Special Report

SKUNK RIVER BASIN
Iowa

WATERSHED INVENTORY

Prepared by
SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

JANUARY 1988

SKUNK RIVER BASIN STUDY

IOWA

WATERSHED INVENTORY

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service

January 1988

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PREFACE

This report was prepared by the Soil Conservation Service (SCS) of the U.S. Department of Agriculture (USDA) at the request of the sponsors of the Skunk River Basin Study. Material herein is based on a study of the potential for development of flood damage reduction projects in small watersheds. This information will be useful to water resource planners for recommending watersheds as potential flood damage reduction projects.

The Basin study was conducted under authority of Section 6 of Public Law 83-566, as amended. The law authorizes the Secretary of Agriculture, in cooperation with other federal, state, and local agencies, to make investigations and surveys of the watersheds of rivers and other streams as a basis for the development of coordinated programs.

Sponsors of the Skunk River Basin Study are:

Skunk River Water Resource District
Iowa Department of Agriculture and Land Stewardship
Division of Soil Conservation
Iowa Department of Natural Resources
Environmental Protection Division
Fish and Wildlife Division
Forests and Forestry Division
Energy and Geological Resources Division
Geological Survey Bureau

Other special reports in this series prepared during the Skunk River Basin Study are:

Water Impoundment Opportunities (full report)
Water Impoundment Opportunities, Summary Edition
Drainage
Forest Forage
Erosion
Wetlands
German Creek Watershed Preauthorization Planning Report
An Overview of Groundwater Quality
Pesticide Use by Tillage System

INTRODUCTION

The Iowa Division of Soil Conservation (DSC) and the U.S. Soil Conservation Service have responsibilities for promoting and administratively managing the Watershed Protection and Flood Prevention Project (P.L. 566) program in Iowa. These agencies assist sponsoring local organizations in making application for small watershed projects. The governor, through the DSC, sets priorities for servicing applications. A purpose of this phase of the Skunk River Basin Study is to stratify the watersheds in the Basin as to their probable feasibility for flood damage reduction projects.

Data were assembled to indicate: size of flood plain, portion of flood plain used as cropland, frequency of flooding, and availability of sites suitable as retarding reservoirs for each watershed. Integration of this information resulted in rating the watersheds for project feasibility. These ratings are of a comparative nature among all watersheds in this Basin. Economic, social, and political aspects were considered in these ratings. Impacts of construction costs, crop prices, and interest rates are explored in this report. Most of these watersheds are direct tributaries of streams wherein water quality is protected for fish, wildlife, and secondary human contact.

A more detailed flood reduction study was done for one selected watershed, German Creek Watershed, a P.L. 566 application area. This watershed investigation did not result in an economically feasible plan; however, data from that study were very useful for evaluating the potential for other watershed projects analyzed in this inventory. Recently planned Soap Creek Watershed in the adjacent Des Moines River Basin was an additional source of comparative data.

A BRIEF LOOK AT THE BASIN

The Skunk River Basin occupies a relatively narrow corridor extending from central Iowa southeast to the city of Keokuk on the Mississippi River (Figure 1). Total drainage area is 4,652 square miles drained by the Skunk River and 297 square miles of direct Mississippi River drainage. This latter portion is known as the Sugar Creek Subbasin. Three other hydrologic subdivisions are: the South Skunk River Subbasin, the North Skunk River Subbasin, and the Skunk River Subbasin (Figures 3 through 6). Physiographic features of the Skunk

River Basin were determined by glacial activity followed by periods of erosion. An upstream area of youthful topography covered by Wisconsin drift contrasts with the downstream area of more mature topography in which the river and tributaries have extensively eroded into older drifts and bedrock.

This Basin is in the Central Feed Grain and Livestock Region 1/ and includes land in three Land Resource Areas (LRA) (Figure 2). In the north is LRA 103, Central Iowa and Minnesota Till Prairies. A large area lies in LRA 108, Illinois and Iowa Deep Loess and Drift. A smaller area of the south part is in LRA 109, Iowa and Missouri Heavy Till Plains.

STUDY PROCEDURE

Basic Data

Boundaries, names, and numbers of the Basin, subbasins, and inventory watersheds were taken from maps supplied by the Iowa Division of Soil Conservation. Within each subbasin inventory watersheds had been numbered increasing from the lower end of the subbasin to the upper end. Watershed names generally follow USGS designations of the principal stream name. Flood plains associated with the major streams, i.e. drainage area larger than 250,000 acres were not studied. Also, flood plains at the lower end of tributary watersheds where they are coincident with main stem flood plains were not studied.

District Conservationists provided estimates of flood frequency, flood plain area, land use in the flood plain and other information, including the incidence of roads and bridges in flood plains. The river basin staff hydraulic engineer made a reconnaissance field tour of many watersheds. Near the end of the study SCS River Basin Staff and Division of Soil Conservation personnel visited a sample of seven watersheds to verify findings and conclusions. This report was adjusted to accommodate refinements stemming from the field spot checks.

Analyses

Field data were tabulated to clearly show the numerical information known for each watershed (Table 2). Calculations were made for each watershed to

1/ Atlas of River Basins of the United States, 1970. Prepared by USDA, Soil Conservation Service.

find the area of flood plain in percent of the watershed drainage area. Each watershed's flood plain was studied to find the percent used as cropland. Flood plain cropland was also related to drainage area as percent.

All 69 watersheds were delineated on USGS topographic maps and the availability of floodwater retarding structure sites reviewed. The special report, "Skunk River Basin, Iowa, Water Impoundment Opportunities," SCS, July 1987, was a frequently used reference. Following are some of the more important criteria used for deciding if a watershed had "Good", "Fair", or "Poor" potential for flood damage reduction through use of retarding structures.

Storage characteristics indicated by topography

Spatial distribution of available sites

Portion of watershed controllable by structures

Land use within potential structure sites

Presence of constructed improvements

Structure site ratings were composited for each watershed and listed in Table 2.

Flood control project recommendations were principally based on two parameters: (1) potential for structural control of runoff, and (2) the amount of flood plain cropland as a percent of the watershed drainage area. Potential for "Good" structural control was an absolute must for rating "High" or "Medium" feasibility. Below in tabulated form are criteria used to rate feasibility (Table 1).

Table 1
WATERSHED RATING CRITERIA
Skunk River Basin

Flood Project Recommendation Rating	Required Structural Control Potential	Amount of Flood Plain Cropland - Minimum (percent of DA)
High	Good	8.0
Medium	Good	5.0
Low	Good	2.5
Low	Fair	3.5
Very Low	(watersheds not meeting above criteria)	

Table 2
WATERSHED ANALYZES
Skunk River Basin
South Skunk River Subbasin (291)

Watershed Number	Stream Name	Drainage Area (acres)	Size of 1/ Flood Plain (percent of DA)	Flood Plain Cropland 2/ (percent of FP)	Flood Plain Cropland 2/ (percent of DA)	Potential 3/ Structures	Project 4/ Feasibility
02	Buckley	24,000	5	85	4.0	G	L
03 part	Carson	6,600	6	58	3.5	G	L
04	Elk	40,200	10	79	8.2	G	H
05	Thunder	19,000	9	57	5.2	G	M
06	Cherry	25,700	7	47	3.2	G	L
07	Prairie	16,400	10	54	5.2	G	M
09	Indian (lower)	60,500	15	71	10.5	P	VL
10	Clear	53,900	8	73	5.6	G	M
11	Indian (upper)	140,200	1	55	.5	P	VL
12	Calamus	9,700	1	93	1.0	P	VL
13 part	Ballard	18,500	2	69	1.1	P	VL
13 part	White Oak	6,700	3	3	.1	G	VL
14	Walnut	12,800	1	62	.5	P	VL
15	Drain #13	8,400	2	89	1.7	P	VL
16	Squaw	145,500	4	15	.5	P	VL
17	So. Skunk (lower)	28,600	1	34	.5	P	VL
18	Keigley	29,900	3	22	.6	P	VL
19	Bear	20,300	1	35	.4	P	VL
20	Long Dick	21,300	4	40	1.7	P	VL
21	So. Skunk (upper)	41,900	4	38	1.7	P	VL
22	Rahto	53,700	1	50	.4	P	VL

Table 2
WATERSHED ANALYZES
Skunk River Basin
Skunk River Subbasin (292)

Watershed Number	Stream Name	Drainage Area (acres)	Size of 1/ Flood Plain (percent of DA)	Flood Plain Cropland 2/ (percent of FP)	(percent of DA)	Potential 3/ Structures	Project 4/ Feasibility
01 part	Long	13,800	5	0	0	F	VL
01 part	Cedar	10,200	4	5	.2	G	VL
01 part	Mud	10,900	1	66	.9	F	VL
02	Big	106,900	2	62	1.2	P	VL
03	Fish	16,500	1	42	.5	F	VL
04 part	Mud	11,400	2	75	1.8	G	VL
04 part	Sugar	12,500	4	44	1.6	G	VL
05	Cedar (lower)	74,100	1	60	.8	P	VL
06	Wolf	19,000	3	54	1.7	G	VL
07	Little Cedar	35,600	2	42	1.0	G	VL
08	Cedar (upper)	176,000	6	68	4.3	P	VL
09	Crow	13,100	4	58	2.1	G	VL
10	Coon	20,000	4	60	2.5	G	L
11	Competine	24,300	4	65	2.5	F	VL
12	Brush	22,500	5	56	2.9	G	L
13	Walnut	57,200	3	63	1.8	G	VL
16	Crooked	182,700	5	71	3.8	P	VL
17	Walnut	11,700	4	2	.1	F	VL
18	Indian	10,100	4	4	.2	F	VL
19	Honey	13,900	2	15	.3	G	VL
20	Richland	22,800	5	36	1.9	G	VL
21	Dutch	25,900	7	19	1.3	G	VL
23	Clear	14,900	4	61	2.7	G	L

Table 2
WATERSHED ANALYZES
Skunk River Basin
North Skunk River Subbasin (300)

Watershed Number	Stream Name	Drainage Area (acres)	Size of 1/ Flood Plain (percent of DA)	Flood Plain Cropland 2/ (percent of FP)	Flood Plain Cropland 2/ (percent of DA)	Potential 3/ Structures	Project 4/ Feasibility
01 part	Unnamed (E. (of German)	7,500	1	92	1.1	F	VL
02	German	35,800	5	75	3.7	G	L
03	Bridge	24,900	7	46	3.2	G	L
04	Cedar	27,400	7	55	3.9	G	L
05	Rock	17,600	6	41	2.5	G	L
06	Coal	14,100	5	44	2.1	G	VL
07 part	Pleasant	8,800	6	28	1.6	G	VL
08	Middle	41,600	9	72	6.7	G	M
09	Moon	21,100	10	79	8.2	F	L
11	Buck	29,300	10	44	4.3	G	L
12	West	32,700	3	94	2.5	F	VL
13	Sugar	35,100	9	84	7.6	G	M
14 part	Turner	4,800	2	54	.9	G	VL
14 part	Bear	5,100	3	60	1.6	G	VL
14 part	Burr Oak	6,600	5	58	2.9	G	L
14 part	Unnamed (Hwy F-17)	3,200	2	73	1.2	G	VL
15	Slater	13,300	5	74	3.9	G	L
16	Rock	30,700	5	70	3.3	G	L
17	Alloway	15,400	5	76	3.6	G	L
18	Snipe	26,400	6	67	3.7	F	L
19	No. Skunk	33,600	5	70	3.2	G	L

Table 2
WATERSHED ANALYZES
Skunk River Basin
Sugar Creek Subbasin (310)

Watershed Number	Stream Name	Drainage Area (acres)	Size of 1/ Flood Plain (percent of DA)	Flood Plain Cropland 2/ (percent of FP)	(percent of DA)	Potential 3/ Structures	Project 4/ Feasibility
01 part	Jack	9,000	2	22	.5	G	VL
01 part	Lamalees	6,500	4	7	.3	G	VL
03	Sugar	103,900	4	32	1.4	F	VL
04	Lost	24,600	7	28	2.0	F	VL

1/ Size of flood plain is listed in percent of drainage area.
2/ Amount of cropland is listed in percent of flood plain area and in percent of the watershed drainage area.
3/ The potential for structural flood control was rated for each watershed. G = Good, F = Fair, P = Poor.
4/ This recommendation column shows the result of evaluating the amount of cropland as a percent of drainage area and the potential for structural flood control. H = High, M = Medium, L = Low, VL = Very Low.

Table 3
SUMMARY OF PROJECT FEASIBILITY
Skunk River Basin

Subbasin	Number of Watersheds by Feasibility Rating				
	Very Low	Low	Medium	High	Total
South Skunk River	14	3	3	1	21
Skunk River	20	3	0	0	23
North Skunk River	7	12	2	0	21
Sugar Creek	4	0	0	0	4
TOTAL	45	18	5	1	69

RESULTS OF INVESTIGATIONS

Applying Table 1 criteria results in 45 watersheds rating "Very Low", 18 rating "Low", only five rating "Medium", and one rating "High" feasibility for flood damage reduction projects (Table 3). Following the field review one inventory watershed, Elk Creek Watershed, number 04 in the South Skunk River Subbasin, was rated "High" for project feasibility. This watershed not only meets criteria requirements for the "High" rating but also exceeds the "Medium" rated watersheds by showing stronger evidence of more frequent flooding, a more level flood area, and a more consistent, uniform topography and land use throughout the flood area. Therefore, Elk Creek Watershed was selected as the only "High" feasibility watershed.

Watersheds rating "Medium" are in the South Skunk and North Skunk Subbasins and are centrally positioned in the Basin (Figures 3 and 5) (Table 4). These five "Medium" feasibility watersheds are all "left bank" (looking downstream) tributaries with one exception, Middle Creek Watershed, a "right bank" tributary of the North Skunk River in Mahaska County.

Reduction of sedimentation is a flood prevention benefit. All six watersheds with "High" or "Medium" project feasibility ratings are direct tributaries of streams rated B(W). These are warm water streams protected for fish, wildlife, and secondary human contact. Structures placed in these watersheds would provide downstream benefits to water quality values.

There are 16 lakes with over 40 acres surface area in the Skunk River Basin. Most of these lakes are for public use. Some have sediment basins

constructed on inlets to enhance water quality.

In 1967 an analysis of inventory watersheds was done state-wide to estimate project feasibility. The summary publication 1/ does not differentiate between "flood prevention" and "drainage" watershed projects. Thirty watersheds in the Skunk River Basin were declared feasible for projects. Several were for "drainage" only, based upon knowledge of those watersheds. Watersheds receiving a "High" or "Medium" potential in this current study that were also declared feasible in the Conservation Needs Inventory are:

Elk Creek, Newton County
Clear Creek, Story, Marshall, Jasper Counties
Middle Creek, Mahaska County
Sugar Creek, Jasper, Poweshiek Counties

Table 4
WATERSHEDS WITH "HIGH" OR "MEDIUM" PROJECT FEASIBILITY
Skunk River Basin

Watershed Number	Project Feasibility	Stream Name	County
		South Skunk River Subbasin	
04	High	Elk Creek	Jasper Marion Mahaska
05	Medium	Thunder Creek	Marion
07	Medium	Prairie Creek	Jasper
10	Medium	Clear Creek	Story Marshall Jasper
		North Skunk River Subbasin	
08	Medium	Middle Creek	Mahaska
13	Medium	Sugar Creek	Jasper Poweshiek

1/ Iowa Conservation Needs Inventory, Iowa Conservation Needs Committee, 1970.

REVIEW OF GERMAN CREEK WATERSHED

German Creek Watershed (Number 02 in the North Skunk River Subbasin, Figure 5) lies east of Sigourney, Iowa. The Keokuk County Soil and Water Conservation District (SWCD), the Keokuk County Board of Supervisors, and the Keokuk County Conservation Board applied for assistance in German Creek Watershed through P.L. 566 in October 1971. One of several soil and water resource problems cited was flooding of cropland and roads. During this current Skunk River Basin Study a preauthorization planning investigation for German Creek Watershed was completed. Potential for P.L. 566 project action was studied for flood damage reduction and for accelerated land treatment. This summary addresses conclusions regarding feasibility for a flood damage reduction project.

Investigations determined the extent of flood damages through personal interviews, examination of flood records, and by hydrologic and economic studies. Flood plain and channel cross-sections were surveyed at 18 locations. Potential floodwater retarding structures were located at 13 sites (Figure 7). Flood reduction was investigated through use of floodwater retarding structures only. The 13 structures were tested in eight combinations (alternatives) to determine physical effects upon flooding and economic feasibility.

The 100-year flood plain area is 1,760 acres. Total without-project average annual flood damage is estimated at $168,100. This amount is a sum of $150,500 crop and pasture damage, and $17,600 other agricultural and road and bridge damage. All eight with-project alternatives reduce flood damage. However, cost estimates for each of the structural plans exceed benefits under present installation costs, interest rates, and crop prices. This analysis was done during fiscal year 1986 and found the highest benefit:cost ratio was 0.77 for Alternative Number Three which included three structures. These structures would control 31 percent of the watershed drainage area and reduce flood damages 40 percent. Increasing structural control to 54 percent of the drainage area with 10 structures would reduce flood damage 64 percent but result in a benefit:cost ratio of 0.60. Therefore, the conclusion was that German Creek Watershed is not a feasible P.L. 566 flood damage reduction project at present.

Under the inventory group analysis described earlier in this report German Creek Watershed has "Good" potential for retarding structure sites but rated "Low" feasibility as a flood reduction project due to there being only 3.7 percent of flood plain cropland with respect to drainage area (Table 2, Sheet 3).

CONCLUSIONS AND RECOMMENDATIONS

Potential for feasible flood damage reduction projects in 69 inventory watersheds of the Skunk River Basin has been analyzed. This study reviewed physical characteristics of these watersheds including: amount of flood plain cropland, and the availability and quality of retarding structure sites.

Six inventory watersheds were distinctively set apart as having "High" or "Medium" potential for flood damage reduction projects. There is no certainty that under current conditions these watersheds would be feasible when studied in detail. This study did stratify the watersheds as to their probability for being feasible (Table 2). Therefore, the ratings provide planners with a guide for selective allocation of limited planning funds and manpower. The value of these comparative ratings will be useful until significant physical changes occur in the watersheds, or there are changes in planning criteria.

Scenarios at which flood damage reduction projects for inventory size watersheds seem to become economically feasible follow below (Table 5). These conclusions stem from the German Creek Watershed preauthorization planning

Table 5
FEASIBILITY SCENARIOS
Skunk River Basin

Scenario	Installation Cost (1986 base)	Interest (percent)	Crop Price (dollars per bushel)	
			Corn	Soybeans
A	Little change	8.5	3.20	7.00
B	Little change	7.5	2.80	5.70
C	+ 10 percent	8.5	3.70	7.30
D	+ 10 percent	7.5	3.20	7.00

investigations discussed above and from Soap Creek Watershed studies in the lower Des Moines River Basin. Soap Creek Watershed has a recent project plan for flood damage reduction. The favorable benefit:cost ratio for that project

stems from good structure sites, large amount of cropland in the flood plain, and large pre-project flood damage from sedimentation, scour, roads, bridges, and other property.

LOCATION MAP

SKUNK RIVER BASIN

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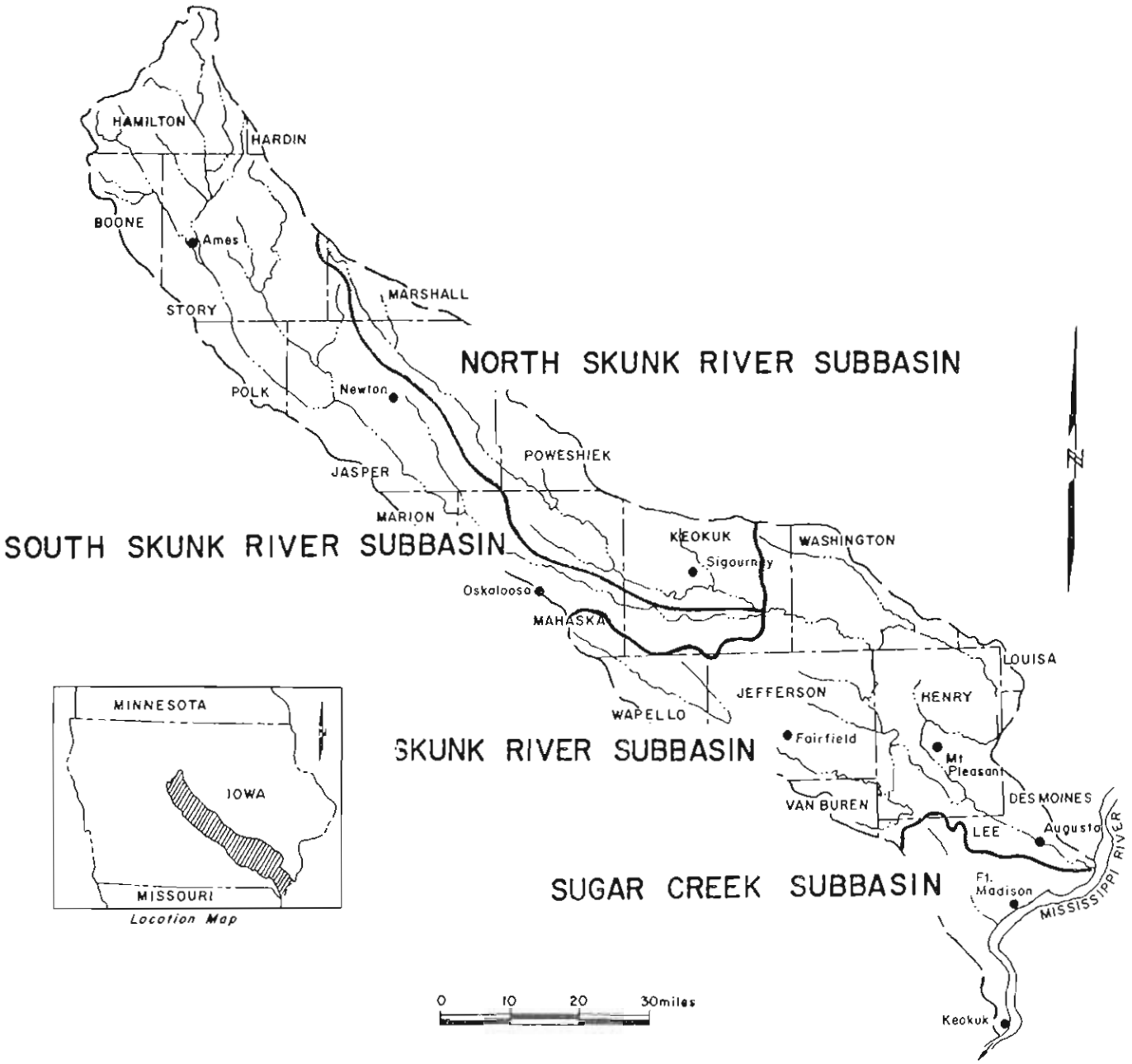

Figure 1

LAND RESOURCE AREAS

SKUNK RIVER BASIN

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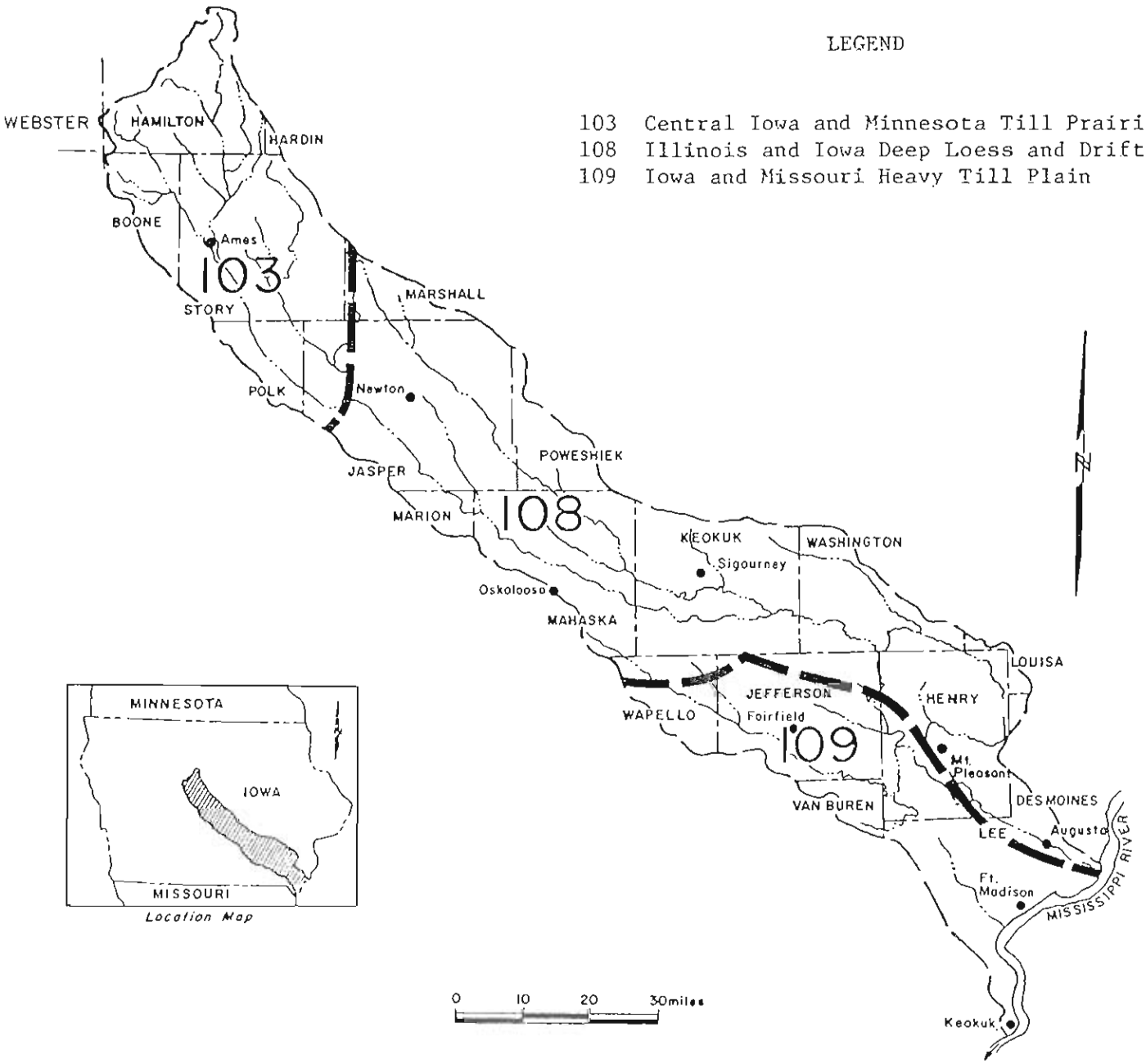

Figure 2

STRUCTURE SITES
GERMAN CREEK WATERSHED
Skunk River Basin, Iowa

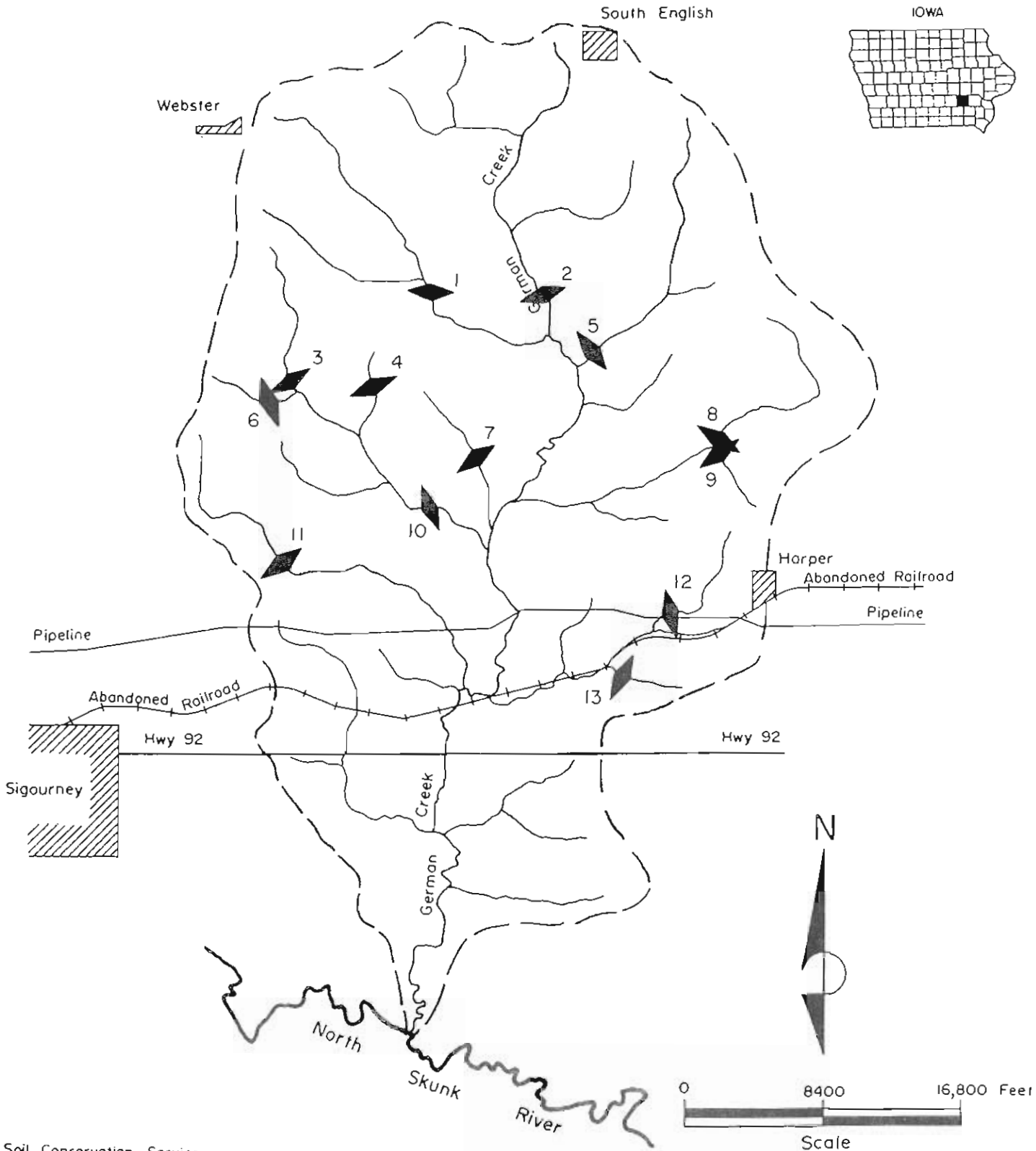

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Figure 7


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AGRICULTURE IS THE AND COMMERCE
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