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Soil Erosion in Wells Creek Watershed

A Report of the Geographic Information System
Effort for the Watershed

Minnesota Department of Natural Resources

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SUMMARY

Soil erosion is a recognized problem among residents of Southeastern Minnesota and Wells Creek watershed, especially among farmers. Much of Wells Creek is highly erodible, as is much of the cultivated land in the watershed. Historically, there is evidence in the county soil survey that includes Wells Creek of extensive erosion of cultivated land. At present, erosion rates are high — near or above soil loss tolerances — and substantial acreages need erosion control.

Soil erosion is controllable from a technical perspective. Existing conservation practices reduce erosion rates. Contour strip cropping is especially effective as an erosion control technique. In addition, changing the agricultural use of cultivated cropland to noncultivated cropland or pastureland substantially reduces erosion rates. Land set asides such as the Conservation Reserve Program (CRP) and the Reinvest in Minnesota Program (RIM) are important, too, but they are limited by their size. In Wells Creek watershed about 5 percent of all highly erodible, cultivated cropland is enrolled in CRP or RIM as of 1995.

DISCUSSION

Soil erosion is a leading land use and environmental concern throughout Southeastern Minnesota, including the Wells Creek watershed. When residents were asked in a recent survey to write in the two most pressing problems in the region, soil erosion was either the first or second most listed response, depending on how the responses are broken down (Table 1). As an environmental and natural resource problem, soil erosion was second only to water quality — which is a major effect of erosion — as the leading problem for residents throughout the region and in Wells Creek. For farmers, it was by far the most prevalent problem. As a land use problem, soil erosion was the most frequent problem indicated by regional residents, and this was

Table 1

What are the two most pressing land use or environmental problems in your region?*
(percent of respondents indicating a problem)

		------- Where do you live? -------			------ Location of residence -------		
	Overall	Farm	Rural Non-farm	City or Town	Wells Creek	Bluffland Counties	Other Counties
Environmental and Natural Resource Problems	63.8	58.5	66.6	64.2	51.7	65.1	61.6
Water Quality and Quantity	**35.4**	**20.0**	**39.9**	**37.7**	**30.3**	**37.1**	**32.6**
water quality	23.2	11.4	28.6	24.4	19.9	22.9	23.8
groundwater	7.6	4.3	8.5	8.1	8.5	8.9	5.5
flooding	6.1	4.3	4.1	7.1	3.3	6.9	4.9
Natural Areas	**26.2**	**24.5**	**27.3**	**26.3**	**13.3**	**25.4**	**27.4**
wetlands	10.3	9.7	11.9	10.0	3.3	8.0	14.0
wildlife habitat	9.0	8.9	8.5	9.1	3.3	10.0	7.3
woodlands/natural areas	8.7	6.6	7.9	9.4	7.1	8.6	8.8
Soil Erosion	**19.0**	**31.5**	**19.5**	**16.0**	**18.5**	**20.6**	**16.5**
soil erosion	19.0	31.5	19.5	16.0	18.5	20.6	16.5
Land Use Problems	55.7	63.6	53.7	54.4	54.5	56.9	53.7
Agricultural	**39.9**	**50.7**	**42.1**	**36.8**	**38.4**	**38.3**	**42.4**
soil erosion	19.0	31.5	19.5	16.0	18.5	20.6	16.5
chemical use	11.9	16.4	12.6	10.6	12.8	10.3	14.3
farm practices	7.8	6.7	9.1	7.6	11.8	6.9	9.1
fertlizer/pesticide/waste runoff	7.6	5.8	7.9	8.0	5.2	6.3	9.8
Urban	**20.4**	**19.2**	**18.2**	**21.2**	**22.7**	**23.7**	**14.9**
overpopulation & housing development	15.6	14.5	15.4	15.9	18.0	18.9	10.4
city expansion	5.4	5.9	3.8	5.7	4.7	5.7	4.9

*Source: MN Department of Natural Resources and North Central Forest Experiment Station, U.S. Forest Service. 1995. Environmental and Land Use Opinion Survey of Residents of Wells Creek Watershed and Southeastern Minnesota. Summary Report.

especially true among farmers.

In the Wells Creek watershed much of the land has moderate to high slopes. A majority of the watershed (57%) is classified as 'highly erodible' by the Natural Resources Conservation Service, Goodhue County (Figure 1). When geographically overlaid with land use and cover (Figure 2), over half of the highly erodible land is found to be cultivated (Table 2 and Figure 3).

Table 2

Use and Cover of Highly Erodible Land (HEL) in Wells Creek Watershed*

Use/Cover	HEL (%)	All of Watershed (%)
Cultivated Land	53.0	61.8
Grassland	10.7	10.2
Deciduous Forest	34.2	25.0
All Other	2.1	3.0
Total	100.0	100.0

*Source: Soils information from Goodhue County Soil Survey and NRCS, and 1989 land use/cover data from International Coalition

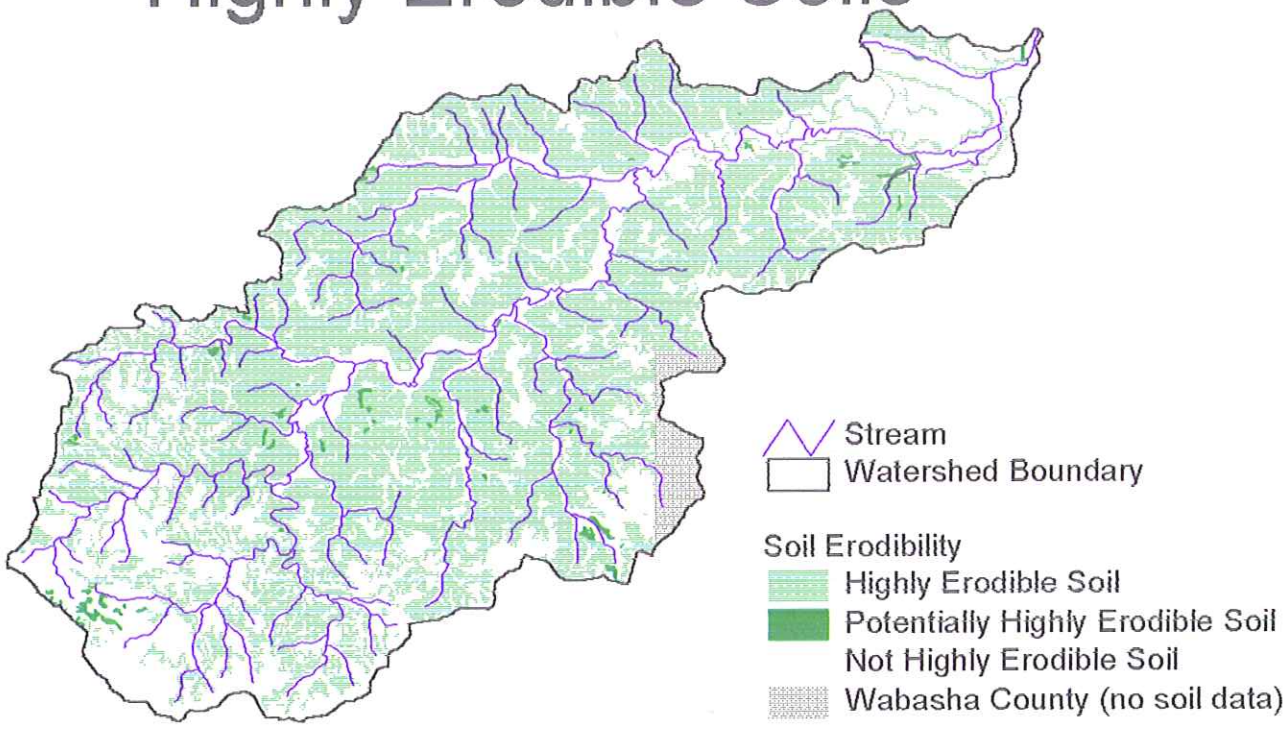
Farming in the watershed depends to a large extent on the cultivation of highly erodible soils. Nearly half (49%) of all cultivated land in the watershed occurs on such soils.

The historical cultivation of highly erodible soils has resulted in the loss of topsoil. The large majority (81%) of the highly erodible, cultivated land shown on Figure 3 had sufficient soil loss at the time of the Goodhue County Soil Survey (conducted between 1940 and 1972) to be classified as 'eroded.' The two biggest highly erodible, cultivated soil mapping units in Wells Creek are Seaton silt loam of 6-12 percent slopes (SfC2), and Seaton silt loam of 12 to 18 percent slopes (SfD2). Together these two mapping units comprise 57 percent of the highly erodible, cultivated land in the watershed. Both soil mapping units at the time of the Goodhue County survey were lacking a subsurface layer and had a thinner subsoil, which translates into the loss of about a foot of topsoil for the soil series.

Much of the cultivated land is still in need of erosion control, according to figures from the 1992 National Resource Inventory (NRI). Land in need of erosion control has an estimated soil loss from the universal soil loss equation that exceeds the soil loss tolerance or T factor. The T factor is the maximum erosion rate at which the quality of the soil for plant growth can be sustained. In Wells Creek nearly all T values are 4 or 5 tons per acre per year. The NRI only estimates water erosion rates for the landscape that includes Wells Creek; wind erosion is not considered significant.

Figure 1

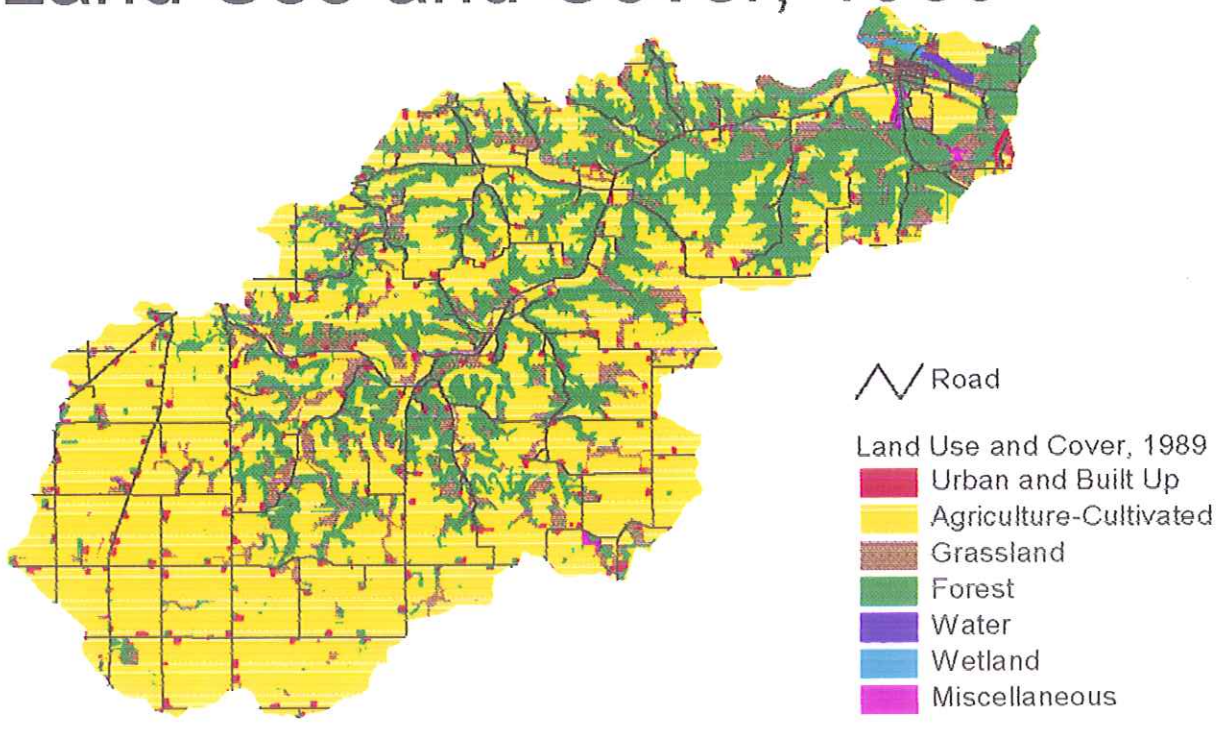
Highly Erodible Soils



Source: Goodhue County Soil Survey, supplied in digital form by UofM SSIS, and NRCS listing of highly erodible soils.

Figure 2

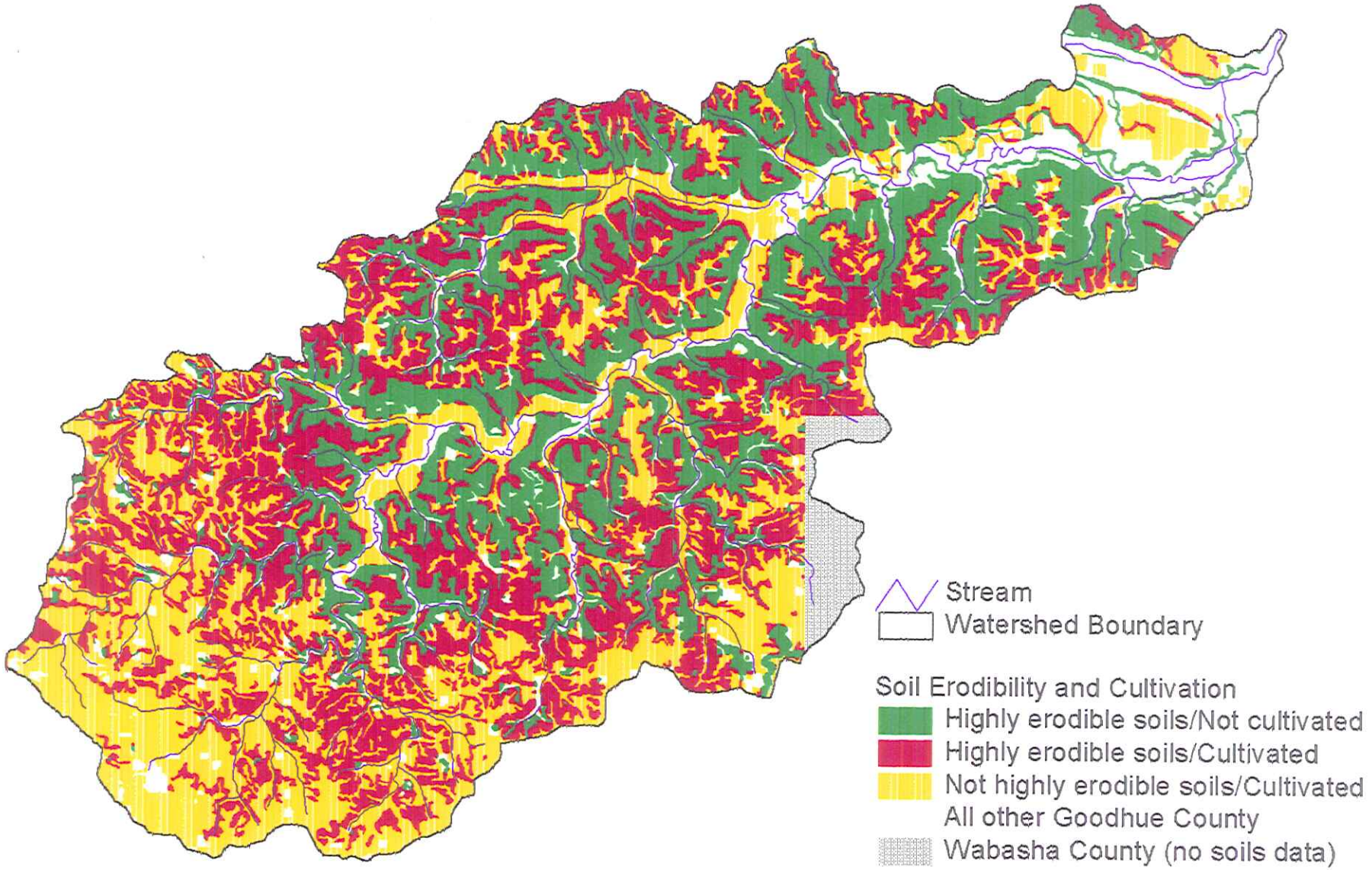
Land Use and Cover, 1989



Source: International Coalition data, supplied in digital form by LMIC.

Figure 3

Soil Erodibility and Cultivation



Source: Soils information from Goodhue County Soil Survey and NRCS, and 1989 land use data from International Coalition.

For the NRI landscape region in Minnesota that includes Wells Creek (Figure 4), just over half of all cultivated cropland was in need of erosion control (Table 3). The percent in need of control was 71 percent for highly erodible soils, and was 43 percent for prime farmland soils (prime farmland soils are less sloping and have fewer management limitations than highly erodible soils). The situation for Wells Creek is estimated to be similar. Wells Creek estimates are based on watershed-specific area weightings of erosion-control need percents by land capability classes for the larger region (MLRA 105 in Minnesota).

Table 3

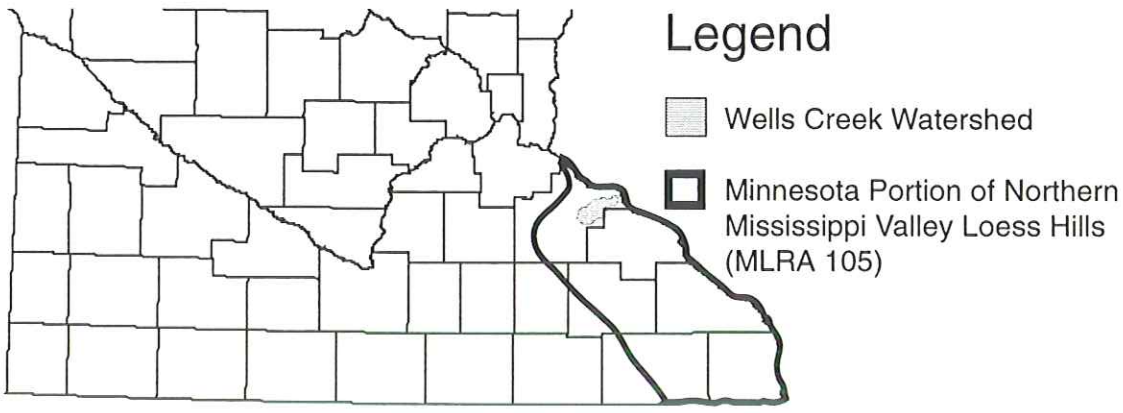
Percent of Cultivated Cropland in Need of Erosion Control for the Minnesota Portion of Northern Mississippi Valley Loess Hills (MLRA 105) and estimated for Wells Creek Watershed*

Cultivated Cropland Category	MLRA 105 in Minnesota	Wells Creek Watershed
All Cultivated Land	53.0	57.8
Prime Farmland (based on land capability classes I, IIe, IIw, IIs, and IIIw)	43.5	40.5
Highly Erodible Land (based on land capability classes IIIe, IVe, VIe, VIs, VIIe, VIIs)	71.0	75.2

*Source: MLRA values from 1992 National Resource Inventory (NRI). Wells Creek values based on NRI.

Figure 4

Location of Wells Creek Watershed within the Minnesota Portion of the Major Land Resource Area Delineated by the National Resource Inventory



The corresponding soil loss values are at or below the T factor for prime farmland soils and 2 to 2.5 times the T factors for highly erodible soils (Table 4). The average for all cultivated soils is 1.5 to 2 times the T factors. The estimates for Wells Creek are derived using the same method as described above. It should be noted that the average soil loss values for MLRA 105 in Minnesota shown on Table 4 are reasonably precise. The 95 percent confidence limit ranges between ±10 and ±15 percent of the average, with the smaller confidence limit for the combined 'all cultivated land' category.

Table 4

Water Erosion Rates on Cultivated Cropland for the Minnesota Portion of Northern Mississippi Valley Loess Hills (MLRA 105) and estimated for Wells Creek Watershed (MLRA values based on universal soil loss equation)*

Cultivated Cropland Category	MLRA 105 in Minnesota (tons/acre/yr)	Wells Creek Watershed (tons/acre/yr)
All Cultivated Land	6.1	7.5
Prime Farmland (based on land capability classes I, IIe, IIw, IIs, and IIIw)	4.3	3.9
Highly Erodible Land (based on land capability classes IIIe, IVe, VIe, VIs, VIIe, VIIs)	9.8	11.1

*Source: MLRA values from 1992 National Resource Inventory (NRI). Wells Creek values based on NRI.

There are a number of technical ways to control erosion. One common way is to adopt conservation practices. Each of the four most common conservation practices in use in the Minnesota portion of MLRA 105 produces erosion rates less that the average for all cultivated land (Table 5). Contour

Table 5

Cultivated Cropland Water Erosion Rates for Different Types of Conservation Practices in the Minnesota Portion of the Northern Mississippi Valley Loess Hills (based on universal soil loss equation)*

		Conservation Practice			
Cultivated Cropland Category	All Cultivated Land (tons/acre/yr)	Contour Strip Cropping (tons/acre/yr)	Conservation Tillage System (tons/acre/yr)	Grassed Waterways (tons/acre/yr)	Contour Farming (tons/acre/yr)
All Cultivated Land	6.1	3.1	4.7	5.4	5.3
Prime Farmland (based on land capability classes I, IIe, IIw, IIs, and IIIw)	4.3	1.4	3.4	3.2	2.8
Highly Erodible Land (based on land capability classes IIIe, IVe, VIe, VIs, VIIe, VIIs)	9.8	4.3	7.0	8.2	8.7

*Source: 1992 National Resource Inventory (NRI).

strip cropping is by far the most effective, with an average rate of soil loss at or below the T factors for even highly erodible lands.

Another way to control erosion is to change the use of the land. Moving cultivated cropland to a noncultivated agricultural use (e.g., hayland) or to pastureland substantially reduces average soil loss to values well below the T values (Table 6).

Similarly, land set aside programs that establish a permanent cover on previously cultivated cropland also have a major reducing effect on soil erosion on enrolled lands. As of 1995, about 5 percent of all highly erodible, cultivated cropland in Wells Creek was enrolled in CRP or in a RIM-marginal agriculture easement for highly erodible land (Table 7). Five percent, or 1 out of every 20 acres, is clearly important, but it still is only 5 percent, leaving a substantially residual to be dealt with through other means.

Table 6

Water Erosion Rates on Different Agricultural Land Uses in the Minnesota Portion of Northern Mississippi Valley Loess Hills (based on universal soil loss equation)*

Agricultural Land Use	All Land (tons/acre/yr)	Highly Erodible Land (tons/acre/yr)
Cropland-Cultivated	6.1	9.5
Cropland-Noncultivated	1.6	2.2
Pastureland	1.3	1.9

*Source: 1992 National Resource Inventory (NRI).

Table 7

Conservation Reserve Program (CRP) and Reinvest in Minnesota (RIM) Program in Wells Creek Watershed

Program	Acres in watershed	Percent of HEL, cultivated land in watershed (13,329 acres)
CRP - Highly erodible land	498	3.7
RIM - Marginal agriculture/ highly erodible land	115	0.9
RIM - Marginal agriculture/ ground water	16	-
RIM - Riparian	26	-
Total	655	

*Source: U.S. Department of Agriculture (CRP data) and Bureau of Soil and Water Resources (RIM data).

SOURCES

Bureau of Soil and Water Resources. Wells Creek watershed data for Reinvest in Minnesota easements in 1995.

International Coalition. 1989 land use and cover data, supplied in digital form by Land Management Information Center.

MN Department of Natural Resources and North Central Forest Experiment Station, U.S. Forest Service. 1995. Environmental and Land Use Opinion Survey of Residents of Wells Creek Watershed and Southeastern Minnesota. Summary Report.

U. S. Department of Agriculture, Natural Resources Conservation Service. 1992 National Resources Inventory. Data obtained through the St. Paul, MN, office of the NRCS.

U. S. Department of Agriculture, Soil Conservation Service, in cooperation with the University of Minnesota, Agricultural Experiment Station. 1976. Soil Survey of Goodhue County, Minnesota. Digital data for soil boundaries and attributes obtained from University of Minnesota, Soil Survey Information System. Natural Resources Conservation Service, Goodhue County, provided the list of highly erodible soils.

U. S. Department of Agriculture. Wells Creek watershed data for Conservation Reserve Program in 1995.