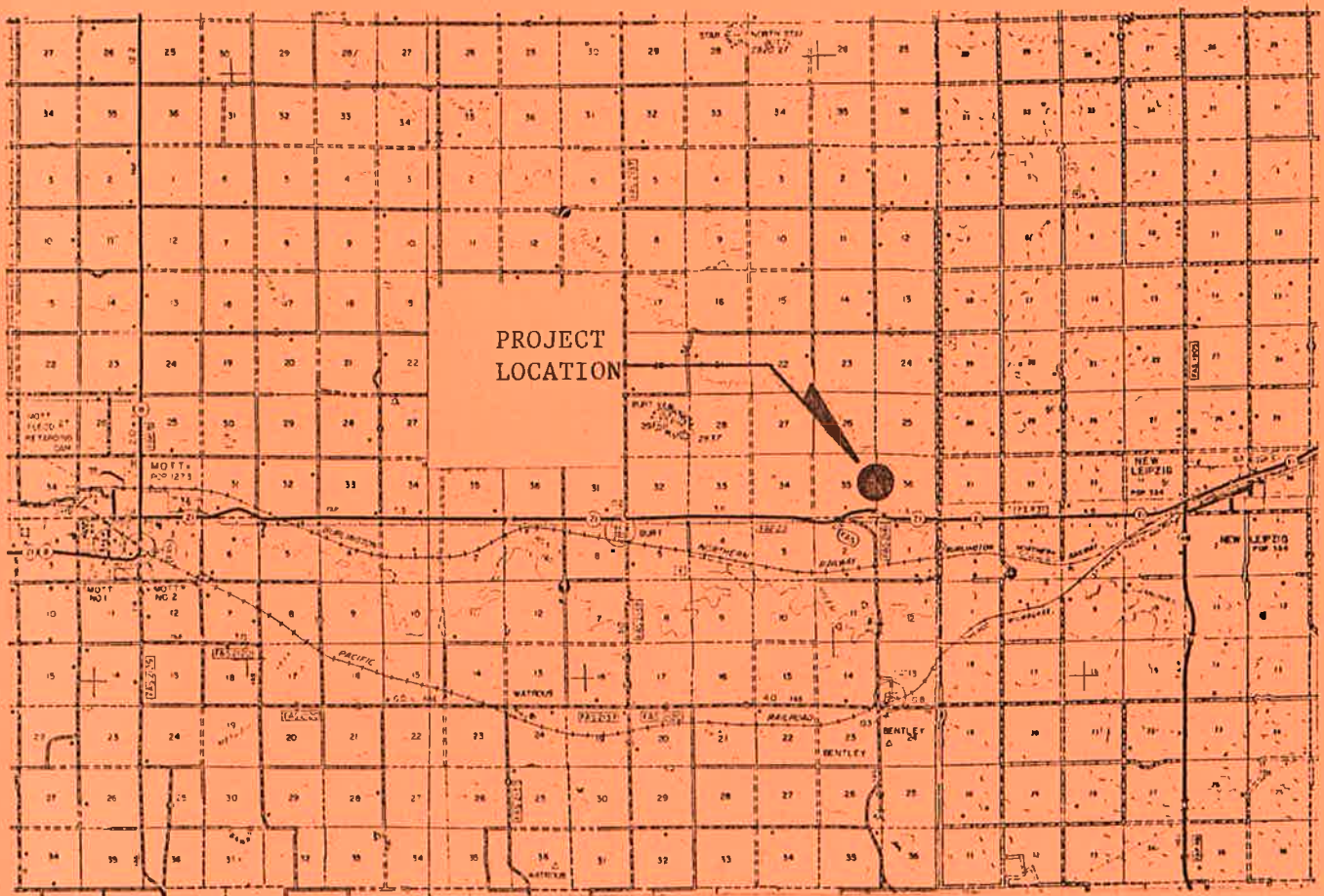


PRELIMINARY ENGINEERING REPORT
THIRTY MILE CREEK DAM- BORROW EXPLORATION
HETTINGER COUNTY

S.W.C. PROJECT NO. 1497



NORTH DAKOTA
STATE WATER COMMISSION
MARCH 1984

PRELIMINARY ENGINEERING REPORT

THIRTY MILE CREEK DAM - BORROW EXPLORATION
SWC PROJECT # 1497

March, 1984

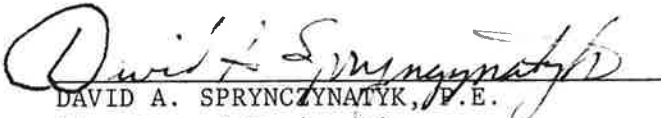
North Dakota State Water Commission
State Office Building
900 E. Boulevard
Bismarck, North Dakota 58505

PREPARED BY:



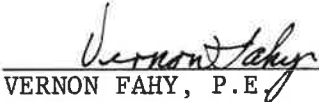
PAUL URBAN, P.E.
Investigation Engineer

SUBMITTED BY:



DAVID A. SPRYNCZYNATYK, P.E.
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APPROVED BY:



VERNON FAHY, P.E.
State Engineer

Prepared for the
Hettinger County Water Management Board

I. INTRODUCTION

Location:

The proposed dam on Thirty-Mile Creek is located in Section 35, Township 134 North, Range 91 West in Hettinger County, North Dakota. It is about five miles west of the City of New Leipzig. Figure 1 is a county map showing the location of the proposed dam. Figure 2 is a quad map showing the dam site and the reservoir area.

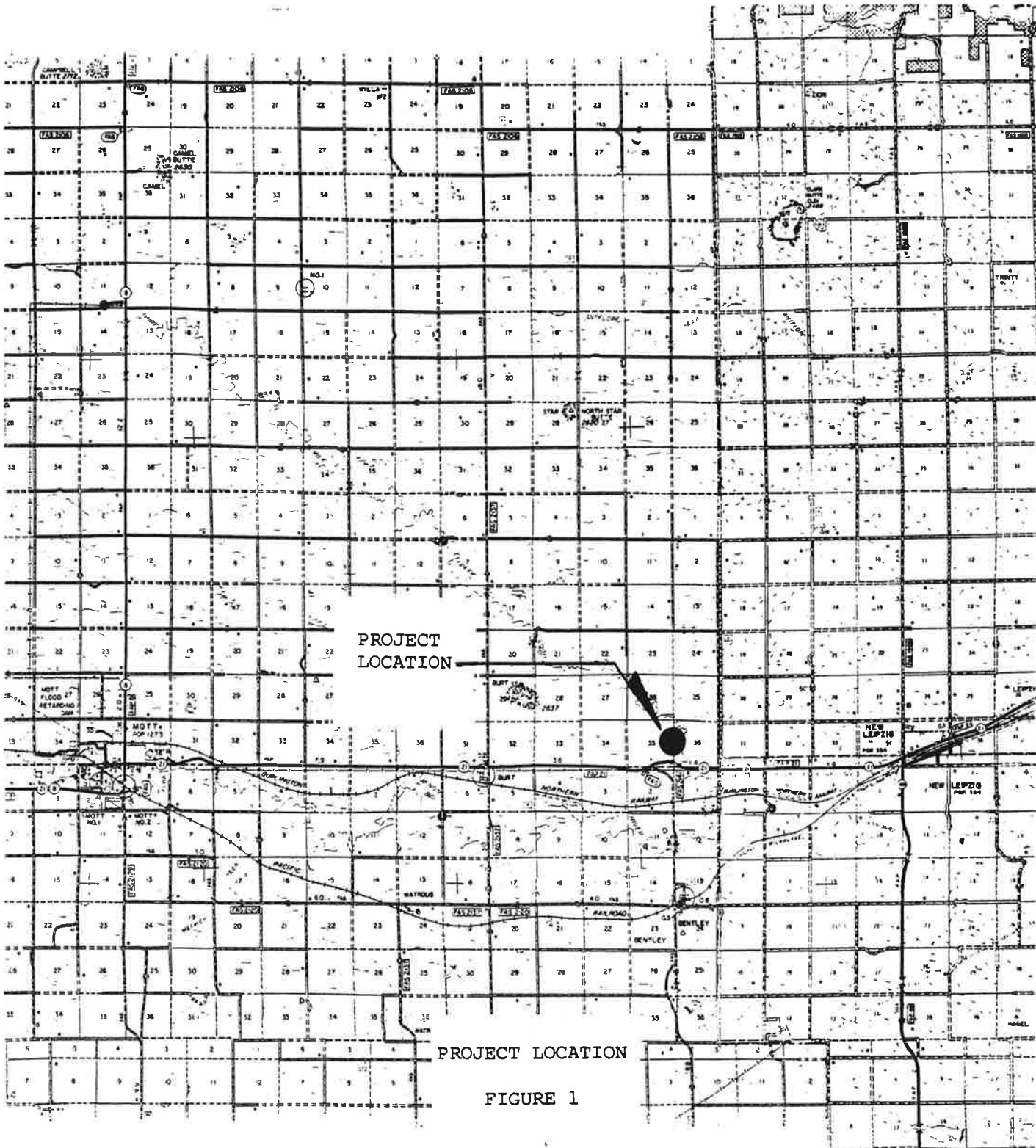
Purpose:

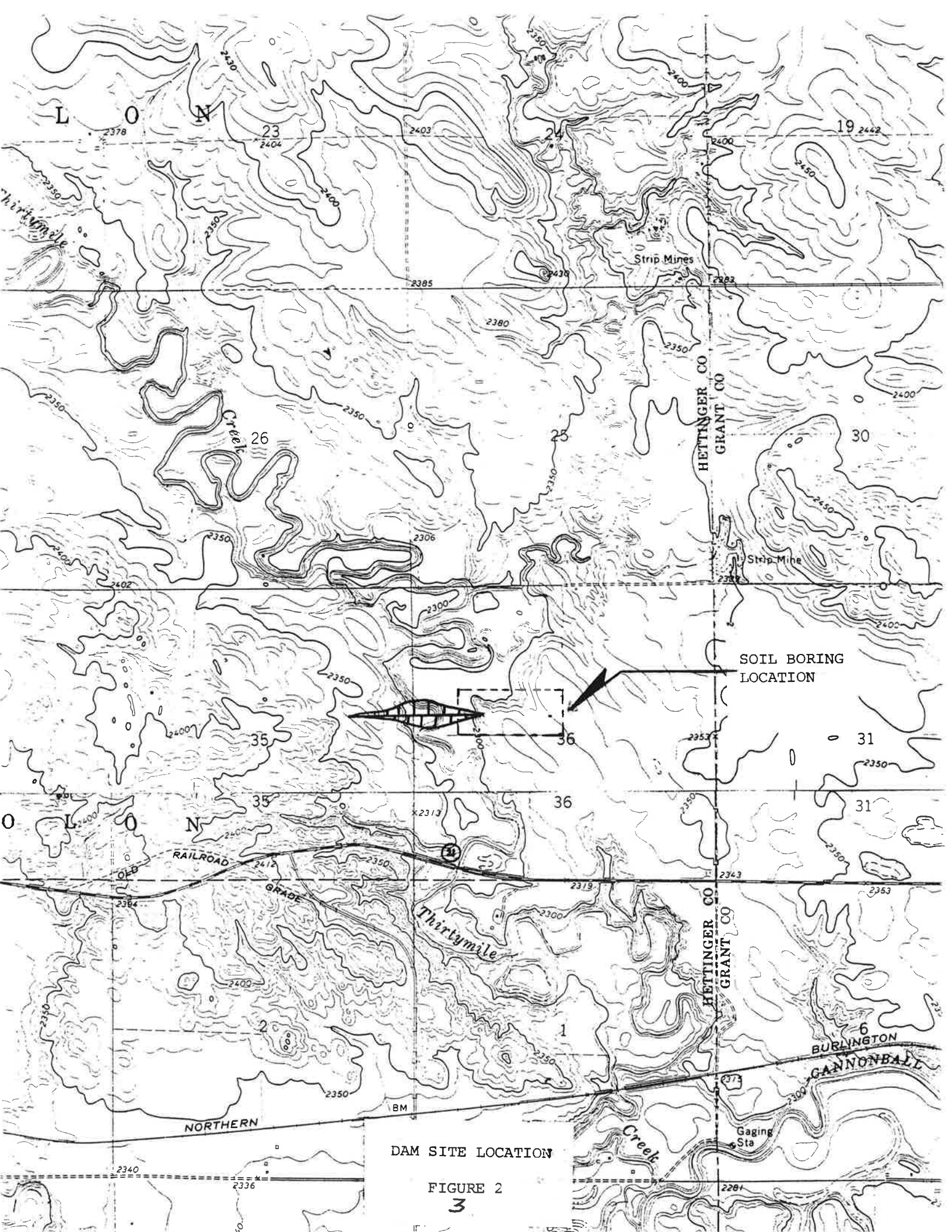
The purpose of this report is to show the results of the borrow exploration conducted in December of 1982. Since this exploration was done to fill a gap left by the previous studies done in 1968 and 1969 some of the important findings of the previous studies are also included.

This report also includes discussion on the possibilities of constructing a dam at this site. These are general statements based on our past experiences in building similar dams. No preliminary designs were done. The discussion presented is intended to make the Board aware of some of the problems, other than borrow material, that could be experienced at this site.

Background:

Construction of a dam on Thirty-Mile Creek is not a new idea. According to our files, it was investigated in 1968. Surveys of the site were done in June of 1968. A topographic map of the reservoir area was done between September 1968 and May 1969. On October of 1968 a





DAM SITE LOCATION

FIGURE 2

3

subsurface investigation was done along the proposed center line. A borrow material exploration was done on the west side of the dam in May of 1969. No borrow investigation was done on the east side because the landowner would not allow it.

Subsurface soils along the center line consisted mostly of sandy soils on top of a gray clay. The gray clay was about 15 to 25 feet below the surface of the valley floor. Most of the boring logs showed coal seams in the clay. The borrow exploration turned up only sandy soils which were unsuitable for the dam.

Hydrology:

The drainage area above the proposed site is 254 square miles. No formal study was done but large flows can be expected from a watershed this size with the topography that exists in it. This would mean the principal spillway would probably have to be fairly large.

Present Investigation:

On February 11, 1982 the Hettinger County Water Resource Board entered into an agreement with the Water Commission to explore the east side of the dam site for borrow material. A study of soils maps showed that the surface material was sandy. The soils on the east and west sides were sandy loams. To determine what the subsurface material was like, Twin City Testing was hired to drill numerous holes in the area to the east of the proposed center line. What they found was mostly sandy material.

II. BORROW INVESTIGATION

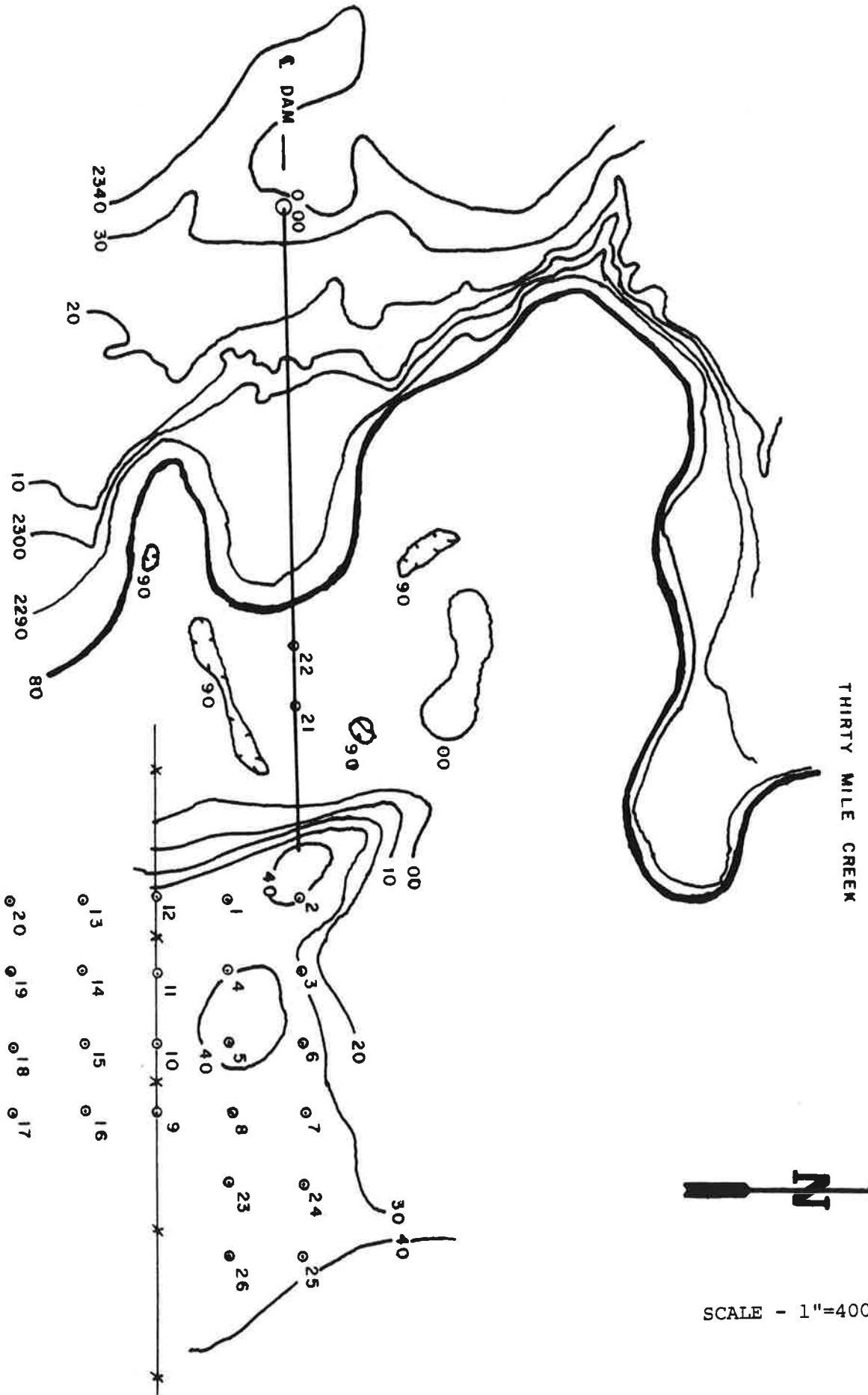
On December 8, 1982, Twin City Testing drilled test holes in an area on the east side of the proposed dam center line. Figure 3 is a map showing the location of the holes drilled. The holes were located in a grid system so quantities of material could be calculated.

The holes were drilled to a depth of five feet. If no clay was found, the drilling was stopped. It would not be economical to strip more than 5 feet of overburden to get suitable material. If clay was found, the holes were drilled deeper to get an idea of how much material was available.

Results:

Twenty-six holes were drilled. Twenty-four holes found no suitable material. Most of these holes showed a thin layer of silty clay at the surface but then encountered sandy material. Two holes showed thicker layers of clay. They were located on the valley floor. The appendix includes a copy of the boring logs.

Even though some clay was found in the valley floor, it may not be easy to use. Usually, in a situation like this, groundwater can become a problem. This means the borrow material could be excessively wet and would have to be dried out. Therefore, placement costs would be higher than normal. Also, the extent of the clay is not known. Because of the potential ground water problems on the valley floor next to a stream, it was decided that this would not be a good borrow area and no more holes were drilled.



MAP OF BORING LOCATIONS

FIGURE 3

III. CONCLUSIONS

General:

As a result of this borrow investigation, it was determined that it would be very difficult to build a dam at the proposed site. Most of the material available near by is sandy and not suitable for the embankment.

The only possible way to use the sandy material is in a zoned embankment. A zoned embankment is made up of a central clay core held in place on both sides by other material. Zoned embankments are more difficult to build and would be more expensive than a homogeneous structure. It also needs a clay core and sufficient clay was not found in the area. The clay that may exist would be too wet due to groundwater. Also, the seepage potential through the dam would have to be studied. Complicated drainage systems may be required in the embankment. Therefore, it is doubtful whether a zoned embankment would be feasible.

Abutments:

From information gathered in the borrow investigations at 1969 and 1982, the abutments of the proposed dam are made up of sandy and coarse material. This is evident on the surface of the area. Extensive study of the abutments is needed to evaluate the potential for seepage around the abutments and through the sides of the reservoir. If a dam were built, it would most likely need slurry trenches and/or a clay blanket to reduce expected seepage. These measures can become very expensive.

1968 Centerline Borings:

In 1968, borings were drilled along the proposed center line. The

boring logs report coal seams 1/2 inch to several inches thick (The appendix includes a copy of these boring logs). It was noted that these seams had a fast seepage rate and were impregnated with water. These coal seams could cause seepage problems under the dam as well as in the abutments. It is expensive to determine the extent of these seams and remedy the seepage problems they may cause. If they were shallow, they could be excavated out and replaced with good material, but little good material exists.

Recommendations:

Based on the soils exploration done in 1968, 1969 and 1982, construction of a dam on this site would not be feasible and is not recommended. There is not enough suitable borrow material. Plus the geology of the site suggests alot of potential problems with seepage. These would be expensive to overcome. Even if there was enough suitable material, the benefits that could be realized from flood reduction and recreation probably would not be enough to justify the costs. This is due mainly to the low population density of the area and the small amount of development along the stretches of river that would receive the most flood reduction benefits.

APPENDIX A

Boring Log For Borrow Exploration
SWC Project #1497
December 8, 1983

<u>Boring No.</u>	<u>Depth Feet</u>	<u>Soil Classification</u>
#1	0-1 1-5	Silty clay br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand with a trace of gravel br.
#2	0-1 1-5	Silty clay br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand with a trace of gravel br.
#3	0- $\frac{1}{2}$ $\frac{1}{2}$ -1 1-5	Silty clay dark br. (CL) Froze Silty clay br. (CL) Fine sand br.
#4	0- $\frac{1}{2}$ $\frac{1}{2}$ -1 $\frac{1}{2}$ 1 $\frac{1}{2}$ -5	Silty clay dark br. (CL) Froze Silty clay br. (CL) Fine sand br.
#5	0-1 $\frac{1}{2}$ 1 $\frac{1}{2}$ -5	Silty clay br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand with a little gravel br.
#6	0-2 2-3 3-5	Silty clay br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand with a trace of gravel br. Fine bedrock sand yellowish br.
#7	0-1 1-9	Silty clay br. (CL) Froze 0'- $\frac{1}{2}$ ' Silty sand yellowish
#8	0-1 1-4	Silty clay br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine silty sand yellowish br.
#9	0-1 1-3 3-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand with a trace of gravel br. Silty sand yellowish br. (SM)
#10	0-1 1-4 4-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine to medium sand with a little gravel Fine sand br.
#11	0-2 $\frac{1}{2}$ 2 $\frac{1}{2}$ -5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand with a trace of gravel br.
#12	0-2 2-3 3-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Silty sand dark br. (SM) Silty sand br. (SM)

<u>Boring No.</u>	<u>Depth Feet</u>	<u>Soil Classification</u>
#13	0-1 1-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Silty sand yellowish br.
#14	0-1 1-3 3-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand with a trace of gravel br. Silty sand yellowish br. (SM)
#15	0- $\frac{1}{2}$ $\frac{1}{2}$ -3	Silty clay dark br. (CL) Froze Fine sand with a little gravel br.
#16	0-1 1-3 3-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand with a trace of gravel br. Fine silty sand br. (SM)
#17	0- $1\frac{1}{2}$ $1\frac{1}{2}$ -5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand br.
#18	0-1 1-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine silty sand br.
#19	0-1 1-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine silty sand br. (SM)
#20	0-1 1-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine silty sand br.
#21	0-3 3-10 10-16 16-20	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Silty clay br. (CL) Silty clay gray (CL) Fine silty sand gray (SM) very wet
#22	0-3 3-12 12-15	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Silty clay br. (CL) Fine silty sand br.
#23	0-1 1-2 2-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Silty clay br. (CL) Fine sand br.
#24	0-1 1-2 2-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine sand with a trace of gravel br. Fine silty sand br.
#25	0-1 1-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine silty sand br.
#26	0-1 1-5	Silty clay dark br. (CL) Froze 0'- $\frac{1}{2}$ ' Fine silty sand br.

APPENDIX B

Log for Centerline Borings
SWC Project #1497
September - October, 1968

LAKE AGASSIZ TESTING LABORATORIES
 P. O. Box 533
 Moorhead, Minnesota

Project Number NDSWC 1497 LA68-162
 North Dakota State Water Commission
 Thirty Mile Creek, New Leipzig,
 Name North Dakota

TEST BORING FIELD LOG

Test Boring Number 2
 Surface Elevation 2295.8
 Engineer A.C. Grunseth (NDSWC)

Location Sec 35 & 36 - T.134N. - R.91W.
 Architect _____
 Date Started 4:15 PM 10-10-68
Finished 10:00 AM 10-11-68

1.5	Brown silty sand top soil and organic matter
	Brown sand-silt mixture "Silty sand" Fine to medium Non plastic to slightly plastic - some clay Moist, loose
7.0	
	Brown sand-clay mixture Clayey sand-fine to medium Slightly plastic to moderately cohesive - very loose Wet to very wet
11.5	
	Gray clayey sand-Fine to coarse - clay layers Moderately plastic and cohesive Very wet to saturated Very loose
17.0	
	Gray sand Fine to medium Non plastic Lignitic Interlensed with laminated clay Very dense and compact
33.0	
34.0	Gray clay Plastic, moist, hard

Depth Feet	Sample Number	N	T
		Bpf	Ft-lbs
2.5-4.5	1497-2-1	5-5-5(10)	
8.0-9.5	1497-2-2	1-1-1(2)	
9.5-11.0	1497-2-3	1-1-1(2)	
13.0-14.5		1-1-1(2)	
14.5-16.0	13.0-16.0 1497-2-4	2-2-2(4)	
17.5-19.0	1497-2-5	18-30-50(80)	
22.5-23.5	1497-2-6	35-85(120)	
27.0-28.0	1497-2-7	$\frac{100}{0.8}$	
33.5-34.0	Auger Sample 1497-2-8		

Water table: Plugged at approximately
 10.0' from surface with trace of water
 3 1/2 hours after completion of boring

LAKE AGASSIZ TESTING LABORATORIES
P. O. Box 533
Moorhead, Minnesota

Project Number NDSWC 1497 LA68-162
North Dakota State Water Commission
Thirty Mile Creek, New Leipzig,
North Dakota

TEST BORING FIELD LOG

Test Boring Number 3
Surface Elevation 2296.5
Engineer A.C. Grunseth (NDSWC)

Name _____
Location Sec 35 & 36 - T.134N. - R.91W.
Architect _____
Date Started 10:25 AM 10-11-68
Finished 1:55 PM 10-11-68

1.5	Tan silty sand top soil and organic matter
	Tan clayey silt
	Fine sand - slightly plastic
	Dry, Loose
6.5	
	Brown lean clay with fine sand and clayey sand
	Slightly plastic to moderately plastic
	Moist, stiff
11.0	
	Brown clayey sand
	Fine to medium
	Moderately plastic and cohesive
	Clay layers
	Wet to very wet
17.5	Loose
	Brown to gray sand
	Fine to coarse - some gravel pebbles
	Non plastic, little clay
21.0	Saturated, loose
	Gray sand - fine to medium
	Non plastic
	Occasional clay layers
	Occasional lignitic
	Very dense and compact
28.0	
	Gray clay with interbedded coal
	Clay is smooth, plastic, Moist and hard

Depth	Sample	N	T
Feet	Number	Bpf	Ft-lbs
2.5-4.5	1497-3-1	7-5-5(10)	
7.5-9.5	1497-3-2	2-4-5(9)	
12.5-14.5	1497-3-3	2-2-3(5)	
18.0-20.0	1497-3-4	5-4-4(8)	Saturated
22.5-24.0	1497-3-5	29-50-50	100 0.8
29.0-30.0	Auger Sample 1497-3-6		Clay and Coal
30.5-31.5		36 ⁸⁰ _{0.5}	Clay and Coal
38.5-39.5	1497-3-7	24 ⁵⁰ _{0.5}	Clay

Water table: 15.3' from surface 1 hour after completion of boring

LAKE AGASSIZ TESTING LABORATORIES

P. O. Box 533
Moorhead, Minnesota

Project Number NDSWC 1497 LA68-162
North Dakota State Water Commission
Thirty Mile Creek, New Leipzig,

TEST BORING FIELD LOG

Name North Dakota
Location Sec 35 & 35 - T.134N. - R.91W.

Test Boring Number 4

Surface Elevation 2287.0

Architect _____

Engineer A.C. Grunseth (NDSWC)

Date Started 3:30 PM 9-11-68
Finished 9:50 PM 9-12-68

2.0	Tan silty sand top soil and organic matter
	Brown lean clay
	Silty fine sand
	Pliable, slightly plastic
	Moist, soft
7.5	Brown sand, fine, tract of clay-non plastic
10.0	Very moist, loose
	Gray sand, fine, saturated
	Non plastic
12.5	Loose
	Interbedded gray clay and hard coal
	Clay is smooth, moist and plastic
	Coal is fractured and impregnated with water
	Seepage appears to be very fast
	Hard to very hard
21.0	Gray clay
	Hardpan
	Plastic, smooth
	Occasional coal seams throughout
	1/2" to 1" thick
	Fine sand at base
	Very hard

Depth Feet	Sample Number	N Bpf	T Ft-lbs
2.5-4.0		2-2-1(3)	
4.0-5.5	(2.5-5.5) 1497-4-1	2-2-2(4)	
8.5-10.0	1497-4-2	3-2-2(4)	
10.0-11.0	1497-4-3	3-2(5)	
13.0-14.5		30-9-30(39)	Coal and Clay
18.0-19.5	1497-4-4	35-43-57	100 Coal and 0.8 Clay
23.0-24.5	1497-4-5	19-35-65	100 0.8 clay
28.0-29.5	1497-4-6	15-43-57	100 0.7
33.0-34.5	1497-4-7	35-60-40	100 0.7
38.0-39.5	1497-4-8	32-58-42	100 Clay with 0.7 fine sand

Water table: 7.9' from surface 25 hours after completion of boring

AGASSIZ TESTING LABORATORIES
P. O. Box 533
Moorhead, Minnesota

TEST BORING FIELD LOG

Test Boring Number 5
Surface Elevation 2291.5
Engineer A.C. Grunseth (NDSWC)

Project Number NDSWC 1497 LA68-162
North Dakota State Water Commission
Thirty Mile Creek, New Leipzig,
Name North Dakota
Location Sec 35 & 36 - T.134N. - R.91W.
Architect _____
Date Started 1:45 PM 10-9-68
Finished 4:40 PM 10-9-68

Tan silty sand top soil	
2.0 and organic matter	
Brown lean clay	
Silty, fine sand	
Moderately plastic	
Moist	
Medium stiff	
8.5	
Brown fine sand	
Friable, non plastic	
Little clay	
Dry, loose	
12.0	
Brown sand, fine to coarse	
Clay lenses	
Non plastic to slightly	
plastic	
15.5 Saturated, loose	
Gray sand	
Fine to medium	
Saturated, non plastic	
Medium dense	
20.0	
Gray clayey silt and	
Clay with interbedded coal	
Coal is fractured and	
impregnated with water	
24.5	
Gray clay	
Smooth plastic	
Moist	
Hard to very hard	

Depth	Sample	N	T
Feet	Number	Bpf	Ft-lbs
2.5-4.0		3-4-3(7)	
4.0-5.5	(2.5-5.5) 1497-5-1	2-2-3(5)	
7.5-9.0	(7.5-8.5) 1497-5-2	2-4-7(6)	
9.0-10.5	1497-5-3	3-5-4(9)	
13.0-14.5	1497-5-4	5-4-3(7)	
14.5-16.0		2-2-2(4)	
17.5-19.0	1497-5-5	9-5-11(16)	
19.0-20.5		15-26-40	Clay & coal
19.5-21.0		16-39-80	Clay & coal
22.0-23.5	1497-5-6	29-51-50(101)	Clayey silt
27.0-28.5	1497-5-7	9-20-36(56)	Clay
32.0-33.0	Poor Recovery	29-91(120)	Clay
37.0-38.0	1497-5-8	40-65(105)	

Water table: 12.1' from surface 46 hours
after completion of boring

AGASSIZ TESTING LABORATORIES
P. O. Box 533
Moorhead, Minnesota

Project Number NDSWC 1497 LA68-162
North Dakota State Water Commission
Thirty Mile Creek, New Leipzig,
Name North Dakota

TEST BORING FIELD LOG

Test Boring Number 6
Surface Elevation 2295.9
Engineer A.C. Grunseth (NDSWC)

Location Sec 35 & 36 - T.134N. - R.91W.
Architect _____
Date Started 10:20 A.M. 9-11-68
Finished 3:05 PM 9-11-68

1.5	Tan silty sand top soil and organic matter
	Brown lean clay
	Silty, fine sand
	Pliable, slightly plastic
	Moist, medium stiff
5.0	
	Brown sand
	Fine, friable
	Non plastic
	Trace of clay
	Loose
10.0	
	Mottled gray-tan sand-clay mixture "clayey sand"
	Oxidized - Laminated
	Slightly plastic and
	Moderately cohesive
	Fine to coarse
15.0	Moist, medium dense
	Gray clay with interbedded coal
	Clay is smooth, moist and plastic
	Coal is fractured and impregnated with water
	Seepage appeared to be very slow at first and increased rapidly with continued drilling
25.5	
	Gray clay
	Hardpan
	Plastic, smooth
	Coal seams several inches thick throughout
	Very hard

Depth Feet	Sample Number	N Bpf	T Ft-lbs
2.4-4.0	(2.5-5.0) 1497-6-1	3-2-5(7)	
4.0-5.5		4-4-5(8)	
7.5-9.0	(7.5-10.0) 1497-6-2	5-5-5(10)	
9.0-10.5		5-6-10(11)	
12.5-14.0		4-6-10(16)	
14.0-15.5	(12.5-15.0) 1497-6-3	9-12-20(21)	
17.5-18.5		$\frac{100}{0.5}$	Coal and clay
22.0-23.0	1497-6-4	37-63 $\frac{100}{0.9}$	Coal and clay
26.5-28.0	1497-6-5	32-50-50	$\frac{100}{0.7}$ Clay
31.5-33.0	1497-6-6	20-28-42(70)	Some coal seams
36.5-37.5	1497-6-7	43-67(110)	Clay
41.0-42.5	1497-6-8	35-55-45	$\frac{100}{0.7}$ Clay

Water table: 15.5' from surface 25½ hours
after completion of boring

AGASSIZ TESTING LABORATORIES
 P. O. Box 533
 Moorhead, Minnesota

Project Number NDSWC 1497 LA68-162
 North Dakota State Water Commission
 Thirty Mile Creek, New Leipzig,
 Name North Dakota

TEST BORING FIELD LOG

Test Boring Number 7
 Surface Elevation 2295.8
 Engineer A.C. Grunseth (NDSWC)

Location Sec 35 & 36 - T.134N. - R.91W.
 Architect _____
 Date Started 9:00 AM 10-9-68
Finished 12:00 PM 10-9-68

1.5	Tan silty sand top soil and organic matter
	Brown lean clay
	Silty fine sand
	Moderately plastic
	Dry, very stiff
8.5	
	Brown clay - Laminated
	Fine sand
	Plastic, moist
	Wet at base
	Stiff
13.5	
	Brown sand-fine to medium
	Some clay
16.0	Saturated, loose
	Gray clay (Lignitic) with interbedded coal seams
	Clay is smooth, moist, and plastic
	Coal is fractured and impregnated with water
	Hard to very hard
25.0	
	Gray silty clay and clay
	Smooth, plastic
	Occasional coal seams throughout
	Very hard

Depth Feet	Sample Number	N	T
		Bpf	Ft-lbs
2.0-3.5		8-12-9(21)	
3.5-5.0	(2.0-5.0) 1497-7-1	10-10-8(18)	
6.5-8.0		8-8-9(17)	
8.0-9.5	(6.5-8.5) 1497-7-2	7-6-5(11)	
11.5-13.0	1497-7-3	5-8-8(16)	
13.0-14.5	(13.5-14.5) 1497-7-4	4-4-3(7)	Wet
17.5-19.0		19-9-23(42)	Clay & coal
19.0-20.5	(17.5-20.5) 1497-7-5	20-40-50(90)	
22.0-23.5		26 $\frac{100}{0.5}$	Clay and coal
27.5-28.5	1497-7-6	41-57(98)	Silty clay
32.5-34.0	1497-7-7	17-27-58(85)	Clay
37.5-38.5	1497-7-8	35-60(95)	

Water table: 14.4' from surface 24 hours after completion of boring

Project Number NDSWC 1497 LA68-162
 North Dakota State Water Commission
 Thirty Mile Creek, New Leipzig,
 Name North Dakota

TEST BORING FIELD LOG

Test Boring Number 8
 Surface Elevation 2292.7
 Engineer A.C. Grunseth (NDSWC)

Location Sec 35 & 36 - T.134N. - R.91W.
 Architect _____
 Date Started 6:35 PM 9-10-68
Finished 10:10 AM 9-11-68

1.5	Tan silty sand top soil and organic matter
	Tan clay-sand mixture
	Lean clay at top
	Clayey sand at base
	Moist - Plastic to slightly plastic
	Moderately cohesive
7.0	Medium dense
	Mottled gray-tan sand-clay mixture "clayey sand"
	Oxidized - fine to medium
	Slightly plastic
	Moderately cohesive at times
12.5	Moist to wet, loose
	Gray to dark gray sand
	Fine to medium
	Saturated - non plastic becoming more coarse with depth with gravelly sand and clay at base
19.0	Medium dense to dense
	Gray clay
	Plastic, smooth
	Coal seams several inches thick throughout
	Some sand layers from 20 to 25 feet
	Hard to very hard

Depth Feet	Sample Number	N	T
		Bpf	Ft-lbs
2.5-4.0	1497-8-1	4-6-5(11)	
4.0-5.5	1497-8-2	4-5-5(10)	
7.5-9.0		3-2-1(3)	
9.0-10.5	(7.5-10.5) 1497-8-3	1-2-3(5)	
13.0-14.5	1497-8-4	3-5-8(13)	
17.5-19.0	1497-8-5	17-17-22(39)	Gravelly sand
19.0-20.0		38-38(76)	
23.5-25.0	1497-8-6	40-50-44(94)	Clay and sand
28.5-30.0	1497-8-7	14-22-43(65)	
33.5-35.0	1497-8-8	30-40-60(100)	
38.5-40.0	1497-8-9	40-70-30	100 0.6

Water table: 10.0' from surface 24 hours
 after completion of boring

AGASSIZ TESTING LABORATORIES
 O. Box 533
 Moorhead, Minnesota

Project Number NDSWC 1497 LA68-162
 North Dakota State Water Commission
 Thirty Mile Creek, New Leipzig,
 Name North Dakota

TEST BORING FIELD LOG

Test Boring Number 9

Location Sec 35 & 36 - T.134N. - R.91W.

Surface Elevation 2308.5

Architect _____

Engineer A.C. Grunseth (NDSWC)

Date Started 11:30 AM 9-10-68
Finished 5:10 PM 9-10-68

1.0	Tan silty sand top soil and organic matter
	Brown silty sand
	Fine, friable
	Non plastic
	Dry, medium dense
5.0	
	Brown sand
	Fine to medium
	Friable, non plastic
	Moist to very moist at base
	Medium dense
15.5	
	Dark gray sand
	Fine to medium
	Non Plastic
	Saturated
	Occasional clay layers
	1 to 3 inches thick
	Loose to medium dense
26.5	
	Gray clay
	Hardpan
	Plastic, smooth
	Coal seams several inches thick throughout
	Very hard

Depth	Sample	N	T
Feet	Number	Bpf	Ft-lbs
2.5-4.0	1497-9-1	5-6-6(12)	
8.0-9.5	1497-9-2	5-5-7(12)	
12.5-14.0	1497-9-3	7-6-7(13)	
17.5-19.0	1497-9-4	2-2-3(5)	
23.5-25.0	1497-9-5	7-2-10(12)	
27.5-28.5	1497-9-6	$\frac{100}{0.8}$	
32.5-33.5		30-75(105)	
37.5-38.5	1497-9-7	$\frac{100}{0.6}$	
42.0-43.5		25-37-63(100)	
47.5-48.5		27-60(87)	

Water table: 15.6' from surface 24 hours
 after completion of boring

Final Boring Depth 48.5'

MASSIZ TESTING LABORATORIES
 P. O. Box 533
 Moorhead, Minnesota

Project Number NDSWC 1497 LA68-162
 North Dakota State Water Commission
 Thirty Mile Creek, New Leipzig,
 Name North Dakota
 Location Sec 35 & 36 - T.134N. - R.91W.
 Architect _____
 Date Started 5:30 PM 10-9-68
Finished 10:30 AM 10-10-68

TEST BORING FIELD LOG

Test Boring Number 10
 Surface Elevation 2321.0
 Engineer A.C. Grunseth (NDSWC)

1.5	Tan silty sand top soil and organic matter
	Tan silty sand
	Fine, friable
	Non plastic to slightly plastic
6.5	Dry, medium dense
	Red-brown sand
	Fine to medium-some pebbles
	Friable, non plastic
	Trace of clay
	Moist, medium dense
11.0	
	Tan fine sand
	Fine to medium
	Friable, non plastic
	Moist
	Occasional clay layers 1-2" thick
	Dense to very dense and compact
	No caving within this horizon
25.0	
	Gray sand-fine to medium
	Non plastic, trace of clay
	Saturated
	Very dense and compact
31.5	
	Gray clay (claypan)
	Silty
	Smooth, plastic
	Very hard

Depth Feet	Sample Number	N Bpf	T Ft-lbs
2.5-4.5	1497-10-1	4-6-6(12)	
8.0-9.5	1497-10-2	7-6-7(13)	
12.0-13.5	1497-10-3	12-22-37(59)	
17.0-18.5	1497-10-4	5-12-19(31)	
22.0-23.5	1497-10-5	28-47-90(137)	
27.0-28.5	1497-10-6	20-31-80(111)	
30.0-31.0	Auger sample 1497-10-7		
32.0-33.0	1497-10-8	46-112(158)	
36.5-38.0	1497-10-9	21-57-75(132)	

Water table: Plugged and dry 27' from surface, 28' hours after completion of boring

