Inc.

Byjaleng
REPORT OF: DENSITY TESTS OF COMPACTED FILL

SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: August 31, 1982
COPIES TO: 1-C S McCrossan Inc
1-Black & Veatch Consulting Engr
Attn: Larry Almarch
P O Box 8405
Kansas City, MO 64114

LABORATORY No. 9-1292

TEST NUMBER: E-31 E-32 E-33 E-34


UNIFIED SOIL CLASSIFICATION:
Sand, fine to medium grained, fine grained, fine grained, trace of gravel, trace of gravel, trace of gravel, brown (SP)-6 brown (SP-SM)-7 brown (SP-SM)-7 brown (SP-SM)-7

(Moisture-Density Sample Number)

LOCATION:
North dike, coordinate E2,028,800
North dike, coordinate E2,028,800
East dike, coordinate E866,000
East dike, coordinate E865,800

ELEVATION OF TEST:
987' 987.5' 971.5' 973'

DEPTH BELOW EXISTING GRADE:
10' 10" 10" 10"

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (pcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>111</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>5.0</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>4</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density</td>
<td>115.2</td>
</tr>
<tr>
<td>Optimum Moisture</td>
<td>11.9</td>
</tr>
</tbody>
</table>

COMPACATION TEST RESULTS:

| Compaction | 96.5 |
| Specified Compaction | 95   |

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
REPORT OF: DENSITY TESTS OF COMPACTED FILL

SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN

DATE: August 31, 1982

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401


UNIFIED SOIL CLASSIFICATION:
Sand, mostly fine to fine grained, medium grained, medium grained, medium grained, trace of gravel, trace of gravel, trace of gravel, trace of gravel, trace of gravel, brown (SP-SM)-7 brown (SP)-6 brown (SP)-6 brown (SP)-6

LOCATION:
East dike, E embankment, coordinate
N865,950

ELEVATION OF TEST:
982' 982.5' 982' 981'

DEPTH BELOW EXISTING GRADE:
10" 10" 10" 10"

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (#4 Basis)
Dry Density (pcf) 116.5 116.5 119 115
Moisture Content (%) 8.7 5.3 5.8 6.1
Plus #4 Material (%) 1 2 3 3

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM: D1557-78, Method "A", (#4 Basis)
Maximum Dry Density (pcf) 120.0 115.2 115.2 115.2
Optimum Moisture (%) 10.5 11.9 11.9 11.9

COMPACATION TEST RESULTS:
Compaction (%) 97 101 103 100
Specified Compaction (%) 95 95 95 95

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.

AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATIONS FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Twin City Testing and Engineering Laboratory, Inc.
By (Signature)
REPORT OF:  DENSITY TESTS OF COMPACTED FILL

PROJECT:  NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

REPORTED TO:  Northern States Power Co
Attn:  Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE:  October 11, 1982
COPIES TO:  1-C S McCrossan
1-Black & Veatch Consulting Eng
Attn:  Larry Almalch

LABORATORY No.  9-1357

TEST NUMBER:  E-39  E-40  E-41  E-42

DATE TAKEN:  Sept 1, 1982  Sept 1, 1982  Sept 1, 1982  Sept 1, 1982

UNIFIED SOIL CLASSIFICATION:  Sand, mostly fine grained, trace of gravel, brown (SP-SM)-7
(Moisture-Density Sample Number)

LOCATION:  East dike west embankment coordinate N865,800

ELEVATION OF TEST:  985'

DEPTH BELOW EXISTING GRADE:  1'

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (4# Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>122.5</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>9.9</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>4</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>120.0</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>10.5</td>
</tr>
</tbody>
</table>

COMPACTION TEST RESULTS:

| Compaction (%) | 102 |
| Specified Compaction (%) | 95  |

ATTENTION:  Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested. The test locations and number of tests were selected by Twin City Testing & Engineering Laboratory.

Twin City Testing and Engineering Laboratory, Inc.

By /Dale R/
### REPORT OF: DENSITY TESTS OF COMPACTED FILL

**PROJECT:** NSP SHERBURN COUNTY GENERATING PLANT  
**BOTTOM ASH POND REVISIONS**  
**BECKER, MINNESOTA**

**REPORTED TO:** Northern States Power Co  
Attn: Roger Anderson  
414 Nicollet Mall  
Minneapolis, MN 55401

**DATE:** October 11, 1982

**PROJECT No.** 9-1357

**LABORATORY No.** E-43, E-44, E-45

**DATE TAKEN:** Sept 1, 1982, Sept 1, 1982, Sept 1, 1982

**UNIFIED SOIL CLASSIFICATION:**  
- Sand, fine to medium grained, brown (SP−SM)−6  
- Sand, mostly fine grained, brown (SP)−7  
- Sand, fine to medium grained, brown (SP−SM)−6

**LOCATION:**  
- East dike east embankment coordinate N866,000  
- East dike east embankment coordinate N865,800  
  (Retest #E43)

**ELEVATION OF TEST:** 982', 983', 982'

**DEPTH BELOW EXISTING GRADE:** 1', 1', 1'

**FIELD DENSITY DETERMINATION:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (−#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>105.5, 118, 109</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>10.2, 8.1, 10.2</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>6, 3, 7</td>
</tr>
</tbody>
</table>

**LABORATORY MOISTURE-DENSITY RELATION OF SOIL:**

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM: D1557-78, Method &quot;A&quot;, (−#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Dry Density (pcf)</td>
<td>115.2, 120.0, 115.2</td>
</tr>
<tr>
<td>Opt. Moisture (%)</td>
<td>11.9, 10.5, 11.9</td>
</tr>
</tbody>
</table>

**COMPACATION TEST RESULTS:**

| Compaction (%) | 88.5, 98.5, 95 |
| Specified Compaction (%) | 95, 95, 95 |

**ATTENTION:** Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested. The test locations and number of tests were selected by Twin City Testing & Engineering Laboratory.
REPORT OF: DENSITY TESTS OF COMPACTED FILL
NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

REPORTED TO:
Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: October 11, 1982

PROJECT:
BOTTOM ASH POND REVISIONS

DATE TAKEN: Oct 11, 1982

LABORATORY No. 9-1357

TEST NUMBER:

<table>
<thead>
<tr>
<th>Test</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>E46</td>
<td></td>
</tr>
<tr>
<td>E47</td>
<td></td>
</tr>
<tr>
<td>E48</td>
<td></td>
</tr>
<tr>
<td>E49</td>
<td></td>
</tr>
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</table>

DATE TAKEN:

<table>
<thead>
<tr>
<th>Date</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept 2, 1982</td>
<td>E46</td>
</tr>
<tr>
<td>Sept 2, 1982</td>
<td>E47</td>
</tr>
<tr>
<td>Sept 2, 1982</td>
<td>E48</td>
</tr>
<tr>
<td>Sept 2, 1982</td>
<td>E49</td>
</tr>
</tbody>
</table>

UNIFIED SOIL CLASSIFICATION:

<table>
<thead>
<tr>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand, fine to</td>
</tr>
<tr>
<td>medium grained,</td>
</tr>
<tr>
<td>trace of gravel,</td>
</tr>
<tr>
<td>(SP) - 6</td>
</tr>
<tr>
<td>Brown</td>
</tr>
<tr>
<td>(SP) - 6</td>
</tr>
<tr>
<td>Brown</td>
</tr>
<tr>
<td>(SP) - 6</td>
</tr>
</tbody>
</table>

LOCATION:

<table>
<thead>
<tr>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>East dike</td>
</tr>
<tr>
<td>East embankment</td>
</tr>
<tr>
<td>Coordinate</td>
</tr>
<tr>
<td>N865750</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>East dike</td>
</tr>
<tr>
<td>East embankment</td>
</tr>
<tr>
<td>Coordinate</td>
</tr>
<tr>
<td>N865,880</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>East dike</td>
</tr>
<tr>
<td>East embankment</td>
</tr>
<tr>
<td>Coordinate</td>
</tr>
<tr>
<td>N866,000</td>
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<table>
<thead>
<tr>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>East dike</td>
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<tr>
<td>East embankment</td>
</tr>
<tr>
<td>Coordinate</td>
</tr>
<tr>
<td>N866,120</td>
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ELEVATION OF TEST:

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<tr>
<th>Elevation</th>
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<tbody>
<tr>
<td>976'</td>
</tr>
<tr>
<td>975'</td>
</tr>
<tr>
<td>973'</td>
</tr>
<tr>
<td>975'</td>
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</table>

DEPTH BELOW EXISTING GRADE:

<table>
<thead>
<tr>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1'</td>
</tr>
<tr>
<td>1'</td>
</tr>
<tr>
<td>1'</td>
</tr>
</tbody>
</table>

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (*-4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>109</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>5.3</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>119</td>
</tr>
<tr>
<td></td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM: D1557-78, Method &quot;A&quot;, (*-4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Dry Density (pcf)</td>
<td>115.2</td>
</tr>
<tr>
<td>Opt Moisture (%)</td>
<td>11.9</td>
</tr>
</tbody>
</table>

| Compaction (%)         | 95 |
| Specified Compaction (%)| 95 |

| Compaction (%)         | 103|
| Specified Compaction (%)| 95 |

COMPAC TION TEST RESULTS:

<table>
<thead>
<tr>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specified Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
</tr>
</tbody>
</table>

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AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED UNTIL OUR WRITTEN APPROVAL IS OBTAINED.

By Dale B.

Twin City Testing and Engineering Laboratory, Inc.
SG-225 (81-A)
REPORT OF:  DENSITY TESTS OF COMPACTED FILL

PROJECT:  NSP SHERBURNE COUNTY GENERATING PLANT
           BOTTOM ASH POND REVISIONS
           BECKER, MINNESOTA

REPORTED TO:  Northern States Power Co
              Attn: Roger Anderson
              414 Nicollet Mall
              Minneapolis, MN 55401

LABORATORY No.  9-1357

TEST NUMBER:  E50  E51  E52  E53


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Sand, mostly fine grained, trace of gravel, brown (SP-SM)-7
Sand, mostly fine grained, trace of gravel, brown (SP-SM)-7
Sand, mostly fine grained, trace of gravel, brown (SP-SM)-7
Sand, mostly fine grained, trace of gravel, brown (SP-SM)-7

LOCATION:  East dike east embankment coordinate N865,800
            East dike east embankment coordinate N865,950
            East dike east embankment coordinate N866,050
            East dike east embankment coordinate N866,120

ELEVATION OF TEST:  978'  977'  975'  976'

DEPTH BELOW EXISTING GRADE:  1'  1'  1'  1'

FIELD DENSITY DETERMINATION:
Method  Density in Place by Sand-Cone Method, ASTM: D1556-64 (Radiation Basis)
Dry Density (pcf)  121  119  118  122.5
Moisture Content (%)  7.2  6.7  6.1  9.9
Plus #4 Material (%)  5  4  4  5

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method  ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf)  120.0  120.0  120.0  120.0
Optimum Moisture (%)  10.5  10.5  10.5  10.5

COMPACTATION TEST RESULTS:
Compaction (%)  101  99  98.5  102
Specified Compaction (%)  95  95  95  95

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As a mutual protection to clients, the public and ourselves all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Twin City Testing and Engineering Laboratory, Inc.

By Dale B. Jani
REPORT OF: DENSITY TESTS OF COMPACTED FILL
NSP SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

DATE: October 11, 1982
COPIES TO: 1-C S McCrossan
1-Black & Veatch Consulting Eng
Attn: Larry Almalch

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

LABORATORY No. 9-1357

TEST NUMBER: E-54 E-55 E-56 E-57


UNIFIED SOIL CLASSIFICATION:
(Soil Classification)
(Soil Type)
Sand, fine to medium grained, a little gravel, brown
(SP-SM)-9

LOCATION:
East dike west embankment coordinate
N865,790

ELEVATION OF TEST:
987'

DEPTH BELOW EXISTING GRADE:
1'

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)
Dry Density (pcf) 124 120 114 118.5
Moisture Content (%) 6.4 6.4 5.3 5.3
Plus #4 Material (%) 6 6 10 6

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 117.7 117.7 117.7 117.7
Optimum Moisture (%) 13.9 13.9 13.9 13.9

COMPACTION TEST RESULTS:
Compaction (%) 105 102 97 101
Specified Compaction (%) 95 95 95 95

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**REPORT OF:**  DENSITY TESTS OF COMPACTED FILL

**PROJECT:**  NSP SHERBURN COUNTY GENERATING PLANT  
BOTTOM ASH POND REVISIONS  
BECKER, MINNESOTA

**DATE:**  October 11, 1982  
**COPIES TO:**  1-C S McCrossan  
1-Black & Veatch Consulting Eng  
Attn: Larry Almalch

**REPORTED TO:**  Northern States Power Co  
Attn: Roger Anderson  
414 Nicollet Mall  
Minneapolis, MN 55401

<table>
<thead>
<tr>
<th>LABORATORY No.</th>
<th>9-1357</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TEST NUMBER:</strong></td>
<td>E-58</td>
</tr>
<tr>
<td><strong>DATE TAKEN:</strong></td>
<td>Sept 7, 1982</td>
</tr>
<tr>
<td><strong>UNIFIED SOIL CLASSIFICATION:</strong> (Moisture-Density Sample Number)</td>
<td>Sand, mostly fine grained, trace of gravel, brown (SP-SM)-7</td>
</tr>
<tr>
<td><strong>LOCATION:</strong></td>
<td>East dike east embankment coordinate N865,800</td>
</tr>
<tr>
<td><strong>ELEVATION OF TEST:</strong></td>
<td>984</td>
</tr>
<tr>
<td><strong>DEPTH BELOW EXISTING GRADE:</strong></td>
<td>1'</td>
</tr>
<tr>
<td><strong>FIELD DENSITY DETERMINATION:</strong></td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td>Density in Place by Sand-Cone Method, ASTM: D1556-64 (- #4 Basis)</td>
</tr>
<tr>
<td>Dry Density (pcf)</td>
<td>125</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>7.0</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>4</td>
</tr>
<tr>
<td><strong>LABORATORY MOISTURE-DENSITY RELATION OF SOIL:</strong></td>
<td>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</td>
</tr>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>120.0</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>10.5</td>
</tr>
</tbody>
</table>

| **COMPACHT TEST RESULTS:** | | | | |
| Compaction (%) | 104.5 | 98 | 97 | 97 |
| Specified Compaction (%) | 95 | 95 | 95 | 95 |

**ATTENTION:**  Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
REPORT OF:  DENSITY TESTS OF COMPACTED FILL

PROJECT:  NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

REPORTED TO:  Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE:  October 11, 1982
COPIES TO:  1-C S McCrossan
1-Black & Veatch Consulting Eng
Attn: Larry Almalich

LABORATORY No.  9-1357

TEST NUMBER:  E62  E63  E64  E65

DATE TAKEN:  Sept 8, 1982  Sept 8, 1982  Sept 8, 1982  Sept 8, 1982

UNIFIED SOIL CLASSIFICATION:  Sand, fine to
(Moisture-Density Sample Number)
medium grained, medium grained, fine grained,
a little gravel, brown (SP-SM)-9

LOCATION:
East dike
East dike
East dike
East dike

coordinate
N865,850
N866,100
N865,950
N865,800

ELEVATION OF TEST:  985'  981'  984'  916.5

DEPTH BELOW EXISTING GRADE:  1'  1'  1'  1'

FIELD DENSITY DETERMINATION:
Method  Density in Place by Sand-Cone Method, ASTM: D1556-64 (#4 Basis)
Dry Density  (pcf)  115  115  116.5  115
Moisture Content  (%)  5.0  5.3  5.0  6.1
Plus #4 Material  (%)  6  8  7  6

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method  ASTM:D1557-78, Method "A", (#4 Basis)
Maximum Dry Density  (pcf)  117.7  117.7  120.0  120.0
Optimum Moisture  (%)  13.9  13.9  10.5  10.5

COMPACATION TEST RESULTS:
Compaction  (%)  98  98  97  96
Specified Compaction  (%)  95  95  95  95

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Twin City Testing and Engineering Laboratory, Inc.

SG-225 (81-A)
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT:
NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

REPORTED TO:
Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: October 11, 1982

DATE TAKEN:
Sept 9, 1982

UNIFIED SOIL CLASSIFICATION:
Sand, fine to medium grained, trace of gravel,
(SP-SM)-9

LOCATION:
East dike east embankment coordinate
N866,100

ELEVATION OF TEST:
982'

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>115</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>4.7</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>4</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>117.7</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>13.9</td>
</tr>
</tbody>
</table>

COMPACCTION TEST RESULTS:

<table>
<thead>
<tr>
<th>Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compaction</td>
<td>98</td>
</tr>
<tr>
<td>Specified</td>
<td>95</td>
</tr>
</tbody>
</table>

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REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

DATE: October 11, 1982

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

LABORATORY No. 9-1357

TEST NUMBER: E-70 E-71 E-72 E-73


UNIFIED SOIL CLASSIFICATION: Sand, mostly fine grained, a little gravel, brown (SP-SM)-7

(Moisture-Density Sample Number)

LOCATION: North dike north embankment coordinate E2,028,950

ELEVATION FOR TEST: 981' 989' 982' 883'

DEPTH BELOW EXISTING GRADE: 1' 1' 1' 1'

FIELD DENSITY DETERMINATION:

Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)
Dry Density (pcf) 122 125 116 107
Moisture Content (%) 6.1 5.5 6.4 6.4
Plus #4 Material (%) 8 6 6 7

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

Method ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf) 120.0 120.0 120.0 109.8
Optimum Moisture (%) 10.5 10.5 10.5 13.8

COMPAC TION TEST RESULTS:

Compaction (%) 101.5 104 96.5 98
Specified Compaction (%) 95 95 95 95

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By

Twin City Testing and Engineering Laboratory, Inc.
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: October 11, 1982

LABORATORY No. 9-1357

TEST NUMBER: E-74 E-75 E-76 E-77


UNIFIED SOIL CLASSIFICATION: Sand, fine to medium grained, trace of gravel, brown (SP-SM)-9

LOCATION: North dike north embankment coordinate E2,028,620

ELEVATION OF TEST: 993'

DEPTH BELOW EXISTING GRADE: 1'

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (- #4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>123</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>5.0</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>5</td>
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</tbody>
</table>

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
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<td>117.7</td>
</tr>
<tr>
<td>Optimum Moisture</td>
<td>13.9</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

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<tr>
<th>Method</th>
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</tr>
</thead>
<tbody>
<tr>
<td>maximum dry density</td>
<td>117.7</td>
</tr>
<tr>
<td>optimum moisture</td>
<td>13.9</td>
</tr>
</tbody>
</table>

COMPACTION TEST RESULTS:

<table>
<thead>
<tr>
<th>Compaction</th>
<th>114</th>
<th>95.5</th>
<th>97</th>
<th>95.5</th>
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</thead>
<tbody>
<tr>
<td>Specified Compaction</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>95</td>
</tr>
</tbody>
</table>

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REPORT OF: DENSITY TESTS OF COMPACTED FILL
NSP SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA
Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: October 11, 1982
COPIES TO: 1-C S McCrossan
1-Black & Veatch Consulting Eng
Attn: Larry Almalch

LABORATORY No. 9-1357

TEST NUMBER: E-78 E-79 E-80 E-81


UNIFIED SOIL CLASSIFICATION: Sand, mostly Sand, mostly Sand, mostly Sand, mostly Sand, mostly,
fine grained, fine grained, fine grained, fine grained, fine grained,
a little gravel, a little gravel, a little gravel, a little gravel, a little gravel,
(SP-SM)-7 (SP-SM)-9 (SP)-8 (SP-SM)-7

LOCATION: North dike North dike North dike North dike
north north south south
embankment coordinate embankment coordinate embankment coordinate
E2,028,700 E2,028,950 E2,028,850 E2,028,940

ELEVATION OF TEST: 996' 994' 991.5' 992'

DEPTH BELOW EXISTING GRADE: 1' 1' 1' 1'

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (-# Basis)
Dry Density (pcf) 117 122 110 120
Moisture Content (%) 5.0 6.1 5.0 5.5
Plus #4 Material (%) 8 6 5 5

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM:D1557-78, Method "A", (# Basis)
Maximum Dry Density (pcf) 120.0 117.7 119.8 120.0
Optimum Moisture (%) 10.5 13.9 13.8 10.5

COMPACATION TEST RESULTS:
Compaction (%) 97 103.5 100 100
Specified Compaction (%) 95 95 95 95

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested.

AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS CONCLUSIONS OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL

Twin City Testing and Engineering Laboratory, Inc.

SG-225 [81-A]
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: October 11, 1982
COPIES TO: J-C S McCrossan
1-Black & Veatch Consulting Eng
Attn: Larry Almarch

LABORATORY No. 9-1357

TEST NUMBER: E-82 E-83 E-84 E-85


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Sand, mostly fine grained, a little gravel, brown (SP-SM)-7

LOCATION:
North dike North dike North dike North dike
embankment embankment embankment embankment
coordinate coordinate coordinate coordinate
E2,029,000 E2,028,940 E2,028,850 E2,029,980

ELEVATION OF TEST: 995' 995' 993.5' 994.5'

DEPTH BELOW EXISTING GRADE: 1' 1' 1' 1'

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>124</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>5.5</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density</td>
<td>120.0</td>
</tr>
<tr>
<td>Optimum Moisture</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td>120.0</td>
</tr>
<tr>
<td></td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td>120.0</td>
</tr>
<tr>
<td></td>
<td>10.5</td>
</tr>
</tbody>
</table>

COMPACTATION TEST RESULTS:

| Compaction (%) | 103 |
| Specified Compaction (%) | 95 |
|                   | 104 |
|                   | 101.5 |
|                   | 104 |
|                   | 95 |

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
REPORT OF:  DENSITY TESTS OF COMPACTED FILL

PROJECT:  NSP SHERBURNE COUNTY GENERATING PLANT
            BOTTOM ASH POND REVISIONS
            BECKER, MINNESOTA

REPORTED TO:  Northern States Power Co
             Attn: Roger Anderson
             414 Nicollet Mall
             Minneapolis, MN 55401

DATE:  October 11, 1982

COPIES TO:  1-C S McCrossan
            1-Black & Veatch Consulting Eng
            Attn: Larry Almacht

LABORATORY No.  9-1357

TEST NUMBER:  E-86   E-87   E-88   E-89


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Sand, fine to medium grained, fine grained,
a little gravel, brown  Sand, mostly fine grained,
a little gravel, brown  Sand, mostly fine grained,
(SP-SM)-9             (SP-SM)-7            (SP-SM)-7        (SP-SM)-9

LOCATION:
East dike  East dike  East dike  East dike
east embankment  east embankment  east embankment  west embankment
coordinate   coordinate  coordinate  coordinate
N866,100      N865,900    N865,800    N865,850

ELEVATION OF TEST:
984'  984.5'  988'  987'

DEPTH BELOW EXISTING GRADE:
1'  1'  1'  1'

FIELD DENSITY DETERMINATION:
Method   Density in Place by Sand-Cone Method, ASTM: D1556-64 (- #4 Basis)
Dry Density (pcf)  119  121  121.5  121
Moisture Content (%)  6.1  7.0  6.7  6.1
Plus #4 Material (%)  6  6  7  3

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method  ASTM:D1557-78, Method "A", (-#4 Basis)
Maximum Dry Density (pcf)  117.7  120.0  120.0  117.7
Optimum Moisture (%)  13.9  10.5  10.5  13.9

COMPACATION TEST RESULTS:
Compaction (%)  101  101  101.5  103
Specified Compaction (%)  95  95  95  95

ATTENTION:  Density tests are valid at the location and elevation of the test only. No representation is made as to
the adequacy of fill and compaction at locations and elevations other than those tested.

__________________________________________
Twin City Testing and Engineering Laboratory, Inc.

SG-225 (81-A)
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURNE COUNTY GENERATING PLANT BOTTOM ASH POND REVISIONS BECKER, MINNESOTA

REPORTED TO: Northern States Power Co Attn: Roger Anderson 414 Nicollet Mall Minneapolis, MN 55401

DATE: October 11, 1982

LABORATORY No. 9-1357

TEST NUMBER: E-90 E-91 E-92 E-93


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Sand, fine to medium grained, a little gravel, brown (SP-SM)-9
Sand, fine to medium grained, a little gravel, brown (SP-SM)-9
Sand, mostly fine grained, a little gravel, brown (SP)-8
Sand, mostly fine grained, a little gravel, brown (SP)-8

LOCATION:
East dike west embankment coordinate
N866,000

ELEVATION OF TEST:
987.5'
988.5'
989'
990'

DEPTH BELOW EXISTING GRADE:
1'
1'
1'
1'

FIELD DENSITY DETERMINATION:

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Cone Method, ASTM: D1556-64 (- #/ Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density (pcf)</td>
<td>124</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>5.5</td>
</tr>
<tr>
<td>Plus #4 Material (%)</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>7</td>
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<tr>
<td></td>
<td>105</td>
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<td>5.0</td>
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<td>7</td>
</tr>
<tr>
<td></td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:

<table>
<thead>
<tr>
<th>Method</th>
<th>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Dry Density (pcf)</td>
<td>117.7</td>
</tr>
<tr>
<td>Optimum Moisture (%)</td>
<td>13.9</td>
</tr>
<tr>
<td></td>
<td>117.7</td>
</tr>
<tr>
<td></td>
<td>13.9</td>
</tr>
<tr>
<td></td>
<td>109.8</td>
</tr>
<tr>
<td></td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td>109.8</td>
</tr>
<tr>
<td></td>
<td>13.8</td>
</tr>
</tbody>
</table>

COMPACATION TEST RESULTS:

|                      | 105                   |
|                      | 95                    |
|                      | 95.5                  |
|                      | 104.5                 |
|                      | 95                    |
|                      | 95                    |

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.

AS A MUTUAL PROTECTION TO CLIENTS THE PUBLIC AND OURSELVES ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF CLIENTS, AND AUTHORIZATION FOR PUBLICATION OF STATEMENTS, CONCLUSIONS, OR EXTRACTS FROM OR REGARDING OUR REPORTS IS RESERVED PENDING OUR WRITTEN APPROVAL.

Twin City Testing and Engineering Laboratory, Inc.

SG-223 (81-A)
# Report of Density Tests of Compacted Fill

**Project:** NSP Sherburne County Generating Plant  
**Bottom Ash Pond Revisions**  
**Becker, Minnesota**

**Reported To:** Northern States Power Co  
**Attn.: Roger Anderson**  
**414 Nicollet Mall**  
**Minneapolis, MN 55401**

**Laboratory No.:** 9-1357

**Test Number:**
- E-94
- E-95
- E-96
- E-97

**Date Taken:**
- Sept 16, 1982
- Sept 16, 1982
- Sept 16, 1982
- Sept 16, 1982

**Unified Soil Classification:**
- Sand, fine to medium grained (SP-SM)-9
- Sand, fine to medium grained (SP-SM)-9
- Sand, fine to medium grained (SP-SM)-9
- Sand, fine to medium grained (SP-SM)-9

**Location:**
- East dike east embankment coordinate N866,050
- East dike east embankment coordinate N865,800
- East dike west embankment coordinate 865, 700
- East dike west embankment coordinate N866,000

**Elevation of Test:**
- 991'
- 992'
- 990'
- 991'

**Depth Below Existing Grade:**
- 1'
- 1'
- 1'
- 1'

**Field Density Determination:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Density in Place by Sand-Gone Method, ASTM: D1556-64 (pcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Density</td>
<td>120</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>5.5</td>
</tr>
<tr>
<td>Plus #4 Material</td>
<td>10</td>
</tr>
</tbody>
</table>

**Laboratory Moisture-Density Relation of Soil:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Maximum Dry Density (pcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM:D1557-78, Method &quot;A&quot;, (-#4 Basis)</td>
<td>117.7</td>
</tr>
<tr>
<td>Optimum Moisture</td>
<td>13.9</td>
</tr>
</tbody>
</table>

**Compaction Test Results:**

<table>
<thead>
<tr>
<th>Compaction (%)</th>
<th>Specified Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>95</td>
</tr>
<tr>
<td>97.5</td>
<td>95</td>
</tr>
<tr>
<td>98.5</td>
<td>95</td>
</tr>
</tbody>
</table>

**Attention:** Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
REPORT OF: DENSITY TESTS OF COMPACTED FILL

PROJECT: NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

REPORTED TO: Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN 55401

DATE: October 11, 1982

COPIES TO: I-C S McCrossan
I-Black & Veatch Consulting Eng
Attn: Larry Almich

LABORATORY No. 9-1357

TEST NUMBER: E-98 E-99 E-100 E-101


UNIFIED SOIL CLASSIFICATION:
(Moisture-Density Sample Number)
Sand, fine to medium grained, trace of gravel, brown
(SP-SM)-9

LOCATION:
East dike east embankment coordinate
N865,800

ELEVATION OF TEST:
993'

DEPTH BELOW EXISTING GRADE:
1'

FIELD DENSITY DETERMINATION:
Method Density in Place by Sand-Cone Method, ASTM: D1556-64 (\#4 Basis)
Dry Density (pcf) 118 112 112 114
Moisture Content (%) 5.0 4.2 5.0 5.5
Plus \#4 Material (%) 3 6 6 4

LABORATORY MOISTURE-DENSITY RELATION OF SOIL:
Method ASTM:D1557-78, Method "A", (-\#4 Basis)
Maximum Dry Density (pcf) 117.7 117.7 117.7 117.7
Optimum Moisture (%) 13.9 13.9 13.9 13.9

COMPACATION TEST RESULTS:
Compaction (%) 100 95 95 96.5
Specified Compaction (%) 95 95 95 95

ATTENTION: Density tests are valid at the location and elevation of the test only. No representation is made as to the adequacy of fill and compaction at locations and elevations other than those tested.
MOISTURE-DENSITY RELATIONSHIPS
MOISTURE-DENSITY CURVE
NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
Northern States Power Co
9-1292

SAMPLE NO. 1

DATE: August 24, 1982

METHOD OF TEST: ASTM:D1557-78, Method "A"

TYPE OF MATERIAL: Sandy clay, brown (CL)

MAXIMUM DENSITY: 128.3 lb./cu. ft.

OPTIMUM MOISTURE 11.0 %
MOISTURE - DENSITY CURVE

NSP SHERBURY COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
Northern States Power Co
9-1292

DATE:
August 24, 1982

DATE:

COPIES TO:
1-C S McCrossan Inc
1-Black & Veatch Consulting Engr
Attn: Larry Almalich
P O Box 8405
Kansas City, MO 64114

SAMPLE NO. 2

METHOD OF TEST:
ASTM:D1557-78, Method "A"

TYPE OF MATERIAL:
Sandy clay, brown (CL)

MAXIMUM DENSITY: 126.0 lb./cu. ft.

OPTIMUM MOISTURE 11.3 %

MOISTURE CONTENT —— %

DRY DENSITY — lb. / cu. ft.

127
126
125
124
123
122

9 10 11 12 13 14
MOISTURE - DENSITY CURVE
NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
Northern States Power Co
9-1292

METHOD OF TEST: ASTM:D1557-78, Method "A"
TYPE OF MATERIAL: Clayey sand, mostly fine grained, reddish brown (SC)

MAXIMUM DENSITY: 134.8 lb./cu. ft.

OPTIMUM MOISTURE 8.4 %

Sample No.
August 24, 1982
1-C S McCrossan Inc
1-Black & Veatch Consulting Engr
Attn: Larry Almalch
P O Box 8405
Kansas City, MO 64114
MOISTURE-DENSITY CURVE

NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
Northern States Power Co
9-1292

METHOD OF TEST: ASTM:D1557-78, Method "A"

TYPE OF MATERIAL: Sandy clay brown (SC-CL)

MAXIMUM DENSITY: 123.9 lb./cu. ft.

OPTIMUM MOISTURE: 11.2 %

DATE: August 24, 1982

COPY TO: I-C S McCrossan Inc
1-Black & Veatch Consulting Engr
Attn: Larry Almalich
P.O. Box 8405
Kansas City, MO 64114
MOISTURE-DENSITY CURVE

NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS

BECKER, MN
Northern States Power Co
9-1292

SAMPLE NO. 5

DATE: September 2, 1982

COPIES TO:
1-C S McCrossan
1-Black & Veatch Consulting Engr
Attn: Larry Almalch
P O Box 8405
Kansas City, MO 64114

METHOD OF TEST: ASTM:D1557-78, Method "A"

TYPE OF MATERIAL: Silty sand, mostly fine grained, dark brown (SM)

MAXIMUM DENSITY: 125.0 lb./cu. ft.

OPTIMUM MOISTURE 11.1 %

DENSITY — lb./cu. ft.

MOISTURE CONTENT — %
MOISTURE - DENSITY CURVE

NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
Northern States Power Co
9-1292

METHOD OF TEST: ASTM:D1557-78, Method "A"

TYPE OF MATERIAL: Sand, fine to medium grained, brown (SP)

MAXIMUM DENSITY: 115.2 lb./cu. ft.

OPTIMUM MOISTURE: 11.9 %
MOISTURE - DENSITY CURVE

SAMPLE NO. 7

SEPT. 2, 1982
1-C S McCrossan
1-Black & Veatch Consulting Engr
Attn: Larry Almalich
P O Box 8405
Kansas City, MO 64114

PROJECT:
NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
Northern States Power Co
9-1292

REPORTED TO:

LABORATORY NO.

METHOD OF TEST:
ASTM: D1557-78, Method "A"

TYPE OF MATERIAL:
Sand, mostly fine grained, brown (SP-SM)

MAXIMUM DENSITY: 120.0 lb./cu. ft.

OPTIMUM MOISTURE: 10.5 %

MOISTURE CONTENT ——— %
MOISTURE - DENSITY CURVE

SHERBURN COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MN
Northern States Power Co
9-1292

SAMPLE No. 8

METHOD OF TEST:
ASTM:D1557-78, Method "A".

TYPE OF MATERIAL:
Sand, mostly fine grained, brown (SP)

MAXIMUM DENSITY: 109.8 lb./cu. ft.

OPTIMUM MOISTURE: 13.8 %

August 31, 1982
1-C S McCrossan Inc
1-Black & Veatch Consulting Engr
Attn: Larry Almalich
P O Box 8405
Kansas City, MO 64114
MOISTURE-DENSITY CURVE

SAMPLE NO. 9
DATE: October 11, 1982

PROJECT:
NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA
Northern States Power Co
9-1357

REPORTED TO:

LABORATORY NO. 1-C S McCrossan

METHOD OF TEST: ASTM:D1557-78, Method "A"

TYPE OF MATERIAL: Sand, fine to medium grained, brown (SP-SM)-9

MAXIMUM DENSITY: 117.7 lb./cu. ft.

OPTIMUM MOISTURE 13.9 %
<table>
<thead>
<tr>
<th>Test No</th>
<th>Date</th>
<th>Location of Test</th>
<th>Elev.</th>
<th>Field Moist. (%)</th>
<th>Opt. Moist. (%)</th>
<th>Moisture Variance From Optimum</th>
<th>Field Density (pcf)</th>
<th>Max. Density (pcf)</th>
<th>Compaction (%)</th>
<th>Comp. Spec. (%)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>8-17-82</td>
<td>East Dike, Coordinate N 866, 120</td>
<td>976'</td>
<td>11.1</td>
<td>11.3</td>
<td>-0.2</td>
<td>126.0</td>
<td></td>
<td>91</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>C-2</td>
<td>8-17-82</td>
<td>East Dike, Coordinate N 866, 000</td>
<td>973'</td>
<td>14.3</td>
<td>11.3</td>
<td>+3.0</td>
<td>126.0</td>
<td></td>
<td>94.5</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>C-3</td>
<td>8-17-82</td>
<td>East Dike, Coordinate N 865, 800</td>
<td>974'</td>
<td>11.7</td>
<td>11.3</td>
<td>+0.4</td>
<td>124.0</td>
<td></td>
<td>99</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>C-4</td>
<td>8-17-82</td>
<td>North Dike, Coordinate E 2, 028, 810</td>
<td>984'</td>
<td>11.1</td>
<td>11.3</td>
<td>-0.2</td>
<td>124.0</td>
<td></td>
<td>99</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>C-5</td>
<td>8-18-82</td>
<td>East Dike, Coordinate N 866, 100</td>
<td>977.5'</td>
<td>14.0</td>
<td>11.3</td>
<td>+2.7</td>
<td>115.0</td>
<td></td>
<td>91</td>
<td>90</td>
<td></td>
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<tr>
<td>C-6</td>
<td>8-18-82</td>
<td>East Dike, Coordinate N 866, 000</td>
<td>975'</td>
<td>12.4</td>
<td>11.3</td>
<td>+1.1</td>
<td>115.0</td>
<td></td>
<td>91</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>C-7</td>
<td>8-18-82</td>
<td>East Dike, Coordinate N 865, 850</td>
<td>975.5'</td>
<td>13.0</td>
<td>11.3</td>
<td>+1.7</td>
<td>115.0</td>
<td></td>
<td>91</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>C-8</td>
<td>8-19-82</td>
<td>East Dike, Coordinate N 866, 130</td>
<td>979'</td>
<td>14.3</td>
<td>11.2</td>
<td>+3.1</td>
<td>116.0</td>
<td></td>
<td>93.5</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>C-9</td>
<td>8-19-82</td>
<td>East Dike, Coordinate N 855, 050</td>
<td>979'</td>
<td>12.4</td>
<td>11.2</td>
<td>+1.2</td>
<td>123.0</td>
<td></td>
<td>99</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>C-10</td>
<td>8-19-82</td>
<td>East Dike, Coordinate N 865, 850</td>
<td>976.5'</td>
<td>12.3</td>
<td>11.2</td>
<td>+1.1</td>
<td>123.0</td>
<td></td>
<td>99</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>C-11</td>
<td>8-19-82</td>
<td>East Dike, Coordinate N 865, 700</td>
<td>988.5'</td>
<td>13.3</td>
<td>11.2</td>
<td>+2.1</td>
<td>117.0</td>
<td></td>
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# Summary of Passing Soil Density Tests

**Project:** Northern States Power Co  
**Location:** Sherburne County Generating Plant  
**Date:** Sept 2, 1982  
**Lab #:** 9-1292  

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### Summary of Passing Soil Density Tests

**PROJECT:** Northern States Power Co

Sherburne County Generating Plant

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<th>Moisture Variance from Optimum</th>
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## Summary of Passing Soil Density Tests

**Project:** Northern States Power Co  
**Sheboygan County Generating Plant**

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## Bottom Ash Pond Revisions

**PROJECT:** Northern States Power Co

Sherburne County Generating Plant

### Summary of Passing Soil Density Tests

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<td>Opt. Moist. (%)</td>
<td>Moisture Variance From Optimum</td>
<td>Field Density (pcf)</td>
<td>Max. Density (pcf)</td>
<td>Compaction (%)</td>
<td>Comp. Spec. (%)</td>
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FIELD DENSITY TESTS
BORROW AREA
REPORT OF: TESTS OF SOIL
NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS

REPORTED TO: BECKER, MINNESOTA
Northern States Power Co
Attn: Roger Anderson
414 Nicollet Mall
Minneapolis, MN  55401

LABORATORY No.  9-1292

DATE:  August 25, 1982
FURNISHED BY:  1-C S McCrossan
COPIES TO:  1-Black & Veatch Consulting Eng

SAMPLE NUMBER:  1  2

SAMPLE IDENTIFICATION:  Proposed Clay  Proposed Clay
Core Fill    Core Fill

LOCATION SAMPLED:  Borrow Area  Borrow Area

UNIFIED SOIL CLASSIFICATION:  Sandy Clay, Sandy Clay
a little    a little
gravel, brown (CL) gravel, brown (SC-CL)

MECHANICAL ANALYSIS:
Passing  3/8"  100%  100%
   #4        98    95
   #10       96    92
   #40       84    79
   #100      62    59
   #200      57    48

LABORATORY MOISTURE-DENSITY RELATION OF SOIL: (see attached curve)
Method -  ASTM:D1557  ASTM:D1557
Maximum Dry Density (pcf)  128.3  126.0
Optimum Moisture (%)      11.0    11.3
LL                      44     26
PL                     16     13
PI                      28     13
Undisturbed Field Density (pcf)  94 -

As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is restricted pending our written approval.
**REPORT OF:** Tests of Soil  
**PROJECT:** NSP Sherburne County Generating Plant  
**BOTTOM ASH POINT REVISIONS**  
**REPORTED TO:** Becker, Minnesota  
Northern States Power Co  
Attn: Roger Anderson  
414 Nicollet Mall  
Minneapolis, MN 55401  
**LABORATORY** No. 9-1292

**DATE:** August 25, 1982  
**FURNISHED BY:** 1-C S McCrossan  
**COPIES TO:** 1-Black & Veatch Consulting  
Attn: Larry Almacht Eng

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<td><strong>UNIFIED SOIL CLASSIFICATION:</strong></td>
<td>Clayey Sand, trace of gravel, reddish brown (SC)</td>
<td>Sandy Clay, a little gravel, brown (SC-CL)</td>
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**MECHANICAL ANALYSIS:**

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**LABORATORY MOISTURE-DENSITY RELATION OF SOIL:** (see attached curve)

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<td>LL</td>
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<td>PL</td>
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<td>PI</td>
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<td>Undisturbed Field Density (pcf)</td>
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*As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions, or extracts from or regarding our reports is reserved pending our written approval.*

Twin City Testing and Engineering Laboratory, Inc.  
By [Signature]
FILTER MATERIAL GRADATION
REPORT OF:
NSP SHERBURNE COUNTY GENERATING PLANT
BOTTOM ASH POND REVISIONS
BECKER, MINNESOTA

DATE: November 29, 1982
FURNISHED BY:
1-C S McCrossan
1-Black & Veatch Consulting Eng

REPORTED TO: Northern States Power Company
Attn: Roger B Anderson
414 Nicollet Mall, 7th Floor
Minneapolis, Minnesota 55401

COPIES TO: Larry Almaleh

LABORATORY No. 9-1357

SAMPLE NUMBER: 1

TYPE OF AGGREGATE: Filter Material - Type 1

LOCATION SAMPLED: East Embankment Coordiant 866, 150N

MECHANICAL ANALYSIS:

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SPECIFICATIONS
Type I Filter Material

REMARKS:
The above sample meets the project specification for a Type I Filter material.
PERMEABILITY TESTS
# LABORATORY TEST DATA

**N.S.P. Sherburne County Generating Plant**

**PROJECT:** Bottom Ash Pond Revisions, Becker, Minnesota  
**DATE:** Sept 10, 1982

**REPORTED TO:** Northern States Power Company  
**JOB NO.:** 9-1357

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<td>Impermeable Clay Core, East Dike, Coordinate N866, 075</td>
<td>Impermeable Clay Core, East Dike, Coordinate N866, 075</td>
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<td>984'</td>
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- **Moisture-Density Relation of Soil**
  - Proctor #1: 128.3  
  - Proctor #2: 126.0  
  - Proctor #4: 123.9  
  - Proctor #4: 123.9

- **Optimum Moisture Content (%)**
  - Proctor #1: 11.0  
  - Proctor #2: 11.3  
  - Proctor #4: 11.2  
  - Proctor #4: 11.2

**Permeability Test**

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<td>In-Situ (Clay Core)</td>
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<td>Type of Specimen</td>
<td>(Clay Core)</td>
<td>(Clay Core)</td>
<td>(Clay Core)</td>
<td>(Clay Core)</td>
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<td>Specimen Height (inches)</td>
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<td>2.83</td>
<td>2.89</td>
</tr>
<tr>
<td>Dv. Density (PCF)</td>
<td>120.0</td>
<td>113.8</td>
<td>114.2</td>
<td>112.1</td>
</tr>
<tr>
<td>Percent of Max. Density</td>
<td>93.5%</td>
<td>90.5%</td>
<td>92%</td>
<td>90.5%</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>12.0</td>
<td>14.4</td>
<td>11.9</td>
<td>12.5</td>
</tr>
<tr>
<td>Max. Head Differential (ft)</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Confining Pressure (effective - PSI)</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Water Temperature (°C)</td>
<td>23</td>
<td>23</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Coefficient of Permeability K @ 20°C (cm/sec)</td>
<td>1x10^-8</td>
<td>2x10^-8</td>
<td>2x10^-6</td>
<td>4 x 10^-6</td>
</tr>
<tr>
<td>K @ 20°C (ft/min)</td>
<td>2x10^-8</td>
<td>4x10^-8</td>
<td>2 x10^-6</td>
<td>8 x 10^-6</td>
</tr>
</tbody>
</table>

**Atterberg Limits**

- **Liquid Limits (%)**
  - 22.3

- **Plastic Limit (%)**
  - 12.4

- **Plasticity Index**
  - 9.9

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**SG-123(81-A)**
SKETCHES OF
COMPACTION TEST
LOCATIONS
BOTTOM ASH POND MODIFICATION

NORTHERN STATES POWER COMPANY
MINNEAPOLIS, MINNESOTA
SHERBURNE COUNTY GENERATING PLANT

COMPACTION TESTING LOCATIONS
BETWEEN ELEVATIONS 971'-980'
TWIN CITY TESTING LABORATORY #9-1292