K PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

LYE CREEK DRAIN WATERSHED

Montgomery County, Indiana

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OUR SOIL ★ OUR STRENGTH

USDA-SCS-LINCOLN, NEBR. 1974

ADDENDUM

to the

LYE CREEK DRAIN WATERSHED WORK PLAN
MONTGOMERY COUNTY, INDIANA

This addendum is in response to the established Principles and Standards of the Water Resources Council and has been developed in accordance with the Interim USDA Procedures for Planning Water and Related Land Resources.

Information included consists of:

I. Evaluation of Plan With Current Construction Costs and Discount Rate

II. Abbreviated Environmental Quality Plan

III. Selected Plan - Display Tables

LYE CREEK DRAIN WATERSHED, INDIANA

I. EVALUATION OF PLAN WITH CURRENT CONSTRUCTION COST AND DISCOUNT RATE

This addendum shows project cost based on 1974 price base for construction costs amortized for 100 years at 5 7/8 percent interest.

Benefits for this addendum are based on current normalized prices for agricultural commodities.

Annual project benefits, costs and benefits--cost ratio are as follows:

Total benefits	$54,480
Total costs	32,100
Benefit-cost ratio	1.7:1

LYE CREEK DRAIN WATERSHED

II. ABBREVIATED ENVIRONMENTAL QUALITY PLAN

ENVIRONMENTAL PROBLEMS

Areas of natural beauty

The watershed has a limited variety of scenery because of land use patterns, topography, lack of lakes, perennial streams, major water courses, and other natural features. About 97 percent of the area is devoted to agricultural uses with three percent in wildlife, recreation and forest land.

The segment of Lye Creek in the watershed is fairly well entrenched, wooded and has some rock riffles. This area is small and is included in the previously mentioned three percent.

Water and land quality

Erosion in terms of sediment production are above tolerable limits on 2,431 acres of cropland or 19 percent of the watershed. The average sediment loss on this area is estimated at 5.7 tons/acre/year, which is about 1.5 times the tolerable limit.

Sediment yield from the watershed is low (0.2 tons/acre/year). However, high intensity, short duration storms on fallow field conditions will periodically discharge sediment and associated pollutants into Lye Creek and Sugar Creek.

Trash and household garbage are being dumped, to a minor extent, throughout the area. Some septic tank effluent from private residence and feedlot waste is being discharged, without treatment into streams.

Biological resources and selected ecosystems

The predominant agricultural monoculture provides a small amount of unvaried wildlife habitat. Clean-tillage practices destroy suitable habitat for wildlife species that favor upland agriculture. Lye Creek Drain does not affort suitable habitat for mature sport fish because it has intermittent flow and lacks cover, pools and riffles.

COMPONENT NEEDS

1. Improve water and land quality by controlling erosion, sedimentation and other pollutants.

COMPONENT NEEDS - CONT'D

2. Establish, improve, and manage fish and wildlife habitat.

3. Provide for satisfactory disposal of untreated sewage and solid waste.

4. Provide diversity of landscape.

PLAN ELEMENTS

1. Install appropriate land treatment measures on about 4,850 acres.

   Included are contour farming, grassed waterways or outlets, minimum tillage, crop residue use, grade stabilization structures and other measures as needed. Soil conserving mechanical practices and cropping systems would be applied on all croplands. Pasture would be used and managed to protect stand cover and maintain vigor of desired plant species. The estimated cost of installation including technical assistance is $34,770.

2. Implement proper land use. Convert 2,431 acres of cropland having excessive erosion to pasture or forest land. The estimated installation cost including technical assistance is $204,953.

3. Eliminate illegal trash and garbage dumping. This could be accomplished by implementing county-wide trash and garbage pick-ups and delivering refuse to appropriate locations.

4. Eliminate feedlot discharge and untreated residential sewage into streams and ground water aquifers. Install 45 holding ponds for livestock feedlot runoff and 45 septic tanks for household sewage disposal at a cost of $217,350.

5. Convert about 900 acres of cropland into parcels of forest land. These parcels should be 10 acres or larger and should be scattered throughout the watershed on soils suited for trees involved. The estimated installation cost of this conversion, including technical assistance, is $103,500.

6. Establish about 450 acres of upland wildlife areas in scattered blocks such as in "odd field" areas and along fencerows and ditchbanks. The vegetation should be a mixture of trees, shrubs, and herbaceous plants which have a high value for wildlife food and/or cover. The estimated establishment cost, including technical assistance is $40,250.

PLAN ELEMENTS - CONT'D

7. Convert about 450 acres of cropland to wetland. A large, single block of wetland is more desirable than scattered wetland areas. The estimated cost of conversion, including technical assistance, is $470,812.

8. Restrict land use for a distance of 50 feet from each edge of the stream or ditch banks. The acreage involved could be considered as part of the 450 acres of the upland wildlife area previously mentioned. The estimated installation cost, including technical assistance, is $79,528.

9. Install stream improvements for fish and wildlife habitat on the lower 1 1/2 miles of Lye Creek Drain. Appropriate measures would be: deflectors, shade improvements, livestock exclusion, bank stabilization, fish cover provisions such as overhangs, and clean-up of litter. The estimated installation cost including technical assistance is $30,170.

INSTITUTIONAL ARRANGEMENT

1. Institutional arrangments available and needed for the implementation of the Environmental Quality Plan. Legal entities of government are in existence for the implementation of the EQ Plan. They include township and county government, joint powers of county government and soil and water conservation districts. All of these have the power of eminent domain and taxation by law.

State and federal programs are available providing financial assistance both for land acquisition and for establishment of measures to implement the EQ Plan, namely:

State Programs

1. Indiana Department of Natural Resources

   a. Forestation Program - Provide tree planting stocks and technical assistance.

   b. Private Land Wildlife Habitat Improvement Program - Provide financial and technical assistance to create wildlife habitat on private lands.

   c. Natural Resource Funds - Provide financial assistance for developing fish and wildlife habitat and recreational areas.

State Programs - Cont'd

2. State Planning Agency

   a. Outdoor Recreation Division - Land acquisition and development of recreational facilities.

Federal Programs

1. U. S. Department of Agriculture

   a. Resource Conservation and Development - Financial and technical assistance involving human and natural resources.

   b. Rural Environmental Conservation Program - Provides cost sharing assistance to individual landowners for application of conservation practices.

   c. Loans and Advances - Provide loans and advances to sponsoring organizations.

2. U. S. Department of Interior

   a. Pitman-Robertson Funds - Provides for wildlife research and financial and technical assistance in developing wildlife habitat areas. Administered by the state.

   b. Dingell-Johnson Funds - Provides for fishery research and financial and technical assistance in developing fishery habitat areas. Administered by the state.

Technical assistance including educational and on-site assistance is available from:

1. Montgomery County Soil and Water Conservation District

2. Cooperative Extension Service

3. Indiana Department of Natural Resources

4. USDA including Soil Conservation Service and Forest Service

5. USDI, U.S. Fish and Wildlife Service.

EFFECTS

Water and land quality

The installation of the land treatment measures will reduce the average annual soil loss on 2,431 acres of cropland from 5.7 tons/acre/year to 3.2 tons/acre/year. This rate is below the tolerable limit of 3.5 tons/acre/year. The measures will reduce erosion and sedimentation by 41 percent and decrease the watershed's contribution of sediment to Lye Creek from 2,505 tons/year to 1,485 tons/year. This reduction will reduce agricultural pollutants that are borne by sediment.

Implementation of land use compatible with the soils capability can reduce erosion and sedimentation in the same manner as land treatment. Therefore, the effects on water and land quality would be similar.

Elimination of illegal trash and garbage dumping and untreated sewage discharge has desirable effects on both water quality and esthetics.

Biological resources and selected ecosystems

The installation of the forest land, upland wildlife habitat, wetlands, the 50 foot strip each side of the stream, and the 1.5 miles of stream improvement will increase desirable habitat for fish and wildlife considerably over the existing conditions.

The nature of the habitat (upland, wetland, forest land) will be compatible with many species of plants and animals that are now scarce or nonexistent in the watershed.

The amount of land required for land use conversion, for improved environmental stability, and for wildlife habitat purposes is approximately 1,800 acres or about 14 percent of the watershed area.

The population of bobwhite quail and other game species such as cottontail rabbit, ringneck pheasant, and squirrel would be improved by an estimated 400 percent. Non-game wildlife species such as songbirds and small mammals would be increased by an estimated 500 percent.

SYSTEM OF ACCOUNTS DISPLAY

The following tables illustrate a display of beneficial and adverse effects of the selected plan for Lye Creek Drain Watershed in the National Economic Development, Regional Development, Social Well-Being and Environmental Quality Accounts.

LYE CREEK DRAIN WATERSHED

III. SELECTED PLAN - NATIONAL ECONOMIC DEVELOPMENT ACCOUNT
Dollars 1/

Components	Measures of Effects Average Annual	Components	Measures of Effects Average Annual
Beneficial Effects		Adverse Effects	
A. The value of users of increased outputs of goods and services		A. The value of resources required for a plan.	
1. Flood prevention	$26,600	1. Channel modification	
2. Drainage	17,700	Project installation	$23,960
		Project administration	3,820
		OM&R	3,680
TOTAL BENEFICIAL EFFECTS	$44,300	TOTAL ADVERSE EFFECTS	$31,460
		NET BENEFICIAL EFFECTS	$12,840

1/ Amortized at 5 5/8 percent interest for 100 years.

LYE CREEK DRAIN WATERSHED

III. SELECTED PLAN - REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects	
	State of Indiana	Rest of Nation
Employment Beneficial Effects		
A. Increase in the number of jobs.		
1. Employment for project construction.	16 man-yr. of labor	-
2. Employment for project OM&R	.7 man-years	-

Components	Measures of Effects	
	State of Indiana	Rest of Nation
Employment Adverse Effects		
A. None		

LYE CREEK DRAIN WATERSHED

III. SELECTED PLAN - REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects		Components	Measures of Effects	
Regional Economic Base and Stability	State of Indiana	Rest of Nation	Regional Economic Base and Stability	State of Indiana	Rest of Nation
Beneficial Effects:	The average net income increase will be approximately $1,100 annually per beneficiary		Adverse Effects:		

March 1975

LYE CREEK DRAIN WATERSHED

III. SELECTED PLAN - SOCIAL WELL-BEING ACCOUNT

COMPONENTS:

A. Income distribution

1. It is estimated the income distribution of the beneficiaries of the project is 35% less than $5,000; 15%- $5,000 to $10,000 and 50% over $10,000. Regional cost of $15,900 will be shared in about the same proportion as the benefits accrued.

March 1975

III. SELECTED PLAN - ENVIRONMENTAL QUALITY ACCOUNT

COMPONENTS:

Beneficial and Adverse Effects

A. Areas of natural beauty

1. Destroy 15 acres of woody wildlife habitat during construction.
2. Plant 21 acres of trees and shrubs.
3. Protect eight acres of existing woody material.
4. Establish a maintenance program for channels and stream banks.
5. Increase flooding on two acres in Reach D.

B. Quality considerations of water, land and air resources

1. Increase noise, air and water pollution for a short term during construction.
2. Reduce erosion on 3,158 acres of cropland, grassland and forest land.

C. Biological resources and selected ecosystems

1. Destroy 15 acres of woody wildlife habitat during construction.
2. Plant 21 acres of trees and shrubs.
3. Protect eight acres of existing woody material.
4. Plant 58 acres of stream bank to grass.
5. Destroy 5,100 feet of fish habitat.
6. Establish six fish pool developments.

D. Irreversible & Irretrievable

1. Thirty acres of cropland converted to wildlife habitat. Land usage within the project permanent easement area before and after project follows:

Land Use	Present	Future
Channel Area	35	43
Cropland	30	--
Forest land	22	23
Grassland	37	58

These conversions are considered to be committed for the project life.

March 1975

WATERSHED WORK PLAN

LYE CREEK DRAIN WATERSHED
Montgomery County, Indiana

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as Amended

Prepared by:

Montgomery County Soil and Water Conservation District
Montgomery County Drainage Board

Technical Assistance By:

U. S. Department of Agriculture, Soil Conservation Service
U. S. Department of Agriculture, Forest Service
Indiana Department of Natural Resources

March 1975

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WATERSHED WORK PLAN AGREEMENT

between the

Montgomery County Soil and Water Conservation District

and the

Montgomery County Drainage Board

(hereinafter referred to as the Sponsoring Local Organization)

State of Indiana

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Lye Creek Drain Watershed, State of Indiana, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Lye Creek Drain Watershed, State of Indiana, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about four (4) years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Montgomery County Drainage Board will acquire, with other than PL-566 funds, such land rights as will be needed in connection with the works of improvement. (Estimated Cost $46,250)

2. The Montgomery County Drainage Board assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Montgomery County Drainage Board and the Service as follows:

	Montgomery County Drainage Board (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars) 1/
Relocation Payments	38.4	61.6	0

1/ Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost shared in accordance with the percentages shown.

3. The Montgomery County Drainage Board will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs of structural measures to be paid by the Montgomery County Drainage Board and by the Service are as follows:

Works of Improvement	Montgomery County Drainage Board (percent)	Service (percent)	Estimated Construction Cost (dollars)
All Measures	32.0	68.0	$356,100

5. The percentages of the engineering costs to be borne by the Montgomery County Drainage Board and the Service are as follows:

Works of Improvement	Montgomery County Drainage Board (percent)	Service (percent)	Estimated Engineering Costs (dollars)
All Measures	0	100.0	$21,750

6. The Montgomery County Drainage Board and the Service will each bear the costs of Project Administration which it incurs, estimated to be $10,690 and $56,980, respectively.

7. The Montgomery County Soil and Water Conservation District will obtain agreements from owners of not less than 50 percent of the land above each structural measure that they will carry out conservation plans on their land.

8. The Montgomery County Soil and Water Conservation District will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Montgomery County Drainage Board will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the availability of appropriations for this purpose.

    A separate agreement will be entered into between the Service and the Montgomery County Drainage Board before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the sponsoring local organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the sponsoring local organization in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the sponsoring local organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties.

14. No member of or delegate to congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any activity receiving federal financial assistance.

16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

Montgomery County Soil and Water Conservation District

By /S/ Clyde Himes

Title Chairman

Rt. 2, Ladoga, Ind. 47954
Address Zip Code

Date March 17, 1975

The signing of this agreement was authorized by a resolution of the governing body of the Montgomery County Soil and Water Conservation District

adopted at a meeting held on March 17, 1975

Clifton Coon
Secretary, Montgomery County Soil and Water Conservation District

Rt. 1, Wingate, Ind. 47994
Address Zip Code

Date March 17, 1975

Montgomery County Drainage Board

Rt. 7, Crawfordsville, Ind. 47933
Address Zip Code

By /S/ Samuel Boots

Title Chairman

Date MAR 2 5 1975

The signing of this agreement was authorized by a resolution of the governing body of the Montgomery County Drainage Board

adopted at a meeting held on MAR 2 5 1975

/S/ Judy K. Cope
Secretary, Montgomery County Drainage Board

Rt. 2, Crawfordsville, Ind. 47933
Address Zip Code

Date MAR 2 5 1975

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

/S/ Cletus J. Gillman
State Conservationist

MAR 27 1975
Date

SUMMARY OF PLAN

The Lye Creek Drain Watershed includes 20.37 square miles (13,035 acres) in Montgomery County, west-central Indiana. The drainage from five major intermittent, manmade, agricultural drains flows into a two mile reach of Lye Creek, a natural, perennial stream which flows through the watershed before joining Sugar Creek one and one-half miles downstream from the watershed boundary.

This project is sponsored by the Montgomery County Soil and Water Conservation District (SWCD) and the Montgomery County Drainage Board (Drainage Board).

Watershed problems covered by the plan are: inadequate land and water management, floodwater damage, erosion,and inadequate drainage.

Land treatment measures will be installed by individual landowners and operators with technical assistance provided by the Soil Conservation Service (SCS) and the Indiana Department of Natural Resources (IDNR), Division of Forestry, in cooperation with the U.S. Forest Service. Land treatment practices considered appropriate for installation in the watershed are: contour farming, grassed waterways, minimum tillage, crop residue uses, grade stabilization structures, conservation cropping systems, subsurface drains, drainage mains and laterals, pasture and hayland planting and management, tree planting, and forestland management. These measures include the needed conservation practices having hydrologic, erosion and sediment control significance in reducing floodwater damage, and those which contribute to achieving agricultural water management benefits. The proposed measures will reduce sheet erosion losses and amount of sediment contributed by the watershed by 41 percent. The Other cost (all funds other than Public Law 566) of the land treatment measures is estimated at $31,420 which includes $2,400 for forest land measures. Public Law 566 (PL-566) cost of $3,350 is estimated for technical assistance for the land treatment measures.

Structural measures will consist of 11.3 miles of multiple purpose flood prevention and drainage channel work. The work will be for deepening and enlargement for 10.2 miles and debris removal only for 1.1 miles. All work will be performed on intermittent, manmade or modified channels.

Floodwater damages will be reduced by 84 percent with the installation of the proposed measures; 3,320 acres will benefit from joint floodwater-drainage relief.

The structural measures are estimated to cost $491,770, of which $320,880 is PL-566 cost and $170,890 is Other cost. The total installation cost is estimated at $526,540, of which $324,230 is PL-566 cost and $202,310 is Other cost. Total annual cost for installation amounts to $27,780.1/

1/ 100 years @ 5-5/8 percent interest.

SUMMARY OF PLAN CONT'D

Annual operation and maintenance costs of $3,680 will be borne by the sponsors. The total annual cost is $31,460.

Total average annual benefits from structural measures are an estimated $54,480, which includes flood damage benefits of $6,760, more intensive land use benefits of $19,840, agricultural water management (drainage) benefits of $17,700 and local secondary benefits of $10,180.

A four-year installation period is planned.

The ratio of average benefits of $54,480 to the average annual cost of $31,460 is 1.7 to 1.0.

WATERSHED RESOURCES-ENVIRONMENTAL SETTING

Physical resources

Lye Creek Drain Watershed contains 20.37 square miles (13,035 acres) of northeastern Montgomery County in west-central Indiana.[1/] Relative locations of some important cities follow: Danville, Illinois, 42 miles west; Lafayette, 18 miles north; Crawfordsville, 9 miles southwest; Frankfort, 19 miles northeast; and Indianapolis, 44 miles southeast.

The watershed is not within any Standard Metropolitan Statistical Area (SMSA). The 1970 census showed Montgomery County to have a population of 33,930. Except for Crawfordsville, a city of 13,842, the county is classed as rural (59.2 percent). There are no built-up areas within the watershed; however, two small towns lie near the boundary: Linden, 1 mile northwest (population 713), and Darlington, 2 miles southeast, (population 802). Population of the watershed is estimated at 275.[2/]

Present land use within the watershed is as follows: cropland, 87 percent (11,315 acres); forest land, one percent (129 acres); pasture, seven percent (891 acres); and other, five percent (700 acres).

A high level of agricultural production may be sustained even though a certain amount of soil is lost each year to erosion. The tolerable limit of soil loss is being exceeded on 2,431 acres of cropland scattered throughout the watershed. An additional 8,082 acres of cropland is

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1/ All information and data, except when otherwise noted by reference to source, were collected during watershed planning activities by the Soil Conservation Service, U. S. Department of Agriculture.

2/ 1970 Census of Population, Advance Report, PC (VI) - 16, Indiana: U.S. Department of Commerce, Bureau of the Census, December, 1970.

Physical resources - cont'd.

on mineral soils having a wetness limitation for crop production. Crops are grown on 802 acres of muck soils with a wetness limitation in the southwestern part of the watershed.

A total of 1,330 acres are subject to overbank flooding; an average of 960 acres is affected annually. Nearly 3,320 acres have joint, inseparable, flooding and drainage problems.

Sediment has accumulated in the one mile section of Lye Creek Drain above Lye Creek.

The climate within the watershed is typical of the region. Average annual precipitation is about 39.5 inches. Distribution is nearly cyclic, ranging from a low monthly average of 2.16 inches in February to a high of 4.74 inches in June. Fifty percent of the precipitation falls in the growing season, often as high intensity rainfall. Snowfall varies considerably from year to year, but averages 22 inches, with 5-6 inches each month from December through February.

Average daily maximum temperatures range from a low of 37° F in January to a high of 87° F in July. Average daily minimums range from a low of 23° F in January to a high of 65° F in July. Average daily temperature ranges from 29.7° F in January to 76.3° F in July. An average of 35 days per year have a maximum temperature over 90° F and the temperature falls below freezing an average of 120 days. The growing (frost-free) season averages 170 days. Average annual sunshine is 2,700 hours. There are usually 45 days a year with thunderstorms.1 & 2/

The watershed is within National Land Resource Area (NLRA) 111, the Indiana and Ohio Till Plain.3/ In Indiana this area is called the Tipton Till Plain and is the largest physiographic region in the state. Typically the region is very flat to gently rolling and has undergone little post-glacial modification by streams.4/

1/ Annual Summary, Climatological Data Indiana: U.S. Department of Commerce, NOAA, EDS, Vol. 76, November 13, 1971.

2/ The National Atlas of the United States of America: U.S. Department of Interior, USGS, 1970.

3/ National and State Land Resources Areas Map, USDA, SCS.

4/ Thickness of Drift and Bedrock Physiography of Indiana North of the Wisconsin Glacial Boundary: William J. Wayne, Indiana Geological Survey Report of Progress #7, 1956.

Physical resources cont'd

Elevations within the watershed range from 835 feet above mean sea level at the extreme eastern boundary to 745 feet at the downstream end of Lye Creek, giving a total relief of 90 feet. Local relief is usually slight but may approach 45 feet on some kames and eskers and along Lye Creek. The major part of the watershed is flat or very gently sloping.

The General Soils Map shows seven soil associations. A soil association is a landscape that has a distinctive proportional pattern of soils. It consists of two or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

The table "Estimated Soil Limitations or Suitabilities for Selected Uses" is to be used in conjunction with the General Soils Map. The table lists the percentage of each soil association, the percentage of soils in each soil association, and the limitations and suitabilities of the major soils for specific land uses.

The General Soils Map, limitation table, and soil association descriptions are found in Exhibits 7A through 7D.[1/]

The landscape in the watershed is a consequence of Pleistocene glaciation of Wisconsin age. See Exhibit 8, General Surficial Geology Map, which pertains to the following discussion.

A complex group of end moraines deposited during a readvance of the glacial front exists around Crawfordsville, southwest of the watershed. Part of one of these end moraines is found in the south-central part of the watershed. As the glacier retreated, meltwaters deposited sand and gravel outwash in front of the ice margin. The presence of the end moraines to the southwest prevented drainage of the meltwaters and created a small lake, since drained, and now represented by the area called "mucks". Some small kames and eskers also developed during the glacial retreat. Lye Creek breached the end moraine and has, over time, developed some alluvial materials in its flood plain.

1/ Montgomery County General Soils Map, Purdue University and SCS, November, 1971.

Physical resources - cont'd

Glacial drift thickness ranges from zero at the extreme downstream part of Lye Creek to over 250 feet at the northwestern watershed boundary. The area is underlain by the Norman Upland, a physiographic unit that developed on erosion resistant sandstones and siltstones of the upper part of the Borden series of Mississippian age.1/

Mineral resources are scarce. There are no metals, mineral fuels (coal, oil, or gas), or industrial minerals being mined or produced in the watershed. The muck area in the southwestern part of the watershed has limited marl and peat deposits. Some sand and gravel can be found in the scattered areas of glacial outwash and stratified drift. Neither of these resources is being commercially utilized.

Lye Creek Drain Watershed is located in the central part of the Wabash River (excluding White and Patoka Rivers) Subregion (0513) of the Ohio River Water Resource Region and is considered physically similar to the rest of the subregion.2/

There are no known areas of wetland types 3, 4 or 5 in the watershed.3/ The central part of Rusk Ditch has 28 acres that receive annual flooding, and Durham Ditch about 155 acres. These areas classify as Type 1 wetland, but 80 percent of the area is presently in cropland. The remainder is grassland and other land. There are also a number of small Type 1 wetlands in the wooded flood plain along Lye Creek.

Eight ponds occur in the watershed. They have a total surface area of about five acres. The largest is the two acre pond owned by the Linden Conservation Club. All ditches and drains are intermittent and manmade or modified.4/

Rusk Ditch, approximately two miles in length, drains about 1,745 acres of the northwestern part of the watershed. It flows in a southerly direction and joins Lye Creek Drain in section 22. Rusk Ditch

1/ Thickness of Drift and Bedrock Physiography of Indiana North of the Wisconsin Glacial Boundary: William J. Wayne, Indiana Geological Survey Report of Progress #7, 1956.

2/ Water Resources Regions and Subregions for the National Assessment of Water and Related Land Resources: U. S. Water Resources Council, 1970.

3/ Wetlands of the United States: U.S. Department of the Interior, Fish and Wildife Service, Circular 39, 1971.

4/ Intermittent - having continuous flow through some seasons of the year but little or no flow through other seasons.

Physical resources - cont'd

beginning at Road 1000N, has a bottom width of 30 feet with side slopes of 2 to 1, but lacks depth to outlet the tile from the north. Downstream about 1000 feet the channel narrows and the bottom width is 13 feet with the same side slopes, and a narrowing channel. Further downstream the channel becomes shallow and parabolic shaped with 2 to 1 side slopes but lacks depth for tile drainage. This type channel continues through Road 900N and then gradually becomes entrenched to the outlet.

Durham Ditch, about a mile long, drains about 803 acres of muck in the southwestern part of the watershed. It flows northeasterly and joins Lye Creek in section 26. The channel, beginning at Road 650N, is parabolic shaped with 2 1/2 to 1 side slopes and contains spoil on the left for 2,800 feet.[1/] Approximately 1,500 feet downstream of the road the channel gains width but lacks depth. The channel then gradually narrows to 12 feet at the outlet where side slopes are 2 1/2 to 1.

Armentrout Tributary, a ditch about two miles long, drains about 1,790 acres of the northeastern part of the watershed. It flows south for about a mile, then turns to the southeast to join Lye Creek Drain just above its confluence with Lye Creek in section 30. The ditch, beginning at Road 900N, is a constructed channel, parabolic in shape, with an average of 1 1/2 to 1 side slopes.

Lye Creek Drain starts in the north-central part of the watershed and flows about two miles southwest. It then turns south for a half-mile, then southeast for a half-mile before flowing about three and one-quarter miles in a generally easterly direction to join Lye Creek. Its total drainage area is about 9,990 acres, or 21.7 percent of the total drainage area of Lye Creek at its junction with Lye Creek Drain. Beginning downstream of Road 800N, the channel has a bottom width of 14 feet with 2 to 1 side slopes and is also the beginning of spoil on the right side. Approximately 3,000 feet further downstream the channel is vee shaped with a continuous spoil on the right side. Continuing on for 2,700 more feet, the channel approaches a parabolic shape with a rounded bottom of 16 feet with the same side slopes. The channel 200 feet further downstream has a 17 foot bottom width with the same side slopes, however, 2,500 feet downstream the side slopes change with one side being 2 to 1 and the other 1 to 1. At this point the channel begins to change shape by narrowing and becoming entrenched through Road 450E and is vee shaped with side slopes of 3 1/2 to 1 on the left and 2 1/2 to 1 on the right. Approximately 1,500 feet downstream of Road 450E and onto the outlet the channel is 16 feet in bottom width with side slopes of 1 to 1.

1/ Note: All directions (left or right side) are looking downstream.

Physical resources - cont'd

Armentrout Drain starts at the extreme eastern end of the watershed, and flows about two miles to the southwest before joining Lye Creek in section 31. It drains approximately 1,190 acres of the southeastern part of the watershed.

Lye Creek, a natural perennial stream flows through the watershed in a generally south-southwesterly direction. About a two-mile reach is present in sections 30 and 31 in the south-central and southeastern part of the watershed.

There are no stream gages in the watershed. The nearest gage is five miles downstream on Sugar Creek and serves an area of 509 square miles. Lye Creek Drain Watershed contributes about three percent of the drainage area of the gage.

The average number and percent of flood events by months at the USGS gage at Sugar Creek are summarized below.

Month	Average No.	Percent of Total
January	0.64	10.53
February	0.57	9.36
March	0.96	15.79
April	1.04	16.96
May	0.57	9.36
June	0.71	11.70
July	0.54	8.77
August	0.11	1.75
September	0.21	3.51
October	0.18	2.92
November	0.21	3.51
December	0.36	5.85
Total	6.11	100.00

The 100 year peak discharge on Lye Creek at the downstream watershed boundary is approximately 4,300 cfs, and on Lye Creek Drain at its junction with Lye Creek, about 1,300 cfs. During droughty summer periods Lye Creek Drain has little or no flow.

The Indiana State Board of Health and Stream Pollution Control Board do not maintain water quality monitoring stations within the watershed; therefore, no water quality classification for the streams or ditches has

Physical resources - cont'd

been established.[1] The United States Geological Survey (USGS) in cooperation with the IDNR, Division of Water, studied the water resources of Montgomery County in a report published in 1965. One surface water sample was taken from Lye Creek Drain and another from Lye Creek about one-half mile below the watershed boundary. Two other samples were taken from the two streams (Bower Creek and Little Potato Creek) that join to form Lye Creek about one mile north of the junction of Lye Creek Drain with Lye Creek. Results of the analyses of the samples are tabulated below and serve as an indicator of the water quality of Lye Creek Drain compared to other streams in the same vicinity.[2]

NAME	LYE CREEK DRAIN	LYE CREEK	BOWER CREEK	L. POTATO CREEK
Location	County R. Br. SE¼, NW¼ SEC.25,T20N,R4W	County Rd. Br. SE¼, NE¼ SEC.1,T19N,R4W	County Rd. Br. SE¼, SE¼ SEC.8,T20N,R3W	County Rd. Br. SW¼, NW¼ SEC.21,T20N,R3W
Date	9-12-61	9-12-61	9-12-61	9-12-61
Temp (^{o}F)	78	78	84	84
Iron (ppm)	.3	.1	.2	.2
Bicarbonate (ppm)	371	346	244	351
Sulfate (ppm)	72	46	34	34
Chloride (ppm)	8	12	8	8
Hardness as $CaCO_3$ (ppm)	344	300	260	292

1/ Indiana Water Quality - 1970: Indiana State Board of Health and the Stream Pollution Control Board, 1970.

2/ Ground Water Resources of West-Central Indiana: Montgomery County: IDNR, Division of Water, Bulletin #27, 1965.

Physical resources - cont'd

As a part of a biological review, the IDNR, Division of Fish and Wildlife made a simple water quality assessment of Lye Creek Drain in September, 1972. They found a temperature of 66° F, dissolved oxygen content of 7 ppm, and a pH of 8. They stated that the drain does not deteriorate the water quality of Lye Creek or affect its sport fishery.1/

The USGS, Water Resources Division in Indianapolis conducted a water quality assessment of the watershed in late April 1974. They have completed their investigations and pertinent activities and conclusions follow: 2/

Reconnaissance sampling was conducted on fourteen sites on April 24, 1974. Five stream sites, one large tile drain and two small tile drains were sampled in detail on April 30, 1974. Field water-quality and stream flow measurements were made and samples were collected for laboratory analysis for some or all of the following: common inorganic constituents, selected metals, nutrients, bacteria, insecticides and certain fractions of the biologic community.

The location of data collection sites, site descriptions and analytical data are tabulated in Exhibit 9.

The data indicate that water quality is generally good, although agricultural fertilizers and insecticides pose potential problems.

Hardness, specific conductance, and concentrations of the major cations and anions were found to be fairly uniform throughout the watershed.

Temperature, pH, and dissolved oxygen content were lower in the tile drain samples than in the open ditch samples.

Metal concentrations were below problem levels. Nutrient concentrations were within normal ranges for an agricultural watershed and should not be a problem with respect to public use, although they were high enough to cause enrichment and possibly some undesirable biologic growth.

Concentrations of fecal coliform and fecal streptococci bacteria show some contamination from sewage effluent and animal wastes, but levels were not alarmingly high.

1/ Lye Creek Drain Stream Survey Report, IDNR, Division of Fish and Wildlife, September 1972.

2/ A Water-Quality Assessment Open-file Report of the Lye Creek Drain Watershed, Montgomery County, Indiana, USGS, Water Resources Division, Indianapolis, 1975.

Physical resources - cont'd

Evidence of chlordane and DDD (residual of DDT) and a significant concentration of dieldrin was found in bottom samples of Lye Creek Drain. These compounds persist long enough to enter the biological food chain.

Four aquifers as described below supply ground water to the watershed:

1. The central one-third of section 15 obtains water from Pleistocene sands and gravels associated with preglacial bedrock channels. Well depths range from 30 to 190 feet. Hardness is about 500 parts per million (ppm) $CaCO_3$ and iron content is 5 ppm.

2. The rest of the western third of the watershed gets water from Pleistocene sands and gravels found as sheet-like interbeds in glacial till. Well depths range from 15 to 100 feet. Hardness ranges from 200 to 375 ppm $CaCO_3$ and iron ranges from 1 to 7.5 ppm.

3. All of sections 11, 14, 23, and 26 and the western half of sections 12, 13 and 24 obtain water from limestone of Mississippian age. Well depths range from 40 to 185 feet. Hardness averages about 300 ppm $CaCO_3$ and iron varies from 0.8 to 2.5 ppm.

4. The eastern and southeastern parts of the watershed obtain water from siltstones and shales of Mississippian age. Well depths range from 30 to 300 feet. Hardness ranges from 200 to 450 ppm $CaCO_3$ and iron from 0.2 to over 7.5 ppm.

Yields in the first three aquifers are adequate for domestic and livestock use and often adequate for small municipal or industrial supplies. Yields in the shale and siltstone aquifer are erratic and range from totally inadequate up to adequate for small municipal and industrial use.[1/]

1/ Ground Water Resources of West-Central Indiana: Montgomery County: IDNR, Division of Water, Bulletin #27, 1965.

Physical resources - cont'd

The town of Linden, one mile northwest of the watershed, has a small municipal water supply system. Two wells drilled 97 feet into Pleistocene sands and gravels (#2 in the previous discussion) supply 619 people with 32,000 gallons per day. Hardness ranges from 220 to 275 ppm $CaCO_3$ and iron ranges from 0 to 2 mg/1.[1/]

Detailed analyses of ground water quality are tabulated in Exhibit 10.[1 & 2/]

1/ Data on Indiana Public Water Supplies: Indiana State Board of Health, Bulletin #S.E. 10, 1968.

2/ Ground Water Resources of West-Central Indiana: Montgomery County: IDNR, Division of Water, Bulletin #27, 1965.

WATERSHED RESOURCES-ENVIRONMENTAL SETTING

Present and projected population

The 1970 census shows the population of Montgomery County as 33,930, a 5.7 percent increase above the 1960 population. The rural population has increased 12.4 percent between 1960 and 1970. The watershed is located primarily in Madison township which had a 6.4 percent increase during the same period.

Area 059 as delineated by the Bureau of Economic Analysis, Department of Commerce, is comprised of Montgomery, Fountain, Warren, Benton, White, Carroll, Clinton and Tippecanoe Counties. The Office of Business Economics, Department of Commerce and the Economic Research Service, Department of Agriculture (OBERS) projections, prepared for the Water Resources Council, indicate the population for this area will about double from 1969 to 2020. Estimation for the project area was not attempted.

Economic resources

The watershed is agricultural, devoted to farming and associated uses. The agricultural area is under private ownership.

Cash grain is the major farm enterprise. There are 60 farms. Twenty-five are covered by cooperative agreement and have conservation plans with the Montgomery County Soil and Water Conservation District. The average size farm is 210 acres with the average farming unit being about 300 acres.

Corn is the major crop grown, comprising 75 percent of the cropland. Soybeans comprise 12 percent of the cropland, pasture is about 7 percent of the watershed. The average yield is 105 bushels per acre for corn and 30 for beans. The primary uses of the land with erosion, flood and drainage problems are corn and soybeans, with current yields of 72 and 23 bushels per acre, respectively.

Land values vary in the watershed. The average value of upland is $625 per acre, flood plain land is $500 per acre and areas with erosion and drainage problems are $475 per acre.

The Penn Central, Chicago and St. Louis, Norfolk and Western, and Monon Railroads furnish rail transportation for the farm products. Interstate Highway 74, U.S. Highways 136 and 231 and State Highways 43 and 47 furnish highway transportation and easy access to markets and service to the area. A good system of bituminous and all weather gravel roads provides easy access to these traffic arteries.

Unemployment is not a problem in the watershed. Many of the farms employ full-time hired help or seasonal part-time help. The net median farm income for Montgomery County in 1970 was $8,617.[1/] The portion of the county in which the watershed is located is slightly above the average in income.

1/ General, Social and Economic Characteristics, Table 137, U. S. Department of Commerce, 1970.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Plant and animal resources

The watershed contains approximately 87 percent cropland, 7 percent pasture, 1 percent forest land, and 5 percent other. Approximately 40 percent of the other is wildlife and recreation land. The cropland is used primarily for corn and soybeans.

Information compiled by the United States Forest Service indicates that present forest stands on the flood plain consist of 60 percent soft maple-ash, 20 percent river birch-cottonwood, and 20 percent walnut-ash. Other varieties observed in combination tracts are: Oak-hickory is dominant on the upland some beech along Lye Creek in the southern portion of the watershed; hackberry, black cherry, red mulberry, boxelder, and Osage orange along the channels, black walnut along lower Armentrout Tributary; black cherry, shagbark hickory, red oak, elm, ash, sycamore, cottonwood, American basswood, silver maple, beech, hackberry, boxelder, honey locust, white oak, redbud, Osage orange, American hornbeam, elderberry, Crataegus and dogwood were found along the two mile reach of Lye Creek and lower Lye Creek Drain.

The forest is all privately owned. The cover is limited and dispersed, occurring as small farm tracts or strips along channels. Wildlife habitat provided by the woody cover is limited but evenly distributed along channels. The existing vegetation provides important food and cover for wildlife. Livestock grazing has eliminated bank ground cover in certain areas exposing the soil to erosion.

The IDNR, Division of Fish and Wildlife census information shows populations of cottontail rabbit as very good; bobwhite quail as good; ringneck pheasant as fair to good; squirrel as good; and deer as none to light over most of the watershed.

White-tailed deer utilize the bottom woodland, and bobwhite quail are common in the grassy areas at the edge of woods and in the more open woods. Some of the open wooded habitat is suitable for woodcock. A high population of muskrats is found in the ditches.

Populations of aquatic wildlife are light due to the general lack of wetland habitat throughout most of the watershed. However, several small Type 1 wetlands are scattered in the wooded bottomland along the two miles of Lye Creek. 1/

The variety of non-game wildlife species such as songbirds and small mammals is restricted by the monoculture of row-crop agriculture in this small watershed. 2/ Some of the more common birds include the horned lark, meadowlark, killdeer, mourning dove, crow, English sparrow, cowbird,

1/ Wetlands of the United States, Circular 39, U.S. Department of the Interior.

2/ Monoculture in Agriculture: Extent, Causes, and Problems, A Task Force report published by USDA, October 1973.

Plant and animal resources - cont'd

grackle, and red-winged blackbird.[1/] Other game and non-game species of wildlife observed in limited favorable habitat are: black-bellied plover, starling, wood duck, woodcock, blue jay, field sparrow, song sparrow, white-throated sparrow, cardinal, chickadee, yellow-shafted flicker, red-bellied woodpecker, redheaded woodpecker, downy woodpecker, hairy woodpecker, robin, brown thrasher, mocking bird, catbird, rufous-sided towhee, yellowthroat, tufted titmouse, house wren, barn swallow, goldfinch, indigo bunting, eastern kingbird, kingfisher, northern waterthrush, ruby-crowned kinglet, kestrel, turkey vulture, great blue heron. The following hawks were identified: red-tailed, red-shouldered, broad-winged, harrier, and rough-legged. Less than 50 percent of the bird and lesser mammal species of Indiana commonly occur throughout this watershed.[2/]

The sport fishery in Lye Creek Drain is limited. The lower segment of the channel, downstream of county road 450E is used as a spawning area. Water quality in this reach is satisfactory for fish production with approximately 7 ppm dissolved oxygen and a pH of 8.[3/] The following is taken from the IDNR survey.

> "In September, 1972, personnel from IDNR, Division of Fish and Wildlife, investigated the fisheries resources of this stream. An area in the lower portion of the ditch was sampled. The upper watershed had not recovered from previous channelization to the point where it could maintain fish populations in low flow periods.
>
> The sample area was blocked off by 1/4 inch nets and treated with three parts per million "Pro-Nonfish" rotenone. The rotenone was detoxified at the lower net to prevent fish below the sample area from being affected.
>
> A total of 188 fish of 15 species were collected from the 150 foot station. The standing crop of fish in this area was estimated at 146 pounds per acre, of which 14.8 pounds per

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1/ American Wildlife and Plants by Martin, Zim and Nelson - 1951; and Audubon field check list for birds of Indiana.

2/ Distribution of the Mammals of Indiana: Russel E. Mumford, Indiana Academy of Science - 1969.

3/ Lye Creek Drain Stream Survey Report: IDNR, 1972.

Plant and animal resources - cont'd

acre were sport species. Sport fish collected included green sunfish, longear sunfish, white sucker, and yellow bullhead. The sport fishery in this stream was limited and did not appear to be utilized by anglers.

The ditch above the sample station had not regained the capability of sustaining a significant fish population in low flow periods, but it has recovered sufficient bank vegetation to maintain satisfactory water quality."

A high percentage of the 15 species found are forage type which are part of the food chain system supporting sports fisheries in Lye Creek and Sugar Creek. There are more than 225 miles of perennial streams supporting fisheries within Sugar Creek Basin. Of this total, only one mile of spawning area is located in the lower reaches of Lye Creek Drain.

Lye Creek Drain above Road 450 E may not support a year round fishery but it is utilized by fish in higher water periods in spring. Biologists have observed fish 4 to 5 inches long, both at the mouth of Durham Ditch and above it in Lye Creek Drain in late April 1974.

No rare or endangered species have been identified as being dependent upon habitat conditions in this watershed.

All the land within the watershed is privately owned and access to the existing resources is available only by permission of the landowner.

Recreational resources

The Linden Conservation Club, a private organization, has the only recreational area within the watershed. This area consists of a two acre lake for fishing. Other outdoor recreation activities of any significance in the watershed are quail hunting and rabbit hunting. There is very little or no fishing on Lye Creek Drain, however, some fishing occurs on Lye Creek within the watershed boundaries.

There are no potential areas identified for major recreational development within the watershed.[1/] However, individual recreation activities such as hunting for and collecting mushrooms, bird watching, hiking, nature study, and picnicking exist along Lye Creek.

1/ An Appraisal of Potentials for Outdoor Recreational Developments in Montgomery County, Indiana: Prepared by the Montgomery County Soil and Water Conservation District, 1968.

WATERSHED RESOURCES-ENVIRONMENTAL SETTING

Archaeological, historical and unique scenic resources

There are no entries for Montgomery County, Indiana in the National Register of Historic Places.[1/] The Indiana Guide to Historic Places lists several places of historic interest in the county. Most are buildings in Crawfordsville, and none are in the watershed.[2/]

The two-mile long section of Lye Creek which passes through the watershed is fairly well entrenched and has several stretches of scenic woodland along it. Purdue University's Darlington Woods Farm is within a mile of the watershed and is a scenic, well managed woodland along Lye Creek.

A sixty-acre remnant of wet prairie lies just south of the project area. Thirty acres of this area was burned to a depth of three feet during the drought of 1935 and is known as the Lye Creek Prairie Burn.

An archaeological study by the Indiana Historical Society was completed in July, 1974. Five sites were identified.[3/] All were located on higher elevations within the project, thus none should be affected by proposed works of improvement.

Investigations indicate that installation of the project will not encroach on any known archaeological values, any historic place or, any planning by the IDNR for historic preservation. However, if artifacts or other items of archaeological or historical significance are uncovered during construction, the state historic officer and the National Park Service will be notified.

Soil, water and plant management status

The present trend in land use is essentially stable with only a slight increase each year in cropland and woodland acreage with an accompanying decrease in pasture.

Adequate local funds are available for applying needed land treatment practices. There is a shortage of local contractors to apply conservation practices.

Approximately 415 acres of the 802 acres of muck soils used for cropland are protected from flooding by a continuous spoil bank along adjacent channels. The existing pump drainage system provides adequate drainage for part of the area. Additional protection and drainage are needed for efficient use of this area as cropland.

Approximately 7,791 cropland acres of mineral upland soil have an inherent drainage problem that has been partially corrected. Additional drainage is needed for most efficient use of this land as cropland.

1/ National Register of Historic Places: National Park Service, Feb. 1973.
2/ Indiana Guide to Historic Places: Indiana Department of Commerce, 1973.
3/ Archaeological Survey of the Lye Creek Drain Watedshed: Indiana Historical Society, 1974.

Soil, water and plant management status - cont'd

Soil loss on 2,431 acres of gently to moderately sloping cropland exceeds tolerable limits. This excess soil loss decreases the productivity of the land and increases production costs of crops. Adequate conservation practices should be applied to reduce average annual soil loss to a tolerable limit of 3.5 tons per acre.

The watershed is serviced by the Montgomery County Soil and Water Conservation District which is active in the preparation of conservation plans and application of land treatment measures by the landowners and operators. The status of land treatment within the watershed is shown on Table 1A.

Adequate forest fire protection is provided for the forest land by the IDNR, Division of Forestry in cooperation with the U.S. Forest Service through the Clarke-McNary Cooperative Forest Fire Control Program.

There are 60 farms in the watershed and 25 (41%) of the farms have conservation plans with the soil and water conservation district.

Acres and percentage by land use of land considered adequately treated are: 4,825 acres cropland, 43%; 429 acres pasture, 48%; 50 acres forest land, 36%; and 410 acres other, 60%. This represents 5,634 acres which comprises 43 percent of the total watershed.

The percentage of conservation practices needed in the watershed which are presently applied on the land are as follows:

Practice[1/]	Practice Unit	Percent Applied
Contour Farming	Ac.	(43%)
Grade Stabilization Structure	No.	(50%)
Grassed Waterway or Outlet	Ac.	(44%)
Conservation Cropping System	Ac.	(52%)
Minimum Tillage	Ac.	(64%)
Crop Residue Use	Ac.	(64%)
Subsurface Drains	Ft.	(90%)
Pasture and Hayland Planting	Ac.	(97%)
Pasture and Hayland Management	Ac.	(48%)

1/ See Exhibit 1 for definition of practices.

Soil, water and plant management status - cont'd

Cost-sharing for some conservation practices is available through the Agricultural Stabilization and Conservation Service which administers the Rural Environmental Conservation Program.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land and water management

Many areas of the watershed now under cultivation have soils with erosion problems and drainage limitations. The ability of these soils to sustain efficient production depends on the establishment and maintenance of needed conservation practices. (See Exhibit 2)

Muck soils, because of their low-lying positon in the topography and because they normally subside with removal of excess water, have an outlet problem for drainage. The muck area located just west of the Durham Ditch has a pump to provide an outlet for the tile system.

Flooding and drainage is a problem on approximately 3,320 acres in the watershed. The total area subject to overbank flooding is 1,330 acres.

Most severely affected within the water problem area are scattered surface depressions and low areas adjacent to inadequate channels. Damaging effects are expressed through impaired root and plant growth, increased disease, greater competition from weeds, reduced crop quality, and delayed field work. Low economic returns do not permit the landowners to apply management for top efficiency.

Overall economic capabilities of landowners and operators present no limitation to application of conservation practices. There is a need for additional conservation contractors; however, this factor is not expected to seriously delay implementation of needed practices.

There is a continuing need for information and education programs to effectively reach and motivate the landowners and operators who must carry out the land treatment measures.

There are 28 landowners affected by out-of-banks flooding. Floodwater damage is primarily caused by out-of-bank flows. Tile systems are made inoperative because the high water restricts the outlets.

The flood plain is used for agriculture only. Corn is the major crop that is grown on the flood plain, and soybeans is next in importance. Damages occurring on agricultural land include reduced yields of crops and pasture and increased costs of crop production.

Floodwater damage

In reach A on Rusk Ditch north of road 900N and Durham Ditch of reach B, flooding begins at about the 0.5 year frequency storm. In the remainder of reach A, flooding starts at about the 5 year frequency storm. In the remainder of reach B, flooding starts at about the 2 year frequency storm and on reach C flooding starts at about the 3 year frequency storm.

Floodwater damage - cont'd

Four reaches were used in the watershed. Reach A includes the upstream portion of Lye Creek Drain from road 800N, including the Rusk Ditch drainage area. This area contains 3,660 acres. Reach B is from the junction of Lye Creek and Lye Creek Drain upstream to road 800N and contains 4,545 acres. Reach C contains 1,785 acres and is the Armentrout Tributary. Lye Creek from the junction of Lye Creek Drain downstream to road 600N, including Armentrout Drain, comprises Reach D containing 3,045 acres. The following table shows the "without project" average annual flooded acres and damage by reach:

Reach	Acres	Damage
A	220	$1,640
B	270	5,820
C	20	360
D	350	3,030

A flood that occurs once in 50 years would affect about 1,300 acres and cause approximately $23,100 damage, while a two-year flood would affect 420 acres and cause approximately $6,400 damage.

Fifty-three percent of the floods occur during the cropping season.

Erosion damages

Most erosion damages are attributable to sheet erosion on 2,431 acres of cropland or 19 percent of the watershed. Average loss on these acres is 5.68 tons/acre/year. The average tolerable limit is 3.57 tons/acre/year.

Present average sheet erosion rates in tons/acre/year for each land use are shown below:

Cropland	Pasture	Forest Land	Other	Watershed
1.22	0.05	0.53	0.79	1.11

Soil loss from gully erosion is estimated at five percent of the sheet erosion soil loss. Streambank, streambed, and flood plain erosion losses are estimated at ten percent of the sheet erosion soil loss. All other erosion losses are estimated at five percent of the sheet erosion soil loss.

The area with erosion problems is limited. Although sheet erosion is significant in small, local areas, it is not a detriment to most of the cropland within the watershed. Wind erosion on muck soils is minor.

The major soil erosion areas are scattered throughout the Miami-Russell-Fincastle soil association. This association extends through the central portion of the watershed running north and south with a small area on both the east and west side (Exhibit 7C).

WATER AND RELATED LAND RESOURCE PROBLEMS

Sediment damages

Sediment yields are low and ditch flow is intermittent; however, over a period of time some sediment has accumulated in the lower gradient channels at ditch junctions. This is not a major problem and is insignificant when compared to flooding and drainage damages.

The average annual sediment yield from Lye Creek Drain (9,991 acres) is estimated at 1,725 tons/year. The sediment contributed by the entire Lye Creek Drain Watershed (13,035 acres) to Lye Creek is 2,505 tons/year.

Joint problems (flooding and drainage)

Agricultural drainage problems exist because of shallow channel depths and lack of channel capacity. Open and closed drains are restricted during flood events. The most significant problems are recurring patterns of drainage impairment and flooding occurring throughout the growing season. Damaging effects are expressed through impaired root and plant growth, increased disease, greater competition from weeds, reduced crop quality and delayed field work. Reach A contains 1,490 acres with joint problems Reach B, 1,240 acres, and Reach C, 590 acres. Costs of production are driven upward and yields downward; consequently fewer inputs such as management, maintenance, and labor and materials are applied to this area. Average annual yields in the area fffected by poor drainage outlets are reduced by an estimated 30 bushels per acre for corn and 10 bushels per acre for soybeans

Adequate drainage is a need long recognized by local landowners. The entire system of drainage ditches was completed about 50 years ago. Successive attempts by individuals to keep their ditches cleaned out have been made since then in order to maintain an adequate outlet for the installed tile systems.

The lack of adequate outlets on Lye Creek Drain, Rusk Ditch, Durham Ditch and Armentrout Tributary and lack of maintenance on existing channels has resulted in the deterioration of a large portion of these drains. Drains are now inadequate either for passage of floodwater or to serve as suitable drainage outlets. Additional depth and capacity are needed to provide adequate outlets on Lye Creek Drain and its three tributaries.

Tile and surface drainage systems (field ditches, grass waterways). are needed to alleviate drainage problems.

The principal soils in the drainage problem areas are Westland, Mahalasville, Brookston and muck soils.

WATER AND RELATED LAND RESOURCE PROBLEMS

Recreation problems

Water quality and sediment are not significant problems in the stream or ponds having recreation potential in the watershed. Hunting and fishing with the landowners permission, are the only activities available to the general public in the watershed.

The watershed is in the Bureau of Economic Analysis Area 059. OBERS population projection for this area in the year 2000 is 288,800 compared to 249,412 in 1969.

There has been very little interest shown by the local people in developing recreational resources.

Plant and animal problems

The original vegetation for the area was primarily trees. The remaining one percent forest land and two percent wildlife and recreation land provides very limited permanent cover for wildlife. An improved balance of land use to provide fish and wildlife habitat is desirable.

The forest land ownership pattern is small and scattered, averaging seven acres per landowner. Erosion and sediment yeilds are minimal. The primary problem is bringing forest land under management.

Flood damages to forest land and fish and wildlife are too small to quantify. The water quality in the streams is good except for small quantities of agricultural sediment and chemicals (See Watershed Resources - Environmental Setting - Physical Resources).

Water quality problems

Water quality is generally good, although fertilizers and insecticides are potential problems. A detailed account of water-quality is presented in the Watershed Resources-Environmental Setting, Physical Resources section.

WATER AND RELATED LAND RESOURCE PROBLEMS

Economic and social problems

The net median income per family in Montgomery County for 1970 was $9,531. The net median income per family for the state of Indiana in 1969 was $9,970.1/ The net median income for all farms in the county was $8,617, and for the state was $8,198.

The watershed is not considered an economically depressed area.

Unemployment is not a problem. The farms in the watershed are family farms. Approximately 20 percent of the farmers use hired help or seasonal part-time help.

1/ General, Social and Economic Characteristics, U.S. Department of Commerce, 1970

PROJECTS OF OTHER AGENCIES

The Corps of Engineers, Louisville District, studied a multiple purpose reservoir on Sugar Creek, located about three miles downstream from the confluence of Lye Creek with Sugar Creek. This structure, if installed, would cause a backwater condition during flood stage into reaches B and D.

In an announcement dated April 17, 1974, the Crops stated that studies indicated the structure to be not economically feasible.

There are no other water resource development projects in operation, or being considered by other agencies or groups that would affect or be affected by the installation of measures proposed in this work plan.

The Lye Creek Drain Watershed project is being considered for inclusion in the Wabash Basin part of the Comprehensive Coordinated Joint Plan (CCJP) being developed by the Ohio River Basin Commission. Adoption of the project as part of the CCJP is expected prior to the completion of the Final Work Plan and Environmental Impact Statement.

PROJECT FORMULATION

The original application was approved for the Armentrout Dredge Ditch by IDNR on June 15, 1965. The watershed area was 7,040 acres.

The Montgomery County Soil and Water Conservation District passed a resolution on July 9, 1968 requesting that the name of the watershed be changed to Lye Creek Drain Watershed so that the name would be consistent with the records of the Montgomery County Surveyor's office.

During preliminary investigations, the determination was made that the application should be amended to include about two miles of Lye Creek downstream of the junction of Lye Creek Drain and Lye Creek. At the time it was believed that work would have to be performed on Lye Creek to provide a satisfactory gravity outlet for the then Lye Creek Drain Watershed. The amended application was approved by the IDNR on March 1, 1971. The watershed area was enlarged to the present size of 13,035 acres.

Major considerations for formulation stated in the original application were reduction of flood and drainage damages and control of erosion.

The first meeting of the steering committee and the planning staff was on April 26, 1968. Hydraulic consideration (gravity outlet vs. pumping) and discussion about the appropriate sponsor to carry out the structural works of improvement were the main topics of discussion. Another meeting was held between the steering committee and the planning staff on June 5, 1968, before completion of the Preliminary Investigation Report.

The Preliminary Investigation Report was completed in June, 1968. This report recommended structural measures that are essentially those in this work plan. However, it also included 2.35 miles of channel work on Lye Creek that was subsequently eliminated from the work plan. A meeting to discuss the report findings with the steering committee was held on September 16, 1968.

USDA authorization for planning was received in November, 1971. During planning, meetings were conducted with the Montgomery County Drainage Board on October 15, 1973 and February 25, 1974 to review plan formulation.

Biology field reviews were carried out in the watershed in March, 1972 and November, 1973. Representatives of the U. S. Fish and Wildlife Service; Division of Fish and Wildlife; and the Soil Conservation Service participated in these reviews.

PROJECT FORMULATION

The watershed is within the Lye Creek Watershed drainage area, which in turn, lies within the Wabash River Basin.

The entire Lye Creek Watershed (SC-14) was recommended for early action installation in the Type II Wabash River Basin Comprehensive Study.[1/] The structural measures proposed for the watershed were 42.9 miles of channel work.

Objectives

The project sponsors expressed as objectives for development in the Lye Creek Drain Watershed the following items: 1) reduce flood damages, 2) improve drainage, 3) control erosion and sedimentation, 4) maintain and enhance where possible, environmental values.

The soil and water conservation district will encourage landowners to install good vegetative treatment and improve farming methods for erosion and water runoff control. Their goal is to have at least 10,706 acres (82 percent) of the watershed area adequately treated by the end of the project installation period. Adequate land treatment will reduce soil loss on eroding cropland from approximately 5.7 to 3.2 tons per acre per year. This is below the tolerable limit of 3.5 tons per acre per year consistent with sustained agricultural production.

Another goal of the sponsors is to provide for the safe and timely removal of excess water from flood plain and depressional areas. The opportunity for subsurface water removal for all areas in need is also desired as a part of project works of improvement. Water removal within a 24 hour period is the general objective of the sponsors.

The primary concern of residents along the major channels is to reduce flooding.

The sponsors recognize the value of conserving fish and wildlife resources consistent with proper use of soil and water resources. Their objective is to retain and enhance as much habitat as possible. The management, improvement and increase of forest land acreage for wildlife habitat and aesthetic values will be accomplished whenever possible.

Environmental considerations

The Preliminary Investigation Report included channel work on Lye Creek (Reach D), primarily to provide a gravity outlet for the work to be done on Lye Creek Drain and its tributaties. More detailed survey data collected during Work Plan development indicated that channel work on Lye Creek was not necessary to provide a gravity outlet, although a slight increase in stage would result on Lye Creek. By eliminating the work on Lye Creek, it was possible to allow the environmental values along Lye Creek to remain intact.

1/ Wabash River Basin Comprehensive Study, Vol. X, Appendix H, Agriculture, June 1971.

Environmental considerations - cont'd

Consideration was given to the fish and wildlife habitat changes that would take place because of the project. Channel work will be done from one side where possible to minimize the amount of existing habitat that will be disturbed. Construction sediment will be controlled by using sediment traps and approved methods of equipment operation. The fish and wildlife habitat destroyed will be re-established using planting and fishery development measures.

Alternatives

The following alternatives were considered:

1) One alternative would be the installation of the planned conservation land treatment only. This alternative would have the same beneficial effect in the upland areas as the proposed plan. Sediment contribution to Lye Creek would be reduced by 41 percent. The installation costs would be $34,770.

2) Pumping was studied as an alternative to a complete channel system. Approximately 8.2 miles of channel work would still be required and also levees in some reaches. The channel work would be eliminated on the lower end of Lye Creek Drain where a spawning area has been identified. The other environmental impacts and benefits would be similar to the planned project. The average annual cost is estimated to be $48,080.

3) Nonstructural measures to reduce flood damages were studied as an alternative. The flood plain acreage is agricultural land with no buildings. A method of flood plain management would be to convert 230 acres of cropland, that is now flooded on the average of one time every two years, to a less intensive agricultural use. Portions of Reaches A and C and all of Reach B would be converted. As a part of this alternative, channel work would still be required in Reaches A and C to retain the drainage benefits.

   The environmental effects of this alternative would be to eliminate adverse effects and have favorable environmental effects due to the cropland conversion in Reach B. The impacts in Reaches A and C would remain the same.

   The channel work in Reaches A and C would retain approximately $19,500 of drainage benefits. The average annual net return foregone by converting cropland to pasture would be approximately $16,000. The average annual cost is estimated to be $22,400.

Alternatives - cont'd

4) Another alternative would be "no PL-566 project--no local action." The on-going land treatment program will in time also reduce sediment contribution to Lye Creek by 41 percent. Floodwater and drainage damages will increase over present condition. The estimated net annual monetary benefits that would be foregone by not implementing the planned project are $23,020.

However, drainage and flooding relief have been a concern of the local people for many years. It is likely that they would attempt to obtain relief through other means. Group projects or work through the county drainage board would be logical approaches. Channel work or on-farm pumping systems could be used to obtain some relief, although any program implemented by the local people would likely not give as full consideration to environmental criteria as the planned PL-566 project.

The planned project was selected because it provided significant drainage and floodwater benefits with relatively minor adverse environmental impacts. The level of protection afforded is consistent with the present land usage. The land treatment program affords the necessary watershed protection to bring the watershed under tolerable soil loss limits.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land treatment measures

The application of soil and water conservation practices will reduce soil loss from erosion, promote the proper use of soil and water resources, and provide lower maintenance costs for the planned structural measures.

The land treatment measures to be installed during the project installation period includes conservation practices on 4,545 acres of cropland, 243 acres of pasture, and 68 acres of forest land. Adequate land treatment will be achieved on 5,072 acres or 39 percent of the total watershed during the four-year installation period.

Conservation practices to be applied on cropland include contour farming, grassed waterway or outlet, minimum tillage, crop residue use, grade stabilization structure, subsurface drain, and drainage main or lateral. A combination of two or more practices is often needed to achieve adequate treatment of land. Land treatement practices such as waterways, diversions, pasture planting and management, tree planting, critical area planting and rotation of grazing will benefit wildlife. Forestation planting, forest land treatment, and forest protection will not only provide enhanced soil protection but these practices will also benefit the forest based economy of the surrounding area. The SCS Technical Guide will be used in planning alternatives for adequate land treatment.

Pasture land treatment measures to be installed include pasture and hayland planting and pasture and hayland management.

Forest land treatment measures to be installed are: tree planting on open land, where necessary to control erosion, establishing windbreaks and adjusting land capability throughout the watershed. Adapted species for planting will be recommended by IDNR, Division of Forestry in cooperation with the U.S. Forest Service. Hydrologic conditions will be improved by manipulation of stand composition, protection from grazing, and developing management plans. The multiple-use forest land treatment program was cooperatively developed by the IDNR, Divison of Forestry and the U.S. Forest Service.

The sponsors estimate that 15 additional landowners or operators will become cooperators with the soil and water conservation district and develop conservation plans during the project installation period.

A soil survey was published for Montgomery County in 1912, however, much of this data is now obsolete and in need of revision. At present, a modern soil survey has been completed on 6,000 acres in the watershed. Plans are to complete an additonal 5,000 acres in the watershed during the next four years.

Land treatment measures - cont'd

The SCS will provide the needed technical assistance for soil surveys, conservation planning and application of conservation practices. Land treatment will consist of voluntary actions taken by individual landowners or operators.

Structural measures

The structural measures included in the plan consist of approximately 11.3 miles of multiple purpose flood prevention and drainage channel work as shown on the project map (Exhibit 11). The existing channels are man-made or previously modified with remnants of spoil present along the total length. The channels have intermittent flow. Sediment deposition has reduced the capacity of the channels and tile outlets. Woody vegetation is also restricting flow in most of the channels. A narrow band of trees and woody vegetation separates the channels from cropland. A small wooded tract borders the channel on the north side upstream of the outlet in Reach B. The last downstream mile of Lye Creek Drain has been identified as a fish spawning area.

The channel work will deepen the existing channel for drainage and also widen it where additional capacity is required. Channel work is planned to follow existing alignment. Excavation will be done from one side to reduce damage to wildlife habitat (Exhibit 3). Significant trees will be left standing on the constructed side if at all practicable. In isolated cases where slope protection is required on the opposite bank, work may be done from both sides. All flow impeding brush and unstable or fallen trees will be removed from both banks. Removal will be carried out from the side designated for spoil. Armor plating (gravel blanket) will be used to protect unstable soils on the bottom and sides of the channel. Preliminary investigation indicates that armor plating will be needed in the following areas: Armentrout Tributary, stations 1156+00 to 1150+00, station 1105+00 to 1115+00, station 1060+00 to 1070+00, and station 1046+00 to 1040+00; Rusk Ditch, station 923+00 to 909+50 and station 850 to 860; Main channel, station 1025+00 to 985+00, station 959+24 to 965+00, and station 903+00 to 847+00. The berm will be used as a maintenance travelway. A 15 foot vegetated buffer strip will be maintained on the unconstructed side to protect the channel from farming operations and also serve as a travel lane for wildlife.

Fence will be installed to protect vegetative cover where there is potential for livestock use of the area adjacent to the channel. Markers will be used to delineate the boundaries of wildlife plantings and vegetative buffer strips (Exhibit 4). Openings will be left in the spoil to avoid induced stages on the unconstructed side. Appurtenances are planned for all reaches to safely lower surface water into the channels. All existing tile outlets disturbed by construction will be replaced.

Structural measures - cont'd

Work, as necessary, will take place on the unconstructed side to install appurtenances. Care will be taken to minimize the disturbance of wildlife habitat.

Work will be limited between stations 903+00 and 959+24 to removal of debris. The work will not affect the stability of the channel.

An existing continuous spoil bank on the south side of Lye Creek Drain and the west side of Durham Ditch will be repaired to give additional protection to the muck area that is presently being pumped for drainage.

Care will be exercised to minimize the amount of construction sediment. Sediment traps will be installed as needed. Cleared material will be buried or disposed of by other acceptable means.

Land rights will consist of approximately 124 acres of permanent easements and 124 acres of temporary easements. The permanent easement area consists of approximately 35 acres of channel area, 22 acres of woody vegetation, 30 acres of cropland, and 37 acres of grassland. As a result of this project, the permanent easement area will consist of 43 acres of channel area, 23 acres of woody vegetation, and 58 acres of grassland. The temporary easement area will be in cropland. These areas will not be available to the public without the permission of the landowner.

Woody vegetation will be established and maintained within the permanent easement area to mitigate approximately 15 acres of woody wildlife habitat destroyed by the structural improvements. A strip of trees and shrubs approximately 15 feet in width will be planted within the permanent easement on the 21 acre spoil area. The vegetated buffer strip on the unconstructed side of the channel, within the permanent easement, will include eight acres of existing woody material and 13 acres that can be utilized for wildlife habitat. Approximately 58 acres of grasses and legumes will be seeded on the disturbed areas within the permanent easement.

Construction will be on the south side of Lye Creek Drain below county road 450E. Fast growing species of trees will be planted to provide shade for the fishery. Six fish pools will be installed in this reach to mitigate the construction damage to fisheries. Deflectors will be placed at the upstream end of each pool to maintain depth by concentrating the flow of water (Exhibit 5).

Condensed profiles of the planned channel work are attached as Exhibit 6.

Structural measures - cont'd

A wide variety of materials will be encountered during construction because of the complexity of the geologic history of the area. A general description of materials, by reach, is tabulated below:

Lye Creek Drain - A	
Station 847+00 to 903+00	1-3.5' of organic topsoil and muck over mostly till, but with some thin sandy outwash lenses.
903+00 to 959+24	1.5-4.5' of muck over mostly till, but with some thin sandy outwash lenses.
Lye Creek Drain - B	
Station 959+24 to 1036+18	1.5-2.5' of organic topsoil and muck over mostly till, but with some thin sandy outwash lenses.
1036+18 to 1098+00	1.5-3.0' of muck over mostly till, but with some thin sandy outwash lenses.
1098+00 to 1158+00	1.5-6.5' of muck over variable till and sandy outwash
1158+00 to 1172+00	1.0-2.0' of organic topsoil and muck over variable till and sandy outwash.
Rusk Ditch - A	
Station 826+30 to 909+50	1.0-6.0' of organic topsoil and muck over variable till and sandy outwash.
909+50 to 923+00	2.0' of muck over variable till and sandy outwash.
Durham Ditch - B	
Station 1017+50 to 1077+00	2.0-6.5' of muck and lacustrine clay over till, no outwash.
Armentrout Tributary - C	
Station 1040+00 to 1156+00	Up to 6.1' of organic topsoil and muck over till, no outwash.

The channel work data is displayed in Table 3.

EXPLANATION OF INSTALLATION COSTS

The costs of installing the land treatment measures are summarized in Table 1. Estimated total cost for technical assistance is $7,900 of which $7,000 will be paid from Soil Conservation Service funds (PL-566 - $3,350) and $900 from Forest Service funds. Landowners and operators will spend an estimated $26,870 for measures installed on their lands.

The estimated schedule of PL-566 and other obligations for installation for the land treatment is indicated as follows:

FISCAL YEAR	PL-566	OTHER FUNDS
1st	$830	$7,850
2nd	830	7,850
3rd	830	7,860
4th	860	7,860
TOTAL	$3,350	$31,420

Installation costs for structural measures to be borne by PL-566 and other funds are shown by cost account category in Table 2 and in summary form in Table 1. Such costs include the expense of construction, engineering, land rights, and project administration.

Construction cost is the estimated contract cost for constructing structural measures. It includes all materials, labor, and machinery involved in construction (including mitigation measures). A contingency is added to the estimated contract cost for all works of improvement to defray any unexpected cost that may occur during construction.

Engineering cost is the cost for preparing construction plans for the structural measures. These costs include the direct cost of engineers, geologists, and technicians for construction surveys and investigations, soil and foundation drilling and testing, design and preparation of construction plans and specifications.

Land rights costs include all expenditures for acquisition of land rights or their value as estimated by the local organization. Also included are all appraisals, legal fees and surveys associated with acquisition of land rights.

Relocation payments are applicable to a displaced person, business, or farm operation. Such payments include compensation for moving and other related expenses incident to relocation as well as financial assistance for replacement housing for a displaced person who qualifies and whose dwelling is required because of the project. No displacement of any person, business or farm operation is expected.

Project administration costs are the PL-566 and Other administrative costs associated with the installation of the works of improvement. Included are the costs for contract administration, review of engineering plans prepared by others, government representatives, construction inspection necessary to insure the installation of structural measures in accordance with plans and specifications, and relocation assistance advisory services.

Cost Allocation. The cost of the multiple purpose channel was allocated equally to flood prevention and drainage. Public Law 566 will pay 100 percent of the construction costs allocated to flood prevention and 36 percent ot the construction costs allocated to drainage.

All engineering costs will be borne entirely with PL-566 funds.

All land rights costs will be borne entirely with Other funds.

Relocation payment costs, if needed, will be shared in accordance with the ratio of PL-566 funds and Other funds to Total Project Costs as shown on Table 1, exclusive of relocation payment costs. This cost share percentage is 61.6 percent PL-566 and 38.4 percent Other funds.

All project administration costs, including relocation advisory assistance services, incurred by the sponsoring local organization will be paid without PL-566 cost sharing. The Service will bear the costs of project administration they incur.

The estimated schedule of PL-566 and Other funds for installation of the structural measures without project administration cost is indicated as follows:

FISCAL YEAR	PL-566	OTHER FUNDS
1st	$ 10,179	$ 36,829
2nd	126,129	71,041
3rd	46,764	17,408
4th	80,821	34,924
TOTAL	$263,898	$160,202

EFFECTS OF WORKS OF IMPROVEMENT

Conservation land treatment

Effects atrributable to conservation land treatment measures will be realized throughout the watershed. Such effects accrue on site and are evidenced through increased efficiency in the use of cropland, pasture, forest land, and other land.

The application of land treatment measures will bring an additional 5,072 acres under adequate treatment. Conservation practices to be applied to cropland are contour farming, grassed waterways, grade stabilization structures, conservation cropping systems, crop residue management, and minimum tillage. These practices will reduce erosion through interception of rainfall and reduction of runoff and stabilization of drainageways. Reducing sheet erosion will permit inherent and applied fertility to be maintained. The use of conservation cropping systems, including minimum tillage, will provide improved plant growth through improvement of soil characteristics. The combined effects of these practices will reduce average annual soil loss on 2,431 acres of cropland from 5.7 tons/acre/year to 3.2 tons/acre/year. This rate is below the tolerable amount of 3.5.

These practices reduce erosion and sedimentation by 41 percent and decrease the watershed's contribution of sediment to Lye Creek from 2,505 tons/year (2.30 acre-feet/year) to 1,485 tons/year (1.36 acre-feet/year). The reduction in sediment yield combined with better agronomic management and less intense crop rotations will reduce the nutrient content of the runoff waters.

Removal of surplus water through installation of subsurface drains, drainage field ditches, and drainage mains or laterals will enhance growth on 3,272 acres of cropland with a wetness limitation. Reduced costs, improved crop quality, and increased yeilds will increase the efficiency for the farm enterprise.

Pasture management practices to be applied on 243 acres will improve the overall quality and productivity of pasture areas. Such areas, when properly treated and managed, complement the overall farm operation, contributing significantly to farm income with a minimum of erosion.

Forest land treatment measures to be applied to 68 acres will improve the overall hydrologic condition of the watershed. Creation of a good humus layer in these areas will reduce runoff and erosion. Approved cultural operations and livestock exclusion from forest land will improve the quality of future forest land production as well as increase the overall quantity of production.

Conservation land treatment - cont'd

Many species of wildlife will benefit from vegetative land treatment measures that contribute to the quality and quantity of wildlife habitat. Some of these are: waterways, diversions, pasture, tree planting, critical area planting and protection from grazing.1/

Projected land use changes, in acres, as a result of such factors as increased crop production, trends in land use, improved watershed protection and changes in farm management are shown below:

	Cropland	Pasture	Forest Land	Other Land
Present	11,315	891	129	700
Future	11,594	737	141	563
Change	+ 279	- 154	+ 12	- 137

Structural measures

Joint floodwater-drainage problems occur throughout Reaches A, B, and C. Benefits will be obtained by removing surplus surface and subsurface water. Many tile drains currently operating unsatisfactorily because of poor outlet conditions will become operational. Farming operations will proceed on a timely basis. A total of 3,320 acres will benefit from joint floodwater-drainage relief. Approximately 50 farming operation units will benefit from the project.

The planned channel work will provide average annual floodwater damage reduction of approximately 84 percent.

The channel work will widen and deepen approximately 10.2 miles of intermittent, manmade channels. The deepening for drainage will have a minor impact on the watertable level immediately adjacent to the channel. An additional 1.1 miles of channel work will be done to remove debris only.

1/ Reference--Wildlife Response to Selected Conservation Practices, Biology Technical Note No. 6, Soil Conservation Service.

EFFECTS OF WORKS OF IMPROVEMENT

Structural measures - cont'd

A summary comparison of flooded areas without and with the project is presented below:

Reach	Without or With Project	(Flood Frequency)1/ 100 yrs.	5 yr.	2 yr.
A	WOP	340AC.	167Ac.	63 Ac.
	WP	215	48	28
B	WOP	725	334	212
	WP	325	124	30
C	WOP	78	27	9
	WP	63	13	---
D	WOP	186	169	159
	WP	188	172	163

The increased flooding in Reach D as shown in the above table is considered minor. The additional area involved is estimated at 2 to 4 acres throughout the frequency range. Also, the increase in flow depth is estimated to be one-tenth of a foot.

The fishery, downstream of county road 450E, will be damaged during installation of the planned channel by construction-related sediment, disturbance of established streambed, and removal of woody growth on the south side of the channel. The removal of shade will result in an increase in water temperature.

The six fishery pools and deflectors to be installed in the same area will be installed downstream of road 450E to offset the damage to fishery habitat.

The planned channel work will destroy approximately 15 acres of woody habitat along the present channels. Approximately 21 acres of trees and shrubs will be planted on the spoil bank to mitigate the 15 acres destroyed. An additional eight acres of existing woody habitat and 13 acres of idle land suitable for wildlife habitat will be protected within the permanent easement on the unconstructed side of the channel.

All disturbed land within the permanent easement area, about 58 acres, will be seeded with a grass and legume mixture to provide herbaceous cover for wildlife.

Construction activity will create some sediment in the channel. Sediment traps and approved methods of construction will minimize sediment damage.

1/ A flood frequency of 100 years means that in any one year there is a one percent chance of this size flood or larger occurring.

Structural measures - cont'd

The USGS water quality report identified concentrations of chlordane, DDD, and dieldrin in the ditch bottom of Lye Creek Drain. These pesticides are attached to soil particles as a normal chemical reaction. Therefore, most of these contaminats will be removed and spread as spoil during excavation. The sediment particles agitated into suspension during construction will settle in sediment traps which will be installed as part of and preceding construction activities. The spoil will be stabilized by adequate vegetation directly following construction. Water quality specialists from the Environmental Protection Agency and the Soil Conservation Service are not aware of any research data concerning plant uptake of these pesticides. However, they believe that the amount of contaminats entering the food chain system would be insignificant.

The proposed design of the channel will provide for improved bank stability. Noise and air pollution will increase during construction.

During the period of construction, approximately 16 man-years of labor will be required for the installation. During the life of the project, about 0.7 man-years will be required annually for the operations and mainteance.

The quality of living for the beneficiaries of the project should be improved because of the benefits realized from the project. The average benefit for 50 farm units will be approximately $1,100 annually.

Secondary effects generated by the project will be through increased demands on local suppliers of goods and services and on local processing, transporting and marketing facilities.

PROJECT BENEFITS

Total average annual benefits are estimated to be $54,480 (Table 6). This total includes flood damage reduction benefits of $6,760, (Table 5) more intensive land use benefits of $19,840, agriculture water management (drainage) benefits of $17,700 and local secondary benefits of $10,180.

Flood damage reduction benefits will be realized as a result of reduced flood damages to cropland and pasture. Joint benefits accrue on cropland as a result of project measures which alleviate problems caused by floodwater and impaired drainage.

Only those secondary benefits generated by the project through increased demands on local suppliers of goods and services and on local processing, transporting and marketing facilities were evaluated. Benefits accruing through an enhancement of the overall environment of the watershed area, although significant locally, were not evaluated. Benefits of a secondary nature from a national viewpoint were not considered pertinent, and were therefore not evaluated.

COMPARISON OF BENEFITS AND COSTS

Average annual costs, benefits, and comparison of benefits and costs are shown in Tables 4 and 6. The ratio of average annual benefits, excluding secondary benefits, of $44,300 to average annual cost of $31,460 is 1.4 to 1. The ratio of benefits to costs is $54,480 to $31,460 or 1.7 to 1.

PROJECT INSTALLATION

Land treatment measures

The Montgomery County Soil and Water Conservation District will assume the responsibility for the application of the land treatment measures. The measures will be installed by private landowners and operators within a four-year period. The SCS will provide personnel to assist the district in providing landowners and operators technical assistance to develop conservation plans and to install planned practices. Technical assistance for the forest land measures will be furnished by the IDNR, Division of Forestry, in cooperation with the U.S. Forest Service.

Structural measures

All works of improvement will be installed within a four-year period. Land rights will be the legal right-of-way provided to the Drainage Board by the Indiana Drainage Code. Construction plans and specifications for contracting will be completed after land rights are secured. Mitigation measures are considered construction costs and will be a part of each construction contract. In order to make efficient use of personnel and to realize the most benefit from the structural measures, the works of improvement will be installed in the following yearly sequence:

1st	No construction
2nd	Lye Creek Drain - Reach B Durham Ditch - Reach B
3rd	Armentrout Tributary - Reach C
4th	Lye Creek Drain - Reach A Rusk Ditch - Reach A

The Montgomery County Drainage Board is the sponsoring local organization that will carry out the works of improvement. The Indiana Drainage Code includes provisions of a right-of-way of 75 feet from each bank on legal drains. This is sufficient for construction, operations and maintenance. The Drainage Board will perform the contract administration during construction. This will require development of a financial management system which shall provide for the maintenance of appropriate records, reports, audits and accounts needed to satisfy the requirements of OMB Circular A-102.

The SCS, under authority of PL-566, will be responsible for all phases of installation of works of improvement except land rights and project administration assigned to the sponsors.

Structural measures - cont'd

As a part of project administration, the sponsor will provide such relocation assistance advisory services as may be needed in connection with the relocation of displaced persons, businesses, or farm operation. There are no anticipated relocations involved in the project.

An interdisciplinary team comprised of representatives from the Indiana Department of Natural Resources, U.S. Fish and Wildlife Service, landowners and sponsors, and the SCS will participate in the development of design plans and specifications and operation and maintenance procedures. These cooperatively developed plans and specifications will be adhered to unless determined inappropriate during construction; however, all members of the team will be provided the opportunity to develop the necessary revisions.

All plans and specifications will be submitted to the Indiana Natural Resources Commission for its consideration and approval prior to construction.

FINANCING PROJECT INSTALLATION

Federal financial assistance for carrying out the works of improvement set forth in this work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (PL-566, 83d Congress, 68 Stat. 666) as amended. Federal financial assistance is contingent on the appropriation of funds to carry out this plan.

Land treatment measures

Technical assistance for installation of all accelerated land treatment for which the Soil Conservation Service has responsibility will be provided with PL-566 funds. Any cost-sharing for installation of approved land treatment measures will be provided through the Rural Environmental Conservation Program (RECP), administered by the Agricultural Stabilization and Conservation Service, or by other funds as might be appropriated by Congress. Technical assistance for forest land treatment measures will be provided by the IDNR, Division of Forestry through the going Cooperative Forest Management Program or Cooperative Forestry Program.

Structural measures

To cover their portion of the installation costs, the Drainage Board intends to levy one assessment against the watershed landowners. The landowners will reimburse the Drainage Board by either one payment or by installment payments over a five year period.

The Drainage Board is responsible for the following installation costs:

1. 100% of the land rights - est. $46,250
2. 32% of the construction costs - est. $113,950
3. Project administration costs - est. $10,690

Invitations to bid on the construction of planned structural measures will be issued after the project agreements are executed. These agreements will be executed when the following conditions have been met: 1) PL-566 funds have been appropriated; 2) the Drainage Board has funds available and is prepared to fulfill its responsibilities; 3) necessary land rights for construction and mitigation have been obtained; 4) construction plans and specifications have been prepared and approved as required; and 5) operation and maintenance agreements have been executed.

In accordance with OMB Circular A-102, the Drainage Board will account to the Service certain earned income during the grant period.

For this purpose, the grant period shall extend from the effective date of the Service's fund obligating agreement until the date on which the Service formally notifies the sponsors that the undertaking has been satisfactorily completed.

Program income may include, but is not limited to, income from service fees, usage, or rental fees and sale of assets purchased with Federal funds under a Service-fund agreement.

PROVISIONS FOR OPERATIONS AND MAINTENANCE

Land treatment measures

The land treatment measures will be operated and maintained by the owners and operators of the farms under agreement with the Montgomery County Soil and Water Conservation District. Technical assistance will be provided by the Soil Conservation Service.

Forest land treatment measures will be maintained by the landowners with technical assistance furnished by the Indiana Department of Natural Resources in cooperation with the U.S. Forest Service under the going Cooperative Forestry Program or Cooperative Forest Management Program.

Structural measures

Operations and maintenance costs include all necessary expenditures after installation to realize the estimated benefits during the 100 year project evaluation period.

The Drainage Board will assume responsibility of the operations and maintenance of all structural measures including measures for fish and wildlife. This work will consist of such items as controlling adverse vegetative growth and removing debris and/or excavation of shoal deposits as required to reduce serious bank erosion and maintain the design channel capactiy. Markers or vegetation which have been damaged accidentally or deliberately, will be replaced or protected by the project sponsors. Additional items may be: repair of critical areas by seeding, sodding, or placement of stone or riprap; repair or replacement of appurtenances; and protection of mitigation measures within the permanent easement areas. Operating agreements will include provisions as indicated in the revegetation and fish pool development plan. Total estimated operation and maintenance will cost $3,680 annually (Table 4, footnote 3). Operations and maintenance activities will be conducted in a manner to minimize adverse environmental effects. State and federal agency restrictions on pesticides will be recognized when providing maintenance on project rights-of-way.

An "establishment period" is prescribed to allow time for latent defects to become apparent. The establishment period for structural works of improvement shall extend three years from the date that the structural works of improvement are accepted from the contractor as being completed. The establishment period for vegetative work associated with a structural measure is to terminate when any of the following conditions are met:

a. Adequate vegetative cover is obtained.
b. Two growing seasons have elapsed after the initial installation of vegetative work.
c. The establishment period for the associated structural measure has terminated.

Structural measures cont'd

During the establishment period for vegetative measures, SCS may approve PL-566 cost-sharing for additional work required to obtain an adequate vegetative cover. Approval of SCS is also required for PL-566 cost-sharing for other repair or additional work on completed structural works of improvement. Requests for approval will be considered if:

a. The need is determined during the establishment period.

b. The need results from latent conditions unknown to both SCS and the sponsors or from misjudgments, deficiencies, or mistakes by SCS.

c. PL-566 cost-sharing requested for the repair of additional work does not exceed the ratio authorized for the original construction of the specific work involved.

d. Performance of the repair or additional work does not lessen or adversely affect the legal liability of the construction contractor or his surety to bear the cost of the work.

The SCS and the sponsors will make a joint inspection annually and after unusually severe floods, and after the occurrence of any unusual conditions that might adversely affect the structural measures. These inspections will continue for three years following installation of each structure. Inspections after the third year will be made annually by the sponsors. They will prepare a report and send a copy to the Service employee responsible for operations and maintenance inspections and follow-up. The IDNR will be informed of any scheduled inspection. A record of each inspection will be kept in the file of the sponsor and will be available for authorized inspection.

An operations and maintenance agreement, detailing the responsibilities of the sponsor and the Service regarding the establishment period and other items, will be executed prior to signing land rights or project agreements. The agreement will use as a basis the SCS State Watersheds Operations and Maintenance Handbook. An operations and maintenance plan will be prepared for each structural measure.

The Drainage Board will be responsible for operating and maintaining the structural measures. They have the authority to finance this work by either taxation or special assessment. They will assess the landowners annually for operations and maintenance until an amount equal to four times

PROVISIONS FOR OPERATIONS AND MAINTENANCE

Structural measures cont'd

the estimated annual amount for operations and maintenance is attained. They will then discontinue to levy until the fund is depleted. The process will then be repeated. The estimated amount of operations and maintenance costs are $3,680 annually.

Specific operation and maintenance agreements and plans will be executed between the sponsors and the Soil Conservation Service prior to signing land rights, relocation or project agreements. These agreements will use as a basis the SCS State Watershed Operations and Maintenance Handbook. These agreements will contain, in addition to specific sponsor responsibilities for non-structural and structural measures, specific provisions of OMB Circular A-102 for retention and disposal of real and personal property acquired in whole or in part with PL-566 funds.

TABLE 1 - ESTIMATED PROJECT INSTALLATION

Lye Creek Drain Watershed, Indiana

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/					
		Non-Federal Land	P.L. 566 Funds		Other			Total
			Non Federal Land		Non Federal Land		Total	
			SCS 3/	Total	SCS 3/	FS 3/		
LAND TREATMENT								
Land Areas 2/								
Cropland	Ac.	4,545			23,990		23,990	23,990
Pasture	Ac.	243			1,380		1,380	1,380
Forest Land	Ac.	68				1,500	1,500	1,500
Technical Assistance			3,350	3,350	3,650	900	4,550	7,900
TOTAL LAND TREATMENT			3,350	3,350	29,020	2,400	31,420	34,770
STRUCTURAL MEASURES								
Construction								
Channel Work 4/ (M)	Mi.	11.3	242,150	242,150	113,950		113,950	356,100
Subtotal - Construction			242,150	242,150	113,950		113,950	356,100
Engineering Services			21,750	21,750	--	--	--	21,750
Project Administration								
Construction Inspection			34,190	34,190	--		--	34,190
Other			22,790	22,790	10,690		10,690	33,480
Subtotal - Administration			56,980	56,980	10,690		10,690	67,670
Other Costs								
Land Rights			--	--	46,250		46,250	46,250
Subtotal - Other					46,250		46,250	46,250
TOTAL STRUCTURAL MEASURES			320,880	320,880	170,890	--	170,890	491,770
TOTAL PROJECT			324,230	324,230	199,910	2,400	202,310	526,540

1/ Price Base: 1973

2/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.

3/ Federal agency responsible for assisting in installation of works of improvement.

4/ Type of channel prior to project: (M) - manmade ditch or previously modified channel.

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Lye Creek Drain Watershed, Indiana

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Contour Farming	Ac.	150	300
Grass Waterway or Outlet	Ac.	7	2,450
Grade Stabilization Structure	No.	3	2,550
Conservation Cropping System	Ac.	4,700	--
Minimum Tillage	Ac.	3,795	--
Crop Residue Use	Ac.	3,805	--
Subsurface Drain	Ft.	220,000	132,000
Pasture & Hayland Planting	Ac.	891	53,460
Pasture & Hayland Management	Ac.	205	--
Tree Planting	Ac.	15	980
Fire Control	Ac.	129	130
TOTAL			191,870

1/ Price Base: 1973

March 1975

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Lye Creek Drain Watershed, Indiana
(Dollars) 1/

Item 2/	Installation Cost P.L. 566 Funds			Installation Cost - Other Funds			Total Installation Cost
	Construction 3/	Engineering	Total PL-566	Construction 3/	Land Rights	Total Other	
REACH A	80,205	7,080	87,285	37,745	15,150	52,895	140,180
REACH B	121,960	11,140	133,100	57,390	22,900	80,290	213,390
REACH C	39,985	3,530	43,515	18,815	8,200	27,015	70,530
Subtotal	242,150	21,750	263,900	113,950	46,250	160,200	424,100
Project Administration	XXXXXXXXXXXXXXXXXXXX		56,980	XXXXXXXXXXXXXXXXXXXX		10,690	67,670
GRAND TOTAL			320,880			170,890	491,770

1/ Price Base: 1973
2/ See Table 3 for type of channel that existed before the project.
3/ Mitigation costs for construction to P.L. 566, $4,010, and to other, $1,890.

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Lye Creek Drain Watershed, Indiana
(Dollars) 1/

Reach 2/	COST ALLOCATION			COST SHARING					
	PURPOSE			P.L. 566			OTHER		
	Flood Prevention	Drainage	Total	Flood Prevention	Drainage	Total	Flood Prevention	Drainage	Total
REACH A	70,090	70,090	140,180	62,515	24,770	87,285	7,575	45,320	52,895
REACH B	106,695	106,695	213,390	95,245	37,855	133,100	11,450	68,840	80,290
REACH C	35,265	35,265	70,530	31,165	12,350	43,515	4,100	22,915	27,015
GRAND TOTAL	212,050	212,050	424,100	188,925	74,975	263,900	23,125	137,075	160,200

1/ Price Base: 1973

March 1975

TABLE 3 - STRUCTURE DATA

CHANNELS

Lye Creek Drain Watershed, Indiana

Channel Name and Reach	Station	Drainage Area Sq. Mi.	Required Capacity cfs.	Channel Dimensions 1/ Bottom Width	Bottom Grade	Depth 2/ of Flow	"n" Value Aged	"n" Value As Built	Velocities ft./sec. Aged	Velocities ft./sec. As Built	Excavation Cu.-Yds.	Type 3/ of Work	Before Project Type of Channel 4/	Before Project Flow Condition 5/
Lye Creek Drain A	847+00 903+00	3.3	175	4	0.10	4.9	0.040	0.025	2.57	3.41	3000	II	M	I
	903+00 959+24	6.4	240	DEBRIS REMOVAL				-				IV	M	I
B	959+24 1036+18	8.5	330	10	0.08	5.7	.040	0.025	2.90	3.73		II	M	I
	1036+18 1098+00	10.9	440	16	0.04	6.4	.035		2.63	3.06		II	M	I
	1098+00 1158+00	12.2	460	18	0.04	6.3	.035		2.56	3.05		II	M	I
	1158+00 1172+00	15.0	520	20	0.04	6.5	.035		2.64	3.24	110000	II	M	I
Rusk Ditch A	826+30 909+50		120	4	0.12	4.0	.040		2.64	3.13		II	M	I
	909+50 923+00	2.7	120	4	0.26	3.4	.040		3.57	4.30	16000	II	M	I
Durham Ditch B	1017+50 1077+00	3.0	80	4	0.03	4.5	.040		1.38	2.19	19000	II	M	I
Armentrout Tributary C	1040+00 1150+00			4	0.17	4.0	.040		3.25	3.96		II	M	I
	1150+00 1156+00	2.8	150	4	0.8	2.9	.040		5.83 6/	5.35 6/	16000	II	M	I

1/ Side slopes on constructed side are 3:1 and on unconstructed side are approximately 2:1.

2/ Depths shown are normal depths for the capacity required. Backwater does affect Reach B. Aged "n" values are used.

3/ II - Enlargement or realignment of existing channel or stream.

4/ M (1944) - Manmade ditch or previously modified channel.

5/ I - Intermittent - continuous flow through some seasons of the year but little or no flow through other seasons.

6/ Velocity Aged is based on the 100 yr. Q while the As Built is based on 10 yr. Q.

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TABLE 4 - ANNUAL COST

Lye Creek Drain Watershed, Indiana
(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
All Structural Measures	23,960	3,680	27,640
Project Administration	3,820	XXXXXXXXXXXXXXX	3,820
GRAND TOTAL	27,780	3,680	31,460

1/ Price Base: Installation 1973
2/ 100 years @ 5-5/8 percent interest.
3/ The annual maintenance and replacement cost for fisheries and vegetation are an integral cost included in the total annual operation and maintenance cost.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Lye Creek Drain Watershed, Indiana

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater	10,850	4,420	6,430
Subtotal	10,850	4,420	6,430
Indirect	390	60	330
Total	11,240	4,480	6,760

1/ Price Base: current normalized - Water Resource Council, February, 1974.

March 1975

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Lye Creek Drain Watershed, Indiana
(Dollars)

Evaluation Unit	Average Annual Benefits 1/				Total	Average Annual Cost 2/	Benefit Cost Ratio
	Reduction	More Intensive Land Use	Drainage	Secondary			
All Structural Measures	6,760	19,840	17,700	10,180	54,480	27,640	2.0:1
Project Administration	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx	3,820	xxxxxxxxxx
GRAND TOTAL	6,760	19,840	17,700	10,180	54,480	31,460	1.7:1

1/ Price Base: current normalized - Water Resources Council, February, 1974.
2/ From Table 4

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INVESTIGATIONS AND ANALYSES

This section describes the type and intensity of the investigations and analyses which were made in formulating and evaluating the project. It describes the scope and intensity of surveys and investigations and the methods used in analyzing and interpreting the basic watershed data in order to determine the physical and economic feasibility of the project. The material is presented under the following appropriate headings.

LAND USE AND TREATMENT

The basic data for watershed land use and treatment was prepared by the sponsors with assistance from the local Soil Conservation Service and the Indiana Department of Natural Resources. Information was obtained from the Conservation Needs Inventory, conservation plans, soil surveys, and local leaders familiar with the watershed.

Procedure used in developing the data began with a listing of predominant watershed soils by capability class, sub-class and treatment unit. Soils having similar use capabilities, treatment needs, and hydrologic characteristics were combined into soil groups. Present and anticipated future use and treatment of soils within each grouping was then determined.

Once finalized, the land treatment data provided the basis for estimations of "with" and "without project" rainfall runoff in the watershed. In so doing, an analytical framework was established within which watershed problems and effects of treatment could be studied.

FISH AND WILDLIFE

Some biology field studies have been made in or near this watershed. The rural letter carrier game surveys, spring crowing counts and sportsman questionaires have been utilized in this study. The game census and fishery survey information has been supplied by the IDNR, Division of Fish and Wildlife. Two multi-agency biology field reviews have been made - one in March 1972 and the other in November 1973 by representatives of the IDNR, Division of Fish and Wildlife, the U.S. Fish and Wildlife Service, and the Soil Conservation Service.

On-site observations by field biologists* indicated the proposed structural measures will be compatible with existing fish and wildlife resources within the watershed area providing current criteria is used. This criteria includes, but is not limited to, such things as sediment traps, vegetative filter strips, one side construction, replanting of woody cover, life of project easements with permanent markers and/or fence as needed, a minimum of six fish deflectors on the last downstream mile of Lye Creek Drain, and other coordinated efforts in planting, design, construction, operations and maintenance.

* Official views of the Fish and Wildlife Service on the proposed project are only provided by the Regional Director or his representative.

HYDRAULICS AND HYDROLOGY

The hydraulic and hydrologic studies cover the Lye Creek Watershed with its main tributaries, Little Potato Creek, Bower Creek and the project area Lye Creek Drain.

Analysis of the watershed followed procedures outlined in the SCS National Engineering Handbook, Section 4, Hydrology. These analyses were used in developing the design data for the works of improvement and for economic evaluation.

Resource material

Basic data used for the hydrologic studies included field surveys, U.S.G.S. topographic quadrangle sheets, water supply papers, and aerial photos. The local people furnished a detailed topographic map of the area west of Durham Ditch and south of Lye Creek Drain, presently being pumped. Watershed visits were made to observe hydrologic features, outline field surveys and collect basic data.

Selected field surveys and information were gathered on 32 valley sections, 33 cross sections, 24 bridges with accompanying centerline of road profiles, and a profile along the top of the existing spoil adjacent to Lye Creek Drain.

Land use and treatment considerations

The Lye Creek Watershed is in three Indiana counties: Clinton, Montgomery and Tippecanoe. The watershed boundary of Lye Creek Drain is within Montgomery County. The basic soils data was obtained from the most recent soil surveys available. The land use and land treatment data from the SCS, district conservationist, U.S. Forest Service and the Indiana Soil and Water Conservation Needs Inventory of 1967 were used to calculate the runoff curve number. The calculated runoff curve number is 80, antecedent moisture condition II. The level of present land management and land treatment practices is high for the project area, and the future "with project" management will remain high with an additional reduction of erosion losses on the IIe soils. The runoff curve number remains the same for both the "without project" condition and the "with project" condition.

Time of concentration

The hydrologic factor, Tc, was calculated by the velocity-travel length method for both Lye Creek Watershed and the project area Lye Creek Drain.

Frequency analysis

There are no stream gages or recording rain gages located within the project area Lye Creek Drain. A stream gage is located at Crawfordsville on Sugar Creek; the project area contributes about three percent to the

Frequency analysis - cont'd

drainage area of this gage. Recording rain gages are located around the watershed at Crawfordsville, Lebanon, and Waveland, and data were used from them for the June 27-28, 1957 storm and compared to the discharge that occurred at the Crawfordsville stream gage. This storm was the largest on record at the Crawfordsville stream gage. The rainfall-runoff relationship for this storm provided a basis, also, for the runoff curve number.

Rainfall amounts by frequency were taken from Weather Bureau Technical Paper No. 40 for the 24 hour duration. Those rainfall amounts for events more frequent than the one year were found by straight-line extension of rainfall frequency curves plotted on semi-log paper. The frequency studies were conducted on the all-year basis.

The following table provides the numerical values of the frequency by year, 24-hour rainfall - "P", and the average runoff - "Q".

Frequency Return Period In Years	Rainfall 24-hour "P" Inches	Present & Future RCN 80 "Q" Inches
100	5.80	3.61
50	5.35	3.20
25	4.80	2.72
10	4.15	2.15
5	3.70	1.80
2	2.90	1.17
1	2.55	0.90
1/2	2.00	0.57

Hydraulic studies

Eight water surface profiles were run by the SCS ADP hydraulics program for the preliminary investigation report on the entire Lye Creek stream system. Within the project area, Lye Creek Drain, additional field surveys were made during work plan development and, therefore, the hydraulics within the project area watershed were updated using WSP 2. Twelve water surface profiles were run at the Indiana University facilities for the "without project" condition. The channel designs were incorporated in the WSP 2 data and twelve profiles were run for the "with project" conditons. The starting elevations for the project area were taken from the rating curve development from water surface profiles calculated on Lye Creek at the junction of Lye Creek Drain.

HYDRAULICS AND HYDROLOGY

Flood routing

The prevailing storm patterns are from southwest to northeast. This would normally wet the lower end of the Lye Creek watershed first. The peak flows from the project area Lye Creek Drain would pass through the lower end of the Lye Creek Watershed before the peaks from the balance of the drainage area. However, no attempt was made to reconstruct historical events. Synthesized data was used and applied to the entire Lye Creek Watershed by approved hydrologic methods.

Flood routings were made using the TR-20 procedure with the standard dimensionless hydrograph (K-484).

The project area, Lye Creek Drain, was flood routed using the computer facilities at Indiana University. The updated basic data developed for the work plan by the engineer was incorporated into the updated material for the "with project" condition.

Hydrologic effects

The flood routed peak discharges, q, were plotted versus volume of runoff in inches, Q. Likewise, water surface elevations were plotted versus volume of runoff in inches. These graphs were made for each evaluation section within the project area. Using the runoff depth by percent chance data developed in the frequency analysis, it was possible to read peak-frequency and elevation-frequency information from these charts. These data were also placed on spread sheets for each evaluation reach. Area flooded curves were developed and provided to the economist using the valley sections contained in each evaluation reach. Discharge curves by frequency in cubic feet per second versus drainage area were developed and furnished to the engineer for channel design purposes.

ENGINEERING

The basic data used for channel designs and cost estimates were field surveys, U.S.G.S. topographic maps, aerial photographs, geological investigations and field observations. Profiles were prepared from cross sections, valley sections and bridge surveys and were used to determine bank full elevations, grades and hydraulic gradients of the channels. Capacities used were based on discharges for a two-year level of protection and were provided by the planning hydrologist.

The preliminary report required excavation downstream of Lye Creek Drain on Lye Creek for approximately two miles. This work was needed to relieve backwater problems in Lye Creek Drain. More detailed surveys were made and hydraulic studies conducted during work plan studies. Backwater curves were run and a channel designed to dissipate the backwater from Lye Creek before it reached an area in the project where it would have an effect on the project benefits thus eliminating excavation on Lye Creek. Results of flood routing the watershed with the design channel in place confirmed the analysis.

An investigation was made of the low muck area southwest of the junction of Durham Ditch and Lye Creek Drain in Reach B. Approximately 400 acres are presently being pumped using an 18-inch and 22-inch pump. Continuous spoil from past excavation provides approximately a five-year level of protection from flooding on Lye Creek Drain. The planned gradeline on Lye Creek Drain would need to be lowered approximately three additional feet to provide a gravity outlet for the muck area. The present pumping system is doing a satisfactory job so a gravity outlet was not provided for this area. Repairing the continuous spoil where openings have occurred has been included as part of the plan therefore increasing the level of flood protection of the area.

The channel will be constructed from one side only using a 3:1 side slope. This side will be chosen during the final design phase with two exceptions. The lower portion of Lye Creek Drain, below the last bridge before reaching Lye Creek, will be constructed from the south side due to a wooded tract on the north side. The portion of the channel in Reach B, where an existing continuous spoil is located, will be constructed from the opposite side. Clearing will be minimized and include only the area within the channel banks and adjacent areas necessary to construction, installation of appurtenances, and spoil disposal.

An "aged" and "as built" analysis of the channel design was made in accordance with Service criteria in Technical Release 25 and Technical Standard 582. The allowable velocity and tractive force methods were used to analyze the soils encountered. Some of the silt and sand materials in Lye Creek Drain, Rusk Ditch, and Armentrout Tributary could not tolerate the stresses that will be present. Protection was accomplished by using armor plating (gravel lining) on the channel bottom and side slopes where needed. The associated costs are incorporated in the project cost.

Area requirements and costs for permanent land rights for channel work were based on that area within the constructed channel banks, plus overbank areas extending 15 feet on the unconstructed side, plus a 12-foot berm and part of the spoil bank on the constructed side. Permanent land rights boundaries are to be marked in the field, or fenced where adjacent lands are pastured, to protect the channel and mitigation areas. (See exhibit 4).

Temporary land rights costs were figured to include the area outside permanent easements needed during construction to maneuver equipment, stockpile material, and for other needs.

The construction costs, including mitigation, were based upon unit prices determined from abstracts of bids on the most recent PL-566 contracts in Indiana. Values for land rights were estimated by the local sponsors. The operations and maintenance costs were based on calculations of the average annual amount of manpower, equipment and material required per mile of channel work.

Supporting data available to design and construction engineers and regulatory agencies show detailed cost analyses.

GEOLOGY

The geologic investigation included a review of published surficial and bedrock geologic maps, soil survey reports, aerial photos, and geologic literature, as well as field investigations.

Erosion and sedimentation

Gross sheet erosion rates were calculated using the Universal Soil Loss Equation. Stream, gully, and other erosion rates were calculated as a percentage of the sheet erosion figures. Delivery ratios were modified from available SCS publications. Soils, land use and land treatment data were supplied by the district and area conservationists of the SCS.

Field investigations indicated that sediment and erosion damages were not severe enough to warrant a detailed economic and physical evaluation.

Channels

Sixty-one power auger holes were drilled to depths below design grade at an average 1000' interval along all drains and ditches for which work was proposed. All holes were logged and sampled. Twenty-eight representative soil samples were sent to the SCS Soil Mechanics Laboratory in Lincoln, Nebraska for testing to determine parameters used in TR25 channel stability analyses (grain size distribution, Atterberg limits, and dispersion).

Logs of the borings were plotted on channel profiles and areas of similar geologic materials delineated whenever possible. The variety of materials encountered and the rapidity with with they change along the channel made it necessary to keep channel design reaches short.

ECONOMICS

Identification of watershed problems and considerations of effects of proposed improvements provided the basis for evaluation of project benefits. Basic data were obtained through interviews with watershed residents, Soil Conservation Service personnel and local watershed leaders. Field economic studies and information supplied by other watershed planning specialists supplemented basic interview data. Analysis of all project benefits was made through a comparison of "with" and "without project" conditions. All information utilized was reviewed for reasonableness and accuracy.

Floodwater damage

The principal method used in the evaluation of floodwater damages was the "frequency method" as described in Chapter 3 of the Economic Guide. Identification of the relationship between flood size and resulting flood damages provided the basis for damage determination under this method.

Crop and pasture

Evaluation of crop and pasture flood damages under the frequency method was achieved utilizing standarized crop depth-damage factors as a base. Factors used had been previously developed for evaluation of watershed projects throughout the northern portion of Indiana. Such factors relate flood depth and month of flood occurrence to expected crop losses. Flood free yield projections were used in the evaluations. Sufficient interview information was obtained to support applicability of the factors for use in the watershed.

A composite acre was developed by sample, aerial photo use and interviews. Composite acre flood depth-damage factors were then developed and incorporated into these factors were crop yields and prices. Resultant composite acre values served as estimated to expected losses on representative flood plain acre from various depths of flooding irrespective of the time of year when flooding occurs.

Application of the composite acre factors to acre-frequency information and monthly probabilities of flood occurrence supplied by the planning hydrologist, provided the means of determining damage-frequency relationships and subsequently average annual damages with and without the project. Such damages were adjusted to eliminate double counting arising through recurrent flooding in a given year.

Floodwater damages were evaluated using this method. Damages on these acres are recorded in Table 5.

Indirect

Indirect damages were evaluated as a percent of direct flood damages. These included such items as added weed cost, increased travel time, etc. The percentage utilized was five percent.

ECONOMICS

More intensive use and drainage benefits

Flood prevention benefits of the more intensive use type were evaluated jointly with drainage benefits. Method of evaluation was the "net income" procedure as described in Chapter 3 of the Economic Guide.

Evaluation was begun with an identification of expected crop yield increases which would result from the project. Present flood free yields of 105 and 30 bushels per acre were used for corn and soybeans respectively on problem areas. Information supplied through farmer interview together with judgment of agronomic and soils specialists familiar with the area provided the basis for these determinations.

Deduction of increased cash production costs and associated costs for the installation of on-farm improvements supplied a measure of increased net income to land, labor and management. Resultant net income increases were discounted for lag in accrual in arriving at project benefits. A weighted average discount value was determined based on 15 percent of the area receiving full benefit from the onset of the project, another 50 percent requiring a gradual build-up to full benefit over an eight year period, 20 percent of the area requiring a gradual build-up over a 12 year period and the remaining 15 percent not participating.

Joint flood prevention-drainage improvement benefits were assigned 35 percent to flood prevention and 65 percent drainage. This breakdown was established to be equitable from local interviews.

Secondary benefits

Secondary benefits accruing locally were evaluated as both "stemming from" and "induced by" the project. Benefits of the "stemming from" type were evaluated at 10 percent of direct primary benefits. "Induced by" benefits were evaluated at 10 percent of increased annual costs required in realizing project benefits.

Prices and interest rate

Current normalized prices, as developed by the Economic Research Service in October 1973 and approved by the Water Resources Council, served as the applicable price base for computation of project benefits and operation, maintenance and replacement costs. Estimated construction costs for project installation were based on 1973 prices.

Prices and interest rate - cont'd

Annual equivalents of installation costs and project benefits were computed using a 5-5/8 percent interest rate. Private expenditures connected with the installation of on-farm improvements required for the realization of project benefits were converted to annual equivalents using a seven percent interest rate.

Cost allocation

Assignment of costs to purpose on project multiple purpose channels was done utilizing the first alternate as described in Chapter 3 of the Watershed Protection Handbook. Such method was believed to supply the more realistic allocation of cost to purpose served.

EXHIBITS

Exhibit 1

DEFINITION OF CONSERVATION PRACTICES AND LAND USE

CONSERVATION PRACTICES

CONSERVATION CROPPING SYSTEM

Growing crops in combination with needed cultural and management measures. Cropping systems include rotations that contain grasses and legumes as well as rotations in which the desired benefits are achieved without the use of such crops.

CONTOUR FARMING

Farming sloping cultivated land in such a way that plowing, preparing and planting, and cultivation are done on the contour. (This includes following established grades of terraces, diversions, or contour strips.)

CROP RESIDUE USE

Using plant residues to protect cultivated fields during critical erosion periods.

DRAINAGE FIELD DITCHES

A shallow graded ditch for collecting water within field, usually constructed with flat side slopes for ease of crossing. (This does not include drainage main or lateral, or grasses waterway or outlet.)

DRAINAGE MAIN OR LATERAL

An open drainage ditch constructed to a designed size and grade. Does not include drainage field ditch.

GRADE STABILIZATION STRUCTURE

A structure to stabilize the grade or to control head cutting in natural or artificial channels. (Does not include structures used in drainage and irrigation systems primarily for water control.)

GRASSES WATERWAY OR OUTLET

A natural or constructed waterway or outlet shaped or graded and established in vegetation suitable to safely dispose runoff from a field, diversion, terrace, or other structure.

MINIMUM TILLAGE

Limiting the number of cultural operations to those that are properly timed and essential to produce a crop and prevent soil damage.

DEFINITION OF CONSERVATION PRACTICES AND LAND USE CONT'D

CONSERVATION PRACTICES CONT'D

PASTURE AND HAYLAND MANAGEMENT

Proper treatment and use of pastureland or hayland.

PASTURE AND HAYLAND PLANTING

Establishing and re-establishing long-term stands of adapted species of perennial, biennial or reseeding forage plants. (Includes pasture and hayland renovation. Does not include grasses waterway or outlet on cropland.)

SUBSURFACE DRAIN

A conduit, such as tile, pipe, or tubing, installed beneath the ground surface and which collects and/or conveys drainage water.

LAND USE

CROPLAND

Cropland includes all cultivated land used for field crops or hay in pasture or rotation; cropland temporarily idle or diverted from production under government programs; permanent hayland; orchards, vineyards and bush fruits; and open land formerly cropped and not converted to another use.

FOREST OR WOODLAND

Forest or woodland includes land that is at least 10% stocked with forest trees and capable of producing forest products or influencing a water regime, land that formerly grew trees and is not currently developed for non-forest use, and land that has been planted to trees.

OTHER LAND

Other land is non-federal rural land which is not classified as cropland, pasture or forest land. It includes strip mines, borrow and gravel pits, farmsteads, farm roads, ditches, rural non-farm residences, and idle, open rural non-farm land.

PASTURE

Pasture includes lands producing forage plants, principally introduced species, primarily for grazing and not included in cropland rotation; includes native pasture and may contain shade or timber trees if canopy is less than 10%.

(Reproduced from SCS Technical Guide Sec. IV and Indiana Soil and Water Conservation Inventory 1968)

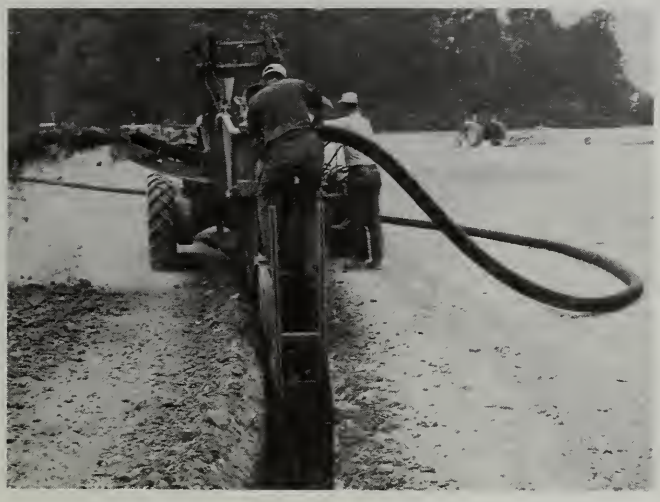
Soil loss can be controlled
with conservation practices

Crop residue use saves soil,
slows storm runoff water, and
saves precious fuel.

Contour farming holds soil
and moisture in place.

USDA-SCS-LINCOLN, NEBR. 1974

Wet spots and poor drainage hurts crop production.



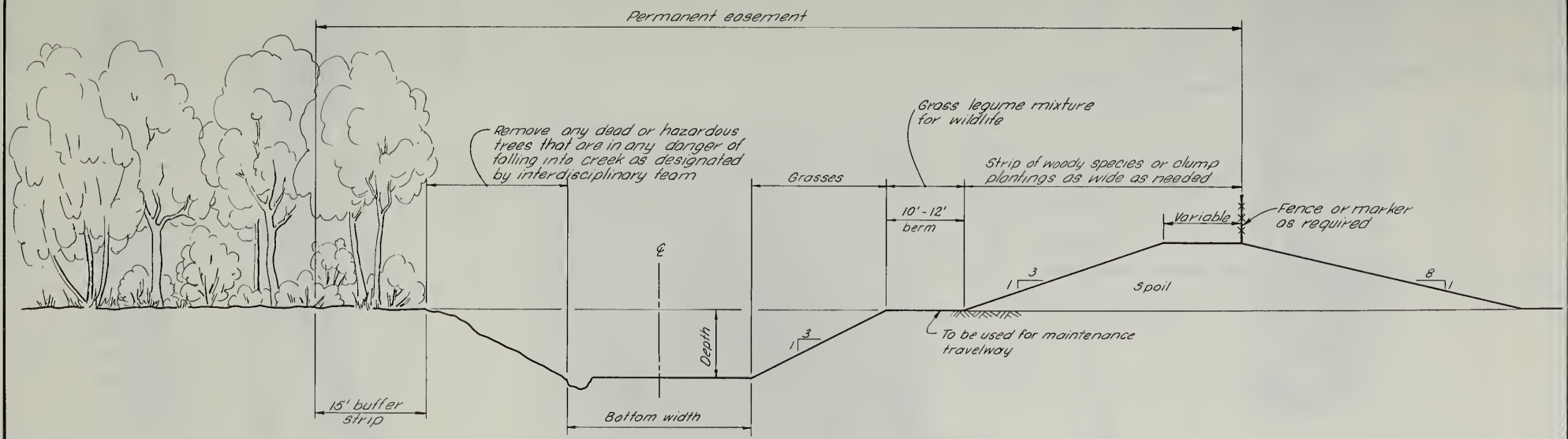
Modern subsurface drains can solve wetness problems.

An outlet ditch with proper depth and capacity.

EXHIBIT 3

Channel work from one side only preserves valuable wildlife habitat.

USDA-SCS-LINCOLN, NEBR. 1974



TYPICAL CHANNEL CROSS SECTION

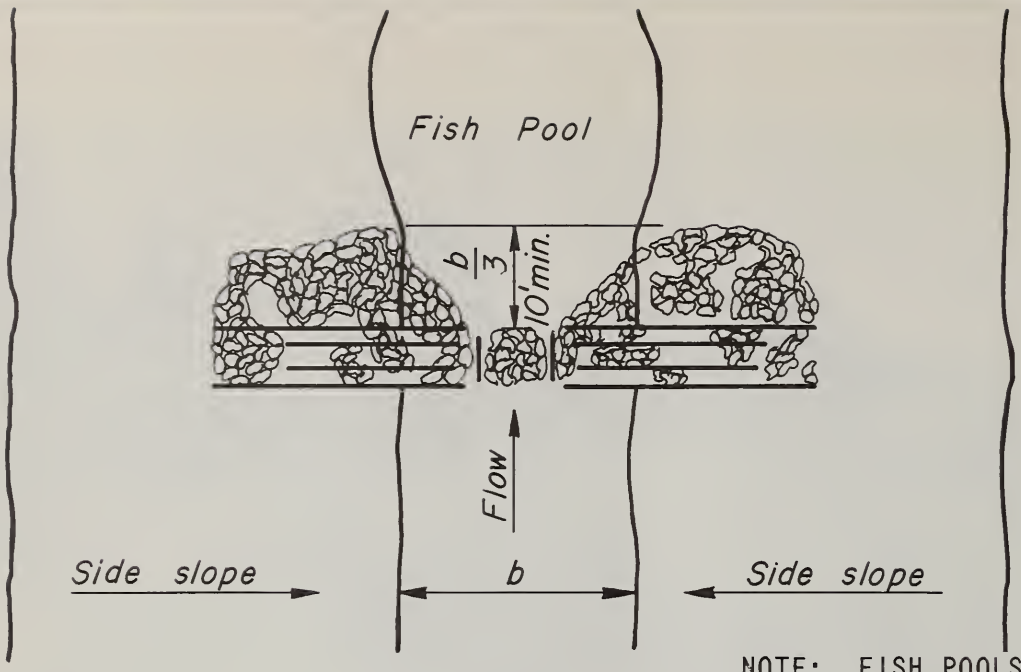
(with berm)

Exhibit 4

IN-EDU 7-71

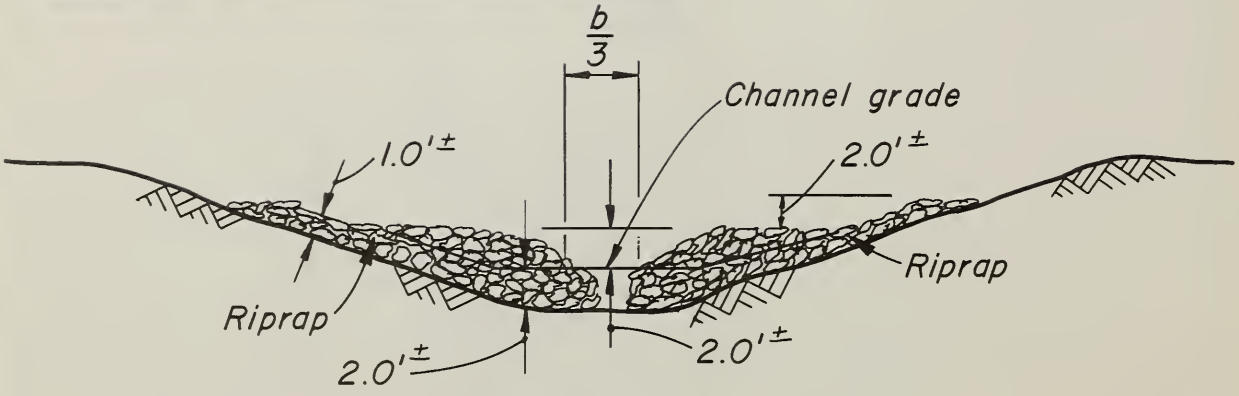
5,E-32,984.1

USDA-SCS-LINCOLN, NEBR. 1974



PLAN

NOTE: FISH POOLS SHALL BE EXCAVATED DOWNSTREAM OF EACH DEFLECTOR.

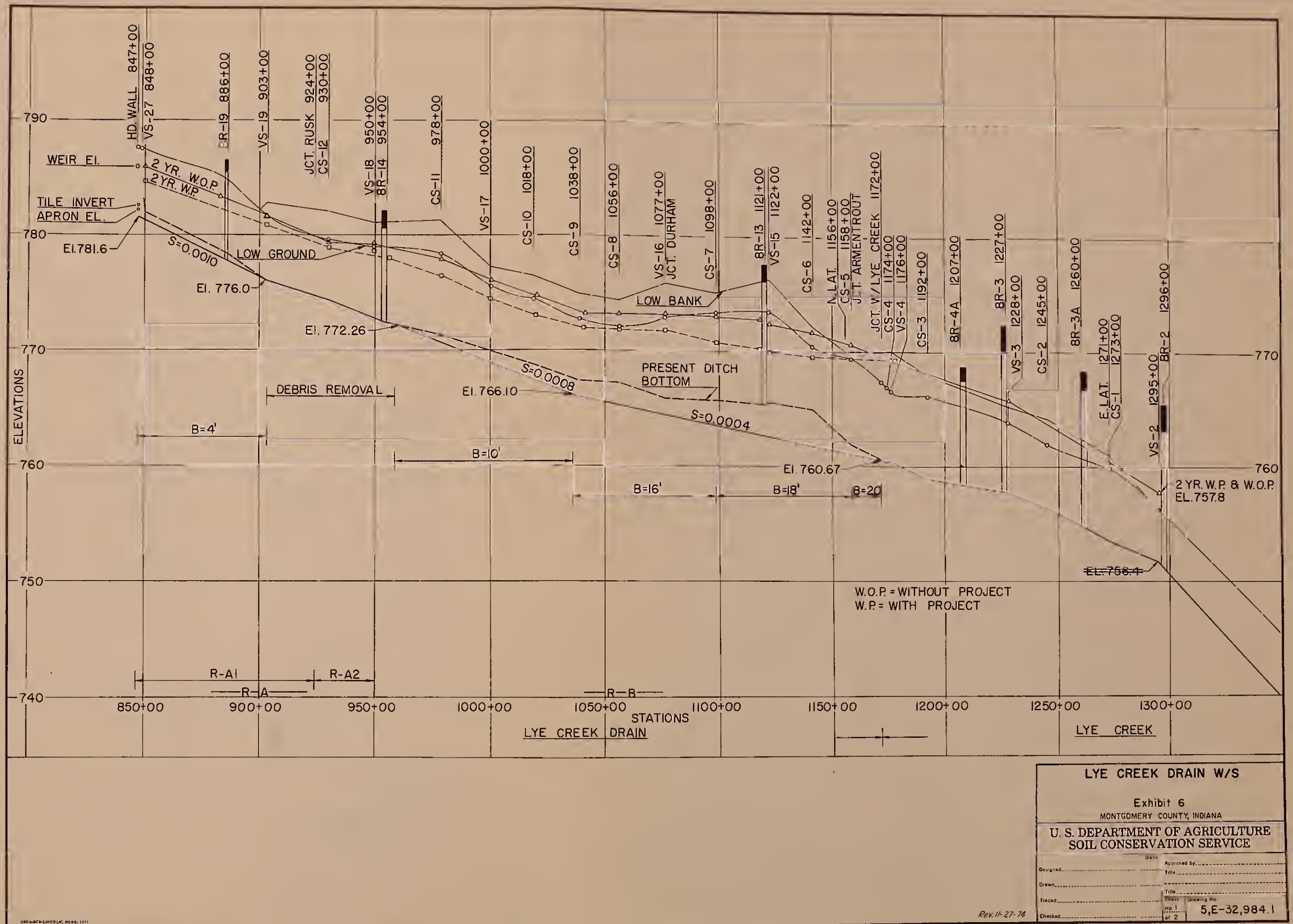


UPSTREAM ELEVATION
TYPICAL DEFLECTOR

Exhibit 5

USDA-SCS-LINCOLN, NEBR. 1974

5,N-32,984.1



LYE CREEK DRAIN W/S

Exhibit 6

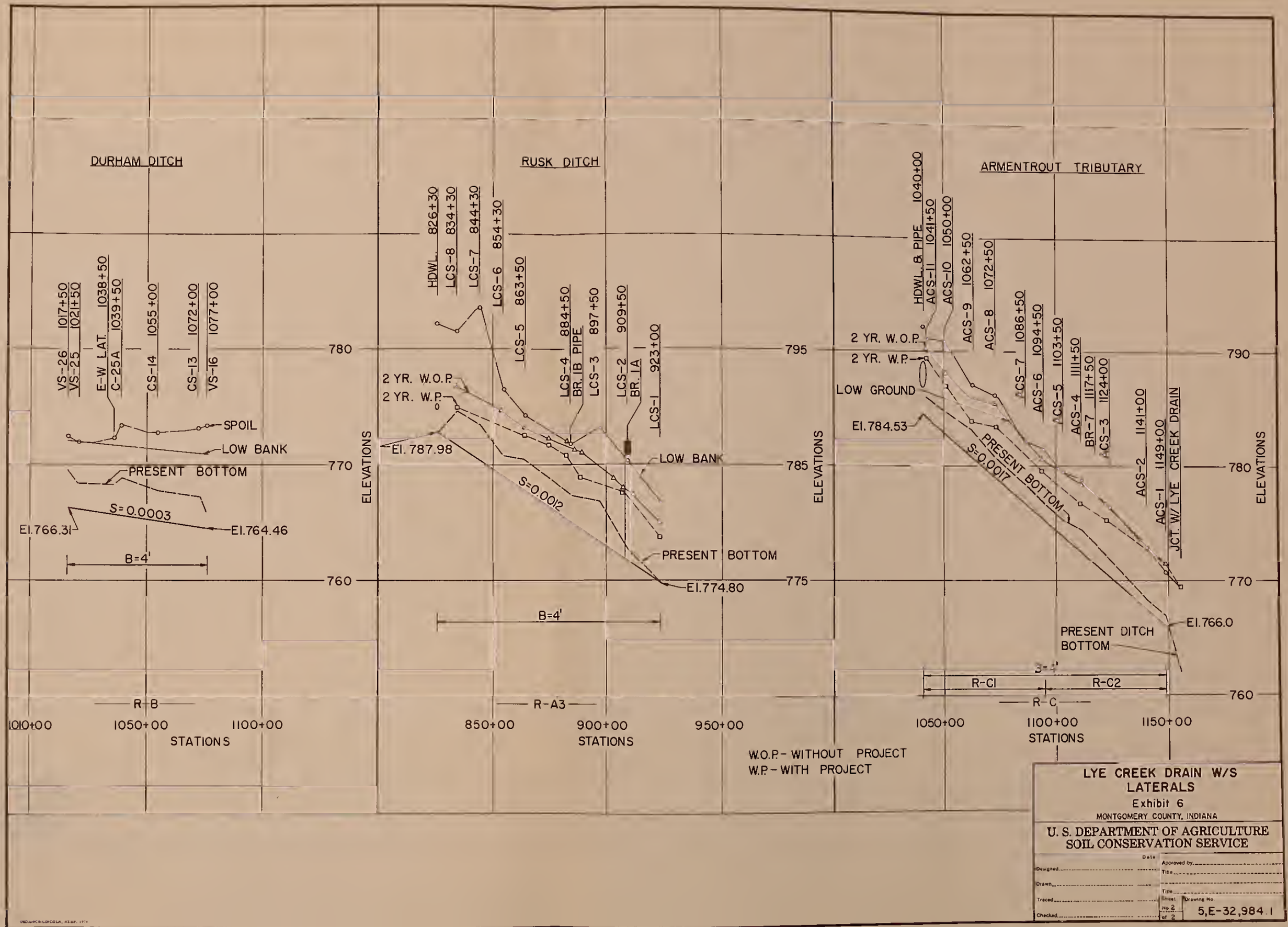
MONTGOMERY COUNTY, INDIANA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed		Approved by	
Drawn		Title	
Traced		Title	
Checked		Sheet No. 1 of 2	Drawing No. 5,E-32,984.1

Rev. 11-27-74

USDA-ACS-LINCOLN, NEBR. 1974



LYE CREEK DRAIN W/S
LATERALS
Exhibit 6
MONTGOMERY COUNTY, INDIANA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed — Date — Approved by —
Drawn — Title —
Traced — Title —
Checked — Sheet No. 2 of 2 — Drawing No. 5,E-32,984.1

EXHIBIT 7A

LYE CREEK DRAIN WATERSHED

ESTIMATED SOIL LIMITATIONS OR SUITABILITY FOR SELECTED USES

SOIL ASSN. & % OF WATERSHED	SOIL SERIES & % OF ASSOCIATION		DWELLINGS WITH BASEMENTS	DWELLINGS WITHOUT BASEMENTS	WASTE DISPOSAL SEPTIC TANK ABSORPTION FIELDS	WASTE DISPOSAL SEWAGE LAGOONS	LOCAL ROADS STREETS PARKING AREAS	SUITABILITY AS SOURCE OF SAND	SUITABILITY AS SOURCE OF GRAVEL	SUITABILITY AS SOURCE OF ROAD FILL	RECREATION CAMP AND PICNIC AREAS	RECREATION PLAYGROUNDS & ATHLETIC FIELDS	INTENSIVE CROPPING	WOODLAND PRODUCTIVITY
1 20 %	Westland Ockley Minor	60 30 10	Severe: 3 Slight	Severe: 3 Slight	Severe: 3 Slight	Severe: 3,7 Severe: 7	Severe: 3,5 Moderate: 5	Good Good	Good Good	Good Good	Severe: 3 Slight	Severe: 3 Moderate: 1	Good Good	Fair Good
2 40 %	Mahalasville Fincastle Ragsdale Minor	40 20 5 35	Severe: 3 Severe: 3 Severe: 3	Severe: 3 Moderate: 3 Severe: 3	Severe: 3 Severe: 2,3 Severe: 2,3	Severe: 3,7 Moderate: 3 Severe: 3	Severe: 3 Severe: 5 Severe: 3,5	Poor Unsuited Unsuited	Unsuited Unsuited Unsuited	Poor Poor Poor	Severe: 3 Moderate: 3 Severe: 3	Severe: 3 Moderate: 3 Severe: 3	Good Good Good	Fair Fair Fair
3 18 %	Miami Russell Fincastle Minor	37 13 12 38	Slight Slight Severe: 3	Slight Slight Moderate: 3	Moderate: 2 Moderate: 2 Severe: 2,3	Moderate:1,7 Moderate:1,7 Moderate: 3	Severe: 5 Severe: 5 Severe: 5	Unsuited Unsuited Unsuited	Unsuited Unsuited Unsuited	Poor Poor Poor	Slight Slight Moderate: 3	Moderate: 1 Moderate: 1 Moderate: 3	Good Good Good	Good Good Fair
4 10 %	Muck Minor	64 36	Severe:3,5,6	Severe:3,5,6	Severe: 3	Severe: 3,7	Severe: 3,5	Unsuited	Unsuited	Poor	Severe:3,5,6	Severe:3,5,6	Good	Poor
5 6 %	Miami Crosby Minor	37 27 36	Slight Severe: 3	Slight Moderate: 3	Moderate: 2 Severe: 2,3	Moderate:1,7 Moderate: 3	Severe: 5 Severe: 5	Unsuited Unsuited	Unsuited Unsuited	Poor Poor	Slight Moderate: 3	Moderate: 1 Moderate: 3	Good Good	Good Fair
6 1 %	Ragsdale Raub Minor	44 26 30	Severe: 3 Severe: 3	Severe: 3 Moderate: 3	Severe: 2,3 Severe: 2,3	Severe: 3 Moderate: 3	Severe: 3,5 Severe: 5	Unsuited Unsuited	Unsuited Unsuited	Poor Poor	Severe: 3 Moderate: 3	Severe: 3 Moderate: 3	Good Good	Fair No Data Avail.
7 5 %	Brookston Parr Minor	39 36 25	Severe: 3 Slight	Severe: 3 Slight	Severe: 2,3 Moderate: 2	Severe: 3 Moderate: 7	Severe: 3,5 Moderate: 5	Unsuited Unsuited	Unsuited Unsuited	Poor Fair	Severe: 3 Slight	Severe: 3 Slight	Good Good	Fair No Data Avail.

Key To Principal Soil Limitations: 1. Excessive Slope 2. Slow Permeability 3. Seasonal High Water Table 4. Flood Hazard 5. Poor Stability 6. Adverse Soil Texture 7. Excessive Permeability

EXPLANATION OF COLUMNS IN THE TABLE

SOIL ASSOCIATION:

THE NUMBERS IN THIS COLUMN CORRESPOND WITH THE NUMBERED SOIL ASSOCIATIONS ON THE GENERAL SOIL MAP OF THE WATERSHED. EACH SOIL ASSOCIATION IS NAMED FOR THE MAJOR SOILS. THE PERCENT OF EACH SOIL ASSOCIATION IN THE WATERSHED IS SHOWN.

SOIL SERIES & PERCENT OF ASSOCIATION:

THIS COLUMN SHOWS THE APPROXIMATE PERCENT OF EACH MAJOR SOIL IN EACH ASSOCIATION, AND THE TOTAL PERCENT OF ALL THE MINOR SOILS.

DWELLINGS-WITH BASEMENTS:

RATINGS ARE FOR UNDISTURBED SOILS THAT ARE EVALUATED FOR SINGLE FAMILY DWELLINGS AND OTHER STRUCTURES WITH SIMILAR FOUNDATION REQUIREMENTS. EXCLUDED ARE BUILDINGS OF MORE THAN THREE STORIES AND OTHER BUILDINGS WITH FOUNDATION LOADS IN EXCESS OF THOSE EQUAL TO THREE STORY DWELLINGS. NO SPECIFIC BEARING STRENGTH IS ESTIMATED OR IMPLIED.

DWELLINGS-WITHOUT BASEMENTS:

THE SAME QUALIFICATIONS AS GIVEN ABOVE FOR DWELLINGS--WITH BASEMENTS APPLY HERE EXCEPT THAT SEASONAL HIGH WATER TABLES ARE NOT AS RESTRICTIVE.

WASTE DISPOSAL - SEPTIC TANK ABSORPTION FIELDS:

RATINGS ARE FOR SHALLOW, SUB-SURFACE TILE ABSORPTION FIELDS AND DO NOT INCLUDE ALTERNATIVE SYSTEMS.

WASTE DISPOSAL - SEWAGE LAGOONS:

RATINGS ARE FOR SHALLOW LAKES USED TO HOLD SEWAGE FOR THE TIME REQUIRED FOR BACTERIAL ACTION.

LOCAL ROADS, STREETS, & PARKING AREAS:

RATINGS ARE FOR IMPROVED ROADS AND STREETS HAVING SOME KIND OF ALL-WEATHER SURFACING, COMMONLY ASPHALT OR CONCRETE, AND ARE EXPECTED TO CARRY AUTOMOBILE TRAFFIC ALL YEAR.

SUITABILITY AS A SOURCE OF:

SAND - THIS COLUMN PROVIDES GUIDANCE ABOUT WHERE TO LOOK FOR SAND. SOIL RATED "GOOD" CONTAINS A SOURCE OF CLEAN SAND. "FAIR" INDICATES SAND WITH SOME FINE MATERIAL. "POOR" INDICATES SOME FINE MATERIAL COSTLY TO REMOVE. UNSUITED INDICATES SAND IS NOT AVAILABLE.

GRAVEL - THE PURPOSE OF THIS COLUMN IS TO PROVIDE GUIDANCE ABOUT WHERE TO LOOK FOR GRAVEL. THE EXPLANATION OF THE RATINGS FOR "SAND" (ABOVE) APPLY ALSO TO "GRAVEL".

ROADFILL - REFERS TO SOIL MATERIAL MOVED FROM ITS ORIGINAL LOCATION AND USED IN ROAD CONSTRUCTION. GENERALLY IT SERVES AS THE SUBGRADE OR FOUNDATION FOR THE ROAD. THE WHOLE SOIL, TO A DEPTH OF 6 FEET, IS GIVEN ONE RATING, ASSUMING IT WILL BE MIXED IN HANDLING.

RECREATION -- CAMP AND PICNIC AREAS:

RATINGS APPLY TO SOILS TO BE USED INTENSIVELY FOR TENTS AND SMALL CAMP TRAILERS AND THE ACCOMPANYING ACTIVITIES OF OUTDOOR LIVING AND FOR PARK-TYPE PICNIC AREAS.

RECREATION - PLAYGROUNDS AND ATHLETIC FIELDS:

RATINGS APPLY TO SOILS TO BE USED INTENSIVELY FOR PLAYGROUNDS FOR BASEBALL, FOOTBALL, VOLLEYBALL, AND OTHER SIMILAR ORGANIZED GAMES. THESE AREAS ARE SUBJECT TO INTENSIVE FOOT TRAFFIC.

INTENSIVE CROPPING:

THE RATINGS ARE BASED ON THE POTENTIAL PRODUCTIVITY OF SOILS TO PRODUCE SUSTAINED CORN YIELDS UNDER HIGH LEVELS OF MANAGEMENT.

WOODLAND PRODUCTIVITY:

THE RATINGS ARE BASED ON THE POTENTIAL PRODUCTIVITY OF SOILS FOR THEIR PRIMARY ADAPTED SPECIES.

GENERAL SOIL MAP

THE GENERAL SOIL MAP OF THE LYE CREEK DRAIN WATERSHED SHOWS SEVEN MAIN PATTERNS OF SOILS CALLED SOIL ASSOCIATIONS. EACH ASSOCIATION CONTAINS A FEW MAJOR SOILS AND SEVERAL MINOR SOILS, AND IS NAMED FOR THE MAJOR SOILS. THE SOILS IN ONE ASSOCIATION MAY BE IN ANOTHER, BUT IN A DIFFERENT PATTERN.

THE GENERAL SOIL MAP IS USEFUL TO PEOPLE WHO WANT A GENERAL IDEA OF THE SOILS, WHO WANT TO COMPARE DIFFERENT PARTS OF THE WATERSHED OR WHO WANT TO KNOW THE LOCATION OF LARGE TRACTS THAT ARE SUITABLE FOR A CERTAIN KIND OF FARM OR NON-FARM LAND USE. SUCH A MAP IS NOT SUITABLE FOR PLANNING THE MANAGEMENT OF A FARM OR FIELD, OR FOR SELECTING THE EXACT LOCATION OF A ROAD, BUILDING OR SIMILAR STRUCTURE BECAUSE THE SOILS IN ANY ONE ASSOCIATION ORDINARILY DIFFER IN SLOPE, DEPTH, DRAINAGE, OR OTHER CHARACTERISTICS THAT AFFECT MANAGEMENT.

DETAILED SOIL MAPS AND INFORMATION ON SOILS AND SPECIFIC USES IS AVAILABLE FOR MUCH OF THE AREA ENCOMPASSED BY THE WATERSHED FOR THIS DETAILED INFORMATION, PLEASE CONTACT THE FIELD OFFICE OF THE SOIL CONSERVATION SERVICE IN THE INDIVIDUAL COUNTIES CONCERNED.

SOIL INTERPRETATIONS

THE INTERPRETIVE TABLE TO THE LEFT PROVIDES SOIL INTERPRETATIONS FOR 12 SPECIFIC USES FOR EACH OF THE SEVEN SOIL ASSOCIATIONS SHOWN ON THE GENERAL SOIL MAP OF THE LYE CREEK DRAIN WATERSHED. THE APPROXIMATE PERCENT OF THE ASSOCIATION OF EACH MAJOR SOIL AND THE TOTAL PERCENT OF ALL OF THE MINOR SOILS IS GIVEN. ESTIMATED LIMITATIONS OR SUITABILITY FOR EACH OF THE NAMED SOILS FOR EACH OF THE 12 USES IS GIVEN IN TERMS OF SLIGHT, MODERATE, OR SEVERE LIMITATIONS OR GOOD, FAIR, POOR OR UNSUITED SUITABILITY. BESIDE EACH OF THE RATINGS THE LIMITING SOIL PROPERTIES OR FEATURES ARE GIVEN BY LISTING ONE OR MORE NUMBERS. THESE NUMBERS CORRESPOND WITH THOSE LISTED IN THE "KEY TO PRINCIPAL SOIL LIMITATIONS", AT THE BOTTOM OF THE TABLE. SOILS RATED AS SLIGHT ARE ESTIMATED TO HAVE NO PRINCIPAL SOIL LIMITATIONS AND ARE NOT REFERENCED TO THE KEY.

SOIL LIMITATION CLASSES

SOILS RATED AS "SLIGHT" HAVE FEW OR NO LIMITATIONS FOR THE USE. SOILS RATED AS "MODERATE" HAVE LIMITATIONS WHICH REDUCE TO SOME DEGREE THEIR DESIRABILITY WHEN USED FOR THE PURPOSE BEING CONSIDERED. THEY REQUIRE SOME CORRECTIVE MEASURES. SOILS RATED AS "SEVERE" HAVE UNFAVORABLE SOIL CHARACTERISTICS THAT SEVERELY RESTRICT THEIR USE AND DESIRABILITY FOR THE PURPOSE. A SEVERE RATING DOES NOT MEAN THE SOIL CANNOT BE USED FOR A SPECIFIC USE. IT DOES INDICATE PROBLEMS DURING OR AFTER APPLICATION OF THE USE, UNLESS SPECIAL DESIGN, ENGINEERING OR OTHER CORRECTIVE MEASURES ARE USED TO OVERCOME THE LIMITATIONS. COSTS ARE USUALLY GREATER THAN ON SOILS RATED SLIGHT OR MODERATE, AND MANY TIMES COSTS ARE PROHIBITIVE.

SOIL SUITABILITY RATING

"GOOD", "FAIR", "POOR" AND "UNSUITED" ARE TERMS USED TO RATE SOILS AS A SOURCE OF SAND, GRAVEL AND ROADFILL. SOILS RATED AS "GOOD" HAVE QUALITIES SUCH THAT THEY CAN BE CONSIDERED AS A SUITABLE RESOURCE MATERIAL. SOILS RATED "FAIR" HAVE SOME PROBLEMS IN THE MATERIAL THAT MAKE THEM LESS DESIRABLE. SOILS RATED AS "POOR" HAVE PROBLEMS THAT GREATLY LIMIT THEIR SUITABILITY AS A SOURCE. SOILS RATED AS "UNSUITED" ARE PHYSICALLY UNFIT, OR IT IS NOT PRACTICAL TO PROCESS THE MATERIAL.

WHERE USED FOR "INTENSIVE CROPPING", "GOOD" INDICATES SOILS ARE CAPABLE OF PRODUCING SUSTAINED CORN YIELDS OF 110 TO 155 BUSHELS OF CORN PER ACRE UNDER HIGH LEVELS OF MANAGEMENT. "FAIR" INDICATES SOILS THAT WILL PRODUCE 70 TO 110 BUSHELS OF CORN AND "POOR" INDICATES THOSE SOILS THAT WILL PRODUCE LESS THAN 70 BUSHELS OF CORN PER ACRE.

WHERE USED FOR "WOODLAND PRODUCTIVITY", "GOOD" INDICATES SOILS ARE CAPABLE OF PRODUCING GREATER THAN 335 BOARD FEET PER ACRE PER YEAR FOR ADAPTED TREE SPECIES. "FAIR" INDICATES SOILS THAT WILL PRODUCE 260 TO 335 BOARD FEET AND "POOR" INDICATES THOSE SOILS THAT WILL PRODUCE LESS THAN 260 BOARD FEET PER ACRE PER YEAR.

USDA SOIL CONSERVATION SERVICE

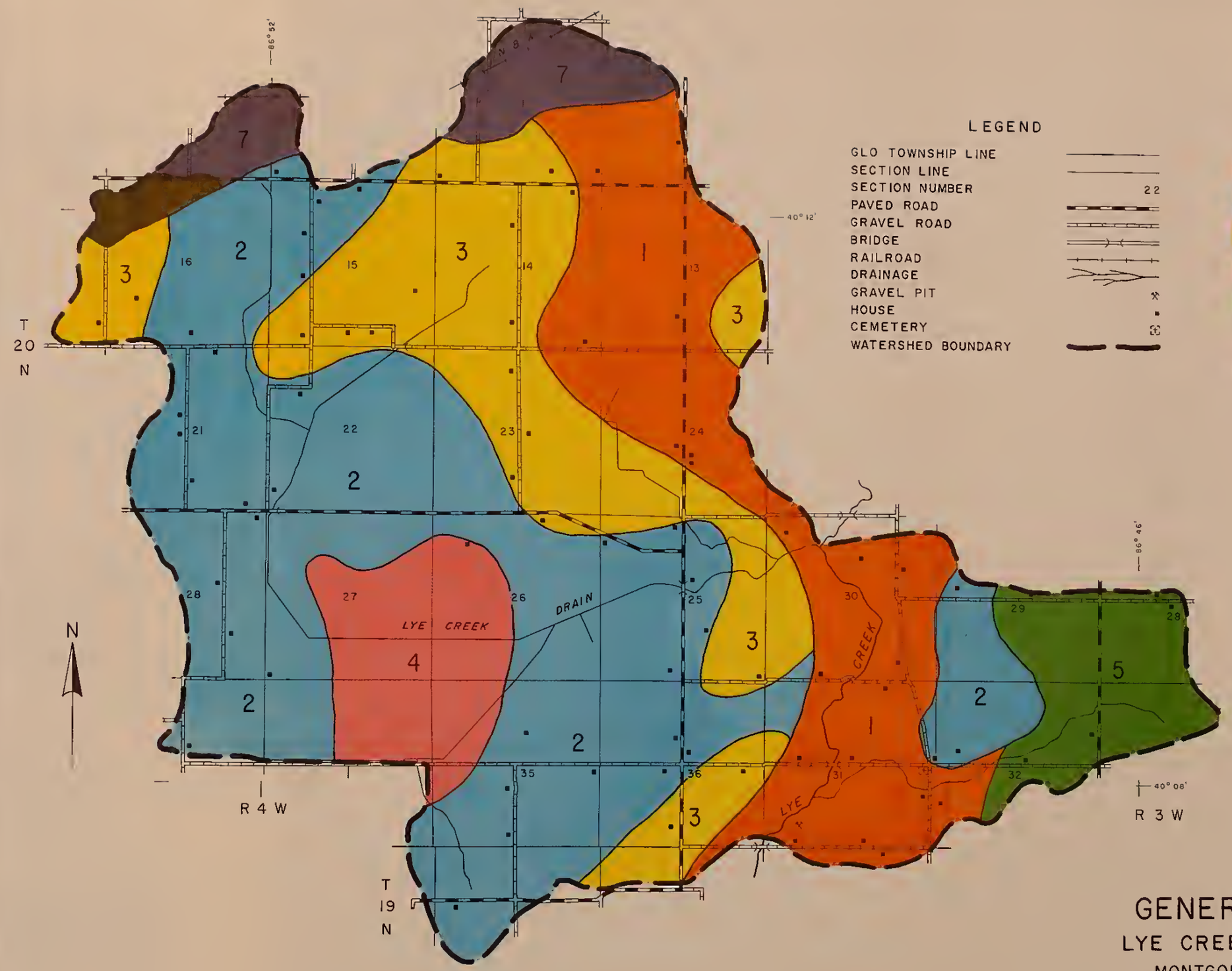
IN COOPERATION WITH

PURDUE UNIVERSITY

AGRICULTURAL EXPERIMENT STATION

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



LEGEND

- GLO TOWNSHIP LINE
- SECTION LINE
- SECTION NUMBER 22
- PAVED ROAD
- GRAVEL ROAD
- BRIDGE
- RAILROAD
- DRAINAGE
- GRAVEL PIT
- HOUSE
- CEMETERY
- WATERSHED BOUNDARY

GENERAL SOILS LEGEND

1. WESTLAND-OCKLEY
2. MAHALASVILLE-FINCASTLE-RAGSDALE
3. MIAMI-RUSSELL-FINCASTLE
4. MUCK AND PEATS
5. MIAMI-CROSBY
7. RAGSDALE-RAUB
8. BROOKSTON-PARR

GENERAL SOILS MAP

LYE CREEK DRAIN WATERSHED

MONTGOMERY COUNTY, INDIANA

SCALE 1/45,000

SCALE 1 0 1 SCALE

SOURCE.
SCS DRAWING 5,P-30392 AND
INFORMATION FROM FIELD TECHNICIANS.

POLYCONIC PROJECTION

USDA-SCS-LINCOLN, NEBR. 1974

EXHIBIT 7

REV 4-1-74
5,P-30393

DESCRIPTIONS OF SOIL ASSOCIATIONS ON THE GENERAL SOIL MAP

The general soil map shows seven soil associations in the watershed. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A description of each soil association on the general soil map follows.

1. Westland-Ockley association: Deep, nearly level and gently sloping, very poorly drained and well drained loamy soils formed in outwash.

Westland soils are nearly level and very poorly drained. Their surface layer typically is very dark brown clay loam about 11 inches in thickness. The subsoil is about 39 inches in thickness. In sequence from the top, the upper part is a dark grayish brown firm clay loam, 10 inches in thickness; the next 24 inches is dark grayish brown firm gravelly clay loam; and the lower 5 inches is dark gray firm gravelly clay loam. The calcareous underlying material, to a depth of about 60 inches, is gray and dark gray stratified sand and gravelly coarse sand.

Ockley soils are gently sloping and well drained. Their surface layer typically is dark grayish brown silt loam about 8 inches in thickness. The subsurface is dark brown friable silt loam about 4 inches in thickness. The subsoil is about 45 inches in thickness. In sequence from the top, the upper part is a dark brown firm silty clay loam and clay loam, 14 inches in thickness; the next 14 inches is dark brown firm gravelly clay loam; and the lower 17 inches is dark reddish brown firm gravelly sandy clay loam. The calcareous underlying material, to a depth of about 60 inches, is a stratified brown sand and gravelly coarse sand.

2. Mahalasville-Fincastle-Ragsdale association: Deep, nearly level and gently sloping, somewhat poorly drained and very poorly drained loamy soils formed in loess and the underlying lacustrine sediments, loess and the underlying glacial till, and loess.

Mahalasville soils are nearly level and very poorly drained. They formed in loess and the underlying lacustrine sediments. Their surface layer typically is a very dark gray silty clay loam about 12 inches in thickness. The subsoil is about 32 inches in thickness. In sequence from the top, the upper part is a gray firm silty clay loam, 27 inches in thickness and the lower part is light gray friable loam, 5 inches in thickness. The

material, to a depth of about 60 inches, is yellowish brown and gray loam.

7. Brookston-Parr association: Deep, nearly level and gently sloping, very poorly drained and well drained loamy soils formed in glacial till.

Brookston soils are nearly level and very poorly drained. They formed in glacial till. Their surface layer typically is very dark gray silty clay loam about 14 inches in thickness. The subsoil is about 32 inches in thickness. In sequence from the top, the upper part is a dark gray firm silty clay loam, 6 inches in thickness; the next 20 inches is a gray firm clay loam; and the lower 6 inches is yellowish brown firm clay loam. The calcareous underlying material, to a depth of about 60 inches, is brown loam.

Parr soils are gently sloping and well drained. They formed in glacial till. Their surface layer typically is very dark brown silt loam about 11 inches in thickness. The subsoil is dark yellowish brown firm clay loam about 20 inches in thickness. The calcareous underlying material, to a depth of about 60 inches, is very pale brown and yellowish brown loam.

U. S. DEPARTMENT OF AGRICULTURE

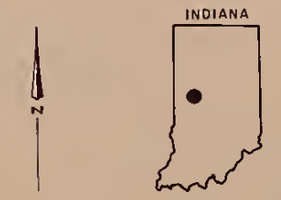
SOIL CONSERVATION SERVICE

LEGEND

GLO TOWNSHIP LINE	
SECTION LINE	
SECTION NUMBER	22
PAVED ROAD	
GRAVEL ROAD	
BRIDGE	
RAILROAD	
DRAINAGE	
GRAVEL PIT	
HOUSE	
CEMETERY	
WATERSHED BOUNDARY	

GENERAL SURFICIAL GEOLOGY LEGEND

- OUTWASH
- KAMES AND ESKERS
- MOSTLY GROUND MORAINE
- MUCKS AND PEATS
- VALLEY TRAIN DEPOSITS
- MOSTLY RECENT ALLUVIUM
- MOSTLY END MORAINE



GENERAL SURFICIAL GEOLOGY MAP

LYE CREEK DRAIN WATERSHED

MONTGOMERY COUNTY, INDIANA

SCALE 1/45,000

SCALE 1 0 1 SCALE

Exhibit 8

SOURCE:
SCS DRAWING 5,P-30392 AND THE
DANVILLE 1°X2° GEOLOGIC MAP, IDNR, IGS, 1966

USDA-SCS-LINCOLN, NEBR. 1974

POLYCONIC PROJECTION

3-4-74
5,S-32,976

Exhibit 9

SURFACE WATER QUALITY ANALYSES - APRIL 24, 1974

Site	Site Description	Discharge (cfs)	W. Temp. (°C)	SC (umhos)	DO (mg/1)
1	Lye Creek Drain @ Rd 900N, sandy bottom, many fish & minnows	1.6	14.5	610	13.6
2	Rusk Ditch @ Rd 900N, sand-mud bottom, fish or minnows not seen	.8	14.0	580	10.8
3	Rusk Ditch @ Rd 200E, sandy bottom, many fish and minnows	1.2	13.5	540	11.2
4	Lye Creek Drain @ Rd 800N, mud bottom, some fish and minnows	5.6	11.0	580	12.0
5	Durham Ditch @ Rd 650N near center of sec. 34, low-lying ditch draining muck area	.1	20.0	870	
6	6-inch tile drain outletting into Lye Creek Drain just upstream of Rd 450E	.1	10.5	480	7.9
7	Lye Creek Drain @ Rd 450E, sand-mud bottom with algal growth and iron oxide deposits, some minnows	9.6	11.5	750	15.6
8	Armentrout Tributary @ Rd 900N, spillway and tile drain outlet, thick grass in downstream flow	.3	11.5	650	7.6
9	6-inch tile drain outletting into Armentrout Tributary just above Rd 450E	.1	10.0	600	6.7
10	Armentrout Tributary @ Rd 450E, sandy bottom with much periphyton, some minnows	.9	15.5	610	15.9
11	Lye Creek @ Rd 800N, sandy bottom		13.5	560	14.4
12	24-inch tile drain outletting into Armentrout Drain just above Rd 650N in eastern part of sec. 31	1.3	9.5	620	8.1
13	Armentrout Drain just above Rd 650N near center of sec. 31, sandy bottom with much periphyton, 400' downstream from site 12	1.3	11.5	610	11.4
14	Lye Creek @ Rd 600N, cobble bottom with much periphyton		12.5	590	14.5

SUMMARY OF LYE CREEK DRAIN WATER-QUALITY DATA COLLECTED ON APRIL 30, 1974

Site	3	4	6	7	9	10	11	12
Drainage area (square miles)	2.38	7.84	---	14.3	---	1.69	56.3	1.54
Time	1745	1645	1515	1500	1415	1400	1245	1130
Discharge (cfs)	1.1	3.8	.03	6.2	.01	1.0	30	.9
Water temp. (°C)	14.0	15.0	10.0	15.0	10.0	15.0	16.0	8.0
pH, Field	7.4	8.0	7.5	8.4	7.5	8.0	8.1	7.3
Specific Conductance (umhos)	610	615	525	640	630	650	570	650
Dissolved oxygen	10.6	14.6	8.5	18.0	9.0	14.1	13.0	9.9
Calcium	85	85	76	92	87	88	77	87
Magnesium	26	29	26	30	28	31	27	29
Potassium	.9	.8	.4	.9	.7	.7	1.0	1.0
Sodium	4.4	5.4	3.8	6.7	4.2	4.6	5.8	4.2
Bicarbonate	302	308	308	311	274	304	288	312
Carbonate	0	0	0	6	0	0	0	0
Chloride	15	14	5.7	16	19	23	15	14
Fluoride	.6	.6	.5	.6	.6	.4	.4	.4
Sulfate	53	56	37	72	52	45	43	49
Silica dioxide	9.3	9.3	9.6	8.1	9.4	6.4	2.1	10
Dissolved solids	357	364	317	398	368	381	332	367
Total alkalinity (as $CaCO_3$)	248	253	253	265	225	249	236	256
Total hardness (as $CaCO_3$)	320	330	300	350	330	350	300	340
Noncarbonate hardness (as $CaCO_3$)	72	79	44	88	110	98	67	81
Ammonia, dissolved (as N)	0.10	0.04	0.04	0.05	0.04	0.05	0.08	0.07
Organic nitrogen, dissolved (as N)	.66	.44	.31	.51	.30	.33	.40	.25
Kjeldahl nitrogen, dissolved (as N)	.76	.48	.35	.56	.34	.38	.48	.32
Nitrite, dissolved (as N)	.03	.02	.01	.02	.01	.04	.03	.01
Nitrate, dissolved (as N)	3.0	2.7	1.4	2.7	7.3	7.2	4.1	4.1
Orthophosphate, dissolved (as P)	.01	.01	0	.01	.01	0	0	.02
Phosphate, dissolved (as P)	.05	.05	.04	.05	.05	.03	.03	.05
Organic carbon, dissolved		3.0	1.5	3.6				1.4
Aluminum, total		.40	.10	.30				.20
Iron, total		.71	.06	.49				.46
Iron, dissolved	.07	.23	.04	.06	.03	.02	.23	.14
Manganese, total		.10	.20	.13				.04
Manganese, dissolved	.17	.07	0	.07	0	0	.02	.02
Fecal coliform*	231	180		85		100	190	180
Fecal streptococci*	430	460		430		100	220	1300

milligrams per litre

*Colonies per 100 millilitres

Exhibit 9 Cont'd

SUMMARY OF AVAILABLE GROUND-WATER QUALITY ANALYSES

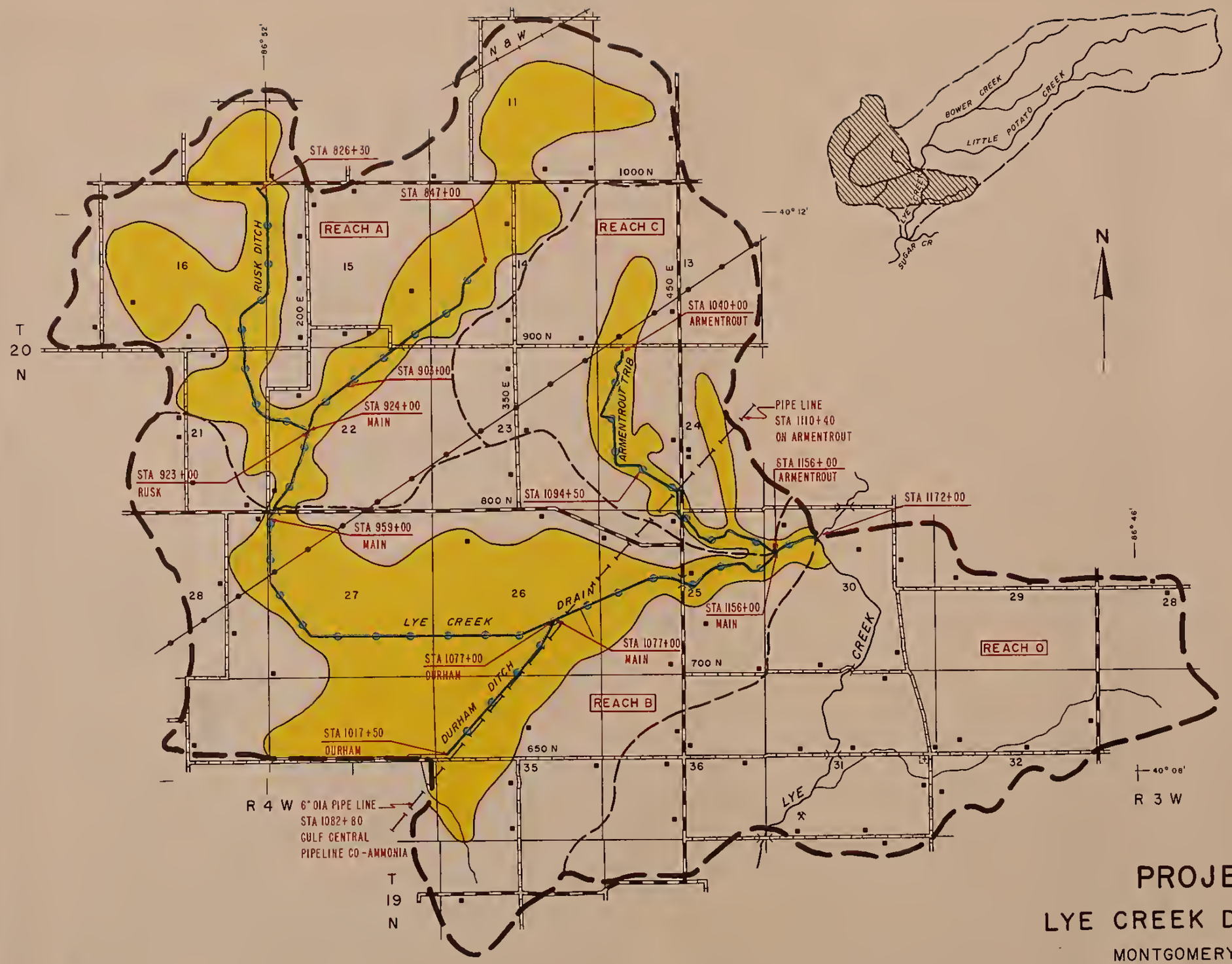
(All figures ppm unless otherwise labeled.)

20-3-31	20-4-8	20-4-11	20-4-21	20-4-21	20-4-23	20-4-27	20-4-33	20-4-36	LOCATION T-R-S
(4)	(2)	(3)	(3)	(2)	(3)	(2)	(2)	(4)	AQUIFER
	7.5								pH
63		55			56	54	60	55	T (°F)
	5								COLOR (S.U.)
	2								TURBIDITY (S.U.)
	332								HARDNESS($CaCO_3$)
444		328	204	372	288	324	372	204	HARDNESS ($CaMgCO_3$)
581		503	517	483	464	434	444	483	BICARBONATE (HCO_3)
	70								CALCIUM (Ca)
	38								MAGNESIUM (Mg)
	26								SODIUM (Na)
	3								POTASSIUM (K)
>7.5	1.8	2.5	1.0	3.0	0.8	7.5	3.0	0.2	IRON (Fe)
	0								MANGANESE (Mn)
	358								ALKALINITY ($CaCO_3$)
22	8	6	24	5	6	6	4	4	CHLORIDES (Cl)
	10		12						SULFATES (SO_4)
	0.1								NITRATES (N)
	0.7								FLUORIDES (F)
	Linden PWS						Gas in water		REMARKS

Sources: "Data on Indiana Public Water Supplies"
"Ground-Water Resources of West-Central Indiana, Bull. 27"

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



LEGEND

- U. S. TOWNSHIP LINE
- SECTION LINE
- SECTION NUMBER 22
- PAVED ROAD
- GRAVEL ROAD
- BRIDGE
- RAILROAD
- DRAINAGE
- GRAVEL PIT
- HOUSE
- CEMETERY
- POWER LINE
- PIPE LINE
- WATERSHED BOUNDARY
- SUBWATERSHED BOUNDARY
- BENEFITED AREA
- CHANNEL WORK
- MULTIPLE-PURPOSE

PROJECT MAP

LYE CREEK DRAIN WATERSHED

MONTGOMERY COUNTY, INDIANA

SCALE 1/45,000

SCALE 1 0 1 MILE

SOURCE
SCS DRAWING 5, P-30,392 AND
INFORMATION FROM FIELD TECHNICIANS

POLYCONIC PROJECTION

USDA-SCS-LINCOLN, NEBR. 1974

Exhibit II
3-8-74
5,S-32,984