Silver Celebration 25/20

WICA

Region V

RECEIVED

Minnesota Pollution Control Agency

Celebrating our 25th anniversary and the 20th anniversary of the Clean Water Act

JZ	BP
AF	SB
LB	
FILE	

August 3, 1992

Mr. Curt Bjertness
Wolverton Farmers Elevator
Box 69
Wolverton, Minnesota 56594

Mr. Mark Sundstrom
Box 69
Wolverton, Minnesota 56594

Dear Mr. Bjertness and Mr. Sundstrom:

RE: Completion of Conditional Closure and Land Treatment Soil Monitoring Requirements
Leaksite: Wolverton Farmers Elevator
Site ID#: LEAK00003517

On August 1, 1991, the Minnesota Pollution Control Agency (MPCA) staff issued a conditional petroleum tank release site closure letter for the site referenced above. The conditional closure letter specified that additional follow-up soil analysis as outlined in part III.C of the MPCA document "Land Application of Petroleum Contaminated Soil: Single Application Sites" (May 1991) is still required.

The MPCA staff has received and reviewed the monitoring results for soil samples collected at the land-application site on June 25, 1992. The results indicate that the soil has been adequately treated. Therefore, no further follow-up soil monitoring and tillage is required at the land application site. This area may now be used for crop production if desired.

The file regarding this petroleum tank release will be closed. If you have any questions, please contact me at 612/297-8576.

Sincerely,

David Holst
Pollution Control Specialist
Tanks and Spills Section
Hazardous Waste Division

DH:mh

cc: Leilyn Honeyman, Great Plains Environmental
Lyle Picotte, Township Chair
Bruce Poppel, Solid Waste Officer

Re: Robyn Livermore

SOIL MONITORING RESULTS FOR LAND TREATED PETROLEUM CONTAMINATED SOIL (FORM D)

Minnesota Pollution Control Agency
Tanks and Spills Section
May 1992

JUL 29 1992

This form should be used for reporting the results of follow-up soil sampling where petroleum contaminated soil has been land treated. Refer to the Minnesota Pollution Control Agency (MPCA) document "Land Treatment of Petroleum Contaminated Soil: Land Treatment Sites" (Guidance Document 24) for specific information on soil sampling.

I. BACKGROUND AND SOIL SPREADING INFORMATION

A. Tank owner/operator (and mailing address)

Contact: Curt Bjertness
Company name: Wolverton Farmers Elevator
Street/Box: Box 69
City, Zip: Wolverton, MN 56594
Telephone: 218-995-2565

B. Site from which contaminated soil originated:

MPCA Site ID#: LEAK0000 3517
Company name: Wolverton Farmers Elevator
Street: Box 69
City, Zip: Wolverton, MN 56594
County: 218-995-2565

C. Land Treatment Site Owner (and mailing address)

Name: Mark Sundstrom
Street/Box: Box 69
City, Zip: Wolverton, MN 56594
Telephone: 218-995-2921

D. Land Treatment Site Operator (and mailing address)

Name: Mark Sundstrom
Street/Box: Box 69
City, Zip: Wolverton, MN 56594
Telephone: 218-995-2921

E. Consultant (or other) preparing this form:

Name: Leilyn Honeyman
Company name: Great Plains Environmental
Street/Box: 1301 40th Street NW
City, Zip: Fargo, ND 58102
Telephone: 701-277-1612

F. Legal Description of Land Treatment Site:

NW ¼ of NW ¼ of Section 3,
Township 135N, Range 48W,
Township Name Roberts,
County Wilkin

II. LAND TREATMENT INFORMATION

A. Actual date soil was spread: September 1991

B. Dates soil tilled (since spreading or the most recent monitoring report):

September 1992, April 1992, May 1992

C. If land treatment plot was cropped indicate type of crop and seeding date:

Spring Wheat - Spring 1992

D. Soil monitoring sampling date: June 25, 1992

(see reverse side)

E. List the soil sample analytical results (total petroleum hydrocarbons, or TPH) from the land treatment site. If additional petroleum constituents were required to be reported, list results on a separate attached table.

Sample Number	TPH as Gas or Fuel Oil (circle one) ppm	Sample Number	TPH as Gas or Fuel Oil (circle one) ppm
SS #1	BDL		
SS #2	BDL		

NOTE: COPIES OF LABORATORY RESULTS AND CHAIN OF CUSTODY FORMS MUST BE ATTACHED

III. COUNTY AND LOCAL NOTIFICATION INFORMATION

A copy of this form must be sent to the appropriate county and local officials before or at the same time that it is submitted to the MPCA. Provide the following for the county and local officials to whom copies of this form have been sent:

County official:	Bruce Poppel	Local Official:	Lyle Picotte
Title:	Environmental Officer	Title:	Township Chairman
Street/Box:	1150 Hwy 75 N	Street/Box:	
City, Zip:	Breckenridge, MN 56520	City, Zip:	Wolverton, MN 56594
Telephone:	218-643-5815	Telephone:	218-557-8891

Mail completed form and attachments to:

Project Manager
Minnesota Pollution Control Agency
Tanks and Spills Section
520 Lafayette Road
St. Paul, Minnesota 55155-4194

-OR-

appropriate MPCA Regional Office land treatment site approval letter was issued by MPCA Regional Office Staff.

MVTL LABORATORIES, Inc.
P.O. BOX 249, 1126 N. FRONT STREET
NEW ULM, MN 56073-0249
PHONE (507) 354-8517 WATS (800) 782-3557 FAX (507) 359-2890

WE ARE AN EQUAL OPPORTUNITY EMPLOYER

Report To:

GREAT PLAINS ENVIRONMENTAL
1301 40TH ST NW box 2706
FARGO ND 58108-2706

Work Order #: 21-5747
Date Sampled: 6/26/92
Date Received: 6/30/92
Date Extracted: N/A
Date Analyzed: See Below
Date Reported: 7/14/92
Account Number: 0006008

RUSH: NOT REQUESTED
Project Name: WOLVERTON FARMERS ELEVATOR
Project Number: 100215

Log Number	Sample Description	MTBE (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-Benzene (ppb)	Xylenes (ppb)	Total Purgeable Hydrocarbons As Gas (ppm)	Total Purgeable Hydrocarbons As Fuel Oil (ppm)
92-Q1047	LAND FARM SITE SS #1	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Date Analyzed:	7/ 8/92							
Minimum Detection Limit		20.0	20.0	20.0	15.0	15.0	2.0	5.0
92-Q1048	LAND FARM SITE SS #2	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Date Analyzed:	7/ 8/92							
Minimum Detection Limit		20.0	20.0	20.0	15.0	15.0	2.0	5.0

***** Analyte Not Requested
BDL Below Detection Limits

Test Method: SW846 - 8020 / 5030 Modified

Report approved by:
Terrance W. Baumgart; Chemist
By and for Minnesota Valley Testing Labs, Inc.

Great Plains Environmental — Sample Identification / Field Chain of Custody Record

Project: Walhalla Farm Elevator, Walhalla
Shipped by: GPE Fargo, ND
Shipped to: MVTL, New Ulm, MN
Comments:

W.O. # 100215 21-5747
Attention of:
Hazardous materials suspected? (yes/no)

Sampling Point	Location	Field ID #	Date	Sample Type	No. of Containers	Analysis Required	Lab ID (optional)
92-Q1047	Landfarm site	SS #1	6-26-92	Soil	1	BTEX TPH MTBE	
92-Q1048	" "	SS #2	" "	"	"	" "	

Sampler(s) (signature) [signature]

Field ID	Relinquished by: (signature)	Received by: (signature)	Date / Time		Comments

Sealed for shipment by: (signature) [signature] Date / Time 6-29-92 1:40 Shipment method: Spec Mail

Received for Lab by: (signature) Jenny Hoffman Date / Time 6-30-92 Comments

Receiving Laboratory: Please return original form after signing for receipt of samples.

GREAT PLAINS ENVIRONMENTAL
1301 40TH ST. NW
FARGO, ND 58102
(701) 277-1612

GPE-SICR-93

FILE COPY

Minnesota Pollution Control Agency

June 27, 1991

Mr. Curt Bjertness
Wolverton Farmers Elevator
Box 69
Wolverton, Minnesota 56594

Dear Mr. Bjertness:

RE: Approval of Land Application of Petroleum Contaminated Soil
Site: S1/2 NW1/4 NW1/4 of Section 3, Roberts Township, Wilkin County, Minnesota
Site ID#: LEAK00003517

The application dated June 25, 1991, to land apply approximately 84 cubic yards of petroleum contaminated soil is hereby approved by staff of the Minnesota Pollution Control Agency (MPCA). This approval is based upon the MPCA staff's understanding that the appropriate county and local officials have been notified and/or have given approval for the land application of this soil and is subject to the following additional conditions:

1. Stockpiled soils shall be protected from infiltration and run-off prior to land application.

2. Soil shall be applied to land located on the Curt Bjertness property in the S1/2 NW1/4 NW1/4 of Section 3, T135, R48, Roberts Township, Wilkin County, Minnesota. Specifically that area as located above and on soil type 56 and/or 57A. See enclosed diagram.

3. The land application site shall be marked with stakes and/or flags prior to the application of petroleum contaminated soil. The stakes shall remain in place until all follow-up monitoring requirements as defined in the MPCA document "Land Application of Petroleum Contaminated Soil: Single Application Sites" (May 1991) are fulfilled.

4. Soils shall be spread to a thickness of no more than four inches and incorporated into the top four to six inches of native soil as outlined in part II.E of the MPCA land application document. Soils shall be disked once per month during the growing season.

5. The land-applied soil shall be sampled and reports shall be submitted in accordance with part III.C of the MPCA land application document until analyses indicate 10 pars per million total petroleum hydrocarbons or lower. The MPCA form entitled "Soil Monitoring Results for Land-Applied Petroleum Contaminated Soil" should be used for reporting.

6. The MPCA's approval of this application does not release the applicant from any duty to comply with county or local ordinances.

7. The MPCA for "Notification of Land Application of Petroleum Contaminated Soil" (May 1991) shall be submitted to the MPCA within seven days following land application.

We believe these actions will provide treatment of petroleum contaminated soils. The MPCA reserves the right to require additional work if this is determined to be necessary to protect public health and the environment. This letter does not release any party from liability for this contamination. Please contact me at 218/846-0733, if you have any questions.

Sincerely,

Doug Bellefeuille
Regional Specialist
Northwest Regional Office

DB:sb

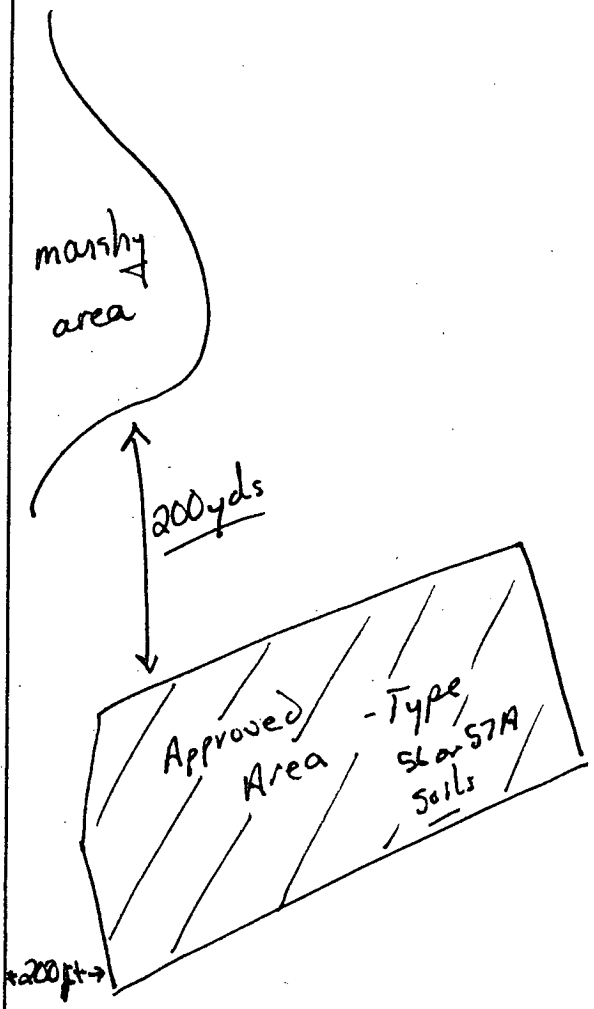
cc: Ann Bidwell, Hazardous Waste Division, MPCA, St. Paul
Terry Kraft, Great Plains Environmental
David Givers, Wilkin County Environmental Office
Lyle Picotte, Roberts Township Chairman
Robyn Livermore, Hazardous Waste Division, MPCA, St. Paul

North ↑

County Rd #184

Farmstead

proposed area, to low.



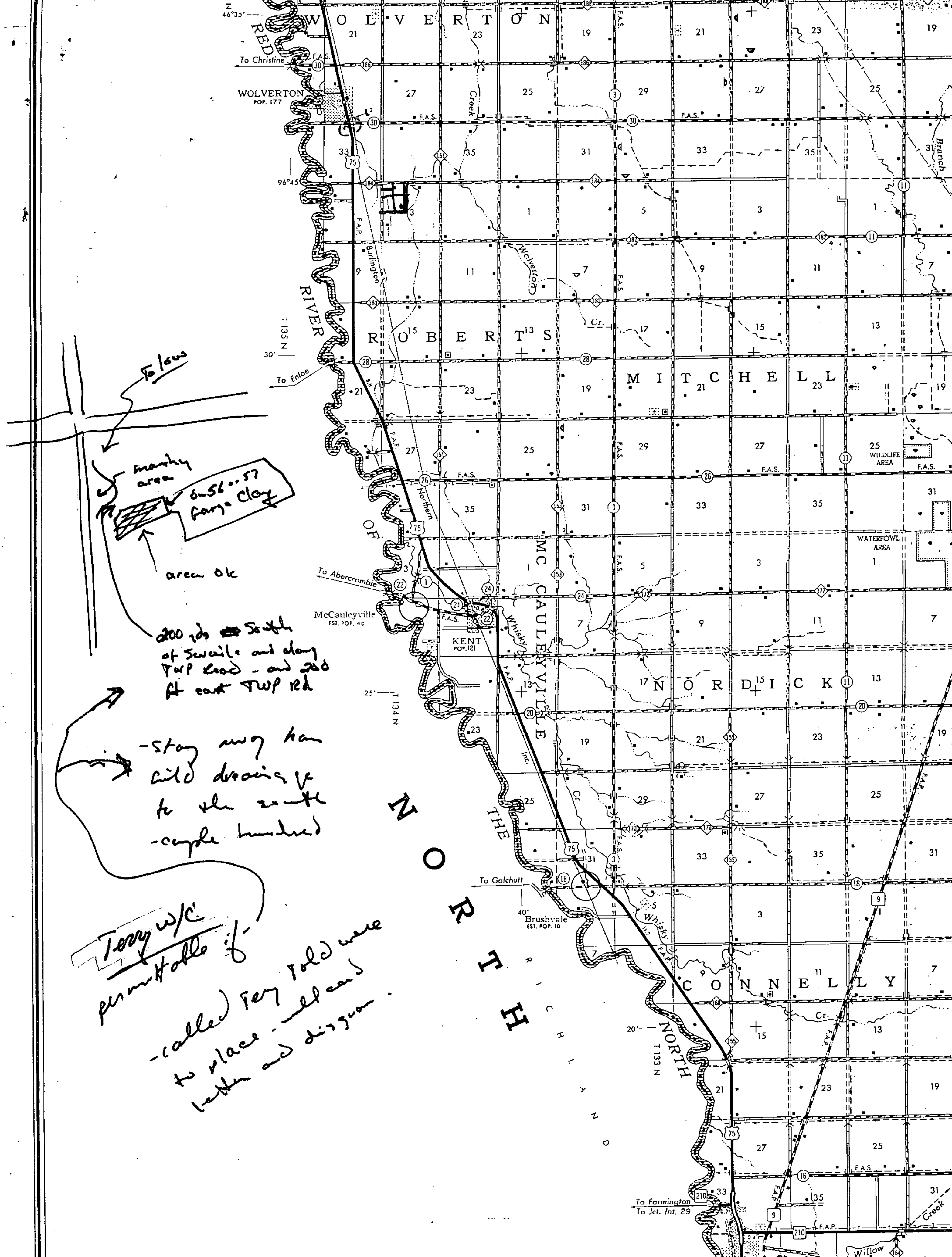
Section 3

Approved Area location

* 200 yd seperation from the marshy area and at least
* 200 ft. seperation from the road ditch

* Also, at least 200 yds north of the field ditch located in the south.

TWP Road



WOLVERTON
ROBERTS
MITCHELL
NORDICK
MC CAULEYVILLE
CONNELLY
RED RIVER OF THE NORTH
RICHLAND
To Christine
WOLVERTON POP. 177
To Enloe
To Abercrombie
McCauleyville EST. POP. 40
KENT POP. 121
To Galchutt
Brushvale EST. POP. 10
To Farmington
To Jct. Int. 29
WILDLIFE AREA
WATERFOWL AREA
Burlington Northern Inc.
Wolverton Cr.
Whisky Cr.
Willow Creek
Branch
F.A.S.
F.A.P.
T 135 N
T 134 N
T 133 N
46°35'
96°45'
To lows
marshy area
On 56 .. 57 Fargo Clay
area ok
200 yds South of Swaile and along Twp Road - and 200 ft east Twp Rd
-Stay away from wild drainage to the south
-couple hundred
Terry w/C permittable if-
-called Terry told were to place - will send letter and diagram.

APPLICATION TO LAND APPLY PETROLEUM CONTAMINATED SOIL

Minnesota Pollution Control Agency
Tanks and Spills Section
April 25, 1990

Refer to the Minnesota Pollution Control Agency (MPCA) document "Land Application of Petroleum Contaminated Soil: Single Application Sites" for specific information on acceptable soil and site criteria.

I. BACKGROUND INFORMATION

A. Tank owner/operator mailing address: contaminated

Contact: Curt Bjertness
Company name: Wolverton Farmers Elevator
Street/Box: Box 69
City, Zip: Wolverton, MN 56594
Telephone: 218-995-2565

B. Site from which soil originated:

Company name: Wolverton Farmers Elev
Street: Highway 75 - Box 69
City, Zip: Wolverton, MN 56594
County: Wilkin

C. Address or legal descripton of land spreading site:

Contact: ~~Curt Bjertness~~ Mark Sundstrom
Street: ~~Box 69~~ Box 69
City, Zip: Wolverton, MN 56594
Telephone: 218-995-2565
NE 1/4 of NW 1/4 of Section 3,
Township 135N Range 48W Township Name Roberts

D. Consultant (or other) preparing this form:

Contact: Terry Kraft
Company name: Great Plains Environ
Street/Box: 1301 40th St NW
City, Zip: Fargo, ND 58102
Telephone: 701-277-1612

E. MPCA Site ID#: LEAK0000 3517
F. Volume of soil to be land applied (cubic yards): 84
G. Projected date of application of soil: May 1991
H. Have there been past waste disposal activities at the proposed site?
No X Yes ___ , please explain.

II. SITE AND SOIL CHARACTERISTICS

A. Site slope (percent): 2-6
B. Distance to surface water (feet or miles): Over 100'
C. Distance to nearest building or residence (feet): Over 200
D. Depth to seasonal high water table (feet): 2-6
Depth to field tile lines (feet): N/A
If bedrock exists at 8 feet or less, indicate depth (feet): _____
E. Area of land to be used (square feet or acres): _____
F. Spreading thickness (inches): 2-3

III. SOIL SAMPLING RESULTS

A. If soil nutrient tests were conducted, list the results below:

Sample Number	Organic Matter, Percent	Extractable Phosphorus, ppm

If fertilizers will be applied, provide application rates:
_____ lbs. nitrogen/acre, _____ lbs. P205/acre, _____ lbs. sulfur/acre

B. Circle the type(s) of petroleum contamination: ~~unleaded gas~~, regular gas, diesel fuel, ~~heating oil, waste oil~~, other (please specify _____).

List the appropriate soil sample analytical results from the excavated contaminated soil (refer to the MPCA document "Soil and Ground Water Analysis at Petroleum Release Sites"). If the petroleum was not gasoline or fuel oil attach a separate table.

Sample Number	THC as gas or FO ppm	Benzene ppm	Ethyl-benzene ppm	Toluene ppm	Xylene ppm	MTBE ppm	Lead ppm
SS #6	2320 - Gas 6410 - FO	10000	7500	16800	72700		

NOTE: ATTACH COPIES OF LABORATORY RESULTS AND CHAIN OF CUSTODY FORMS

IV. FIGURES

Include the following figures:

A. Copy of county soil survey map (if the county has been mapped) with copies of the interpretation tables or interpretation sheets.
B. Site location map with exact application location marked (scale should be approximately one inch = 50 feet)

****

Signature and Title of MPCA Staff Inspector (or other authorized inspector):
Jay Bellfuss

Date Inspected : 6-28-91

Signature and Title of County Official: * See attached letter

Signature and Title of City/Township Official: Lyle Lacotte

Inspected 6-26-91 JBF

****

Mail to:

Minnesota Pollution Control Agency
Attention: (Project Manager)
Hazardous Waste Division
Tanks and Spills Section
520 Lafayette Road
St. Paul, Minnesota 55155

Wilkin County, Minnesota

ENVIRONMENTAL RESOURCES MANAGEMENT OFFICE
P.O. BOX 110
BRECKENRIDGE, MINNESOTA 56520
(218) 643-5815

April 12, 1991

Terry Kraft
Great Plains Environmental
Service, Inc.
1301 40th Street NW
Fargo, ND 58102

re: LEAK 00003517

Dear Mr. Kraft,

Wilkin County does not regulate land spreading of petroleum contaminated soils. The Minnesota Pollution Control Agency is resonsible for this activity and Wilkin County must rely on their expert opinion in these matters. Therefore, Wilkin County does not approve or disapprove of this activity.

I have looked at the depth to groundwater on the site you have chosen. If the site is true to the data, then I would be concerned, because the Fargo series seasonal groundwater is listed as 0 to 3 feet.?

I have asked Doug Bellefeuille, MPCA Detroit Lakes, to notify me when he inspects the site. I will be present, if my schedule allows. I appreciate receiving notification of your application and I have forwarded the application as requested to the Chairman of Roberts Township.

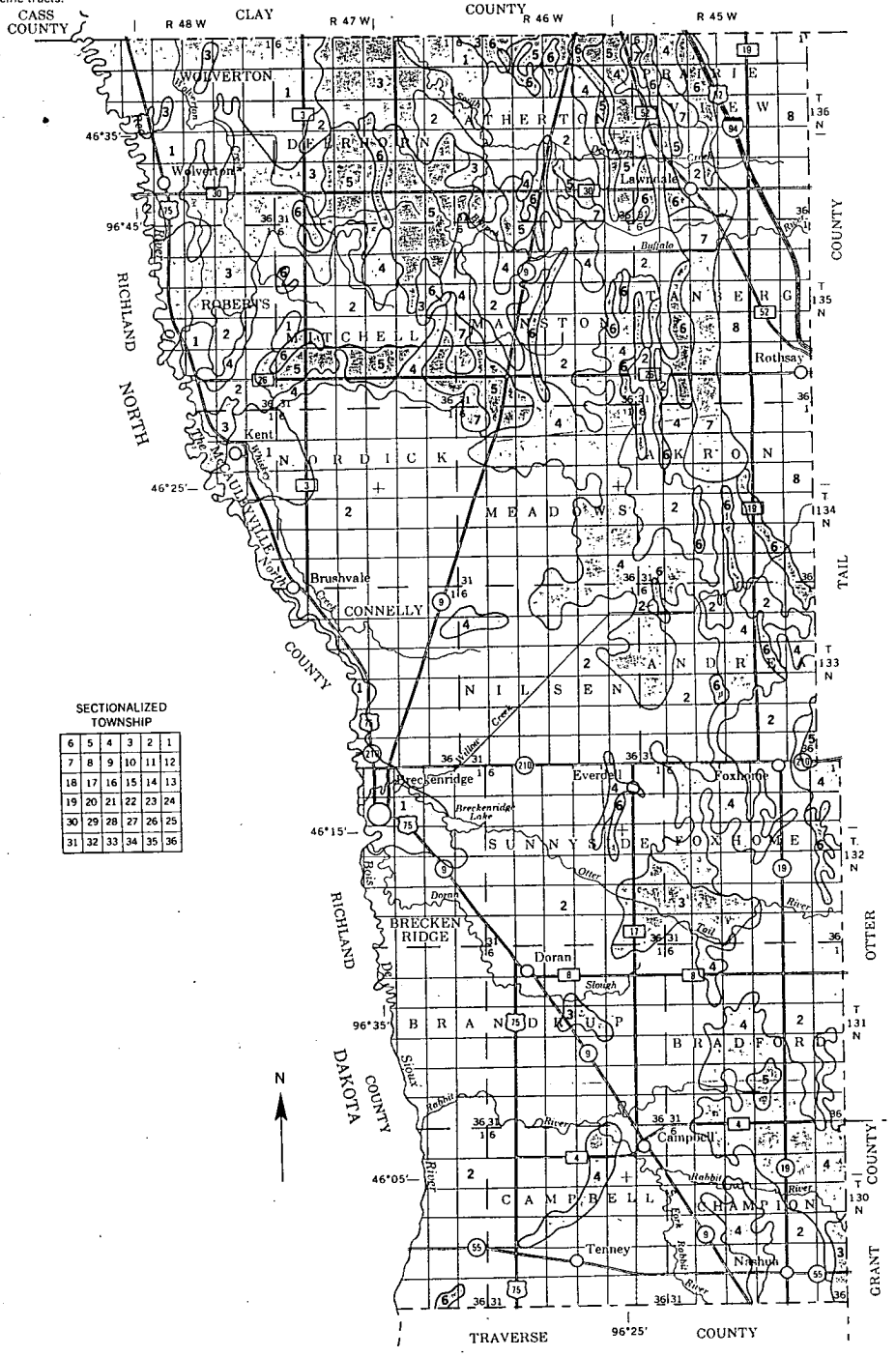
Best wishes and sincerely yours,

David R. Givers (copy)

David R. Givers
Environmental Officer

218-643-5815 meet us at 7:30 in Wolverton

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

LEGEND

1 — FARGO-NORTHCOTE association: Nearly level and gently sloping, poorly drained soils formed in clayey lacustrine sediments; on lake plains

2 — HAMERLY-DORAN association: Nearly level, somewhat poorly drained and moderately well drained soils formed in loamy glacial till and in lacustrine sediments; on uplands, lake plains, and till plains

3 — WHEATVILLE-BEARDEN-GLYNDON association: Nearly level and gently sloping, somewhat poorly drained and moderately well drained soils formed in silty or loamy lacustrine sediments; on lake plains

4 — ELMVILLE-DONALDSON association: Nearly level, somewhat poorly drained and moderately well drained soils formed in loamy or sandy lacustrine sediments or in glacial till; on lake plains

5 — WYNDMERE-ULEN-FLAMING association: Nearly level, somewhat poorly drained and moderately well drained soils formed in loamy or sandy sediments; on lake plains

6 — LOHNES-SIOUX association: Nearly level and gently sloping, moderately well drained, well drained, and excessively drained soils formed in sandy or loamy deposits; on lake plains and outwash plains

7 — URNESS-HAUG association: Level, very poorly drained soils formed in silty lacustrine sediments or organic deposits; on lake plains and ground moraines

8 — BARNES-ROTHSAY association: Nearly level to hilly, well drained soils formed in loamy or silty glacial till or lacustrine deposits; on till plains, lake plains, and

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MINNESOTA AGRICULTURAL EXPERIMENT STATION

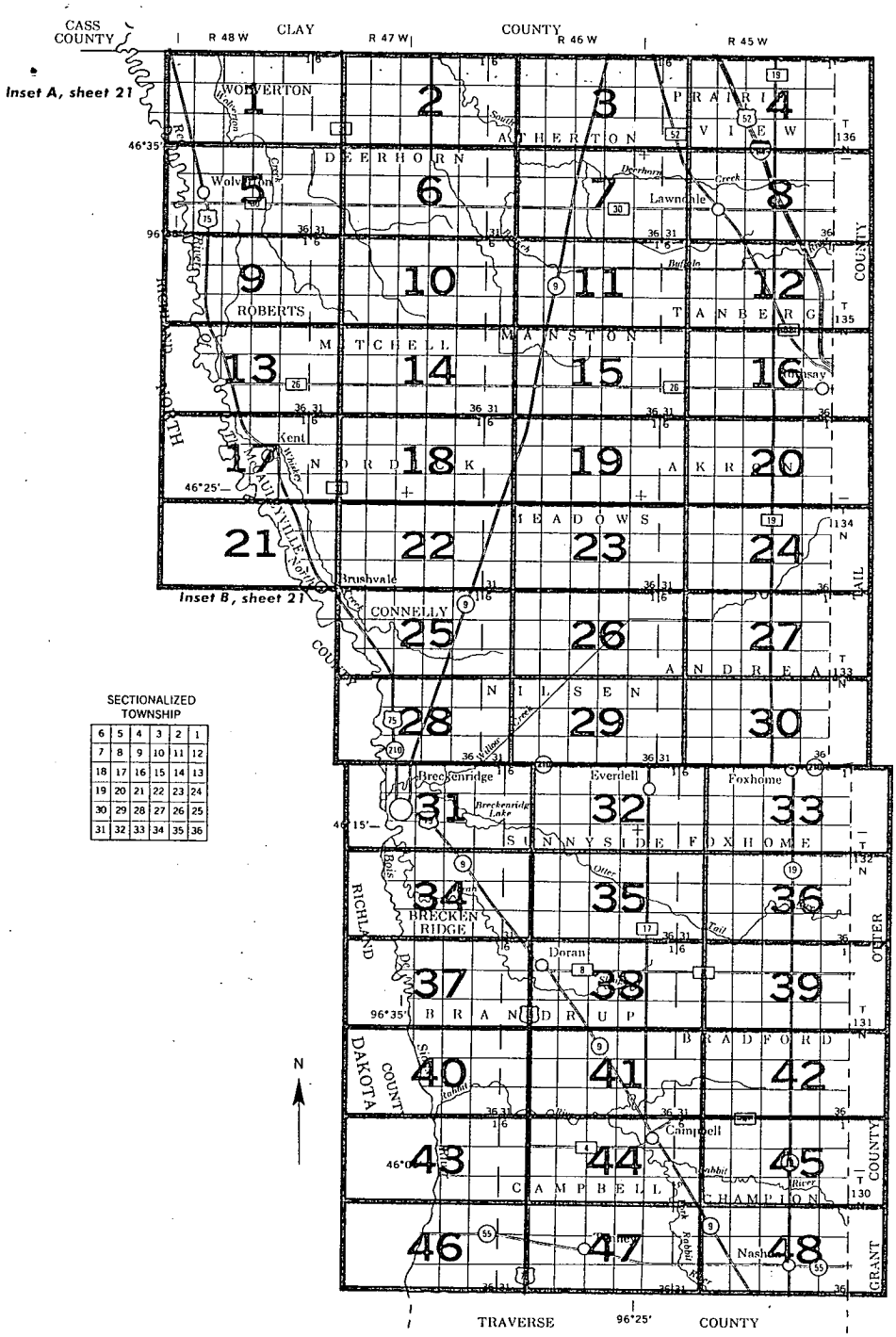
GENERAL SOIL MAP

WILKIN COUNTY, MINNESOTA

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Km



INDEX TO MAP SHEETS

#46:26

SOIL SURVEY OF WILKIN COUNTY, MINNESOTA - SHEET NUMBER 9

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Fargo silty clay, 0 to 2 percent slopes, is a phase of the Fargo series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Rothsay-Zell silt loams, 2 to 6 percent slopes, eroded, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Haplaquolls and Histosols, ponded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Some soil boundaries and soil names in this survey do not fully match those in the surveys of adjoining counties that were published at an earlier date. Differences are the result of changes and refinements in series concepts, different slope groupings, and the application of the latest soil classification system.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

26—Aazdahl clay loam. This nearly level and gently undulating, moderately well drained soil is on ground moraines in the basin of glacial Lake Agassiz. It is typically on slightly convex slopes. Individual areas are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is black clay loam about 12 inches thick. The subsoil is dark grayish brown clay loam about 6 inches thick. The underlying material to a depth of about 60 inches is calcareous silty clay loam. It is light olive brown in the upper part and grayish brown and mottled in the lower part. In some areas the soil is more silty. In a few areas the dark surface layer is more than 16 inches thick. In some areas on the lake plain, the soil is subject to rare flooding.

Included with this soil in mapping are small areas of Barnes, Donaldson, Doran, Hamerly, and Kittson soils.

Barnes soils are well drained and typically are in the higher landscape positions. Donaldson, Hamerly, and Kittson soils are somewhat poorly drained and moderately well drained. They are on the lower parts of the landscape. Doran soils are somewhat poorly drained and are on flats on the lower parts of the landscape. Included soils make up about 15 percent of the unit.

Permeability is moderately slow in the Aazdahl soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 3 to 6 feet.

Most areas are cropped. This soil is well suited to cropland. Unless the surface is protected, soil blowing is a hazard. It can be controlled by crop residue management, conservation tillage, and cover crops. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is I.

33B—Barnes loam, 1 to 6 percent slopes. This nearly level and gently undulating, well drained soil is on till plains. It is typically on side slopes and the crest of knolls. Individual areas are irregular in shape and range from 4 to 100 acres in size.

Typically, the surface layer is black loam about 10 inches thick. The subsoil also is loam about 10 inches thick. The upper part is very dark grayish brown, and the lower part is dark grayish brown. The underlying material to a depth of about 60 inches is light olive brown, calcareous loam and clay loam. In places layers of sand and gravel are in the underlying material. In some areas the soil has a higher content of very fine sand and silt. In other areas moderate erosion has removed part of the topsoil.

Included with this soil in mapping are small areas of Aazdahl, Darnen, Kittson, and Langhei soils. Aazdahl and Darnen soils are moderately well drained and are in swales and on the lower side slopes. Kittson soils are somewhat poorly drained and moderately well drained and are in the slightly lower swales. Langhei soils are calcareous throughout. They are at the crest of knobs and on slope breaks. Also included are some small areas of poorly drained soils. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Barnes soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

Most areas are cropped. This soil is well suited to cropland. The principal management concerns are controlling water erosion and soil blowing and maintaining tilth and fertility. Crop residue management, cover crops, and, where possible, contour farming help to prevent excessive soil loss. In areas of concentrated waterflow, grassed waterways may be needed to keep rills and gullies from forming. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIe.

33B2—Barnes loam, 2 to 6 percent slopes, eroded. This gently undulating, well drained soil is on till plains. It is typically on side slopes and the crest of knolls. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsoil is brown loam about 6 inches thick. The underlying material to a depth of about 60 inches is light yellowish brown and light olive brown, calcareous loam. In some places layers of sand and gravel are in the underlying material. In other places the soil has a higher content of very fine sand and silt. In some areas it is not eroded. In other areas the slope is more than 6 percent.

Included with this soil in mapping are small areas of Aazdahl, Darnen, Kittson, and Langhei soils. Aazdahl and Darnen soils are moderately well drained and are in swales and on the lower side slopes. Kittson soils are somewhat poorly drained and moderately well drained and are in the lower swales. Langhei soils are well drained and are at the crest of knobs and on slope breaks. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Barnes soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium or rapid.

Most areas are cropped. This soil is well suited to cropland. The principal management concerns are controlling water erosion and soil blowing and maintaining tilth and fertility. Crop residue management, cover crops, and, where possible, contour farming help to prevent excessive soil loss. In areas of concentrated waterflow, grassed waterways may be needed to keep rills and gullies from forming. Applications of commercial fertilizer increase the supply of plant nutrients.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on this soil. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIe.

34—Parnell silt loam. This level, very poorly drained soil is in shallow swales and small depressions on ground moraines. It is subject to ponding and to rare flooding. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Figure 7.—An area of Haplaquolls and Histosols, ponded.

surface. In some places the underlying material is sand. In other places the surface layer is less than 16 inches thick. In some areas the soil is calcareous.

Permeability is moderately rapid to moderately slow in the Haplaquolls and Histosols. Available water capacity is high. Organic matter content is high or very high. Surface runoff is ponded. The seasonal high water table is 3 feet above to 1 foot below the surface.

Most of the acreage is idle land that supports sedges, cattails, rushes, and other water-tolerant plants. Because of the ponding, these soils are generally unsuitable as cropland. They are suited to wetland wildlife habitat.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of extreme wetness and ponding. Because of the wetness, seedling mortality is severe.

The land capability classification is VIIIw.

1819—Glyndon silty clay loam. This nearly level, somewhat poorly drained and moderately well drained soil is in lake basins. It is on flats and gentle rises. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer is gray, calcareous silty clay loam about 8 inches thick. The subsoil is light yellowish brown, calcareous very fine sandy loam about 6 inches thick. The underlying material to a depth of about 60 inches is light brownish gray, mottled, calcareous very fine sandy loam and silt loam. In places the surface soil is mixed with the subsoil and is calcareous. Some areas are subject to rare flooding.

Included with this soil in mapping are small areas of Aazdahl, Bearden, Fargo, and Wheatville soils. Aazdahl soils are moderately well drained and are on the higher rises. Bearden and Wheatville soils are somewhat poorly

drained and are in landscape positions similar to those of the Glyndon soil. Fargo soils are poorly drained and are on the lower flats. Included soils make up about 15 percent of the unit.

Permeability is moderate in the upper part of the Glyndon soil and moderately rapid in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The depth to a seasonal high water table is 2.5 to 6.0 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The content of carbonates is the principal limitation, and soil blowing is a hazard. Excess carbonates may cause chlorosis. Carefully balanced fertility levels and the selection of crops and crop varieties tolerant of carbonates reduce the likelihood of chlorosis. Leaving protective amounts of crop residue on the surface helps to control soil blowing. Soil blowing also can be controlled by planting field windbreaks and seeding cover crops. The hay and pasture plants best suited to this soil are alfalfa, crownvetch, smooth bromegrass, big bluestem, little bluestem, indiangrass, and switchgrass.

This soil is fairly well suited to windbreaks. The best suited trees and shrubs are those that are tolerant of excess carbonates.

The land capability classification is IIs.

1871—Fargo silty clay, swales. This nearly level, poorly drained soil is in swales on lake plains. It is subject to ponding and to rare flooding. Individual areas are typically elongated and range from 20 to 150 acres in size.

Typically, the surface soil is black silty clay about 10 inches thick. The subsoil is dark olive gray, mottled clay about 8 inches thick. The underlying material to a depth of about 60 inches is light olive gray, mottled clay. In some areas the content of clay is higher in the upper part of the soil. In a few areas the soil has dark buried layers. In some places the dark surface soil is more than 24 inches thick. In other places coarse fragments are on the surface.

Included with this soil in mapping are small areas of Cashel and Colvin soils. Cashel soils are somewhat poorly drained and are in the swales. Colvin soils are poorly drained and are in landscape positions similar to those of the Fargo soil. Included soils make up about 15 percent of the unit.

Permeability is slow in the Fargo soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is ponded. The seasonal high water table is 0.5 foot above to 1.0 foot below the surface.

Most areas are cropped. This soil is fairly well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are toler of a high content of lime and the wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing weeds.

The land capability classification is IIIw.

1872—Fargo silty clay, silty substratum. This nearly level, poorly drained soil is on lake plains. It is typically on flats and gentle rises. It is subject to rare flooding. Individual areas are irregular in shape and range from 3 to 320 acres in size.

Typically, the surface soil is black silty clay about 13 inches thick. The subsoil is dark olive gray silty clay about 17 inches thick. The underlying material to a dep of about 60 inches is olive gray, mottled, calcareous sil clay loam. In some areas the soil is somewhat poorly drained. In places the underlying material is loam. In a few areas the surface layer is calcareous.

Included with this soil in mapping are small areas of Colvin and Bearden soils. Colvin soils are poorly drained and are in landscape positions similar to those of the Fargo soil. Bearden soils are somewhat poorly drained and are in the slightly higher positions. Included soils make up about 15 percent of the unit.

Permeability is slow in the upper part of the Fargo so and moderately slow or moderate in the lower part. Available water capacity is moderate or high. Organic matter content is high. Surface runoff is very slow. The depth to a seasonal high water table is 1 to 3 feet.

Most areas are cropped. This soil is well suited to cropland and pasture. The wetness is the principal limitation. Soil blowing is a problem in bare areas. Improving or maintaining fertility also is a management concern. A drainage system is needed. Crop residue management, cover crops, and field windbreaks help to control soil blowing. Applications of commercial fertilizer increase the supply of plant nutrients.

The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolera of wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivatio or applications of herbicide help to remove competing weeds.

The land capability classification is IIw.

1874—Lohnes sandy loam. This nearly level, moderately well drained soil is on lake plains and outwash plains. It is typically on the lower side slopes and in shallow swales. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is black sandy loam about 12 inches thick. The subsoil is about 9 inches thick. It is dark grayish brown loamy sand in the upper part and

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(7)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Calciaquolls (*Calc*, meaning a concentration of calcium carbonate, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aeric* identifies the subgroup that is characterized by better aeration or drainage than is typical of the great group. An example is Aeric Calciaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, frigid Aeric Calciaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (6)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (7)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Aazdahl Series

The Aazdahl series consists of moderately well drained, moderately slowly permeable soils on ground moraines. These soils formed in calcareous, loamy and silty glacial till. Slopes range from 0 to 3 percent.

Typical pedon of Aazdahl clay loam, 800 feet east and 1,000 feet north of the southwest corner of sec. 3, T. 130 N., R. 46 W.

Ap—0 to 12 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine granular

structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.
Bw—12 to 18 inches; dark grayish brown (10YR 4/2) clay loam; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; clear wavy boundary.
C1—18 to 32 inches; light olive brown (2.5Y 5/4) silty clay loam; massive; friable; about 1 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.
C2—32 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8) mottles; massive; friable; few medium white (10YR 8/1) masses of lime; few fine black (5YR 2/1) concretions of iron; about 1 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 14 to 27 inches. The mollic epipedon is 12 to 16 inches thick. The content of coarse fragments ranges from 0 to 8 percent.

The A horizon has value of 2 or 3. It is typically clay loam, but the range includes loam and silty clay loam. The Bw horizon has hue of 2.5Y or 10YR and value of 3 or 4. In some pedons it is mottled in the lower part. It is clay loam or silty clay loam. It is neutral or mildly alkaline and has free carbonates in some pedons. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 to 4. It is clay loam, silty clay loam, silt loam, or loam. It is mildly alkaline or moderately alkaline. It has pockets of gypsum crystals in some pedons.

Arveson Series

The Averson series consists of poorly drained and very poorly drained soils on flats and in slight depressions on lake plains and outwash plains. These soils formed in calcareous, loamy lacustrine sediments overlying sandy material. Permeability is moderate or moderately rapid in the subsoil and moderately rapid or rapid in the underlying material. Slopes are 0 to 1 percent.

Typical pedon of Arveson loam, 1,935 feet east and 250 feet south of the northwest corner of sec. 29, T. 136 N., R. 45 W.

A—0 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; friable; strong effervescence; mildly alkaline; clear smooth boundary.
Bkg1—11 to 18 inches; dark gray (2.5Y 4/1) loam; weak very fine granular structure; friable; few fine soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.
Bkg2—18 to 35 inches; dark grayish brown (2.5Y 4/2) sandy loam; few fine and medium distinct yellowish brown (10YR 5/4) mottles; weak very fine granular structure; very friable; common medium soft white (5Y 8/1) masses of calcium carbonate; violent effervescence; moderately alkaline; clear smooth boundary.
Cg1—35 to 42 inches; dark grayish brown (2.5Y 4/2) fine sand; common fine prominent brownish yellow (10YR 6/6) and few medium prominent yellowish brown (10YR 5/6) mottles; single grain; loose; strong effervescence; mildly alkaline; gradual smooth boundary.
Cg2—42 to 60 inches; dark grayish brown (2.5Y 4/2) fine sand; streaks of very dark gray (10YR 3/1) loam; single grain; loose; slight effervescence; mildly alkaline.

The mollic epipedon ranges from 7 to 24 inches in thickness. The depth to loamy fine sand or coarser textured sediments is more than 18 inches. The 10- to 40-inch control section is fine sandy loam, sandy loam, or loam. In some pedons the content of coarse fragments is as much as 5 percent. Some pedons have a few stones and cobbles on the surface. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 5Y, 2.5Y, or 10YR, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 or 3 and chroma of 0. It is mottled in a few pedons. It is typically loam, but the range includes sandy loam, fine sandy loam, sandy clay loam, silt loam, and clay loam. Some pedons have an Ak horizon. The Bk horizon has hue of 2.5Y or 5Y, value of 4 to 7, and chroma of 1 or 2. It is dominantly sandy loam, fine sandy loam, sandy clay loam, or loam. In some pedons, however, it is loamy sand or loamy fine sand in the lower part. The C horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It is mottled in some pedons. It is sand, fine sand, loamy sand, loamy fine sand, sandy loam, or fine sandy loam.

Augsburg Series

The Augsburg series consists of poorly drained soils on lake plains. These soils formed in a mantle of loamy sediments and in the underlying clayey or silty lacustrine sediments. Permeability is moderately rapid in the upper part of the profile and slow or very slow in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Augsburg very fine sandy loam, 80 feet west and 50 feet north of the southeast corner of sec. 13, T. 132 N., R. 46 W.

A—0 to 13 inches; black (10YR 2/1) very fine sandy loam, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; some bleached sand grains; strong effervescence; mildly alkaline; clear smooth boundary.

2BC—18 to 25 inches; brown (10YR 4/3) very gravelly sand; single grain; loose; about 35 percent gravel; neutral; clear smooth boundary.
2C—25 to 30 inches; yellowish brown (10YR 5/4) very gravelly coarse sand; few fine distinct grayish brown (10YR 5/2) mottles; single grain; loose; about 45 percent gravel; slight effervescence; mildly alkaline; abrupt smooth boundary.
3C—30 to 60 inches; light olive gray (5Y 6/2) silt loam; common medium prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; friable; about 4 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of solum and the depth to free carbonates range from 15 to 30 inches. The mollic epipedon is 10 to 16 inches thick. The content of coarse fragments is less than 15 percent in the A, B, and 3C horizons and ranges from 35 to 75 percent the 2B and 2C horizons.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is sandy loam, fine sandy loam, or loam. The B horizon has value of 3 or 4 and chroma of 2 or 3. It is loamy sand, sandy loam, or loam. The 2C and 3C horizons are mildly alkaline or moderately alkaline. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is very gravelly sand or very gravelly coarse sand. The 3C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 or 3. It is typically silt loam, loam, or clay loam, but sandy loam, fine sandy loam, and silty clay loam are within the range.

Galchutt Series

The Galchutt series consists of somewhat poorly drained soils on lake plains. These soils formed dominantly in silty lacustrine material and in the underlying clayey sediments. Permeability is moderate in the upper part of the profile and slow in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Galchutt silt loam, 560 feet east and 2,620 feet south of the northwest corner of sec. 21, T. 132 N., R. 47 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very friable; neutral; abrupt smooth boundary.
E—10 to 13 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; few fine distinct brown (10YR 5/3) and yellowish brown (10YR 5/6) mottles; weak very thin platy structure parting to weak very fine subangular blocky; friable; neutral; clear broken boundary.
2Bt1—13 to 16 inches; dark grayish brown (2.5Y 4/2) clay; common fine prominent dark reddish brown (5YR 3/4) and reddish brown (5YR 4/4) mottles; strong medium angular blocky structure; very firm; very dark gray (10YR 3/1) coatings on faces of peds; neutral; clear smooth boundary.
2Bt2—16 to 23 inches; dark grayish brown (2.5Y 4/2) clay; few fine prominent yellowish red (5YR 5/6 and 5/8) mottles; strong fine and medium angular blocky structure; very firm; very dark grayish brown (10YR 3/2) coatings on faces of peds; neutral; clear smooth boundary.
2BC—23 to 36 inches; olive brown (2.5Y 4/4) clay; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; firm; slight effervescence; mildly alkaline; gradual smooth boundary.
2C—36 to 60 inches; olive brown (2.5Y 4/4) silty clay; common fine distinct yellowish brown (10YR 5/6 and 5/8) mottles; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 10 to 24 inches. The depth to free carbonates ranges from 19 to 48 inches. The thickness of the silty sediments ranges from 13 to 40 inches.

The Ap or A horizon has value of 2 or 3. In some pedons it has faint mottles in the lower part. It is silt loam, loam, or silty clay loam. The E horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 to 3. It is very fine sandy loam, silt loam, or loam. It is discontinuous and mixed with the Ap horizon in many pedons. The 2Bt and 2C horizons are silty clay or clay. The 2Bt horizon has value of 4 or 5 and chroma of 2 or 3. It is neutral or mildly alkaline. The 2C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 to 4. It has distinct or prominent mottles in some pedons. In some pedons it has few or common soft accumulations of lime.

Glyndon Series

The Glyndon series consists of somewhat poorly drained and moderately well drained, moderately permeable or moderately rapidly permeable soils in lake basins. These soils formed in silty lacustrine material high in content of very fine sand. Slopes range from 0 to 2 percent.

Typical pedon of Glyndon very fine sandy loam, 780 feet west and 370 feet north of the southeast corner of sec. 33, T. 131 N., R. 45 W.

Ap—0 to 9 inches; black (10YR 2/1) very fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine granular; friable; strong effervescence; moderately alkaline; abrupt smooth boundary.
Ak—9 to 13 inches; very dark gray (10YR 3/1) very fine sandy loam, gray (10YR 5/1) dry; weak fine

subangular blocky structure parting to weak fine granular; friable; violent effervescence; strongly alkaline; clear smooth boundary.

Bk—13 to 23 inches; dark gray (10YR 4/1) sandy clay loam; weak fine and medium subangular blocky structure; very friable; violent effervescence; moderately alkaline; clear wavy boundary.

C1—23 to 39 inches; light olive brown (2.5Y 5/4) very fine sandy loam; few fine faint light olive brown (2.5Y 5/6) mottles; weak very fine subangular blocky structure; very friable; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—39 to 60 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam; common fine and medium distinct olive yellow (2.5Y 6/6 and 6/8) mottles; few fine prominent strong brown (7.5YR 5/8) mottles; weak very fine subangular blocky structure; very friable; slight effervescence; mildly alkaline.

The mollic epipedon is 7 to 16 inches thick. The calcic horizon is within 16 inches of the surface.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically very fine sandy loam or silty clay loam, but the range includes loam, silt loam, and sandy clay loam. This horizon is mildly alkaline to strongly alkaline. Some pedons do not have an Ak horizon. The Bk horizon has value of 4 to 6 and chroma of 1 to 3. It is mottled in some pedons. It is loam, silt loam, silty clay loam, sandy clay loam, very fine sand, or very fine sandy loam. It is mildly alkaline to strongly alkaline. The C horizon has hue of 2.5Y or 5Y and value of 5 or 6. It has chroma of 3 or 4 in the upper part and chroma of 2 to 4 in the lower part. It is very fine sandy loam, very fine sand, or loamy very fine sand.

Grimstad Series

The Grimstad series consists of somewhat poorly drained and moderately well drained soils on lake plains. These soils formed in sandy material over silty and loamy glacial till or lacustrine deposits. Permeability is rapid in the subsoil and moderate in the underlying material. Slopes range from 0 to 2 percent.

Typical pedon of Grimstad sandy loam, 2,600 feet west and 100 feet north of the southeast corner of sec. 13, T. 136 N., R. 46 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; few fine bleached sand grains; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bk1—10 to 18 inches; dark gray (10YR 4/1) sandy loam; weak medium subangular blocky structure; friable; violent effervescence; moderately alkaline; clear smooth boundary.

Bk2—18 to 23 inches; dark brown (10YR 4/3) loamy fine sand; weak fine granular structure; very friable; strong effervescence; mildly alkaline; clear smooth boundary.

C—23 to 32 inches; light yellowish brown (2.5Y 6/4) fine sand; few fine distinct brownish yellow (10YR 6/8) mottles; single grain; loose; discontinuous pebble band at the bottom of the horizon; slight effervescence; mildly alkaline; abrupt smooth boundary.

2C—32 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; many medium distinct yellowish brown (10YR 5/6 and 5/8) and few fine and medium prominent strong brown (7.5YR 5/8) mottles; massive; firm; few black (10YR 2/1) concretions of iron; about 5 percent coarse fragments; slight effervescence; mildly alkaline.

The mollic epipedon is 7 to 16 inches thick. The top of the calcic horizon is within 16 inches of the surface. The depth to the 2C horizon ranges from 20 to 40 inches. Free carbonates are throughout the profile. Reaction is mildly alkaline or moderately alkaline in the surface layer and mildly alkaline to strongly alkaline in the underlying material. Some pedons do not have a thin pebble band at the contact point of the upper sediments and the 2C horizon.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is typically sandy loam, but the range includes loamy fine sand, loamy very fine sand, fine sandy loam, and loam. Some pedons have an Ak horizon. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is loamy sand, sandy loam, or loamy fine sand. It has a calcium carbonate equivalent of 5 to 20 percent. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It commonly is mottled in most parts, but it does not have distinct or prominent mottles within a depth of 20 inches. It is sand, fine sand, loamy sand, or loamy very fine sand. The 2C horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 2 to 4. It commonly has distinct or prominent mottles. It is loam, silt loam, fine sandy loam, clay loam, or silty clay loam.

Hamerly Series

The Hamerly series consists of somewhat poorly drained and moderately well drained, moderately permeable soils on uplands. These soils formed in lake-washed till. Slopes range from 0 to 4 percent.

Typical pedon of Hamerly clay loam, 0 to 2 percent slopes, 1,050 feet north and 200 feet west of the southeast corner of sec. 18, T. 130 N., R. 46 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 2 percent coarse fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
26----------	0-12	Clay loam--------	CL	A-7, A-6	0-3	95-100	90-100	85-100	75-90	35-50	15-30
Aazdahl	12-18	Clay loam, silty clay loam.	CL	A-7, A-6	0-3	95-100	90-100	85-95	70-80	35-50	15-30
	18-60	Clay loam, silty clay loam, loam.	CL	A-7, A-6	0-3	95-100	90-100	85-95	70-80	35-50	15-30
33B, 33B2--------	0-10	Loam----------	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	80-100	35-90	20-40	5-20
Barnes	10-20	Loam, sandy clay loam, clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	20-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
34----------	0-24	Silt loam, loam	OL, ML	A-4	0	100	100	90-100	70-90	25-40	2-10
Parnell	24-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-80	20-50
46----------	0-10	Loam----------	ML	A-4	0	100	100	95-100	70-95	20-34	NP-7
Borup	10-25	Very fine sandy loam, loamy very fine sand, loam.	ML	A-4	0	100	100	90-100	60-95	<30	NP-5
	25-60	Loamy very fine sand, very fine sand, very fine sandy loam.	ML	A-4	0	100	100	85-100	50-90	<30	NP-5
47----------	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
Colvin	9-24	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	25-50	10-30
	24-60	Loam, silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	25-50	10-25
50----------	0-9	Silty clay-------	CH, CL	A-7	0	100	100	95-100	85-100	45-70	20-40
Cashel	9-60	Silty clay, clay, silty clay loam.	CH, CL, MH	A-7	0	95-100	95-100	95-100	85-100	45-70	20-40
52----------	0-13	Very fine sandy loam.	ML, CL, OL, CL-ML	A-4, A-6	0	100	100	95-100	50-90	15-40	NP-15
Augsburg	13-20	Loam, very fine sandy loam, silt loam.	ML	A-4	0	100	100	95-100	50-90	20-40	NP-10
	20-27	Loamy very fine sand, very fine sandy loam, loam.	ML	A-4	0	100	100	95-100	50-85	20-40	NP-10
	27-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	50-90	35-55
56----------	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-50	11-25
Fargo	10-28	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	28-60	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
57A, 57B----------	0-11	Silty clay-------	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
Fargo	11-20	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50
	20-60	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	25-50

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
987---------- Rockwell	0-12	Fine sandy loam	ML, SM, SM-SC, CL-ML	A-4	0	100	95-100	70-85	40-55	15-25	
	12-19	Fine sandy loam, sandy loam, loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	60-85	35-55	15-25	
	19-26	Fine sand, sand, loamy fine sand.	SM	A-2	0	100	95-100	65-80	20-35	---	
	26-60	Silt loam, loam, clay loam.	CL, CL-ML, SC, SM-SC	A-6, A-4	0-1	95-100	90-100	70-90	40-85	15-40	
1029*. Pits											
1055*: Haplaquolls.											
Histosols.											
1819---------- Glyndon	0-18	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-95	30-45	
	18-24	Silt loam, very fine sandy loam, loam.	ML, CL-ML, CL	A-4	0	100	100	90-100	60-95	20-30	
	24-60	Loamy very fine sand, very fine sand, very fine sandy loam.	ML, SM, SC, CL	A-4	0	100	100	85-100	35-75	10-30	
1871---------- Fargo	0-10	Silty clay-------	CH	A-7	0	100	100	95-100	85-100	50-75	
	10-18	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	
	18-60	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	
1872---------- Fargo	0-13	Silty clay-------	CH	A-7	0	100	100	95-100	85-100	50-75	
	13-30	Silty clay, clay	CH	A-7	0	100	100	95-100	85-100	50-75	
	30-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-100	25-50	
1874---------- Lohnes	0-12	Sandy loam-------	SM, SM-SC	A-2, A-4	0	100	100	60-70	30-40	<20	
	12-60	Coarse sand, loamy coarse sand, loamy sand.	SM, SP-SM, SP	A-2, A-1, A-3	0	80-100	55-100	35-60	2-20	---	
1913C*: Wahpeton--------	0-17	Silty clay-------	CH	A-7	0	100	100	95-100	80-95	50-75	
	17-60	Clay, silty clay, silty clay loam.	CH, CL	A-7, A-6	0	100	100	95-100	80-95	35-75	
Cashel----------	0-14	Silty clay-------	CH, CL	A-7	0	100	100	95-100	85-100	45-70	
	14-60	Silty clay, clay, silty clay loam.	CH, CL, MH	A-7	0	95-100	95-100	95-100	85-100	45-70	
1916---------- Lindaas	0-9	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	75-95	30-50	
	9-27	Silty clay, clay	CH	A-7	0	100	100	95-100	80-95	50-70	
	27-60	Silt loam, clay loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	55-95	20-40	

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
26---------- Aazdahl	B	None--------	---	---	3.0-6.0	Apparent	Mar-May	High-----	Moderate	Low.
33B, 33B2--------- Barnes	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
34---------- Parnell	C/D	Rare--------	---	---	+2-2.0	Apparent	Jan-Dec	High-----	High-----	Low.
46---------- Borup	B/D	Rare--------	---	---	1.0-2.5	Apparent	Apr-Jul	High-----	High-----	Low.
47---------- Colvin	C/D	Rare--------	---	---	1.0-2.0	Apparent	Apr-Jul	High-----	High-----	Low.
50---------- Cashel	C	Occasional	Brief-----	Mar-May	1.0-3.0	Apparent	Apr-Jul	Moderate	High-----	Low.
52---------- Augsburg	B/D	Rare--------	---	---	1.0-3.0	Apparent	Apr-Jul	High-----	High-----	Low.
56, 57A, 57B------ Fargo	D	Rare--------	---	---	0-3.0	Apparent	Sep-Jun	High-----	High-----	Low.
58---------- Kittson	C	None--------	---	---	2.5-6.0	Apparent	Nov-Jun	High-----	High-----	Low.
59---------- Grimstad	B	None--------	---	---	2.5-4.0	Apparent	Apr-Jul	Moderate	Moderate	Low.
60---------- Glyndon	B	None--------	---	---	2.5-6.0	Apparent	Apr-Jul	High-----	High-----	Low.
61---------- Arveson	B/D	Rare--------	---	---	1.0-2.0	Apparent	Apr-Jul	High-----	High-----	Low.
63---------- Rockwell	B/D	Rare--------	---	---	1.0-3.0	Apparent	Apr-Jul	High-----	High-----	Low.
64---------- Ulen	B	None--------	---	---	2.5-6.0	Apparent	Apr-Jul	Moderate	Low------	Low.
65---------- Foxhome	B	None--------	---	---	2.5-6.0	Apparent	Nov-Jun	High-----	Moderate	Low.
66---------- Flaming	A	None--------	---	---	2.5-4.0	Apparent	Nov-Jun	Moderate	Low------	Low.
67A, 67B2--------- Bearden	C	None--------	---	---	2.0-4.0	Apparent	Apr-Jun	High-----	High-----	Low.
68---------- Arveson	B/D	Rare--------	---	---	+1-1.0	Apparent	Jan-Dec	High-----	High-----	Low.
71---------- Fossum	A/D	Rare--------	---	---	1.0-2.5	Apparent	Nov-Oct	Moderate	High-----	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
42C2*, 942D2*: Langhei----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Barnes----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
67B2*: Rothsay----------	B	None--------	---	---	>6.0	---	---	High-----	Low------	Low.
Zell----------	B	None--------	---	---	>6.0	---	---	High-----	High-----	Moderate.
69B*, 969C2*, 69D2*: Zell----------	B	None--------	---	---	>6.0	---	---	High-----	High-----	Moderate.
Rothsay----------	B	None--------	---	---	>6.0	---	---	High-----	Low------	Low.
7---------- ockwell	B/D	Rare--------	---	---	+1-1.0	Apparent	Jan-Dec	High-----	High-----	Low.
29*. lts										
35*: plaquolls.										
stosols.										
9---------- yndon	B	None--------	---	---	2.5-6.0	Apparent	Apr-Jul	High-----	High-----	Low.
1---------- rgo	D	Rare--------	---	---	+.5-1.0	Apparent	Jan-Dec	High-----	High-----	Low.
2---------- rgo	D	Rare--------	---	---	1.0-3.0	Apparent	Sep-Jun	High-----	High-----	Low.
4---------- mes	A	None--------	---	---	3.0-5.0	Apparent	Apr-Oct	Low------	Moderate	Low.
C*: peton----------	C	Occasional	Brief-----	Mar-Jun	>6.0	---	---	High-----	High-----	Low.
hel----------	C	Frequent----	Brief-----	Mar-May	1.0-3.0	Apparent	Apr-Jul	Moderate	High-----	Low.
---------- daas	C/D	Rare--------	---	---	+1-2.0	Apparent	Apr-Jun	High-----	High-----	Low.
---------- dahl	B	None--------	---	---	2.5-4.0	Apparent	Nov-Jun	High-----	Moderate	Low.
---------- lla	B	None--------	---	---	2.0-4.0	Apparent	Apr-Jun	High-----	High-----	Low.
: o----------	D	Rare--------	---	---	0-3.0	Apparent	Sep-Jun	High-----	High-----	Low.
e----------	D	Rare--------	---	---	+1-1.0	Apparent	Apr-Jun	High-----	High-----	Low.
---------- ie	B	None--------	---	---	2.5-5.0	Apparent	Apr-Jun	Moderate	High-----	Low.

See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Aazdahl	Fine-loamy, mixed Aquic Haploborolls
Arveson	Coarse-loamy, frigid Typic Calciaquolls
Augsburg	Coarse-silty over clayey, frigid Typic Calciaquolls
Barnes	Fine-loamy, mixed Udic Haploborolls
Bearden	Fine-silty, frigid Aeric Calciaquolls
Borup	Coarse-silty, frigid Typic Calciaquolls
Cashel	Fine, montmorillonitic (calcareous), frigid Mollic Udifluvents
Clearwater	Fine, montmorillonitic (calcareous), frigid Typic Haplaquolls
Colvin	Fine-silty, frigid Typic Calciaquolls
Darnen	Fine-loamy, mixed Pachic Udic Haploborolls
Deerwood	Sandy, mixed, frigid Histic Humaquepts
Divide	Fine-loamy over sandy or sandy-skeletal, frigid Aeric Calciaquolls
Donaldson	Coarse-loamy over clayey, mixed Aquic Haploborolls
Doran	Fine, mixed Aquic Argiborolls
Elmville	Coarse-loamy over clayey, frigid Aeric Calciaquolls
Enloe	Fine, montmorillonitic, frigid Argiaquic Argialbolls
Espelie	Sandy over clayey, mixed, frigid Typic Haplaquolls
Fargo	Fine, montmorillonitic, frigid Vertic Haplaquolls
Flaming	Sandy, mixed Aquic Haploborolls
Foldahl	Sandy over loamy, mixed Aquic Haploborolls
Fossum	Sandy, mixed (calcareous), frigid Typic Haplaquolls
Foxhome	Sandy-skeletal over loamy, mixed Aquic Haploborolls
Galchutt	Fine, montmorillonitic, frigid Typic Argialbolls
Glyndon	Coarse-silty, frigid Aeric Calciaquolls
Grimstad	Sandy over loamy, frigid Aeric Calciaquolls
Hamerly	Fine-loamy, frigid Aeric Calciaquolls
*Hantho	Coarse-silty, mixed Pachic Udic Haploborolls
Haplaquolls	Loamy, mixed, frigid Haplaquolls
Haug	Coarse-loamy, mixed (calcareous), frigid Histic Humaquepts
Hilaire	Sandy over clayey, mixed Aquic Haploborolls
Histosols	Euic, frigid Histosols
Kittson	Fine-loamy, mixed Aquic Haploborolls
Lamoure	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Langhei	Fine-loamy, mixed (calcareous), frigid Typic Udorthents
Lindaas	Fine, montmorillonitic, frigid Typic Argiaquolls
Lohnes	Sandy, mixed Udorthentic Haploborolls
McIntosh	Fine-silty, frigid Aeric Calciaquolls
Northcote	Very fine, montmorillonitic, frigid Vertic Haplaquolls
Osakis	Sandy, mixed Aquic Haploborolls
Parnell	Fine, montmorillonitic, frigid Typic Argiaquolls
Perella	Fine-silty, mixed, frigid Typic Haplaquolls
Quam	Fine-silty, mixed, frigid Cumulic Haplaquolls
Rockwell	Coarse-loamy, frigid Typic Calciaquolls
Roliss	Fine-loamy, mixed (calcareous), frigid Typic Haplaquolls
Rothsay	Coarse-silty, mixed Udic Haploborolls
Seelyeville	Euic Typic Borosaprists
Sioux	Sandy-skeletal, mixed Udorthentic Haploborolls
Swenoda	Coarse-loamy, mixed Pachic Udic Haploborolls
Syrene	Sandy, frigid Typic Calciaquolls
Ulen	Sandy, frigid Aeric Calciaquolls
Urness	Fine-silty, mixed (calcareous), frigid Mollic Fluvaquents
Vallers	Fine-loamy, frigid Typic Calciaquolls
Viking	Very fine, montmorillonitic (calcareous), frigid Typic Haplaquolls
Wahpeton	Fine, montmorillonitic Udertic Haploborolls
Wheatville	Coarse-silty over clayey, frigid Aeric Calciaquolls
Winger	Fine-silty, frigid Typic Calciaquolls
Wyndmere	Coarse-loamy, frigid Aeric Calciaquolls
Zell	Coarse-silty, mixed Udorthentic Haploborolls

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MVTL LABORATORIES, Inc.
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WE ARE AN EQUAL OPPORTUNITY EMPLOYER

Report To: Great Plains Environmental
1301 40th Street NW
Fargo, ND 58102
Attn: Terry Kraft

Date: November 29, 1990
Work Order: 21-1897
Date Received: 11-19-90
PO# 100048

RE: Wolverton Farmers Elevator

Date Analyzed = 11/25/90

ANALYZED FOR BENZENE, ETHYL BENZENE, TOLUENE, XYLENE & TOTAL HYDROCARBONS:

Sample I.D.	Lab #	Ethyl Benzene /ppb	Benzene /ppb	Toluene /ppb	Xylene /ppb	* Total Hydrocarbons /ppm
SS #1 (Soil)	7557	< 15.0	< 20.0	< 20.0	< 15.0	BDL
SS #2 (Soil)	7558	< 15.0	< 20.0	< 20.0	< 15.0	BDL
SS #3 (Soil)	7559	395	1380	30.0	257	12.2 As Gas or 27.3 As Fuel Oil
SS #4 (Soil)	7560	< 15.0	< 20.0	< 20.0	< 15.0	BDL
SS #5 (Soil)	7561	< 15.0	< 20.0	< 20.0	< 15.0	BDL
SS #6 (Soil)	7562	< 7500	<10000	16800	72700	2320 As Gas or 6410 As Fuel Oil
SS #7 (Soil)	7563	< 15.0	< 20.0	< 20.0	< 15.0	BDL
Trip Blank (Water)	7564	< 1.5	< 2.0	< 2.0	< 1.5	BDL

BDL = Below Detection Limits.

* SOIL - Total Hydrocarbons Minimum Detection Limits

As Gasoline - 2.0 ppm
As Fuel Oil/Diesel - 5.0 ppm

* WATER - Total Hydrocarbons Minimum Detection Limits

As Gasoline - 0.5 ppm
As Fuel Oil/Diesel - 1.0 ppm

Test Method: SW846 - 8020/5030 Modified
Report approved by Wade Pullman,
Chemist
By and for Minnesota Valley Testing labs., Inc.
\SH

Great Plains Environmental Service, Inc.

Sample Identification / Field Chain of Custody Record

Project: Wolverton Farmers Elevator, Wolverton, MN
Shipped by: Great Plains Environmental, Fargo, ND
Shipped to: MVTL, New Ulm, MN
Comments: Gasoline Contamination

P.O. # 100048
Attention of:
Hazardous materials suspected? (yes/no)

	Sampling Point	Location	Field ID #	Date	Sample Type	No. of Containers	Analysis Required	Lab ID (optional)
SS7	10' Elevation (Floor)	Basin #1 - Below SBO UST	SS #1 (10')	11/12/90	Soil	2	BTEX-TPH	
SS8	8' Elevation	Basin #1 - West Wall	SS #2 (8')	11/12/90	Soil	2	BTEX-TPH	
SS9	6' Elevation	Basin #1 - North Wall	SS #3 (6')	11/12/90	Soil	2	BTEX-TPH	
SL0	7' Elevation	Basin #1 - East Wall	SS #4 (7')	11/12/90	Soil	2	BTEX-TPH	
SL1	7' Elevation	Basin #1 - South Wall	SS #5 (7')	11/12/90	Soil	2	BTEX-TPH	
SL2	Contaminated Stockpile	Basin #1 - C. Soil	SS #6	11/13/90	Soil	2	BTEX-TPH	
SL3	9' Elevation (Floor)	Basin #2 - Below SBO	SS #7 (9')	11/12/90	Soil	2	BTEX-TPH	

Sampler(s) (signature) Terry Kraft

Field ID	Relinquished by: (signature)	Received by: (signature)	Date / Time		Comments

Sealed for shipment by: (signature) Terry Kraft Date / Time 11/15/90 3:30 P Shipment method: UPS

Received for Lab by: (signature) Shelly Heim Date / Time 11/19/90 11:15 AM Comments

Receiving Laboratory: Please return original form after signing for receipt of samples.

GREAT PLAINS ENVIRONMENTAL
1301 40TH ST. NW
FARGO, ND 58102
(701) 277-1612

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