

Appendix E

Addendum
(2007 Wetland Delineation Former Willmar Municipal Airport Site)
Assessment of Individual Wetland Function and Quality

Location: Sections 16, 17, 18, & 20, T.119N., R.35W., Kandiyohi County,
Minnesota.

FAA Minneapolis
Airports Dist. Office

Owners: City of Willmar
Attn: Bruce Peterson
333 SW 6th Street
Willmar, MN 56201
(320) 235-4913

SEP 1 2009

Received

10

Purpose

At the request of Bruce Peterson, City of Willmar, a re-assessment of the Individual Wetland Function and Quality was conducted on the Former Willmar Municipal Airport Site.

Discussion

Wetland Descriptions

Table 3, taken from *Wetland Delineation: Former Willmar Municipal Airport Site*, provides general descriptions of site wetlands. The table provides wetland type and other relevant information. Other wetland characteristics are provided in the following individual assessments.

Wetlands W1

Vegetation: Mixed native and invasive species. Dominant plants: sandbar willow.

Diversity: Moderate

Hydrology: Ditch. No floodwater retention.

Wildlife: Provides food, shelter, and travel corridor for wildlife.

Function: Moderate

Quality: Moderate

Area: 1.96 acres

Wetland W2

Vegetation: Mainly native, with minor invasive species. Dominant plants: grasses, sedges. Diversity: High

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides food and shelter for wildlife.

Function: High

Quality: High

Area: 0.82 acres

Wetland W3

Vegetation: Mainly native, with minor invasive species. Dominant plants: rushes, sedges. Diversity: High

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides food and shelter for wildlife.

Function: High

Quality: High

Area: 1.65 acres

Wetland W4

Vegetation: Mainly native, with minor invasive species. Dominant plants: sedges, grasses, willows. Diversity: Moderate

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides food and shelter for wildlife.

Comments: Close to road.

Function: Moderate

Quality: Moderate

Area: 2.47 acres

Wetland W5

Vegetation: Mixed native and invasive species. Dominant plants: cattail, reed canary grass. Diversity: Moderate.

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides food and shelter for wildlife.

Comments: Road ditch

Function: Moderate

Quality: Moderate

Area: 0.82 acres

Wetland W6

Vegetation: Row crops.

Hydrology: Tiled. Limited floodwater retention and filtration.

Wildlife: Provides no food and shelter for wildlife.

Function: Low

Quality: Low

Area: 2.58 acres

**Table 3
Delineated Wetlands**

<i>Wetland</i>	<i>Type</i>	<i>Stations</i>	<i>Description</i>
W1	6	54	Ditch, willow swamp, native seeded
W2	2	8	Isolated pothole, native seeded
W3	3/4	11	Isolated pothole, native seeded
W4	2/6	18	Isolated pothole, native seeded
W5	3	10	Isolated pothole
W6	2	11	Isolated pothole, farmed and tiled wetland
W7	2	7	Isolated pothole
W8	4	20	Segment of larger wetland dissected by road
W9	2	26	Isolated wetland
W10	1/2	21	Ditched low area, sedge meadow
W11	2	12	Isolated pothole
W12	2/3	16	Drained by storm sewer
W13	2/3	19	Drained by storm sewer
W14	2	8	Road ditch
W15	2/3	7	Isolated pothole
W16	3/4	-	Ditch
W17	3	-	Ditch

Wetland W7

Vegetation: Row crops.

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides no food and shelter for wildlife.

Function: Moderate

Quality: Low

Area: 0.46 acres

Wetland W8

Vegetation: Mixed native and invasive species. Dominant plants: cattail, reed canary grass. Diversity: Moderate

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides food and shelter for wildlife.

Comments: Road ditch

Function: Moderate

Quality: Moderate

Area: 6.48 acres

Wetland W9

Vegetation: Row crops.

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides no food and shelter for wildlife.

Function: Moderate

Quality: Low

Area: 2.68 acres

Wetland W10

Vegetation: Dominant plants: grasses, sedges. Diversity: Moderate

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides limited food and shelter for wildlife.

Function: Moderate

Quality: Low

Area: 1.44 acres

Wetland W11

Vegetation: Dominant plants: grasses, sedges. Diversity: Moderate

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides limited food and shelter for wildlife.

Function: Moderate

Quality: Low

Area: 0.62 acres

Wetland W12

Vegetation: Dominant plants: weeds. Diversity: Moderate

Hydrology: Drained by storm sewer. Minor floodwater retention and filtration.

Wildlife: Provides limited food and shelter for wildlife.

Function: Low

Quality: Low

Area: 1.03 acres

Wetland W13

Vegetation: Dominant plants: weeds. Diversity: Moderate

Hydrology: Drained by storm sewer. Minor floodwater retention and filtration.

Wildlife: Provides limited food and shelter for wildlife.

Comments: Road ditch

Function: Low

Quality: Low

Area: 0.93 acres

Wetland W14

Vegetation: Dominant plants: grasses, sedges. Diversity: Moderate

Hydrology: Provides limited floodwater retention and filtration.

Wildlife: Provides limited food and shelter for wildlife.

Comments: Road ditch

Function: Low

Quality: Low

Area: 0.41 acres

Wetland W15

Vegetation: Dominant plants: grasses, sedges. Diversity: Moderate

Hydrology: Provides floodwater retention and filtration.

Wildlife: Provides limited food and shelter for wildlife.

Function: Moderate

Quality: Low

Area: 0.64 acres

Wetland W16

Vegetation: Mixed native and invasive species. Dominant plants: reed canary grass, boxelder, cottonwood. Diversity: Moderate

Hydrology: Ditch. No floodwater retention.

Wildlife: Provides food, shelter, and travel corridor for wildlife.

Function: Moderate

Quality: Low

Area: 0.36 acres

Wetland W17

Vegetation: Mixed native and invasive species. Dominant plants: reed canary grass. Diversity: Low

Hydrology: Ditch. No floodwater retention.

Wildlife: Provides limited food and shelter, and narrow travel corridor for wildlife.

Function: Low

Quality: Low

Area: 1.13 acres

Conclusions

Due to artificial drainage (tiling, sewers, and ditches), road traffic, commercial and industrial businesses, and farming, the majority of site wetlands are moderately to highly degraded. Only wetlands W2 and W3, which were seeded with native vegetation, could be considered high quality and high functioning.

Signatures

I hereby declare that this wetland assessment was performed according to guidelines set forth by the US Army Corps of Engineers, for purposes of the Minnesota Wetland Conservation Act, Section 404 of the Clean Water Act.

Greg J. Goeser
Wetland Delineator/Geologist

Wetland Delineation
Former Willmar Municipal Airport Site
Sections 16, 17, 18, & 20, T.119N., R.35W.
Kandiyohi County, MN

for

City of Willmar
Bruce Peterson
333 SW 6th Street
Willmar, MN 56201
(320) 235-4913

by

American Scientific Services Inc.
1201 Grace Ave. SW
Willmar, MN 56201
(320) 235-3049

Abstract

At the request of Bruce Peterson, City of Willmar, American Scientific Services, Inc. conducted a Wetland Delineation on the Former Willmar Municipal Airport Site. The property is located in Sections 16, 17, 18, & 20, T.119N., R.35W., Kandiyohi County, Minnesota.

Seventeen (17) site areas, plus Hawk Creek/Ditch #10, were delineated. The wetlands contained hydrophytic vegetation, hydric soils, and wetland hydrology.

Field work was started in January of 2007 and completed May 2, 2007.

Atypical and problem areas have been identified.

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Introduction

Purpose

At the request of Bruce Peterson, City of Willmar, a Wetland Delineation was conducted on the Former Willmar Municipal Airport Site. The delineation was performed according to guidelines set forth by the US Army Corps of Engineers, for purposes of the Minnesota Wetland Conservation Act, Section 404 of the Clean Water Act, and the conservation provisions of the Food Security Act ("Swampbuster").

Site Description

Ownership

City of Willmar
Attn: Bruce Peterson
333 SW 6th Street
Willmar, MN 56201
(320) 235-4913

Location

The Former Willmar Municipal Airport Site is located on the west side of Willmar, in Sections 16, 17, 18, & 20, T.119N., R.35W., Kandiyohi County, Minnesota (see Figure 1).

Setting

The site and surrounding areas have low topographic relief (see Figure 2). Adjoining properties include farms, industrial sites, and commercial businesses (see Figures 3-8).

Site History

The site has been highly altered. Construction of the airport included paved runways and a series of shallow, open ditches to drain these areas. The site is further modified through the use of tiling to drain the agricultural fields. The foundation of at least one demolished farmhouse was found on-site. Storm sewer was installed in the wetlands north of the Jennie-O plant. The segment of Hawk Creek which passes through the site has been channeled into Ditch #10.

Discussion

Vegetation

Site vegetation consists of row and forage crops, weeds and invasive species, wetland hydrophytes, and minor woodland plants. Some seeding of native vegetation is apparent on the west portion of the site (see Figure 5). Tables 1 and 2 list the dominant site plants.

Table 1
Dominant Site Wetland Vegetation

<i>Common Name</i>	<i>Scientific Name</i>	<i>Stratum</i>	<i>Indicator Status</i>
Reed Canary Grass	<i>Phalaris arundinacea</i>	Herb	FACW+
Black Bulrush	<i>Scirpus atrovirens</i>	Herb	OBL
Cattail	<i>Typha latifolia</i>	Herb	OBL
Common Reed	<i>Phragmites australis</i>	Herb	FACW+
Smartweed	<i>Polygonum pennsylvanicum</i>	Herb	FACW+
Stinging Nettle	<i>Urtica dioica</i>	Herb	FACW-
Swamp Milkweed	<i>Asclepias incarnata</i>	Herb	OBL
Giant Goldenrod	<i>Solidago gigantea</i>	Herb	FACW
Aster	<i>Boltonia asteroides</i>	Herb	FACW
Horsetail	<i>Equisetum arvense</i>	Herb	FAC
Cocklebur	<i>Xanthium strumarium</i>	Herb	FAC
Curled Dock	<i>Rumex crispus</i>	Herb	FAC+
Sandbar Willow	<i>Salix exigua</i>	Shrub	OBL
Pussy Willow	<i>Salix discolor</i>	Shrub	FACW
Eastern Cottonwood	<i>Populus deltoides</i>	Tree	FAC+
Box Elder	<i>Acer negundo</i>	Tree	FACW-

Table 2
Dominant Site Upland Vegetation

<i>Common Name</i>	<i>Scientific Name</i>	<i>Stratum</i>	<i>Indicator Status</i>
Corn	<i>Variety?</i>	Herb	NI
Soy Beans	<i>Variety?</i>	Herb	NI
Alfalfa	<i>Variety?</i>	Herb	NI
Kentucky Bluegrass	<i>Poa pratensis</i>	Herb	FAC-
Smooth Brome	<i>Bromus inermis</i>	Herb	UPL
Green Foxtail	<i>Setaria viridis</i>	Herb	NI
Yellow Foxtail	<i>Setaria glauca</i>	Herb	FACU
Clover	<i>Trifolium repens</i>	Herb	FACU+
Dandelion	<i>Taraxacum officinale</i>	Herb	FACU
Yellow Sweetclover	<i>Melilotus officinalis</i>	Herb	FACU
Red-root Pigweed	<i>Amaranthus retroflexus</i>	Herb	FACU+
Canada Thistle	<i>Cirsium arvense</i>	Herb	FACU
Canada Goldenrod	<i>Solidago canadensis</i>	Herb	FACU
Milkweed	<i>Asclepias syriaca</i>	Herb	NI
Siberian Elm	<i>Ulmus pumila</i>	Shrub/Tree	NI

Hydrology

Area hydrology has been highly modified through artificial drainage. Ditches, tiling, and storm sewers effectively drain much of the site. Hawk Creek has been channelized into Ditch #10. Surface water run-off and shallow groundwater flow south, towards the Minnesota River.

Soils

According to the Soil Survey of Kandiyohi County (Figures 4 & 4A), site soils consist of Harps (112), Webster (113), Okoboji (134), Seaforth (423), and Normania (446A & B) series, plus Wadenill-Sunburg (805B), Seaforth-Swanlake (897B), Harps-Seaforth-Okoboji (927), Ves-Swanlake (954B), Canisteo-Harps (981), Ves-Swanlake-Hawick (999B), and Okoboji-Canisteo (1900) complexes, and Udorthents (1016). Not all site soils were verified. Many of these soils are hydric.

Delineated Wetlands

Seventeen site areas (W1-W17) and Hawk Creek/Ditch #10 were delineated as wetlands (see Table 3 and Figures 5-8). Hydrophytic vegetation, hydric soils, and wetland hydrology were present in these areas. Transects were conducted at W6-11, W7-7, and W8-8 (see Appendix B).

Table 3
Delineated Wetlands

<i>Wetland</i>	<i>Type</i>	<i>Stations</i>	<i>Description</i>
W1	6	54	Ditch, willow swamp, native seeded
W2	2	8	Isolated pothole, native seeded
W3	3/4	11	Isolated pothole, native seeded
W4	2/6	18	Isolated pothole, native seeded
W5	3	10	Isolated pothole
W6	2	11	Isolated pothole, farmed and tiled wetland
W7	2	7	Isolated pothole
W8	4	20	Segment of larger wetland dissected by road
W9	2	26	Isolated wetland
W10	1/2	21	Ditched low area, sedge meadow
W11	2	12	Isolated pothole
W12	2/3	16	Drained by storm sewer
W13	2/3	19	Drained by storm sewer
W14	2	8	Road ditch
W15	2/3	7	Isolated pothole
W16	3/4	-	Ditch
W17	3	-	Ditch
Hawk Creek (Ditch 10)	3/4	-	Ditch, channelized stream

Many of the site wetlands are farmed. The farmed wetlands were distinguished from the non-wetlands by the presence of hydrophytic vegetation and soil saturation. Black bulrush bulbs were found in the plowed soil of all of the farmed wetlands.

Atypical and Potential Problem Areas

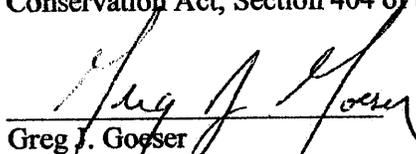
Atypical and potential problem areas include the farmed and artificially-drained wetlands and low areas. Ditches, tiling, and storm sewer have removed much of the site wetland hydrology, which also eliminates hydrophytic vegetation.

Conclusions

The site has both effectively-drained and functional wetlands, plus numerous tile lines and ditches. The property has very little topographic relief and many of the soils are hydric. Site wetland restoration or creation could be accomplished through tile breaks and ditch modification.

Signatures

I hereby declare that this wetland delineation was performed according to guidelines set forth by the US Army Corps of Engineers, for purposes of the Minnesota Wetland Conservation Act, Section 404 of the Clean Water Act.



Greg J. Gosser
Wetland Delineator Certification # 1107

Figure 1
Site Location Map
 Former Willmar Municipal Airport
 Secs. 16, 17, 18 & 20, T.119N., R.35W.
 Kandiyohi County, MN

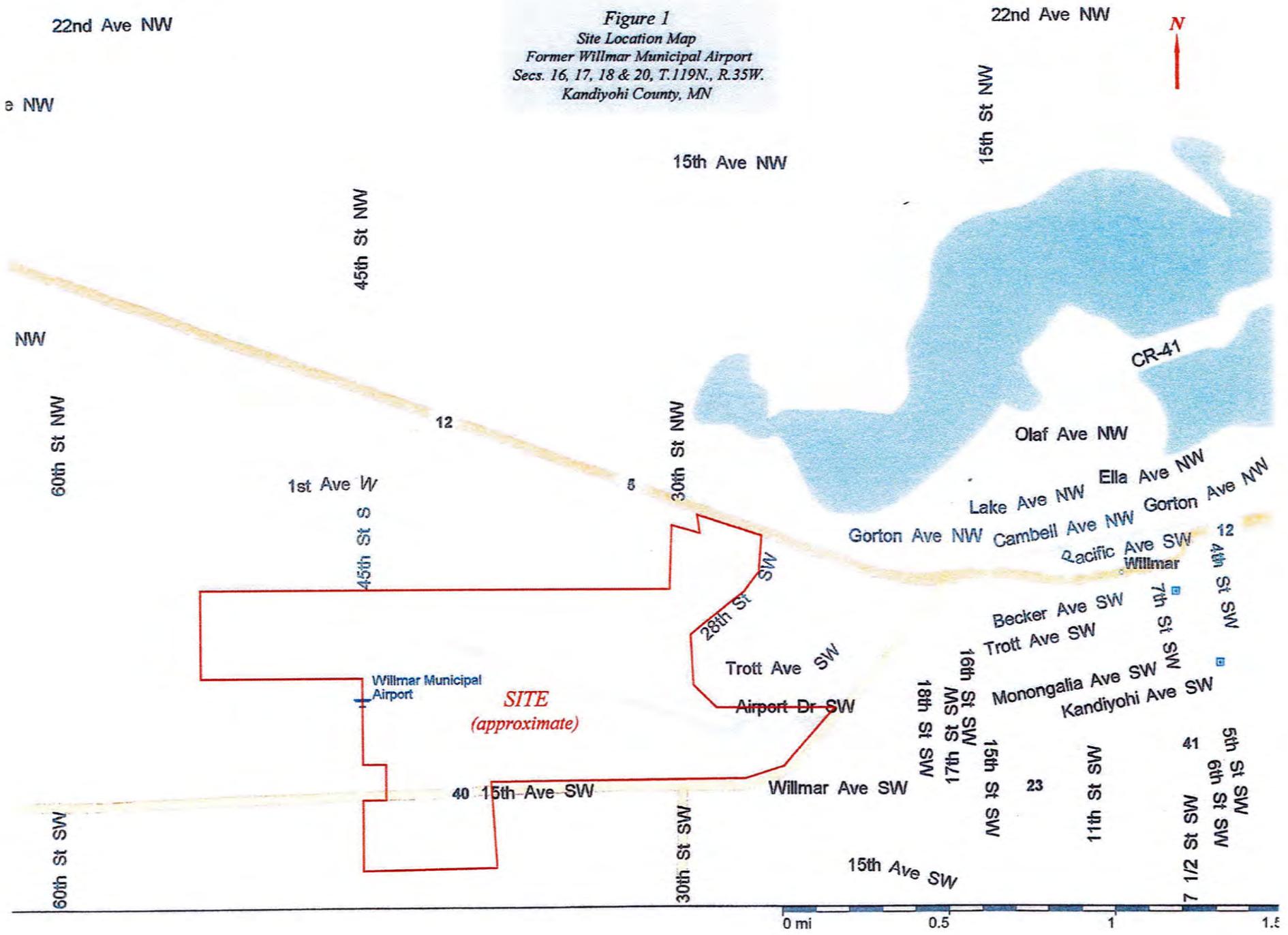


Figure 2
1994 USGS Topographic Map
Former Willmar Municipal Airport
Secs. 16, 17, 18 & 20, T.119N., R.35W.
Kandiyohi County, MN

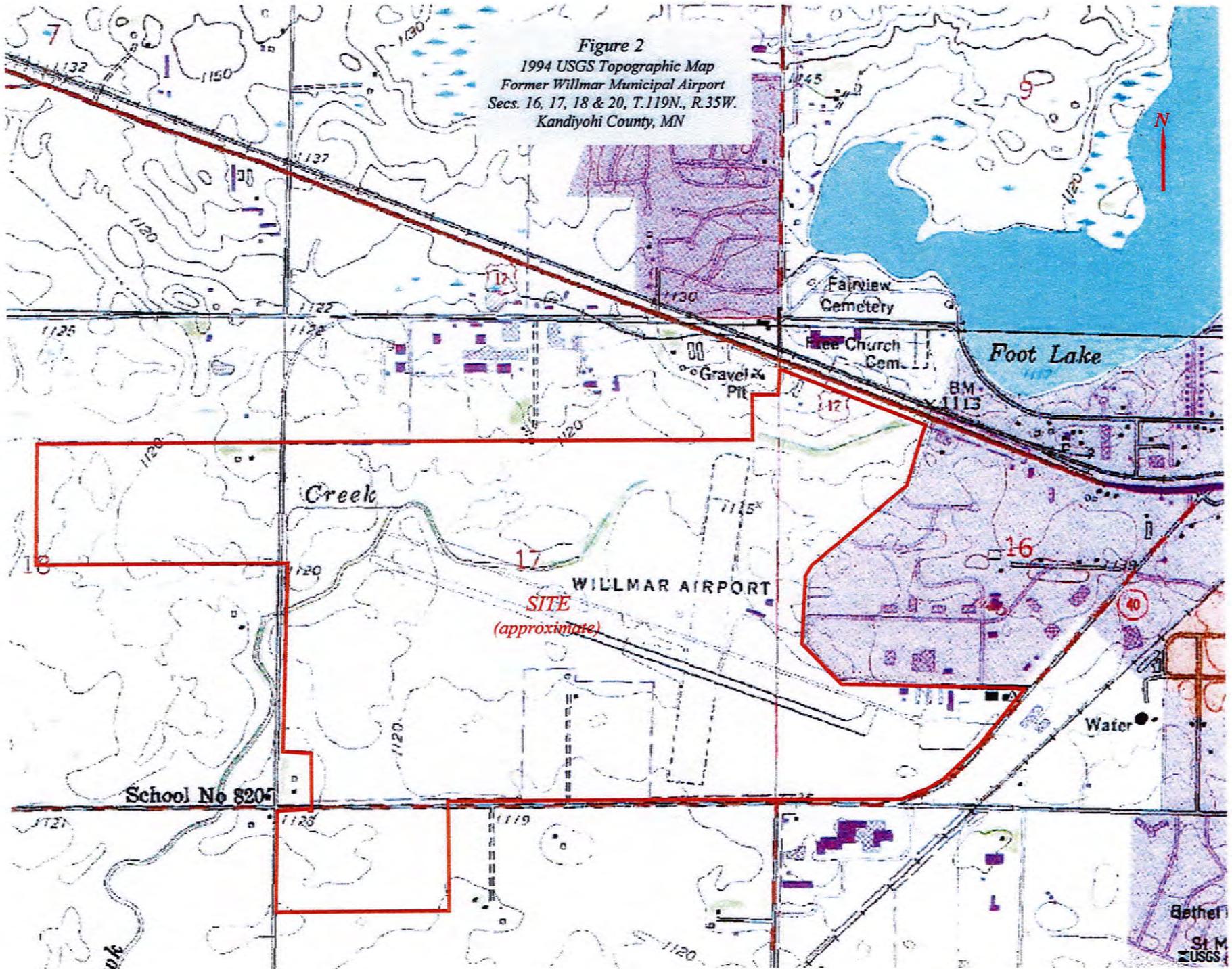


Figure 3
1991 USGS Aerial Photograph
Former Willmar Municipal Airport
Secs. 16, 17, 18 & 20, T.119N., R.35W.
Kandiyohi County, MN

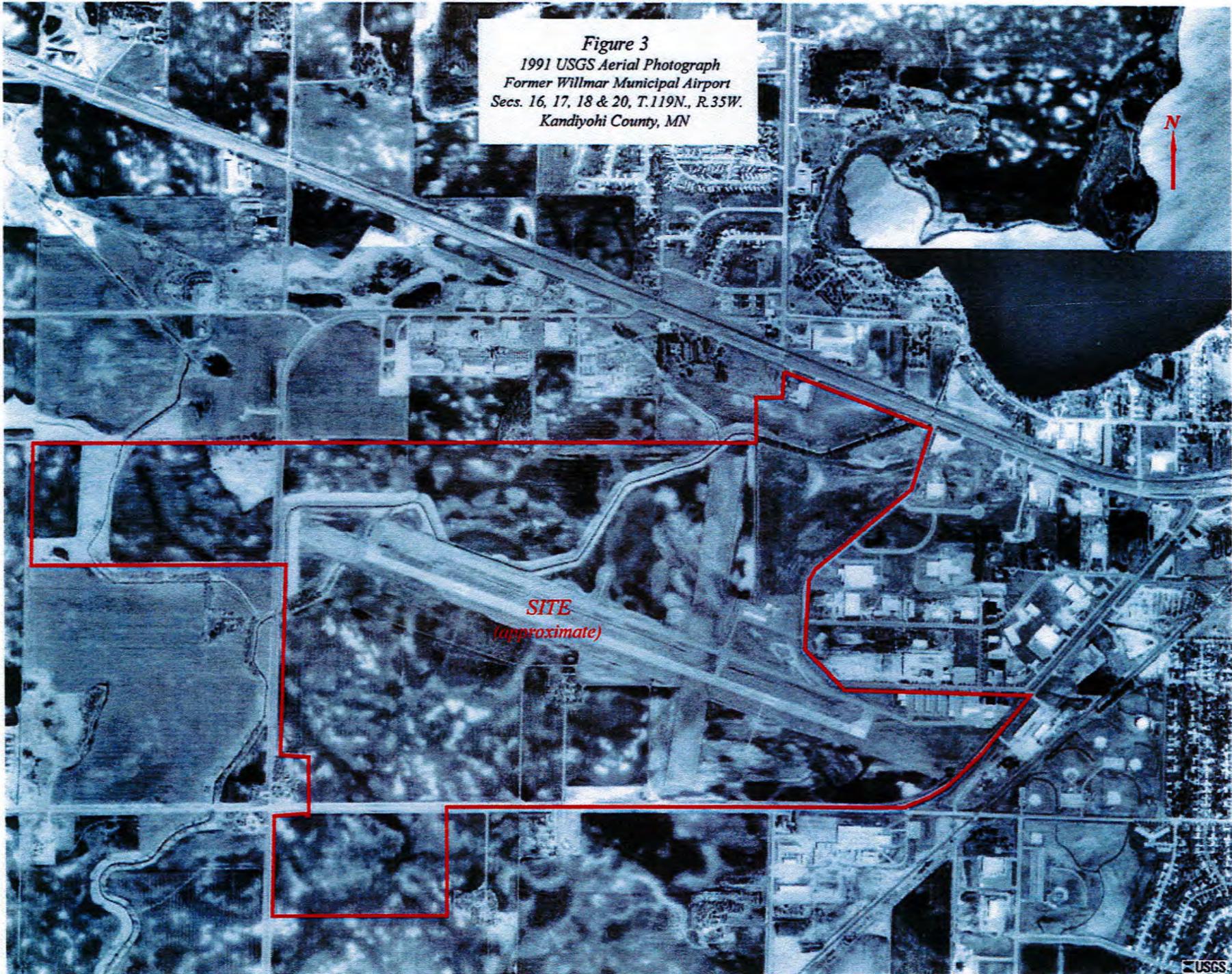


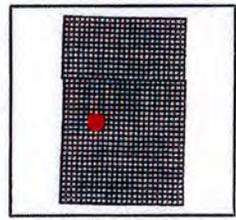
Figure 5
Delineated Wetlands
Former Willmar Municipal Airport
Secs. 16, 17, 18 & 20, T.119N., R.35W.
Kandiyohi County, MN



USDA U.S. Dept. of Agriculture
 Farm Service Agency

Minnesota
Kandiyohi County
 18-119-35

-  Wetlands
-  CLU Field Boundary
-  Tract Boundary
-  Section Lines



USDA FSA maps are for FSA Program administration only. This map does not represent a legal survey or reflect actual ownership; rather it depicts the information provided directly from the producer and/or the 2003 ortho rectified imagery for Minnesota. The producer accepts the data 'as is' and assumes all risks associated with its use. The USDA Farm Service Agency assumes no responsibility for actual or consequential damage incurred as a result of any user's reliance on this data outside of FSA Programs.

November 06, 2006

Figure 6
Delineated Wetlands
 Former Willmar Municipal Airport
 Secs. 16, 17, 18 & 20, T.119N., R.35W.
 Kandiyohi County, MN

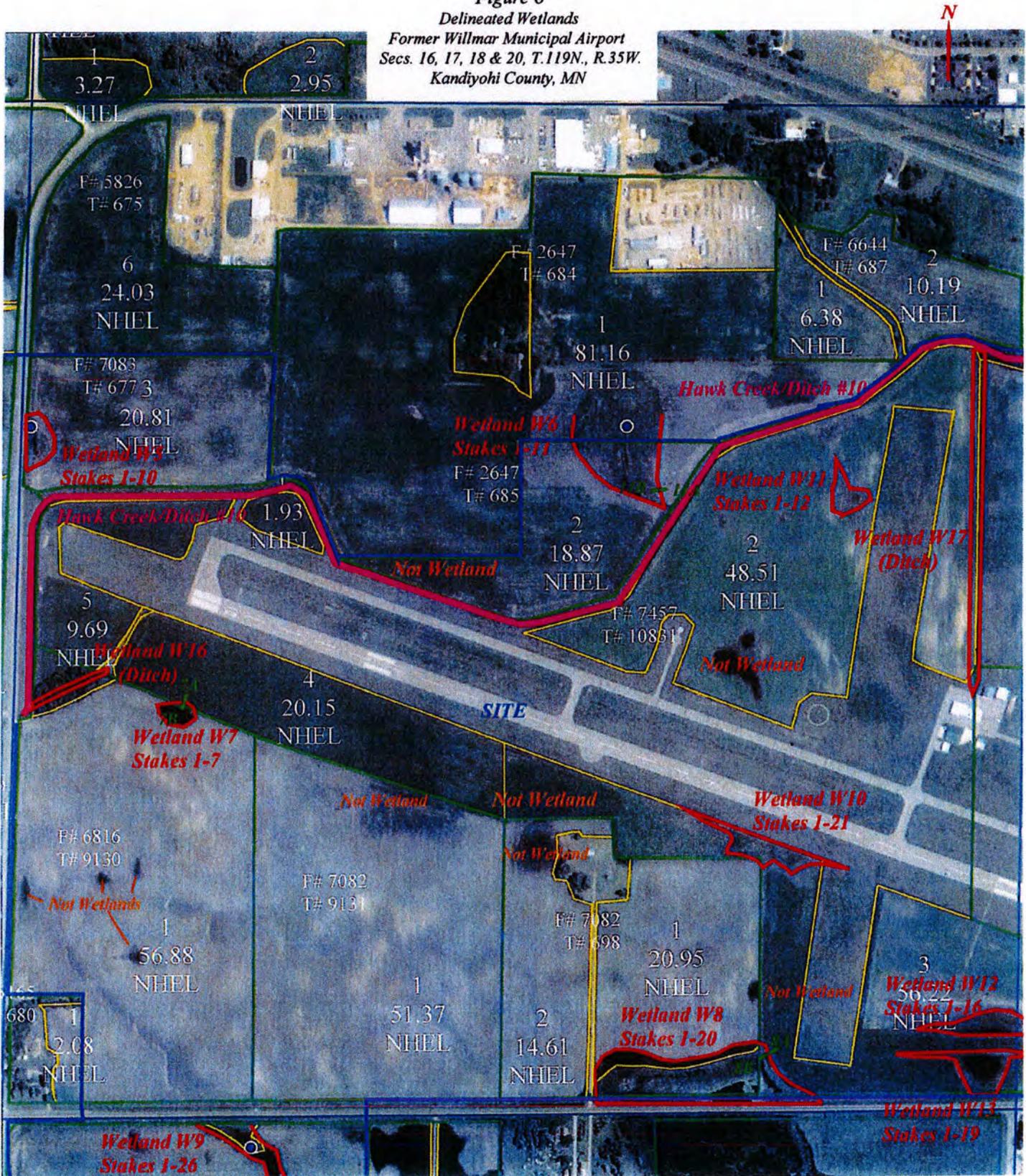


Figure 7
Delineated Wetlands
 Former Willmar Municipal Airport
 Secs. 16, 17, 18 & 20, T.119N., R.35W.
 Kandiyohi County, MN

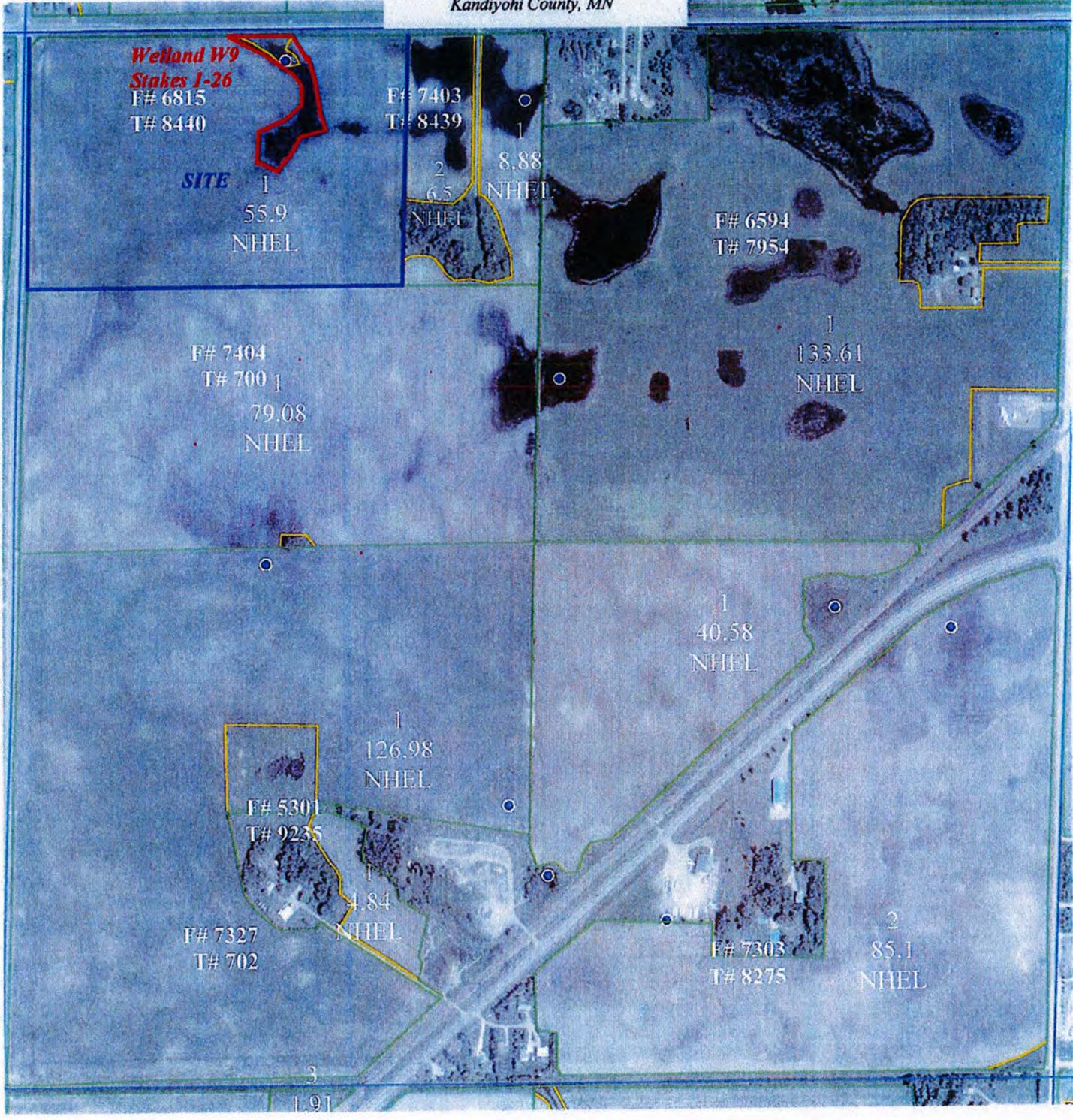


Figure 8
Delineated Wetlands
Former Willmar Municipal Airport
Secs. 16, 17, 18 & 20, T.119N., R.35W.
Kandiyohi County, MN



Appendix A
Official Soil Series Descriptions

LOCATION CANISTEO
Established Series
Rev. AGG-TCJ
06/2001

MN+IA IL SD

CANISTEO SERIES

The Canisteo series consists of very deep, poorly and very poorly drained soils that formed in calcareous loamy glacial till or in a mantle of loamy or silty sediments and underlying calcareous loamy glacial till. These soils are on glacial moraines. They have moderate permeability. Slopes range from 0 to 2 percent. Mean annual precipitation is about 28 inches. Mean air annual temperature is about 48 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, calcareous, mesic Typic Endoaquolls

TYPICAL PEDON: Canisteo clay loam with a nearly level slightly convex slope on a ground moraine in a cultivated field. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 10 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak medium subangular blocky structure; friable; about 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

A--10 to 18 inches; very dark gray (N 3/0) clay loam, dark gray (N 4/0) dry; moderate very fine subangular blocky structure; friable; about 2 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary. (Combined thickness of A horizons is 7 to 20 inches thick.)

Bkg1--18 to 24 inches; olive gray (5Y 5/2) loam; weak medium subangular blocky structure; friable; few light gray (2.5Y 7/2) calcium carbonates on faces of peds; about 3 percent gravel; few fine prominent olive (5Y 5/6) Fe concentrations; strongly effervescent; moderately alkaline; clear smooth boundary.

Bkg2--24 to 39 inches; light olive gray (5Y 6/2) loam; weak medium subangular blocky structure; friable; few light gray (2.5Y 7/2) calcium carbonates on faces of peds; about 3 percent gravel; common fine prominent light olive brown (2.5Y 5/6) Fe concentrations; slightly effervescent; slightly alkaline; clear smooth boundary. (Thickness of the Bkg horizons is 0 to 24 inches.)

Cg1--39 to 65 inches; gray (5Y 6/1) loam; massive; friable; about 5 percent gravel; common medium prominent light olive brown (2.5Y 5/4) Fe concentrations; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg2--65 to 80 inches; gray (5Y 6/1) loam; massive; friable; few dark yellowish brown (10YR 4/6) Fe concretions in pores; about 5 percent gravel; many medium prominent dark yellowish brown (10YR 4/6) Fe concentrations; slightly effervescent; slightly alkaline.

TYPE LOCATION: Waseca County, Minnesota; about 4.5 miles south and 3 miles west of Waseca; 1800 feet south and 200 feet west of northeast corner of sec. 22 T.108N., R.22W.; USGS Morristown quadrangle; lat. 44 degrees 8 minutes 49 seconds N. and long. 93 degrees 26 minutes 50 seconds W., NAD27.

RANGE IN CHARACTERISTICS: Free carbonates are in all parts between 10 and 20 inches. The solum and C horizon are mildly alkaline or moderately alkaline with a calcium carbonate content of 5 to 20 percent. Some pedons have a noncalcareous A horizon 10 inches or less thick. The mollic epipedon ranges from 14 to 24 inches in thickness. The control section has between 18 and 35 percent clay. These soils contain 2 to 8 percent by volume of rock fragments of mixed lithology, although in some pedons the upper 20 to 30 inches or less do not have rock fragments.

The A and Ap horizon has hue of 10YR or is neutral, value of 2 or 3 and chroma of 0 or 1. It is clay loam, loam, silty clay loam, or silt loam.

The Bg horizon has hue of 2.5Y, 5Y or 10YR, value of 4 or 5, and chroma of 1 or 2. It is clay loam, loam, silty clay loam, silt loam, or less commonly sandy loam. Some pedons have a coarser textured subhorizon as much as 5 inches thick.

Some pedons have a Bkg or BCg horizon.

The C or Cg horizon has hue of 10YR, 2.5Y or 5Y, value of 4 or 6, and chroma of 1 to 4. The moderately fine substratum phase has textures of loam or clay loam. It has 20 to 30 percent clay and less than 45 percent total sand. The moderately coarse substratum phase has textures of loam, fine sandy loam or sandy loam. It has 12 to 22 percent clay and more than 40 percent total sand.

COMPETING SERIES: These are the Jeffers, Tappan, and Tilfer series. Jeffers soils have appreciable amounts of gypsum and have horizons with firm consistence in the control section. Tappan soils have a thinner mollic epipedon. Tilfer soils have a lithic contact at depths between 20 and 40 inches.

GEOGRAPHIC SETTING: The Canisteo soils have concave to slightly convex slopes with gradient of 0 to 2 percent in shallow swales, flats and on rims of depressions. They formed in loamy glacial till or in a thin, silty mantle and loamy glacial till. Mean annual air temperature ranges from 45 to 52 degrees F. Mean annual precipitation ranges from 26 to 33 inches. Annual frost free days range from 120 to 180. Elevation above sea level ranges from 700 to 1400 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Clarion, Glencoe, Harps, Nicollet, Okoboji and Webster soils. These soils are members of a hydrosequence with Canisteo soils. Well drained Clarion soils have convex slopes and are on higher lying and more sloping terrain. Very poorly drained Glencoe and Okoboji soils are in depressions. Poorly drained Harps soils have a calcic horizon. Somewhat poorly drained Nicollet soils have slightly concave to slightly convex slopes and are on higher lying terrain. Poorly drained Webster soils are on adjacent nearly level slopes.

DRAINAGE AND PERMEABILITY: Poorly drained and very poorly drained; runoff is negligible to low. Permeability is moderate. The seasonal high water table on the poorly drained phase is at depths of .5 to 1.5 feet from November to July in most years. The very poorly drained phase is at depths of +1 to .5 feet from November to July in most years.

USE AND VEGETATION: Mostly under cultivation; corn and soybeans are the principal crops. Native vegetation is wet-site community of the tall grass prairie.

DISTRIBUTION AND EXTENT: Southern Minnesota, northern Iowa, and Illinois, and eastern South Dakota. Extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Dodge County, Minnesota, 1959.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface of the soil to a depth of 20 inches (Ap, A, and AB horizons); cambic horizon - the zone from 20 to 31 inches (Bg1 and Bg1 horizons); calcareous family - free carbonates at 10 to 25 inches; aquic regime - low chroma below mollic epipedon.

The concepts of moderately fine and moderately coarse substratum phases were established by the MLRA-103 steering committee based on an analysis of particle size data from Iowa and Minnesota. The Des Moines Lobe till generally gets sandier and has less clay as one progresses south along the path of the Des Moines advance.

National Cooperative Soil Survey
U.S.A.

LOCATION HARPS
Established Series
Rev. CSF-JRW-RJK-AGG
07/2000

IA+MN SD

HARPS SERIES

The Harps series consists of very deep, poorly drained, moderately permeable soils formed in glacial till or alluvium on uplands. Slope ranges from 0 to 3 percent. Mean annual air temperature is about 48 degrees F. Mean annual precipitation is about 30 inches.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Typic Calciaquolls

TYPICAL PEDON: Harps clay loam on a nearly level rim of a depression in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches; black (10YR 2/1) clay loam, dark gray (5Y 4/1) dry; moderate fine granular structure; friable; some gravel; violently effervescent; moderately alkaline; abrupt smooth boundary.

Ak1--8 to 12 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) kneaded, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; some gravel; violently effervescent; moderately alkaline; clear smooth boundary.

Ak2--12 to 16 inches; very dark gray (N 3/0) and 20 percent dark gray (5Y 4/1) clay loam, very dark gray (10YR 3/1) kneaded, gray (10YR 5/1) dry; weak fine and very fine subangular blocky structure; friable; some gravel; violently effervescent; moderately alkaline; clear wavy boundary. (Combined thickness of A horizons is 12 to 24 inches.)

Bgk--16 to 26 inches; mixed light olive gray (5Y 6/2) and gray (5Y 5/1) loam, weak fine subangular blocky structure; very friable; few very dark gray (10YR 3/1) krotovinas; some gravel; common fine prominent dark yellowish brown (10YR 4/4) Fe concentrations; violently effervescent; moderately alkaline; clear smooth boundary. (6 to 10 inches thick)

Bg--26 to 34 inches; mixed olive gray (5Y 5/2) and gray (5Y 5/1) loam, weak medium prismatic structure parting to weak medium subangular blocky; friable; a 1 inch very dark gray (10YR 3/1) krotovina; some gravel; many fine prominent light olive brown (2.5Y 5/6) Fe concentrations; strongly effervescent; moderately alkaline; gradual smooth boundary. (6 to 10 inches thick)

BCg--34 to 42 inches; mixed olive gray (5Y 5/2) and gray (5Y 5/1) loam, weak medium prismatic structure parting to very weak medium subangular blocky; friable; few dark

gray (5Y 4/1) and very dark gray (N 3/0) prism faces; a 1 inch very dark gray (N 3/0) krotovina; some gravel; many fine prominent dark yellowish brown (10YR 4/4) Fe concentrations; strongly effervescent; moderately alkaline; diffuse smooth boundary. (6 to 9 inches thick)

Cg--42 to 60 inches; mixed gray (5Y 5/1) and dark gray (5Y 4/1) loam; massive with some vertical cleavage from 42 to 48 inches; friable; some gravel; many fine prominent dark yellowish brown (10YR 4/4) Fe concentrations; strongly effervescent; moderately alkaline.

TYPE LOCATION: Webster County, Iowa; about 8 miles east of Fort Dodge; 250 feet west and 2,265 feet north of the southeast corner of sec. 23, T. 89 N., R. 27 W.

RANGE IN CHARACTERISTICS: The mollic epipedon ranges from 12 to 24 inches thick. Horizons having evident structure extend to depths ranging from 30 to 50 inches, and solum thickness is assumed to be the same. Rock fragments of mixed lithology comprise about 1 to 5 percent of the volume of the control section, although in some pedons the upper 2 feet or less lack appreciable amounts. Structure is weak except for the A horizon which has a stronger grade. Calcium carbonate equivalent of the upper 6 to 18 inches centers on about 30 percent and ranges from 15 to 40 percent, except for thin layers which have as much as 45 percent. This is 5 to 20 percent more than in the upper part of the Cg horizon. The lower part of the BCg horizon and the upper part of the Cg horizon have 10 to 20 percent calcium carbonate equivalent; but as depth increases in the Cg horizon, some layers may have as much as 20 to 30 percent. The soil contains redoximorphic features with hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 4 to 8, and they increase in size and number as depth increases.

The Ap, Ak or A horizons have hue of 10YR or is neutral, value of 2 or 3 and chroma of 0 or 1. Dry colors have hue of 10YR or 5Y, value of 4 or 5 and chroma of 1. They are loam or clay loam containing 25 to 35 percent clay.

Some pedons have an AB horizon that has hue of 10YR through 5Y or is neutral, value of 3 or 4 and chroma of 0 or 1.

The Bg horizon has hue of 10YR, 2.5Y, or 5Y; value of 5 or 6; and chroma of 1 or 2. The Bg horizon is loam, clay loam, or sandy clay loam containing 18 to 32 percent clay. It contains some thin strata of sandy loam that range from 50 to 60 percent sand, much of which is fine or coarser.

The Cg horizon has hue of 2.5Y or 5Y, value of 4 through 6, and chroma of 1 or 2. Colors of high chroma are dominant in the upper part of the Cg horizon in some pedons. The moderately fine substratum phase has textures of loam or clay loam. It has 20 to 30 percent clay and less than 45 percent total sand. The moderately coarse substratum phase has textures of loam, fine sandy loam or sandy loam. It has 12 to 22 percent clay and more than 40 percent total sand. Thin strata of coarser texture are within the range.

COMPETING SERIES: These are the Lawet and Revere series. Lawet soils formed in alluvium and do not have rock fragments. Revere soils have a gypsic horizon.

GEOGRAPHIC SETTING: Harps soils are on till plains or moraines on narrow rims or shorelines of depressions and on slight rises within poorly defined swales or flats, and in a few places in swales or poorly defined drainageways. Slope gradients are 0 to 3 percent. Harps soils formed in glacial till of Wisconsin age or in alluvium derived from till. Thickness of the parent material ranges from 4 feet to more than 20 feet. Mean annual air temperature is 45 to 52 degrees F. Mean annual precipitation ranges from about 26 to 36 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Canisteo, Drummer, Klossner, Okoboji, Wacousta, and Webster soils. All of these except the Canisteo soils are noncalcareous, and all except the Drummer soils are at lower elevations or in depressions. Okoboji soils have finer texture, and Klossner soils have organic material over loamy material.

DRAINAGE AND PERMEABILITY: Poorly drained. Runoff is slow. Permeability is moderate. Soil saturation occurs as high as the surface during periods of March through May in most years in an undrained condition.

USE AND VEGETATION: Commonly used for cultivated crops when drained. Corn and soybeans are generally grown. Native vegetation is prairie grasses tolerant of wetness.

DISTRIBUTION AND EXTENT: Primarily in MLRA-103. This soil is extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Webster County, Iowa, 1968.

REMARKS: The soils now placed in the Harps series were formerly included in the Harpster loam.

Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface to a depth of 16 inches (Ap, Ak1 and Ak2 horizons). Calcic horizon - the zone from a depth of 8 to 26 inches (Ak1, Ak2 and Bgk horizons)

The moderately coarse substratum phase is recognized in the southern part of MLRA-103 and the moderately fine substratum phase is recognized in the northern part of MLRA-103. This difference is based on statistical analysis of lab data throughout the MLRA.

LOCATION OKOBOJI
Established Series
Rev. RIT-RJK-AGG
02/2002

IA+MN

OKOBOJI SERIES

The Okoboji series consists of very deep, very poorly drained, moderately slowly permeable soils formed in silty alluvium washed from glacial till. They are in depressions on till plains and moraines. Slope ranges from 0 to 1 percent. Mean annual air temperature about 48 degrees F. Mean annual precipitation is about 30 inches.

TAXONOMIC CLASS: Fine, smectitic, mesic Cumulic Vertic Endoaquolls

TYPICAL PEDON: Okoboji silty clay loam - cultivated - in a distinct landlocked depression. (All colors are for moist soil unless otherwise stated.)

Ap--0 to 6 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak fine granular and very fine subangular blocky structure; friable; slightly alkaline; abrupt smooth boundary.

A1--6 to 16 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak fine granular and very fine subangular blocky structure; friable; slightly alkaline; gradual smooth boundary.

A2--16 to 26 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular and very fine subangular blocky structure; friable; few very fine distinct olive (5Y 4/3) Fe concentrations; slightly alkaline; gradual smooth boundary.

A3--26 to 32 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; firm; very few fine distinct olive (5Y 4/3) Fe concentrations and few medium distinct olive gray (5Y 5/2) Fe depletions; slightly alkaline; gradual smooth boundary. (Combined thickness of the A horizons is 24 to 36 inches.)

Bg1--32 to 36 inches; very dark gray (N 3/0) silty clay loam; weak very fine prismatic structure parting to weak very fine subangular blocky; firm; few fine dark concretions; common fine distinct olive gray (5Y 5/2) Fe depletions; slightly alkaline; clear smooth boundary.

Bg2--36 to 48 inches; dark gray (5Y 4/1) and olive gray (5Y 5/2) silty clay loam; weak fine prismatic structure parting to weak very fine subangular blocky; firm; common medium dark oxides; few dark krotovinas; slightly alkaline; slightly effervescent; gradual smooth boundary.

Bg3--48 to 56 inches; dark gray (5Y 4/1) and olive gray (5Y 5/2) silty clay loam; weak medium prismatic structure parting to weak medium subangular blocky; friable; few very fine dark concretions; few krotovinas; common coarse distinct olive brown (2.5Y 4/4) Fe concentrations; slightly alkaline; slightly effervescent; clear smooth boundary. (Combined thickness of the Bg horizons is 0 to 28 inches.)

Cg--56 to 60 inches; dark gray (5Y 4/1) and gray (5Y 5/1) silty clay loam; some vertical cleavage; friable; few very fine dark concretions; few medium distinct olive brown (2.5Y 4/4) Fe concentrations; moderately alkaline; strongly effervescent.

TYPE LOCATION: Webster County, Iowa; about 6 miles south of Fort Dodge; 220 feet east and 1,310 feet south of the northwest corner of sec. 26, T. 88 N., R. 29 W.

RANGE IN CHARACTERISTICS: Thickness of mollic epipedon ranges from 24 to 60 inches. Carbonates commonly are at depths ranging from 25 to 40 inches but the full range is from 20 inches to 60 inches. The 10- to 40- inch control section averages between 35 to 40 percent clay and greater than 10 to 15 percent fine sand and coarser.

The A horizon is has hue of 10YR, 5Y or neutral, value of 2, and chroma of 0 or 1. It is silty clay loam, mucky silty clay loam, silty clay, silt loam, or mucky silt loam. The upper 10 inches of the A horizon contains from 20 to 42 percent clay and the lower part from 35 to 42 percent clay. The A horizon contains some redox features of high or low chroma. The upper part of the A horizon ranges from slightly alkaline to slightly acid. The lower part is neutral or slightly alkaline.

The Bg horizon has hue of 2.5Y, 5Y, or neutral, value of 3 to 6, and chroma of 0 to 2. The content of clay in the Bg horizon is typically about the same as that of the lower part of the A horizon, but the full range is from 35 to 45 percent. It is neutral to slightly alkaline.

Some pedons have a Bkg horizon with secondary carbonate accumulations.

The Cg horizon has hue of 2.5Y, 5Y, or neutral, value of 4 to 6, and chroma of 0 to 2. It is silty clay loam that grades to silt loam with depth. In the lower part of this horizon the material can be stratified with textures of silt loam, very fine sandy loam or clay loam. It is slightly alkaline or moderately alkaline.

Below depths of 60 inches a 2Cg horizon of glacial till can be present. Color is similar to the Cg but includes textures of loam, clay loam and sandy loam with 1 to 8 percent rock fragments. The moist bulk density is 1.4 to 1.6 g/cc.

COMPETING SERIES: These are the Chivato, Clamo, Lura, Peotone, Shiloh, Woods Cross, Zoe, and Zook in the same family. Chivato and Woods Cross soils are drier in the moisture control section during the 120 days following the summer solstice. Clamo soils have a more erratic decrease in organic matter with depth and are also drier in the moisture control section during the 120 days following the summer solstice. Lura soils

contain 45 to 65 percent clay in the particle size control section. Peotone soils have a stronger grade of structure in the upper portion of the B horizon and have a A horizon thinner than 24 inches. Shiloh soils have less than 10 percent fine sand and coarser in the control section. Zoe soils are higher in soluble salts and exchangeable sodium in the control section resulting in conductivities ranging from 3 to 8 millimhos/cm. Zook soils do not have secondary carbonates in the series control section.

GEOGRAPHIC SETTING: Okoboji soils are on till plains in closed depressions which were formerly lakes or ponds and some of which were small size. Slope gradients are less than 1 percent. Okoboji soils formed in about 4 to 12 feet of silty alluvium washed from till on the surrounding slopes. Mean annual temperature ranges from 45 degrees to 50 degrees F. Mean annual precipitation ranges from 28 to 32 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Canisteo, Harps, Palms, Wacousta, and Webster soils. Canisteo, Webster, and Harps soils are higher in sand content, lower in clay content, and have thinner dark surface layers. They are on concave slopes above the Okoboji soil. In many places, Harps soils form a convex shoreline rim around the Okoboji soils. Palms and Wacousta soils are in landlocked depressions. Palms soils formed in sapric material. Wacousta soils have a thinner A horizon.

DRAINAGE AND PERMEABILITY: Very poorly drained. Runoff is negligible. Permeability is moderately slow. In an undrained condition, soil saturation occurs at the surface in normal years. Ponding conditions also are common if undrained.

USE AND VEGETATION: Where drained they are cultivated to corn, soybeans, and small grain. Native vegetation is water tolerant grasses and sedges.

DISTRIBUTION AND EXTENT: MLRA-103. Central and north-central Iowa and southern Minnesota. Okoboji soils are extensive.

MLRA OFFICE RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Polk County, Iowa, 1958.

REMARKS: The differences between the Okoboji and Peotone soils are not clear. Peotone soils have a stronger grade of structure, formed in materials containing much more illite and presumably would have more illite in the sola. Peotone soils receive mean annual precipitation of 35 to 45 inches in contrast to about 30 inches for the Okoboji soils.

Diagnostic horizons and features recognized in this pedon are: Mollic epipedon - the zone from the surface to a depth of 36 inches (Ap, A1, A2, A3 and Bg1 horizons; Cambic horizon - the zone from a depth of 32 to 56 inches (Bg1, Bg2, and Bg3 horizons); Aquic moisture regime.