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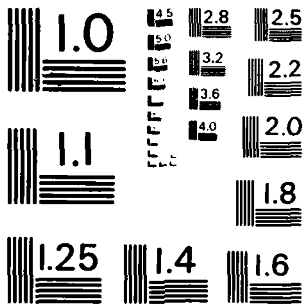

Environmental Inventory
Upper Cumberland River
Harlan, Kentucky

(16)

December 1981

US Army Corps
of Engineers
Nashville District

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

There is a high potential for significant environmental impacts resulting from the construction of alternative flood control measures at Harlan, Ky. and surrounding communities.

Located in southeastern Kentucky, the study area is composed of approximately 300 square miles along the Cumberland River and its three major tributaries, Poor Fork, Clover Fork, and Martins Fork. Lying within the Cumberland Mountains section of the Appalachian Plateau Physiographic Province, the topography is

typified by rugged mountains reaching elevations of 1263 meters.

The types of underlying rock in the area are predominantly Pennsylvanian shale, conglomerate siltstone and coal, capped with sandstones. Coal is by far the the most common mineral resource of economic importance. Majority of the area soils are composed of the Cuba silt loam series, with intermittent areas of Alleghany loam, Barbourville gravelly loam, whitley silt loam, and Shelocta gravelly silt loam.

The discharge from the Cumberland River and its tributaries above Harlan, Ky., varies greatly with climatic conditions. The flood of record accurred in April, 1977 and had devastating effects on the floodplains of the valley, including the associated urban areas. Peak discharge recorded was 64,500 cfs on April 5. Strip mining activities have significant adverse impacts on the hydrology and water quality. This stripminig could eventually lower pH values below acceptable levels, however, this impact is generally neutralized by carbonate materials present in soils and by aquifer materials beofre it enters.

Located in the Mixed Mesophytic Forest Region of North America, which, because of its cool, humid, and relatively high rainfall is the most diverse deciduous forest in North America. The project area supports very limited flora and very little natural vegetation remains in the project corridor, resulting in terrestrial fauna being limited. Twenty-two species of fish and 23 species of invertebrates were identified. One species of fish, Notropis galacturus, the whitetail shiner, represents the first known collection from above Cumberland Falls.

Six recreational facilities were identified. The Cumberland River represents a limited recreational resource in this area.

PREFACE

This environmental inventory of the area around Harlan, Kentucky, was prepared by Soil Systems, Inc., 525 Webb Industrial Drive, Marietta, Georgia 30062, under contract to the U.S. Army Engineer District, Nashville, Tennessee. The objective of the inventory was to use a multidisciplinary team of environmental professionals to prepare a comprehensive environmental resources data base for future flood control planning in the area. Meeting this objective required thorough literature searches, special field studies, data analysis, and presentation of findings in narrative and graphic form in several fields of study.

The inventory report which follows is presented in seven sections: (I) Introduction, (II) Description of the Project, (III) Environmental Resources, (IV) Coordination, (V) Exhibits, (VI) References, (VII) Appendices, and (VIII) Map Folio. Since the purpose of this inventory is to present data in a concise, easy-to-use form, bulky data have been removed from the body of the report to the Exhibits section.

The assistance provided by the representative of the contracting agency, Ms. Vechere Lampley, has been an invaluable asset to the inventory. Many other cooperating agencies and individuals also contributed significantly to the inventory. These are included in the Coordination section. However, several were particularly helpful, including Mr. Melvin Warren of the Kentucky Nature Preserves Commission, Dr. Branley A. Branson, Department of Biological Sciences, Eastern Kentucky University, and Mr. Wayne L. Davis, Kentucky Department of Fish and Wildlife Resources.

These organization and individuals deserve special credit for the extra effort and time they provided in assisting the study team.

A

SUMMARY

The potential for significant environmental impacts resulting from the construction of alternative flood control measures at Harlan and surrounding communities, is high. In compliance with the National Environmental Policy Act (NEPA) of 1969, the Nashville District U.S. Army Corps of Engineers will prepare a comprehensive report either an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) covering the various flood-reduction alternatives at Harlan Kentucky. This inventory has been completed in order to gather data necessary for the preparation of either of these documents.

Located in southeastern Kentucky, the study area is composed of approximately 300 square miles along the Cumberland River and its three major tributaries, Poor Fork, Clover Fork, and Martins Fork. The general area is easily accessible by U.S. 25E to U.S. 421, U.S. 119, and State 38.

The Harlan study area lies within the Cumberland Mountains section of the Appalachian Plateau Physiographic Province. This section has a topography typified by rugged mountains reaching maximum elevations of 1263 meters. The majority of the Cumberland Mountains section ranges in elevation from 730 to 1077 meters.

The types of underlying rock in the area are predominantly Pennsylvanian shale, conglomerate, siltstone and coal, capped with sandstones of variable thickness and hardness. Pine Mountain, the boundary between the adjacent Cumberland Plateau and the mountain section, does possess exposed limestones, siltstones, shales, and sandstones of the Devonian and Mississippian ages. Coal is by far the most common mineral resource of economic importance in the area, and is present in all parts of the study area. This valuable resource is undergoing extensive utilization presently and has also been historically mined in large quantities.

Relevant and up-to-date data on soils for the Harlan area are not abundantly available. No published or unpublished mapping was available, instead a specific soils survey of the study area was implemented by the Soil Conservation Service (SCS) office in Harlan just prior to the preparation of the Harlan Inventory. Because the study was limited to the area along the floodplain, the soil diversity is limited also. The majority of the study area is comprised of the Cuba silt loam series, with intermittent areas of Allegheny loam, Barbourville gravelly loam, Whitley silt loam, and Shelocta gravelly silt loam. All of these series are classified as Kentucky Prime Farmland Soils, however, due to urban planning and development only a very small amount of the total area is considered prime farmlands by the local SCS office.

The discharge from the Cumberland River and its tributaries in the study area varies greatly with climatic conditions. The maximum discharge, recorded in April, 1977 during the flood of record, was 64,500 cfs. At this flood stage the river has devastating effects on the floodplain areas of the valley, including the associated urban areas.

Strip mining activities within the watershed of the study area have significant adverse impacts on the hydrology and water quality of the Cumberland River. The most important impact of mining activities is the increased silt and sediment loads that are introduced into the streams. The construction of Martins Fork and Cranks Creek dams have greatly reduced the amount of siltation found in the lower 15 miles of Martins Fork, they have also lowered the amounts of suspended and dissolved solids released downstream. The overall quality of the water chemistry within the study area is acceptable within the parameters outlined by the state of Kentucky. Stripmining activity could potentially lower pH values below acceptable levels, however, this impact is generally neutralized by carbonate materials present in soils and by aquifer materials before it enters streams.

The study area is situated in the Mixed Mesophytic Forest Region of North America, which, because of its cool, humid, and relatively high rainfall, is the most diverse deciduous forest in North America. Although mesophytic forests occur in the general vicinity of the project area, they are not found in the immediate project area. Due the long period of development in the project area, it supports a very limited flora. Very little natural vegetation remains in the narrow project corridor. Four vegetative communities presently occur in the study area, they are, in order of abundance, scrub, residential, agricultural land, and alluvial forest.

The region's terrestrial fauna is limited because of the absence of a wide variety of vegetative communities. Many upland species of migratory birds potentially inhabit this area, but are commonly found elsewhere in the state. The aquatic collection conducted for this project identified 22 species of fish and 23 species of invertebrates within the study area. One species of fish, Notropis galacturus, the whitetail shiner, represents the first known collection from above Cumberland Falls.

The arrow darter, Etheostoma sagitta, is presently considered as threatened in Kentucky by the Kentucky Nature Preserves Commission. Although it was not collected during the present investigation, it is known from localities close to the study area.

Six recreational facilities were identified within the study area, only one was privately-owned, the Harlan Country Club. The City of Harlan presently operates the following three facilities. Huff Park, Harlan High School, and Harlan Elementary School. The City of Loyall maintains Loyall City Park and Loyall Elementary School. The Cumberland River represents a limited recreational resource. It is not well suited for recreational boating, and fishing is relatively poor, due to the inaccessibility of the river throughout most of the study area. Martins Fork Lake does possess the attributes to maintain a high level of recreation, however, this lake is not within the study area.

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I. INTRODUCTION

I.1. Authority

The work undertaken in this environmental inventory of the area in and around Harlan, Kentucky, was authorized by resolutions of the Committees on Public Works of the U.S. Senate and House of Representatives on March 19, 1963 and June 19, 1963, respectively. The Congressional resolutions responded to the severe property damage caused by the extensive floods that occurred in March, 1963 along the Cumberland River. Congress asked the Chief of Engineers to study the flood problems of the upper Cumberland River Basin and to determine whether the existing project should be modified for the protection of the areas residents. The exact resolution is as follows:

> Resolved by the Committee on Public Works of the U.S. Senate (and House of Representatives) that the Board of Engineers for Rivers and Harbors, be, and is hereby, requested to review the reports of the Chief of Engineers on the Cumberland River and its tributaries, Tennessee and Kentucky, published as House Document 761, 79th Congress, Second Session, and other reports, with a view to determining whether the existing project should be modified in any way at the present time, with particular reference to the provision of improvements for flood control and allied purposes in the Upper Cumberland River Basin, in view of recent severe floods and resulting heavy damage in the area.

The Corps of Engineers produced an interim report, which in 1965 resulted in the authorization and construction of Martins Fork Dam at a location upstream from Harlan. A draft survey report was completed and submitted for review in August, 1967. However, this report was returned to the District for re-evaluation and coordination with ARC studies. Further funding for additional studies in the area was authorized in November, 1974 after continued flooding and the expression of local concerns regarding the resulting damages. This study was under way when the flood of record occurred in April, 1977, necessitating revision of all economic and hydrologic data.

Section 202 (PL 96-367) of the Energy, Water Development Appropriation Act of 1981, passed on October 1, 1980, authorized and directed the Secretary of the Army, acting through the Chief of Engineers, to design and construct flood-control measures at, or in the vicinity of, Pineville, Kentucky, and other flood-damaged localities and their immediate environs on the Cumberland River. In May, 1981 the Senate Supplemental Appropriations and Recission Bill clarified that the Corps of Engineers' authorities under Section 202 includes nonstructural, as well as structural, activities.

I.2. Purpose of Environmental Data Inventory

The potential for significant environmental impacts to result from the construction of alternative flood control measures at Harlan, Loyall, Rio Vista and vicinity, is high. In compliance with the National Environmental Policy Act of 1969 the Nashville District of the U.S. Army Corps of Engineers will prepare a comprehensive Environmental Impact Report (EA or EIS) covering the various flood reduction alternatives at Harlan, Kentucky This inventory has been completed in order to gather data necessary for preparing the report. This inventory also provides information to assist in planning for the development of flood-control measures and for monitoring environmental impacts both during construction and after completion of the project. Data concerning engineering soils, unique geological features, and sensitive communities of plants and wildlife have been gathered to indicate where suitable soils for constructing a levee might be found and what natural features might be affected when borrow material is gathered for such construction. Data on water quality and aquatic biology have been gathered to determine the potential impacts and to provide baseline data for any subsequent surveys aimed at determining the actual impacts of any flood-reduction measures implemented.

II. PROJECT DESCRIPTION

II.1. General

The project's study area includes approximately 300 square miles of southeastern Kentucky along the Cumberland River and its three major tributaries, Poor Fork, Clover Fork, and Martins Fork, from Cumberland River mile (CRM) 690 below Harlan, to mile 2 of Poor Fork, mile 4 of Clover Fork, and mile 15.6 of Martins Fork.

The discharge from the Cumberland River and its tributaries above Harlan, Kentucky, varies greatly with climatic conditions. Exhibits 1, 3-5, 7, and 9 provide information relative to discharge rates within or near the study area. The flood of record occurred in April, 1977, and had devastating effects on the floodplain areas of the valley, including the associated urban areas. The peak discharge recorded was 64,500 cfs on April 5.

The scope of this study is to provide a basic description of ecosystems encountered in the upper Cumberland River Basin within the study area, with specific emphasis on vegetative communities, geology, wildlife, fisheries, aquatic invertebrates, and water quality. Recreation resources and facilities of the study area are also described.

II.2. Location

The study area is located in extreme southeastern Kentucky and is aligned along the Cumberland River and its three prinicipal tributaries as they flow through and around the city of Harlan, Kentucky. Figure 1 presents a vicinity map for the area. The nearest major city is Knoxville, Tennessee, approximately 140 miles southwest of the study area. Corbin, Kentucky, the largest town near the area, is 70 miles northwest of Harlan. The site is easily reached from U.S. 25E on U.S. 119 from Corbin or from U.S. 421 from Kingsport, Tennessee. Figure 2 illustrates the exact study area included in this inventory.

The City of Harlan is located on a horseshoe bend of Clover Fork. In Harlan, the slope of the Clover Fork channel is about 12 feet per mile. Channel width is about 100 feet with banks measuring from 5 to 30 feet. Considerable development in Harlan is on high ground; however, floods have inflicted substantial property damage. Most commercial development in Harlan is located on Clover Fork and the lower end of Martins Fork. Martins Fork enters Clover Fork at about mile 1.6, just below the new U.S. 421 Bridge. The main channel of Martin's Fork in Harlan is about 80 feet in width.

The towns of Baxter, Loyall and Rio Vista are immediately downstream from the formation of the Cumberland River and lie in a narrow valley ranging from 1000 to 1500 feet in width. This highly developed valley, with its greatest density at Loyall, is subject to flooding with about 80 percent of the acreage lying within the floodplain of the 100 year flood zone. The river channel averages about 150 feet in width with banks about 30 feet in height.

III. ENVIRONMENTAL RESOURCES

III.1. General

The study area lies wholly within the Cumberland Mountains section of the Appalachian Plateau Physiographic Province. This section extends northeast-southwest through portions of Kentucky, Tennessee, and Virginia. This division is bounded on the north by the unglaciated Allegheny Plateau section, on the west principally by the Cumberland Plateau section, and on the east by the Ridge and Valley province. The Cumberland Mountains section is approximately 250 kilometers long and 42 kilometers wide. Its topography is distinct from that of the adjacent Cumberland Plateau in that the mountains are much higher reaching maximum elevations of 1263 meters. The majority of the Cumberland Mountains section ranges in elevation from 730 to 1077 meters, while elevations in the neighboring Cumberland Plateau are generally in the range of 430 to 660 meters, with the highest point recorded as 910 meters.

The types of underlying rock in the area are predominantly Pennsylvanian shale, conglomerate, siltstone and coal, capped with sandstones of variable thickness and hardness (Bouchard 1976). Pine Mountain, the best boundary between the plateau and mountain sections, does possess exposed strata of limestones, siltstones, shales, and sandstones of the Devonian and Mississippian ages. Soils are generally thin, porous and acidic, with high runoff.

All climatic data available for the study area is from reporting stations in the valleys at Middlesboro and Williamsburg. These data indicate an average of 48.4-50.4 inches of precipitation annually. The average daily temperature in the summer is approximately 76°F (July), and the average temperature in the winter is approximately 39°F (January). The higher elevations in the mountainous study area usually cause higher average rainfall, as well as cooler temperatures. These factors especially influence the character of the forests in the higher elevations and on the north and west slopes of these mountains.

Differences in the predominant vegetation of the study area will be used here to define the different habitats. These differences are due largely to a slope's exposure, elevation, and geology, under natural conditions. The study region is situated in Mixed Mesophytic Forest Region described by Braun (1950). This forest region is characterized by having a great number of dominant canopy tree species along with a lush and highly diverse herbaceous layer. However, as will be discussed in Section III.5, the immediate project area no longer contains this type of vegetation, due to man's development and its' resulting impacts.

The region's fauna is mostly typical of that of the west slope of the Allegheny Plateaus. Because of the region's central location in the humid eastern United States and because of the influences from other regions of faunal distribution, its fauna has the potential to be quite diverse. The appropriate sections of this document dealing with the terrestrial and aquatic faunas will address this condition in depth.

III.2. Geology

III.2.1. General

The area of interest, which contains the towns of Harlan, Baxter, Loyall, and Rio Vista, Kentucky, lies on the northeast-southwest trending Pine Mountain overthrust fault block. The area is situated almost completely on floodplain alluvium deposited by the Cumberland River and four of its tributaries, including portions of the Martins, Clover, and Poor Forks, and the Fourmile Branch. Drainage over the area exhibits a highly developed classic dendritic pattern. The development of urban areas is limited to the wider areas of floodplain, either where tributaries converge with the Cumberland River, or where the river meanders leave wide areas of alluvium deposited in their paths as they migrate downstream. The Cumberland River and its tributaries involved in the study area are confined in narrow, steep-sided, V-shaped valleys, surrounded by Sukey Ridge, between the north side of the Cumberland River and the west side of Poor Fork; Black Mountain, between the east side of Poor Fork and the north side of Clover Fork; Little Black Moutain, between the south side of Clover Fork and the east side of Martins Fork; and the Ewing Spur, between the west side of Martins Fork and the south side of the Cumberland River. The mountainous terrain is typical of the Cumberland Mountain region with ridge to valley elevations ranging from EL 3040 to EL 1160 and irregular ridges being characteristic throughout the area. The bulk of the information presented in this section was gathered utilizing data contained in the U.S. Geological Survey Geologic 7.5 minute maps (1972, 1975).

III.2.2. Alluvium and Colluvium

Alluvial deposits are located on valley bottoms and consists of unconsolidated sand, silt, gravel, and clay. Deposits of flat but rounded boulders and cobbles composed of siltstone and soft sandstone from local outcrops are confined in the major stream channels. Stratified clay, silt, and sand, with some pebbles, overlies the channel gravel in thicknesses up to five feet in terraces where the floodplains are the widest. The most well-drained surfaces in this area are the terraces and floodplains along the Martins, Poor, and Clover Forks of the Cumberland River. Colluvium consists of angular blocks and boulders of sandstone in a matrix composed of poorly-sorted gravel, sand, silt, and clay. Landslide deposits are comprised of slumped, colluvial beds and dislocated bedrock. Although no landslide debris or colluvium is mapped within the study area, small localized deposits may be encountered along unstable slopes, forming a veneer over the steep-sided valleys and, then, thinning and merging with the alluvial deposits at the bases of the slopes.

III.2.3. Bedrock Lithology

The area of interest lies on the fringe of where the bedrock begins to dip more steeply as it approaches the Pine Mountain overthrust fault. The tectonic activity in the past has caused rock of Pennsylvanian (300-325 million years old), Mississippian (325-350 million years old), and Devonian (350-400 million years old) ages to be thrust to the surface with Pennsylvanian rock being exposed on the mountain ridges and steep-sided slopes immediately surrounding the area of interest, and those of Mississippian and Devonian ages being exposed only in the proximity of Pine Mountain. The sequence of sediments is as follows:

Hignite Formation (Lower and Middle Pennsylvanian) Interbedded sandstone, siltstone, limestone, and coal. Sandstone is light to medium gray and is partially micaceous and feldspathic; cliff-forming; caps Black and Little Black Mountains. Shale is medium to dark gray and is partially carbonaceous. Includes limestone coal bed.

Catron Formation (Lower and Middle Pennsylvanian) Shale interbedded with sandstone, siltstone, and coal. Sandstone is partly argillaceous, continuous in upper portion of formation and lenticular in basal portion; cliff-forming; caps Ewing spur. Includes Wallins Creek and Smith coal zones.

Mingo Formation (Lower and Middle Pennsylvanian) Gray sandstone interbedded with partially calcareous siltstone and shale which contain marine fossils. Includes Darby, Harlan, Creech, and Kellioka coal beds.

Hance Formation (Lower and Middle Pennsylvanian) Principally siltstone interbedded with shale, sandstone, and coal. Sandstone at top of formation caps Sukey Ridge. Includes Hance coal zone which outcrops near Pine Mountain.

Lee Formation (Lower Pennsylvanian) Interbedded sandstone, shale, siltstone, and coal. Sandstone is generally light to medium gray and partially conglomeritic.

Pennington Formation (Mississippian and Pennsylvanian) Quartzose sandstone interbedded with siltstone and shale in the upper and basal portions; locally calcareous and fossiliferous; cliff-forming.

Newman Limestone (Mississippian) Calcareous shale and limestone; locally cherty and dolomitic; fossiliferous.

Grainger Formation (Mississippian) Shale interbedded with siltstone and sandstone.

Chattanooga Formation (Devonian and Mississippian) Dark gray, pyritic, carbonaceous shale.

III.2.4. Structural Geology

The dominant geologic structure in the area is Pine Mountain and its associated overthrust fault block. The area within the boundaries of the area of interest has been only mildly affected by the tectonic activity associated with the Pine Mountain orogeny. The study area exhibits a relatively flat-lying, homoclinal structure. A map of unique geological structures was not deemed necessary due to the homoclinal nature of the structure and the complete absence of folding or faulting within the confines of the area of interest. The structural relief within the area of study is comparatively shallow when compared with the nearby Pine Mountain. The topographic relief which is present is principally controlled by the dendritic drainage pattern with ridges being formed where there is more resistant rock capping those topographic structures.

III.2.5. Seismic Activity

The area of study lies in the Southern Appalachian Seismic Zone (Bollinger, et al. date unknown), which is an area of greater than average seismic activity. Since the historical record was begun in 1774, three earthquakes of Modified Mercali Intensity V to VI have occurred within a 40 miles radius of the area of interest. The epicenters of two of these events were approximately two miles east of Middlesboro, Kentucky, which is about 20 miles southwest of Harlan, Kentucky. One occurred in 1975 and the other occurred in 1954. The third occurrence was centered about one mile north of Barbourville, Kentucky, which lies approximately 35 miles west of Harlan and occurred in 1976.

III.2.6. Mineral Resources

The only mineral resource that has been developed in the general area is coal. Only one exploratory well was drilled for oil and natural gas on the west side of Ewing Creek. The well showed only minor amounts of natural gas and oil in a carbonate zone which probably underlies the Pine Mountain overthrust fault.

Upon a thorough examination of the study area, no coal mines or coal outcrops were observed within the limits of the area of interest. The coal in the general area is exposed in contour outcrops which are located on the sideslopes of the ridges. The closest outcrop to the study area lies on the 1400 foot topographic contour and is located about three-tenths mile southeast of Harlan, Kentucky. Several outcrops of coal are present but are further removed from the area of interest. Since this was found to be the case, a map of mineral resources does not accompany this report. Due to the fact, however, that the general area exhibits several outcroppings of coal, a brief discussion of the coal reserves has been included since a few of these small outcroppings are within 500 to 1000 feet of the limits of the study area and might be considered for exploitation in the future.

Most of the coal is of a highly volatile, a bituminous rank. The most highly exploited beds are about 3.5 feet thick, although beds throughout the area range in thickness from a few inches to 11 feet.

The Harlan Coal Bed is the most widely exploited of all the major coal beds in the area. This coal has been almost totally exploited since it possesses excellent coking qualities and has a consistent thickness and is generally free of partings.

The Darby Coal Bed is similar to the Harlan in continuity, thickness, and quality. The Darby coal is characteristically a high-quality coal with low ash content. Mining of this bed has been extensive and remaining reserves are small.

The Wallins Creek and Smith coal zones have been extensively augered and stripmined in the higher ridges. The Smith coal is generally impure and possesses a high ash content.

The Hance coal zone has been mined underground along Fourmile Branch and is split by relatively thin shale partings. It is exposed to a minor extent on the south side of Pine Mountain.

The Kellioka coal bed is irregular in thickness, being about two feet thick over most of the area. This coal bed has not been mined extensively due to its high ash content.

Future use of reserves in the area of interest are primarily dependent on the mining of exposed coal beds less than two feet in the thickness and on exploration for, as yet, unexposed coal beds.

III.2.7. Soils and Prime Farmlands

The data for the soils interpretation and mapping was provided by the Soil Conservation Service (SCS) office in Harlan. Since no published or unpublished mapping was available, a specific soils survey of the study area was implemented by SCS just prior to the preparation of the Harlan Inventory. The study area is limited to the area along the banks and floodplain of the Cumberland River and Clover, Martin, and Poor Forks. Consequently, the soil diversity in the study area is limited as a result of similar soil developmental characteristics.

The majority of the study area (80-90 percent) is comprised of the Cuba silt loam series, with intermittent areas of Allegheny loam, Barbourville gravelly loam, Whitley silt loam, and Shelocta gravelly silt loam. Descriptions of these soil series are found in Table 1. All of these series are classified as Kentucky Prime Farmland Soils at slope classifications less than 6 percent. However, only the limited area shown on Figure 3 are considered prime farmlands by the local SCS office because of urban planning and development.

There are several areas of fill material, located south and west of the confluence point of Martin and Clover Forks, at the origin of the Cumberland River. The areas of fill are mapped (Figure 3) because individual site investigations are required for interpretations as to their suitability for engineering purposes and farming potential.

Two different USDA soil classification groups, the Shelocta and Whitley series, were interpreted as suitable for engineering purposes, primarily based on the physical characteristics of the Plasticity Index and the Liquid Limit. Based on a minimum Plasticity Index of 15 and a minimum Liquid Limit of 40, these two soil series are the only known groups in the area that are considered suitable for engineering purposes. However, both series are interpreted as having severe limitations to embankment, dike, and levee construction. These soils are mostly found underlying the urbanized areas of Harlan and Loyall. Two locations not urbanized, are found in the vicinity of the confluence point of Poor Fork with the Cumberland River and shown on Figure 3.

TABLE 1. SOIL DESCRIPTIONS, HARLAN INVENTORY, HARLAN, KENTUCKY

Allegheny loam, 2-6 percent slopes. Deep, well drained, acid soil. Loamy plow layer. Moderate erosion hazard when cultivated. High yield potential.

Barbourville gr. loam, 2-6 percent slopes. Deep, well drained, acid soil. Gravelly loam plow layer. Moderate erosion hazard when cultivated. Moderate yield potential.

Barbourville gravelly loam, 6-12 percent slopes. Deep, well drained, acid soil. Gravelly loam plow layer. Severe erosion hazard when cultivated. Moderate yield potential.

Cuba silt loam. Level, deep, well drained, acid bottom soil. Erosion hazard is slight to none. Yield potential is very high where flooding is not a hazard.

Fill material. Individual site investigation required for interpretations.

Shelocta gravelly silt loam, 12-20 percent slopes. Deep, well drained, acid soil. Gravelly silt loam plow layer. Very severe erosion hazard when cultivated.

Whitley silt loam, 2-6 percent slopes. Deep, well drained, acid soil on stream terraces with a silt loam plow layer. Moderate erosion hazard when cultivated. Yield potential is high.

Whitley silt loam, 6-12 percent slopes. Deep, well drained, acid soil on stream terraces with a silt loam plow layer. Severe erosion hazard when cultivated.

III.3. Hydrology

III.3.1. Surface Water

III.3.1.1. Cumberland River

The Cumberland River is formed by the junction of Clover and Poor Forks in Harlan, Kentucky; it terminates approximately 694 miles downstream at its confluence with the Ohio River.

The Cumberland River watershed drained by the downstream limit of the study area (CRM 690) is roughly triangular in shape, and its long axis is oriented in an southwest-northeast direction. This watershed has a drainage area of approximately 374 square miles (Mayes, Sudderth and Etheredge, Inc. 1975). The drainage pattern within the Cumberland River is dendritic in shape.

The Kentucky Division of Water has adopted a system whereby the Upper Cumberland River Basin is divided into sub-basins, or segments. This system was developed by Mayes, Sudderth and Etheredge, Inc. (1975). The study area contains portions of segments 42, 43, 44, and 45. Figure 4 illustrates these subbasins.

Within the study area, the Cumberland River is an Order V stream, one characterized by a few shoals over bedrock and large rock substrates, and long pools of moderate depths with sand, silt and coal substrates.

Within the study area, the U.S. Geolcgic Survey (U.S.G.S.) maintains streamgaging stations in each of the three major tributaries, as well as in the Cumberland River, itself, within the study area. Exhibits 1, 3-5, 7, and 9 summarize available discharge data.

III.3.1.2. Tributaries

The three major tributaries which combine to form the Cumberland River consist of Martins Fork, which flows in a northerly direction to merge with Clover Fork and which enters the system from the east. The third tributary is Poor Fork which flows in a southwesterly direction to join Clover Fork and Martins Fork at the community of Baxter, in Harlan County. The official origin of the Cumberland River is considered to be the point where Clover Fork and Poor Fork merge, with Martins Fork often considered a tributary to Clover Fork.

All three of these tributaries are classified as Order IV, and exhibit a wide range of flow characteristics. They all originate in, and flow through, areas of rough topography which are, at times, heavily strip-mined for coal. The rate of fall for these tributaries is relatively steep, and the substrates are primarily bedrock with large quantities of boulder and rubble. Well-defined streambanks, 5 to 30 feet in height, support dense growths of riparian vegetation.

Due to the poor quality of the area's soils, extensive strip-mine activity, haul-road construction, and occassional logging activities within the area, the tributaries are subject to extreme and rapid rises after prolonged or intense precipitation.

III.3.1.3. Floods

The Cumberland River and its principal tributaries respond rapidly to precipitation with a pronounced discharge peak following major storms, an indication that a high percentage of the yearly runoff occurs as direct surface runoff. Several factors contribute to the very rapid surface drainage within the study area. The relatively steep topography, the narrow and restricted watershed, the fairly thin weathered rock mantle, and the moderate permeability of the bedrock all combine to result in significant fluctuations in discharge within the study area (Talley 1979).

The majority of floods area occur during the wet winter and spring months (December through April). Although the area experiences severe summer thunderstorms, the longer duration of less intense spring storms usually produces the peak flow for the year. Rain falling in April, 1977, produced the flood of record (U.S. Geologic Survey 1980). Table 2 shows the history of flood occurrences in the Cumberland River near Harlan, Kentucky.

III.3.1.4. Droughts

Two major droughts have occurred in the Upper Cumberland River Basin since recorded hydrologic data has been available. In 1930, Kentucky suffered the most severe dry period it has ever known, and during the late summer and fall of 1953 another severe and equally devastating drought took place. The streamflows measured by the gages at Barbourville and at Cumberland Falls dramatically illustrate the severity of the two droughts, Table 3.

III.3.2. Groundwater

In the upper Cumberland River Basin, groundwater is generally abundant in the eastern half (which includes the study area) of the basin. In the Cumberland Mountains section the Pennsylvanian rocks supply fresh waters for both wells and stream recharge. Movement through these rocks is principally through small openings along joint systems, bedding planes, and fractures, with some flow through the interstitial openings of the medium and coarse-grained sandstone.

In the study area, because most people live along streams, nearly all wells are drilled in valley bottoms. Here, wells generally yield 500 gallons per day. With such an ample water supply it is not unusual for some communities to utilize wells for the water supply.

Groundwater is currently the most common source of domestic water for the residents of the upper Cumberland River Basin (Mayes, Sudderth and Etheredge 1975).

III.3.3. Effects of Mining

Mining on a watershed can have significant effects on its hydrology. In addition to coal, strip mining removes large amounts of soil and weathered rock overburden down to a layer of shale underlying the coal, which removes, or greatly reduces, the volume of material capable of holding and transmitting

TABLE 2. FLOOD OCCURRENCES
CUMBERLAND RIVER NEAR HARLAN, KENTUCKY

Date of Crest	Crest State (Ft.)	Discharge (Cfs)	Date of Crest	Crest Stage (Ft.)	Peak Discharge (Cfs)
January -, 1918	22.0	-	April 16, 1956	15.75	22,000
March -, 1929	20.0	-	July 16, 1956	10.47	11,800
February -, 1939	15.0	-	January 29, 1957	19.89	31,000
April 20, 1940	10.0	10,500	December 7, 1957	13.33	17,100
July 4, 1941	8.30	8,140	May 7, 1958	12.06	14,600
March 17, 1942	10.40	11,000	January 22, 1959	17.57	25,900
December 30, 1942	11.7	13,800	June 2, 1959	10.55	11,900
March 13, 1943	11.1	12,700	November 28, 1959	11.65	13,900
April 19, 1943	12.64	15,600	February 23, 1961	10.23	11,400
February 17, 1944	18.40	27,700	February 25, 1961	12.63	15,700
February 29, 1944	14.0	18,400	December 18, 1961	10.32	11,500
March 19, 1944	10.0	11,000	February 28, 1962	13.67	17,700
February 17, 1945	9.87	10,800	March 6, 1963	15.50	21,400
January 8, 1946	22.81	37,900	March 12, 1963	24.89	43,100
January 15, 1947	12.6	15,600	March 17, 1963	20.28	31,900
January 20, 1947	13.2	16,800	May 16, 1963	10.39	11,700
June 28, 1947	15.02	20,400	March 5, 1964	8.49	8,530
February 14, 1948	17.35	25,500	January 10, 1965	10.49	11,800
January 5, 1949	11.83	14,200	March 26, 1965	14.13	18,700
March 18, 1949	11.3	13,200	February 13, 1966	13.79	18,000
December 13, 1949	11.4	13,400	May 1, 1966	8.80	9,030
January 30, 1950	13.85	18,100	December 28, 1966	9.64	10,400
February 2, 1950	12.2	14,900	January 27, 1967	9.36	9,930
December 7, 1950	10.80	12,400	March 7, 1967	20.88	33,300
January 15, 1951	9.74	10,600	December 22, 1967	9.71	10,500
February 1, 1951	16.63	23,800	March 12, 1968	9.62	10,400
February 21, 1951	10.04	11,100	February 2, 1969	6.14	5,050
December 8, 1951	9.92	10,900	December 31, 1969	24.90	43,200
December 15, 1951	14.66	19,700	February 15, 1970	11.22	13,100
December 21, 1951	9.95	10,900	April 2, 1970	11.25	13,200
January 22, 1952	11.06	12,800	April 28, 1970	17.90	26,600
March 23, 1952	11.66	13,900	December 21, 1970	9.65	10,400
February 21, 1953	12.97	16,300	February 5, 1971	9.34	9,890
May 19, 1953	12.58	15,800	May 7, 1971	14.23	18,900
January 16, 1954	9.29	9,810	January 21, 1972	11.22	12,000
December 30, 1954	11.09	12,900	January 28, 1972	9.88	9,820
March 6, 1955	9.95	10,900	February 25, 1972	11.36	12,200
March 16, 1955	12.14	14,800	April 12, 1972	14.05	16,900
March 22, 1955	14.41	19,200	December 10, 1972	16.66	21,900
February 18, 1956	14.50	19,400	March 16, 1973	18.70	26,000
March 14, 1956	10.72	12,200	May 28, 1973	14.36	17,400

Date of Crest	Crest State (Ft.)	Discharge (Cfs)	Date of Crest	Crest Stage (Ft.)	Peak Discharge (Cfs)
November 28, 1973	19.74	28,200	March 30, 1975	13.81	16,500
December 26, 1973	13.17	15,300	May 18, 1975	9.74	9,610
January 11, 1974	19.22	27,100	March 30, 1976	14.42	17,600
March 21, 1974	15.02	18,600	April 5, 1977	30.26	64,500
April 4, 1974	9.39	9,080	October 2, 1977	13.21	15,200
June 2, 1974	10.58	10,900	October 9, 1977	9.73	9,580
March 12, 1975	15.48	19,500	November 7, 1977	16.07	20,600
March 24, 1975	11.49	12,400	January 26, 1978	12.60	14,100

NOTES:

(1) Period of gage record, March 9, 1940 to September 1978.
(2) Zero of gage, elevation 1140.10.
(3) List includes annual (water year) maximums and all other rises exceeding a stage of 10 feet, or a flow of 8200 cfs.
(4) Stages for rises prior to start of gage records were estimated from high-water marks.

Source: U.S. Army Corps of Engineers, 1979.

TABLE 3. STREAMFLOWS, IN CFS, MEASURED AT BARBOURVILLE AND CUMBERLAND FALLS DURING TWO MAJOR DROUGHTS

Duration	Barbourville		Cumberland Falls	
	1930	1953	1930	1953
1-day	0.5	7.0	18.0	6.0
7-days	5.4	7.5	19.7	6.2
14-days	8.5	7.7	20.1	7.1
60-days	14.7	14.1	37.7	10.2
90-days	19.5	20.1	53.9	17.7
120-days	24.2	31.8	62.1	48.4

Source: Mayes, Sudderth and Etheredge, Inc., 1975 water. The extent and proximity of strip mining on a watershed will determine its effect on an area's drainage and runoff. Harlan County, is the leading coal producing county in the basin and ranks third in production in the state.

Surface mining in the region has been shown (Curtis 1973; Collier, et al. 1964) to increase the discharge, and consequently the flood potential, of receiving streams. In addition, it creates greater variability in stream flow and less retention and storage of groundwater. Effects of surface mining on water quality will be discussed in detail in Section III.4.

III.4. Water Quality

III.4.1. General

The Cumberland River's water quality within the study area can be described in general terms as ranging from fair to good; perhaps the most accurate conclusion is that, at best, the water quality of the Cumberland River and its main tributaries where they enter the Cumberland River meets the Kentucky State Standards. Parameters of water quality, which have been measured at numerous locations within or near the study area, are presented in Exhibits 2 through 10. The locations of the sites sampled during the present investigation are plotted on Figure 4. Station descriptions are also given in Section III.6.2. The methodology followed for the chemical analyses presented is given in Table 4.

The water quality of several tributary streams near the study area is significantly degraded. Pollution from strip or shaft mines has degraded 29 miles of Martins Fork, 20 miles of Clover Fork, and 40 miles of Poor Fork (Mayes, Sudderth and Etheredge, Inc. 1975). Exhibit 11 lists all reports of stream pollution, exclusive of fishkills, which the Kentucky Department of Fish and Wildlife Resources investigated from 1977-1980.

The major problems with water quality are the abnormally high loads of silt and sediment contributed to the river. Another problem is the input from acid mine drainage.

It was forecast that, with the construction of Martins Fork Lake in 1978 the water quality below the lake would improve. Those parameters which presumably would be most affected included suspended solids, dissolved solids, and sediment load. Theoretically the lake would act as a settling basin wherein the levels of the above parameters would be reduced. Although for the present investigation, it was not possible to locate data from before impoundment that was directly comparable to that which was taken during this study, a qualitative evaluation reveals that sediment deposits are indeed less below the dam than in adjacent streams. Also the values for both dissolved and suspended solids in Martins Fork were the lowest for any of the sites sampled throughout the study area. The values for these parameters increase as you move downstream due to the introduction of materials from tributary streams.

TABLE 4. METHODOLOGY FOR WATER QUALITY ANALYSES USED IN THE PRESENT STUDY

Test	EPA Method Code	Maximum Holding Time	Summary
pH	150.1	6 hours	Electrometric
Total Dissolved Solids	160.1	7 days	Gravimetric, Dried at 180°C
Total Suspended Solids	160.2	7 days	Gravimetric, Dried at 103-105°C
Alkalinity	310.1	24 hours	Titrimetric to pH 4.5
BOD	405.1	24 hours	5 Days at 20°C
Dissolved Oxygen	360.1	6 hours	Membrane Electrode

Holding time apply only where proper preservation steps have been taken:

All parameters require refrigeration at 1-4.4°C after receipt into the laboratory. For actual holding times, please consult individual analysis.

III.4.2. Silt and Sediment

The major cause of the excess silt and sediment present in the streams is the extensive coal mining on the area's watershed (Curtis 1973; U.S. Army Corps of Engineers, 1976; Mayes, Sudderth and Etheredge, Inc. 1975; Harker, et al. 1979, 1980; and Talley 1978). Introduced sediments produce high suspended solids loads in the streams of the mountainous headwaters area. Sediment is transported from spoil banks, unreclaimed areas, abandoned mining areas, deforested areas, sediment retention structures which fail or do not operate properly, coal washing activities, and from construction and use of haul roads. Coal washing activity causes the release of so-called "blackwater" into the drainage basin. It is called blackwater because of the large amount of fractionated coal contained in it. An additional source of introducted sediment into the Cumberland River is the highway construction presently occurring in Harlan.

The excessive turbidity at high flows and the other large sediments associated with strip mining are very obvious features of the streams in the study area. These negative impacts from stripmining are not unexpected. Stripmined areas can yield over 1000 tons of sediment per acre per year to receiving waters (U.S. Army Corps of Engineers 1976). The erosion rates can increase more than eight times on a partially stripmined watershed. These factors, obviously, increase sediment loads, suspended solids, and discharges in the receiving streams.

Upstream mining and the secondary causes of increased silt and sediment adversely affect fish populations in two ways. First, silt and sediment can indirectly harm the fish population by reducing its macrobenthic food supply. The gradual destruction of aquatic macroinvertebrate populations caused by increased siltation has been well documented. The size of populations and the number of taxa are both dramatically reduced (Branson and Batch 1972; Tebo 1955; Virginia Polytechnic Institute and State University 1971; Henderson 1949; Duchrow 1980; Czarnezki 1980; Vaughn 1979; Penrose, et al. 1980; Collier, et al. 1964, 1970). However, it has also been shown that the populations will recover once the stress from increased siltation is removed (Talak 1977; Matter, et al. 1978; Vaughn, et al. 1978; Duchrow 1980).

Direct deleterious effects to fish populations are the second way in which increased siltation from mining, logging, and road construction can harm fish (Branson and Batch 1974; Starnes and Starnes 1978; Harker, et al. 1979; Vaughn 1979). Siltation damages fish primarily by smothering incubating eggs (Cordone and Kelly 1961; Branson and Batch 1971; Shaw and Magna 1943) and by covering preferred habitat. Darters and minnows are particularly susceptible to elimination, with resulting fish populations always smaller in total numbers and in number of species present.

III.4.3. Acid Mine Drainage

The study areas' secondary problem with water quality, acid drainage, is also the result of coal mining activities (Mayes, Sudderth and Etheredge, Inc. 1975; Talley 1978). This problem is caused by acid drainage from coal deposits which contain quantities of sulfides and sulfates. Oxidation of iron disulfide, exposed by mining, initiates the formation of water-soluble acidic pollutants, such as ferrous sulfate and sulfuric acid. These chemicals are, at times, neutralized by natural calcium carbonate in the water. In the study area, a limestone bed and calcareous shale formations create a relatively high natural alkalinity in the Cumberland River and its major tributaries, which allows them to buffer acidic waters coming in from some tributary streams and upstream sources. Acidic groundwater is generally neutralized by carbonate minerals present in soils and by aquifer materials before it enters streams. The buffering prevents the natural pH in the Cumberland River from being significantly lowered. This stabilization of pH prevents the acid mine drainage received by the Cumberland River within the study area from becoming the severe problem it is in many other streams adjacent to the study area, including several of the Cumberland's tributaries.

The adverse effects acid drainage from coal mining causes to aquatic macroinvertebrates populations are well documented (Lackey 1938; Roback and Richardson 1969; Warner 1971; Koryak, et al. 1972; Tomkiewicz and Dunson 1977). It has also been demonstrated that these populations will recover if the stress from lowered pH is alleviated (Herricks and Cairns 1974; Preston and Green 1978). The extreme physiological harm low pH can cause in fish has been soundly substantiated and was recently reviewed (Stuhrenberg 1980). The destructive results of these effects on fish populations have been demonstrated in several Appalachian streams (Collier, et al. 1964; Nichols and Bulow 1973; Carrithers and Bulow 1973; Turner 1958).

III.4.4. Organic Wastes

Biodegradable wastes impose a load on the dissolved oxygen resources of a stream. Such discharges affect water quality based upon the relationship between amount of discharge and amount of flow in the stream. Also, the slope (reaeration characteristics) of the stream determines to a great extent the ability of the stream to revive itself after being subjected to organic wasteloads.

Exhibit 12 lists some of the main municipal, domestic, and industrial dischargers known from the study area at the time of the report of Mayes, Sudderth and Etheredge, Inc. (1975).

In addition to acting as the only significant point source pollution, domestic discharge is also responsible for much of the excess organic waste load in receiving streams. A significant amount of litter, a large part of its biodegradable, is apparent on the banks and backwaters of the river. Most of the trash is household garbage that was improperly discarded on the streambanks of the watershed. The next period of high flow removes the accumulation; to the short-sighted, this seems a good method of waste disposal.

Much of the observable debris is non-biodegradable, and as such would have very little impact on the actual water quality of the river.

III.4.5. Conclusions

The most critical water quality problem affecting the study area is the unnaturally high load of silt and sediment caused by present and past mining, logging, and road construction on its upstream watershed. This situation causes changes in, and the eventual elimination of, fish and macroinvertebrate fauna and a deterioration of the area's aesthetic values. A major ecological trait that sensitive fish species in this area share is a general intolerance of high turbidity and excessive siltation. These conditions cause the progressive elimination of sensitive fish species and is occurring in the Cumberland River and its tributaries within the study area. These problems could become much worse as the current energy situation causes an increase in coal mining, especially in areas on the Cumberland River watershed (Richland Coal Today 1980). Less than 40 years ago the water quality of the Cumberland River was high (U.S. Army Corps of Engineers 1964; Clay et al. undated). "Prior to land use changes in the basin, the quality of water in these streams was apparently quite good. Percolation of rainfall through the soils of heavily vegetated mountainsides provided a constant but regulated flow of relatively sediment free water" (Talley 1979).

III.5. Terrestrial Biology

III.5.1. General

The Harlan, Kentucky, study area is located along the upper reaches of the Cumberland River in and around the towns of Harlan, Baxter, Loyall, and Rio Vista. This area is situated in the Cumberland Mountain Physiographic Region of southeastern Kentucky, a rugged mountainous area which is included in the great mixed mesophytic forest region described by Braun (1950). This forest region is characterized by having a great number of dominant canopy tree species along with a lush and highly diverse herbaceous layer.

Although mesophytic forests and other closely related deciduous forests occur in the general vicinity of the project area, they are not found in the immediate project area. The Harlan study area supports a very limited flora and fauna due to the fact that it is situated in an area which has been developed for many years. In fact, very little natural vegetation remains in the narrow project corridor, thus limiting potential wildlife.

The four vegetative communities which occur in the project area are, in order of abundance, scrub, residential, agricultural land, and alluvial forest. These communities are depicted in Figure 5, and are described below along with their potential fauna. The scientific and common names of the potential flora and fauna of the study area are included in Appendices 1 and 2. Species listed in the appendices are based on field observation and literature references (Barbour 1971; Barbour, et al. 1973; Barbour and Davis 1974; Braun 1950; Conant 1975; Kuehne, et al. 1979; Warton and Barbour 1971 and 1973). Appendices 3 and 4 included endangered, threatened, and special concern species of plants and animals reported to occur in Harlan County, Kentucky by the Kentucky Nature Preserves Commission (1981).

III.5.2. Vegetation Types

III.5.2.1. Scrub

The scrub community is the most abundant vegetative community (Figure 5). Scrub vegetation includes abandoned fields and disturbed ground which are in early stages of succession and are dominated by fast growing weed species.

Trees and shrubs which characterize the scrub community include box elder, black locust, river birch, sycamore, mimosa, princess tree, tree of heaven, poison ivy, and sumac. Herbaceous plants include common weeds such as giant ragweed, knotweed, lespedeza, beggar's ticks, asters, golden rods, cranesbill, pokeweed, and broomsedge. Japanese honeysuckle and kudzu are often found in this plant community.

In terms of wildlife, old fields often support a great variety of wildlife, while disturbed areas are much less attractive to wildlife. Opossum, cottontail rabbit, several species of rodents, and fox are potential inhabitants of the old field area. Many species of birds are attracted to old field habitats due to the abundance of forage material which is usually available. Birds which frequent old fields include the killdeer, nighthawk, mourning doves, common crow, brown-headed cowbird, grackle, field sparrow, indigo bunting, and American goldfinch. It should be noted, however, that these species are not restricted solely to the old field habitat. Reptiles also can be quite abundant in old fields, while amphibians are somewhat restricted due to the lack of water. Northern fence lizard, five lined skink, black racer, black rat snake, and garter snake are all likely to occur in the old field habitat.

III.5.2.2. Residential

Residential vegetation which includes native and exotic plants used to landscape homes, streets, and businesses is the second most abundant type of vegetation found in the project area (Figure 5). Plants commonly used for landscaping in the project area include white pine, weeping willow, silver and red maple, holly, apple trees, tulip poplar, sycamore, flowering quince, dogwood, and azaleas. This type of vegetation supports few species of wildlife other than birds such as sparrows, cardinals, robins, mockingbirds, crows, and towhees, all of which are mmon in residential areas.

III.5.2.3. Agricultural Land

Agricultural land is uncommon in the project area and is restricted to a small area along the Cumberland River west of Rio Vista (Figure 5). This agricultural area is a pasture which has a few fruit trees planted on one side. Fescue and other grasses are the predominant vegetation.

Agricultural land can support a variety of wildlife, especially when located adjacent to forestlands. However, in this case, the agricultural land is adjacent to a residential area (Figure 5), which minimizes its value as a wildlife habitat. The most abundant species in such situations are generally birds and rodents. Birds which could be expected include killdeer, meadowlark, nighthawk, mourning dove, hummingbirds, common crow, grackle, field sparrow, barn swallow, and Carolina wren.

III.5.2.4. Alluvial Forest

The alluvial forest community is the least abundant vegetative type and the only natural vegetative community present in the project area. Alluvial forest is found on the banks and floodplains of the Cumberland River and its tributaries.

The canopy trees of the alluvial forest include river birch, hornbeam, sycamore, silver maple, American elm, sweetgum, tulip poplar, willow, and box elder. Common shrubs, include alder, dogwood, spicebush, and poison ivy. Jewelweed, knotweed, asters, joe-pyeweed, Japanese honeysuckle, and microstegium grass are common herbaceous plants in the alluvial forest.

The alluvial forest supports a variety of terrestrial wildlife. Mammals which frequent the alluvial forest include raccoon, mink, muskrat, opossum, bats, and fox. A great variety of birds utilizes this habitat; the green heron, barred owl, several species of woodpeckers, blue jay, chickadee, cardinal, vireos, towhee, flycatchers, and ovenbird are just a few of the birds which frequent this habitat. Amphibians and reptiles in the alluvial forest community are numberous and include American toad, wood frog, tree frogs, spring peeper, several species of salamanders, black racer, ringneck snake, garter snake, and hognose snake.

III.5.2.5. Non-Vegetated Land

This classification applies to the Harlan Business District which consists of many large buildings and little to no vegetation (Figure 5). This area is of little importance as a wildlife habitat as it only supports a few species which have become adapted to urban environments.

III.5.3. Endangered Species and Sensitive Ecological Areas

Twenty-four plant species and four wildlife species included on the Kentucky Nature Preserves List of Rare Elements of Natural Diversity have been documented in Harlan County (Appendices 3 and 4). No species included on the Federal List of Endangered and Threatened Species have been reported from Harlan County. Due to the disturbed nature of the project area, it is highly unlikely that any of the rare species noted above would occur in the project area.

There are no ecologically sensitive areas in the study area. Wetland communities were not noted during air-photo interpretation, nor are they likely due to the nature of the terrain.

III.5.4. Vector Biology

III.5.4.1. General

The incidence of vector-borne diseases in the United States is greater than records indicate, and this region is no exception. The surveillance, diagnosis, and reporting of vector-borne disease cases is a problem in rural areas, due to limited facilities and personnel. Thus, it is not surprising that there are no data available concerning documented cases of vector-borne diseases in the study area.

The vector-borne diseases most likely to occur in the project area are St. Louis Encephalitis and Rocky Mountain Spotted Fever. Other vector-borne diseases less likely to occur include Tick Bite Paralysis, California Encephalitis, Tularemia, and Q Fever.

III.5.4.2. St. Louis Encephalitis

St. Louis Encephalitis can cause serious disease in man and is characterized by suddenly developing headache and malaise, fever, marked drowsiness, and often nausea, vomiting and convulsions. This disease is caused by a virus in birds which is transmitted to man and horses by mosquitoes. Some of the more common species of birds which are known to be affected by the virus include house sparrows, pigeons, blue jays, and robins.

Four species of mosquitoes including *Culex pipiens*, *C. tarsalis*, *C. salinarius*, and *C. restuans* are possible vectors for St. Louis Encephalitis in the study area. *Culex salinarius* and *C. restuans* are the most important vectors, with the latter species being most important due to its preference for woodland pools and pools in streams. *Culex pipiens* is more common north of the study area, and *C. tarsalis*, an important western vector, is uncommon in the east. It should be noted, however, that mosquitoes are relatively uncommon in the region of the study area because of the lack of stagnant water; thus, mosquito-borne vector diseases are rare.

Between 1971 and 1976, there were 151 reported cases of encephalitis in Kentucky. The worst outbreak of encephalitis in Kentucky occurred in 1956 when 110 cases and 12 deaths were reported. Most encephalitis occurs in and around major cities and, in Kentucky, the area along the Ohio River has the greatest number of reported cases (Center for Disease Control 1976).

Although the vast majority of the cases of encephalitis in Kentucky have been St. Louis Encephalitis, rare cases of California Encephalitis have also been recorded in the state.

III.5.4.3. Rocky Mountain Spotted Fever

Rocky Mountain Spotted Fever is a disease characterized by rashes or spotting on the skin and high fever. The disease is caused by the virus *Rickettsia rickettsii* which is carried by rodents and other wild animals, and is transmitted to man by ticks. The major vectors are the American dog tick (*Dermacentor variabilis*) and, to a lesser extent, the lone star tick (*Amblyomma americanum*). These ticks are most often found in recently disturbed areas where there is dense vegetation (Center for Disease Control 1978). A steady rise in the incidence of Rocky Mountain Spotted Fever has occurred during the last 20 years. This increase reached a high of 1115 cases nationwide in 1977. During this 20 year period, there has been a shift in the geographical distribution of this vector-borne disease from the western states to the east and south Atlantic states. Although between one and five cases were reported from several counties near the study area in 1976, no occurrences have been reported from Harlan County (Center for Disease Control 1978).

III.5.4.4. Other Vector-Borne Diseases

Tick bite paralysis is a progressive ascending motor weakness caused by a neurotoxic substance in the saliva of the female hard tick. The disease is most frequent in children; in adults the disorder rarely progresses to full paralysis. Removal of the tick usually results in complete recovery within 24 to 72 hours. In the region of the study area, the American dog tick is the most common cause of this disorder. This disease also occurs in cattle, sheep, horses, and dogs (Center for Disease Control 1978).

Tularemia (rabbit fever) is a bacterial disease of rabbits and rodents which can be transmitted by ticks of the genera *Dermacentor*, *Ambloyomms* and *Haemephysalis*. This disease is also subject to transovarial and transtadial transmission. Humans acquire the disease through tick bites or contact with infected animals or tick feces. Other arthropods, such as the deer fly, can also be important in the spread of the disease (Center for Disease Control 1978). Tularemia occurrence has been declining steadily since 1950 and is rare in Kentucky (Center for Disease Control 1978; Kappus 1979). The nearest epicenter of incidence is in Arkansas (Center for Disease Control 1978).

Q Fever, which is not likely to be of consequence, is a rickettsial disease caused by the virus *Coxiella burnetti*. This disease has been recorded in veterinarians and farmers in the United States. The Rocky Mountain wood tick (*Dermacentor andersoni*), lone star tick, spinose ear tick (*Otobius megnini*) and many other species may transmit this virus. Tick tissue and feces become massively infected with this rickettsial agent; it is thought that humans inhale the disease organisms with dust and droplets contaminated with material from infected animals (Center for Disease Control 1978). No statistics on the frequency and distribution of this disease are available.

III.6. Aquatic Biology

III.6.1. General

The aquatic fauna of southeastern Kentucky has been the subject of various collection efforts for over 150 years. However, only a comparatively small number of collections have been made due to the relative inaccessibility of the area. The computer printouts available from the Kentucky Department for Natural Resources and Environmental Protection, Division of Water, which list all aquatic biota recorded for a particular sub-basin, are the only attempt at a complete compilation of the data from published collection efforts.

Within the study area itself, little collecting of aquatic fauna has been done, and there have been no attempts to synthesize the scattered collection records into a comprehensive review. The primary objective of the aquatic biology portion of this project was to compile just such a comprehensive inventory of the aquatic fauna in the study area. An extensive search of the literature and field collections were used to achieve this objective. The methods and results of the field collection efforts are described in the following section. These are followed by the complete inventory presented in taxonomic groupings. All amphibians (Phylum Chordata, Class Amphibia), including those with an aquatic adult stage, are considered in the terrestrial discussions of this inventory.

III.6.2. Field Collections

The aquatic fauna was sampled on September 30 and October 1 at a total of 12 locations. These sites are depicted on Figure 4 in the Map Folio. Intensive collecting at each site included sampling of all available habitats (e.g. overhanging banks, riffles, pools, silt-laden backwaters, and moss- covered rocks) for both macroinvertebrates and fish. Collecting techniques consisted of a 20-foot seine, triangular kick nets, and hand picking substrates. Fish were preserved in the field in 10 percent formalin and were later transferred to 55 percent isopropyl alcohol for storage. Macroinvertebrates were preserved in the field in 55 percent isopropyl alcohol. The fishes were identified using keys in Pflieger (1975), Clay (1975), and Etnier (unpublished mimeo). Macroinvertebrates were identified through the use of keys in Parrish (1975), Pennak (1978), Usinger (1956), Edmunds, Jensen, and Berner (1976), and Wiggins (1977).

Collections of fish and macroinvertebrates were made at 12 different locations. The following list gives the station number, locality description, date of collection and selected physical parameters. Station descriptions are based on the 7.5 minute Topographic Maps produced by the U.S. Geological Survey (1978; 1980).

Collecting Stations:

1. Martins Fork immediately below Martins Fork Lake at mile 15.4, south of Cawood, Harlan County, Kentucky. October 1, 1981. Water Temperature-20°C; Air Temperature-22°C; pH-6.88; Substrate-rubble and boulders, with scattered pockets of gravel, and abundant amounts of coal washings present; Current-moderately fast; Width-maximum of 200 feet below dam; Depth-2" to 5'.

2. Martins Fork at mile 12 along State Highway 987 South of Cawood, Harland County, Kentucky. October 1, 1981. Water Temperature-18.2°C; Air Temperature-22°C; pH-6.87; Substrate-rubble and some boulders, all with very heavy deposits of silt, 3-4 inches thick; Current-moderately slow; Width-maximum 75 feet; Depth-1' to 10'.

3. Martins Fork at mile 9 along U.S. 421 at Bobs Creek, southeast of Harlan, Harlan County, Kentucky. October 1, 1981. Water Temperature-19°C; Air Temperature-26°C; pH-7.08; Substrate-rock and rubble with large amounts of silt present; Current-moderately slow; Width-maximum 40 feet; Depth-2" to 2'.

4. Martins Fork at mile 6 along U.S. 421 at Chevrolet, southeast of Harlan, Harlan County, Kentucky. October 1, 1981. Water Temperature-22°C; Air Temperature-26°C; pH-7.42; Substrate-large slab rocks with scattered patches of rubble and gravel; Current-slow; Width-maximum 50 feet; Depth-1' to 3'.

5. Martins Fork at mile 3 off U.S. 421 behind Memorial Hospital and adjacent high school, Harlan, Harlan County, Kentucky. September 30, 1981. Water Temperature-20°C; Air Temperature-27°C; pH-7.58; Substrate-gravel and rubble with dense unknown algal growths, silt load heavy; Current-moderately slow; Width-maximum 40 feet; Depth-4" to 3'.

6. Martins Fork just above junction with Clover Fork in Harlan, Harlan County, Kentucky. September 30, 1981. Water Temperature-22°C; Air Temperature-25°; pH-7.95; Substrate-rock and rubble, with heavy deposits of silt in backwaters where all rocks were covered with silt; Current-moderately fast; Width-maximum 70 feet; Depth-4" to 4'.

7. Clover Fork at mile 4 along State Highway 38 at Coxton, northeast of Harlan, Harlan County, Kentucky. September 30, 1981. Water Temperature-23°C; Air Temperature-26°C; pH-8.52; Substrate-rock and rubble, heavy deposits of iron compounds, also recent gravel removal evident; Current-moderately fast; Width-maximum 60 feet; Depth-4" to 3'.

8. Clover Fork at mile 2 at Kitts along State Highway 38, northeast of Harlan, Harlan County, Kentucky. September 30, 1981. Water Temperature-22°C; Air Temperature-25°C; pH-8.14; Substrate-gravel and rubble with small amounts of silt deposited in pools; Current-moderately slow; Width-maximum 45 feet; Depth-2" to 4'.

9. Cumberland River at and just above junction of Poor Fork and Clover Fork, CRM 694, Harlan, Harlan County, Kentucky. September 30, 1981. Water Temperature-23°C; Air Temperature-26°C; pH-7.2; Substrate-rock and rubble with patches of sand; Current-moderately fast; Width-maximum 200 feet; Depth-2" to 8'.

10. Poor Fork Cumberland River at mile 1.7 at Gatun along U.S. 119, Harlan County, Kentucky. September 30, 1981. Water Temperature-23°C; Air Temperature-26°C; pH-8.17; Substrate-gravel and rubble with coal deposits and silt deposits; Current-moderately slow; Width-maximum 50 feet; Depth-4" to 3'.

11. Cumberland River at mile 692, west of Harlan at Loyall, Harlan County, Kentucky. October 1, 1981. Water Temperature-24°C; Air Temperature-26°C; pH-7.85; Substrate-mud and silt, 2 to 3 feet thick; Current-slow; Width-maximum 175 feet; Depth-1' to 10'.

12. Cumberland River at mile 690 just south of Keith and north of Fresh Meadows off U.S. 119, Harlan County, Kentucky. September 30, 1981. Water Temperature-23°C; Air Temperature-26°C; pH-8.47; Substrate-mud bottom often with silt deposits four feet thick, with giant boulder outcroppings common; Current-moderately fast; Width-maximum 250 feet; Depth-2' to 15'.

III.6.3. Aquatic Invertebrates

Table 5 presents the list of aquatic invertebrates collected during the present investigation. Exhibit 13 lists aquatic invertebrates collected in or near the study area by previous investigators. Sampling techniques were qualitative in nature, therefore, the number of specimens collected at any one station should be regarded with care. An attempt was made, however, to spend an equal amount of time sampling the various types of habitats available at each station. The data should, therefore, present an estimate of the abundance of the various taxa collected.

TABLE 5. AQUATIC INVERTEBRATES COLLECTED FROM THE HARLAN STUDY AREA

Taxa	Collection Sites 1	2	3	4	5	6	7	8	9	10	11	12
Decapoda												
Cambaridae												
Orconectes sp.	7		1	3	2	10	5	13	2	6		2
Ephemeroptera												
Baetidae												
Baetis sp.					1	3	1	4				
Caenidae												
Caenis sp.									2			
Heptageniidae												
Stenacron sp.	4			12	2	5	2			4		
Stenonema sp.			7	3	4	2	18	2	7	1		
Siphlonuridae												
Isonychia sp.							2	4	1			
Tricorythidae												
Tricorythodes sp.			1									
Odonata												
Aeshnidae												
Boyeria vinosa		11							1	1		
Epiaeschna sp.		1										
Coenagriidae												
Argia sp.	2			1			2	1		3		
Macromiidae												
Macromia sp.	3	1	1							4	4	2
Hemiptera												
Gerridae												
Metrobates sp.											1	
Megaloptera												
Corydalidae												
Corydalus cornutus	4		3	4	2	2	7	8	5	5	1	
Trichoptera												
Hydropsychidae												
Cheumatopsyche sp.	21		11		14	5	1	7	1	1		
Hydropsyche sp.	8				11	2	6	4		4		
Hydroptilidae												
Leucotrichia sp.									4			
Philopotamidae												
Dolophilodes sp.								1				
Coleoptera												
Elmidae												
Stenelmis sp.			7									
Diptera												
Chironomidae	9	1				1		3	3			

Taxa	Collection Sites											
	1	2	3	4	5	6	7	8	9	10	11	12
Mollusca												
Ancylidae												
Ferrissia sp.				1						4		
Physidae												
Physa sp.	1							1				
Planorbidae												
Heliscma sp.	33											
Pleuroceridae												
Goniobasis sp.										27		
Total Number of Taxa:	10	5	7	6	7	8	9	11	9	11	3	2
Total Number of Taxa Collected in Study Area: 23												

The invertebrates collected during the present study belong to two Phyla and three Classes. The Phylum Mollusca was represented by the single Class Gastropoda with four genera: Ferrissia, Physa, Helisoma, and Goniobasis. The Phylum Arthropoda was represented by two classes, Crustacea and Insecta. The Class Crustacea contained only the genus Orconectes, the common crayfish. This genus was collected from all stations, except 2 and 11. Station 11 was characterized by deep, slow-moving pools with mud and silt bottoms, conditions which crayfish of the group collected generally do not inhabit.

The remaining 18 taxa collected belong to the large and diverse Class Insecta. They constitute 78 percent of the total number of taxa collected during the study.

Few people now doubt the importance of the insects as part of the overall fauna of the aquatic biotope. They are found inhabiting all types of habitats, feeding on a complete range of food habits, and possessing numerous adaptations to aquatic respiration. In order to assess the "quality" of the streams in the study area one must first assess the diversity of life currently existing there. If the stream is undamaged it would theoretically support a diverse and balanced fauna, with all trophic levels proportionally represented. This, in essence, would typify a "healthy" stream. In order to determine this, the physical structure and available habitats must be considered. Any downward change from this state would be considered "biological damage," and does not necessarily bear any relation to use, economics, or aesthetics (Roback 1974).

In the study area, Stations 2, 11, and 12 were lacking riffle habitats, which normally contain the microhabitats which are inhabited by numerous species of Ephemeroptera, Plecoptera, and Odonata. This condition is clearly manifested in Table 5, where those stations contain the fewest number of taxa. The absence of the order Plecoptera from the study area may possibly be explained by the fact that this order is one of the most pollution-sensitive group of aquatic insects found in the southeastern United States. Their absence could be due to collecting efforts, i.e., not present during sampling, however, because of the concerted effort to sample all available habitats this explanation can be ruled out. Harker, et al. (1980) collected several genera of Plecoptera from streams which drain into the study area (Exhibit 13). The locations of their samples was upstream from the present study and occurred in habitats, dominated by shallow, oxygen-rich riffles, they were also in areas receiving little to no pollution.

The order Megaloptera was represented by one species, Corydalus cornutus. Another common genus, Sialis, was not collected during the present study. Sialis is generally considered more tolerant than Corydalus, often times becoming common in acid-mine drainages. Perhaps the presence of Corydalus is indicative of the capabilities of the soil and rock formations of the area to neutralize acidic runoff from stripmines.

III.6.4. Fish Inventory

Because of the splitting of old species, elevation of subspecies to species rank, merger of species, and confusion of species, it is difficult to assess the older records. The habitats where the species were collected, however, generally agreed with those presented by Lee, et al. (1980).

Members of the family Cyprinidae dominated the ichthyofauna, constituting 45 percent of the total number of species. Centrarchids were next in abundance, constituting 27 percent of the total.

The collection of Notropis galacturus represents the first records for the species above Cumberland Falls.

A total of 22 species of fish were collected during the present investigation (Table 6). Previous literature documents a total of 38 forms (consists of both species and subspecies) of fish known to naturally inhabit the Cumberland River above Cumberland Falls. An additional 18 species have been introduced. Table 7 presents those forms known from above Cumberland Falls along with possible reasons for the absence of a form from the study area.

As was also noted with the data from the aquatic invertebrate inventory, there is a drastic drop in the number of species found between stations 1 and 2. This reduction is most likely due to the absence of a riffle habitat at Station 2, where the stream consisted of a long, slow-flowing pool. This could also be due to the introduction of runoff waters from strip mines. An examination of the results obtained from the water quality analyses taken during the present study reveals no significant differences between the two stations.

Previous studies concerned with stream inventories have revealed the phenomenon known as "longitudinal succession." It, in short, consists of the general trend of the addition of species with increasing stream size, most likely due to the addition of new stable habitats with increased stream size. Bauer, et al. (1978) found that streams receiving significant amounts of pollution may exhibit a reversal of this phenomenon, with fewer species found in larger sections of streams below the point of effluent introduction. In the present study there is no trend for the addition of species with increased stream size, probably representative of fluctuating water quality conditions at each individual sampling site.

III.6.5. Aquatic Fauna of Special Interest

According to the Kentucky Nature Preserves Commission (KNPC), the only species found near the study area which is presently on their Kentucky list of Rare Elements is the arrow darter, Etheostoma sagitta, known at present from Martins Fork above Martins Fork Lake and also from the headwaters of Bobs Creek, a tributary to Martins Fork below Martins Fork Lake. This species is sensitive to strip mine pollution and currently inhabits these two areas because there is no strip mine activity close to their localities. This species is presently considered threatened by KNPC, and should, therefore, be protected from strip mine runoff.

III.6.6. Conclusions

The aquatic fauna found represents a fauna that has or is presently being impacted from either domestic or strip mine pollution, or both. Monitoring and enforcement of violations at the state level is the responsibility of the Kentucky Department of Natural Resources, Bureau of Surface Mining Reclamation & Enforcement, and Bureau of Environmental

TABLE 6. FISHES COLLECTED FROM THE HARLAN STUDY AREA

	Collection Sites											
Taxa	1	2	3	4	5	6	7	8	9	10	11	12
Cyprinidae												
Campostoma anomalum	1			1	2	3	9	1	3			
Ericymba buccata	2		5		2		5		2			
Notropis chrysocephalus			3	1	5	1	6	4	4	4		3
N. galacturus							2	1				
N. rubellus	2	1	17	5	34	14	7	71	74	14	15	15
N. spilopterus			5	10	4	2	1	13	5	3	14	
N. volucellus											1	6
N. whipplei						1			2	1		
Pimephales notatus	22		14		4	15	5	8	6	1	30	22
Semotilus atromaculatus			1		2			1				
Catostomidae												
Hypentelium nigricans			1		2	1	1	5	2	2		
Moxostoma erythrurum												4
Centrarchidae												
Ambloplites rupestris	2									1		
Lepomis macrochirus	7	14						1	1			7
L. megalotis	4	4		1	1			9		1		4
Micropterus dolomieui					3		1	1				
M. punctulatus			2					2			1	4
Pomoxis annularis	1											
Percidae												
Etheostoma blennioides				1		1	1		9	1		
E. caeruleum	9		2					2	2			
Percina caprodes		1						4				
Stizostedion vitreum		1										
Total Number of Taxa	9	5	9	6	10	7	10	14	11	9	5	8

Total Number of Taxa Collected in the Study Area: 22

TABLE 7. FISH REPORTED FROM THE CUMBERLAND RIVER ABOVE CUMBERLAND FALLS

Taxa	Reason for Absence in Present Study*
Lampetra aepyptera	Recent collection of only a few individuals well downstream of study area, will likely move into study area.
Salmo gairdneri	Introduced into small, cold headwater tributaries.
Salvelinus fontinalis	Introduced into small, cold headwaters.
Campostoma anomalum	Present in study area.
Carassius auratus	Introduced, could eventually inhabit Cumberland River mainchannel.
Phoxinus cumberlandensis	Known only from small headwater tributaries.
P. erythrogaster	Known from small tributaries.
Cyprinus carpio	Introduced, probably present at stations 9, 11, and 12.
Ericymba buccata	Present
Nocomis micropogon	Possibly an intolerant species, affected by low levels of pollution.
Notropis ardens	Unknown, collected both above and below study area.
N. atherinoides	Typically inhabits large rivers, possibly present at stations 9, 11, and 12.
N. chrysocephalus	Present
N. galacturus	Present
N. rubellus	Present
N. spilopterus	Present
N. volucellus	Present
N. whipplei	Present
Pimephales notatus	Present
P. promelas	Introduced and only locally abundant.
P. vigilax	Introduced and only locally abundant.
Rhinichthys atratulus	Inhabits small, headwater streams.
Semotilus atromaculatus	Present
Catostomus commersoni	Migratory into small streams in the spring to spawn, large adults probably present at stations 9, 11, 12.
Hypentelium nigricans	Present
Moxostoma anisurum	Inhabits large, deep, slow-flowing streams except during spring spawning migrations upstream.
M. duquesnei	Inhabits large, deep, slow-flowing streams except during spring spawning migrations upstream.
M. erythrurum	Present
Ictalurus melas	Inhabits large streams.
I. natalis	Inhabits large streams.
I. nebulosus	Uncommon in eastern Kentucky.
I. punctatus	Inhabits large streams.
Noturus miurus	Recently collected well downstream of study area.
Pylodictis olivaris	Inhabitant of large rivers.

Taxa	Reason for Absence in Present Study*
Fundulus catenatus	Unknown
Gambusia affinis	Introduction, will undoubtably be collected in study area.
Labidesthes sicculus	Unknown.
Ambloplites rupestris	Present.
Lepomis cyanellus	Unknown.
L. gulosus	Unknown.
L. macrochirus	Present.
L. megalotis	Present.
Micropterus coosae	Introduced, generally occurs in small streams.
M. dolomieui	Present.
M. punctulatus	Present.
M. salmoides	Possibly introduced.
Pomoxis annularis	Present.
Etheostoma blennioides	Present.
E. caeruleum	Present.
E. kennicotti	Unknown.
E. nigrum susanae	Records available only from vicinity of Cumberland Falls.
E. s. sagitta	Inhabits small headwater streams, known from upstream of study area.
Etheostoma (Ulocentra) sp.	Unknown.
Percina caprodes	Present.
P. maculata	Unknown.
Stizostedion vitreum	Present, introduced.

* all species absent may be so due to effects of pollution, both domestic and from mining activities.

Protection. The Office of Surface Mining enforces federal regulations concerning strip mining activities.

III.7. Recreational Resources

III.7.1. General

This section of the environmental resources chapter presents information on the public and private recreational facilities within the Harlan, Loyall, Baxter and Rio Vista study area. Briefly described is the regional recreational setting, and provided is a listing of recreational facilities within or near the study area, a description of these facilities as well as a description of those recreational resources which are not facility oriented. Further, a brief assessment of the recreational needs for additional activities and facilities is included.

III.7.2. Regional Context

Located in the mountainous region of southeastern Kentucky, the topography of the study area is rugged; ridges and mountains are dissected by rivers and streams. Black Mountain, the highest elevation in Kentucky, is nearby. This region of Kentucky has traditionally attracted out-of-state recreationalists. A major attraction has been a component of the Daniel Boone National Forest which lies just north of the study area and is accessible from Harlan by U.S. Highway 421. Other attractions, within the region but outside the study area include Cumberland Gap National Historic Park, Cumberland Falls State Park, Kingdom Come and Pine Mountain State Parks. These other recreational resources are more accessible than the component of the Daniel Boone National Forest near Harlan.

In the vicinity of the study area, the U.S. Forest Service manages the largest holdings of recreational land; however, the only federally-owned acreage in Harlan County is managed by the Corps of Engineers. The recently completed Martin's Fork Dam provides 340 (summer pool level) acres for water-based recreation and is located 10 miles south of the city of Harlan. The State of Kentucky is the second-largest owner of recreational land; however, no state-owned land is in the study area even though there is a total of 6211 acres within Harlan County (Cranks Creek Public Hunting Area, Kentenia State Forest, and Kingdom Come State Park). Within or near the study area, privately-owned recreational acreage exceeds that owned by local governments. Table 8 lists all the recreational facilities in or near the study area; the location of facilities within the study area is pinpointed in Figure 6.

III.7.3. Privately-Owned Facilities

Only two privately-owned recreational facilities are located in or near the study area, the Harlan Country Club and a Fish & Game Club near Baxter. Occupying approximately 75 acres, the Harlan Country Club provides to its members a variety of recreational activities including golf, tennis, and swimming. The Fish and Game Club near Baxter occupies 40 acres of which 5 acres are developed. This facility provides a shooting range for its members. There are no other private recreational facilities such as riding stables or amusement parks.

TABLE 8. EXISTING RECREATIONAL FACILITIES WITHIN OR NEAR THE STUDY AREA

Name	Facilities	Ownership	Acres
	Harlan		
(1) Huff Park	ball field, playfield, swimming pool	public	5
(2) Harlan High School	athletic field, track, courts, gym	public	8
(3) Harlan Elementary School	playground and equipment	public	8
*(4) Harlan Country Club	golf, tennis, swimming	private	75
(5) Georgetown Park	playground, ballfield	public	5
(6) Little League Park	baseball	public	4
*(7) Elzo Guthrie Elementary School	baseball, basketball	public	7
	Loyall		
(8) Loyall City Park	community center, pool, ball field, playground	public	3½
(9) Loyall Elementary School	playground and equipment	public	1
	Baxter		
*(10) Fish and Game Club	shooting range	private	40

* Indicates locations near, but outside the study area limits.

III.7.4. Local Government-Owned Facilities

Public recreational facilities are not abundant; those that are available are concentrated in or near the cities of Harlan and Loyall. There are no public recreational facilities outside of these two communities. Public recreational facilities only occupy about 34 acres. Of the total public recreational acreage, 17 acres, or 50 percent, are managed by the school system. As a consequence, only half of this public recreational acreage is totally available to the general public.

The city-owned Huff Park in Harlan was at one time part of the Harlan high school complex. Located on the river bank, this recreational facility, comprised of a field and swimming pool, has experienced flooding (Frances 1981). Other public facilities in or near Harlan include the facilities at Harlan High School, Harlan Elementary School, Georgetown Park, Little League Park and at Eizo Guthrie Elementary School. Georgetown Park and the Little League Park together provide about 9 acres for activities such as baseball and football. Loyall City Park, in addition to the playfield at the local elementary school, provides residents with a community center, pool, playground and ballfield.

III.7.5. Non-Facility Oriented Recreational Resources

The only non-facility oriented recreational resources are the Cumberland River and its tributaries, the Poor, Clover and Martins Forks. The Cumberland River's potential as a recreational resource is limited due to private land holdings and relatively steep banks. There are no developed public access sites. Silt loads and turbidity make this potential resource unattractive for passive recreational activities or for sport fishing. Also, the river does not have the characteristics which make it practical or suitable for boating activities either by powerboat or whitewater or sailing enthusiasts. The same description holds true for the Poor and Clover Fork tributaries.

In contrast, a section of Martins Fork was designated as a State Wild River. Although outside the study area, Martins Fork from Kentucky Route 987 bridge to the east boundary of the Cumberland Gap National Park was added to the state wild rivers inventory in 1974. This section of the Fork has a very steep gradient, one that has been characterized as too steep for canoeing. Water quality in 1970 and 1974 has been described as excellent.

Martins Fork Lake, constructed in 1978, presently offers a variety of recreational opportunities to the public. Nashville District, Corps of Engineers figures reveal that in 1979 Martins Fork experienced some 20,500 public visitations, with sightseeing listed as the primary activity. During 1980, visitations increased to 92,300, again sightseeing as the dominant activity, however both fishing and boating underwent large increases over the 1979 rates. Although a breakdown into activities was not available for 1981, there were approximately 147,200 visitations to Martins Fork from January through September, 1981.

III.7.6. Recreational Needs

Within the Cumberland Valley Area Development District (Harlan, Bell, Clay, Jackson, Knox, Whitley, Laurel and Rockcastle Counties), the State Comprehensive Outdoor Recreation Plan has identified that through the year 1995, the region's supply of outdoor recreational facilities is sufficient to meet demand in the categories of hiking, camping, horseback riding, trap shooting, waterfowl hunting, sailing, and canoeing. The region, however, is deficient in facilities for outdoor games, bicycling, tennis, picnicking, small game hunting, fishing, boating, water skiing, golf, baseball, swimming, and basketball.

IV. COORDINATION

Throughout the course of this environmental inventory, numerous agencies, institutions, organizations and individuals were contacted. The purpose of these contracts was to make official notice of the project and to make a request for relevant project data. The entities contacted are listed in Table 9. Many of these agencies also occur throughout this report as specific references cited.

It should be noted that the cooperation extended by the agencies and organizations contacted was excellent. The comprehensive nature of this inventory is largely reflective of the positive response of the individuals within these agencies and organizations.

TABLE 9. COORDINATION

Agency	Contacted by Letter	Meeting	Phone
Federal Agencies			
Soil Conservation Service	x	x	x
U.S. Fish and Wildlife Service	x		
Environmental Protection Agency	x		x
State Agencies			
Department of Natural Resources and Environmental Protection: Division of Water			x
Department of Public Parks	x		x
State Geologist			x
Geologic Survey	x		x
Kentucky Nature Preserves Commission	x		x
Department of Fish and Wildlife Resources	x		x
Local and Institutional			
Eastern Kentucky University	x		x
Universtiy of Tennessee	x	x	x
Cumberland Valley Area Development District	x		x

V. EXHIBITS

EXHIBIT 1

Streamflow Gaging Data for the Upper Cumberland River Basin

Gage No.	Station Name	Years of Record	Drainage Area (sq mi)	Average Dis-charge (cfs)	1-Day Historical Low Flow (cfs)	7-Day 10-Year Low Flow (cfs)	30-Day 10-Year Low Flow (cfs)	Historical Peak Discharge (cfs)	Mile-Point
4005	Poor Fork at Cumberland, KY	33	82.3	141	2.5	3.6	5.5	11,800	718.8
4008	Martins Fork at Smith, KY	3	56.2	-	2.8	-	-	8,390	15.2
4010	Cumberland River at Harlan, KY	33	374.	674	5.0	9.7	15.8	43,200	691.9

Source: Mayes, Suddereth, and Etheredge, Inc. (1975), based on U.S. Geological Survey Data.

EXHIBIT 2

Results of Water Quality Analyses for the Harlan Study Area - October 1, 1981, SSI

Parameters	Collection Sites											
	1	2	3	4	5	6	7	8	9	10	11	12
pH Units	6.88	6.87	7.08	7.42	7.58	7.95	8.52	8.14	7.93	8.17	7.85	8.47
Total Alkalinity, Mg/L $CaCO_3$	23.70	25.28	34.76	44.24	53.72	77.42	126.40	123.24	120.08	180.12	118.54	93.22
Total Suspended Solids, Mg/L	7	9	19	19	15	24	6	11	41	18	31	16
Total Dissolved Solids, Mg/L	60	50	170	190	240	266.67	313.33	360	376.67	365	290	330
BOD 5 Day, Mg/L	2.78	4.8	2.0	1.2	0.45	0.6	1.5	1.65	2.70	2.40	0.3	8.10
Dissolved Oxygen, Mg/L	8.1	8.1	8.2	8.4	9.0	9.2	10.1	9.3	8.0	8.7	8.9	10.4
Temperature, °C	20	18.2	26	22	20	22	23	22	23	23	24	23

EXHIBIT 3

Selected Physical and Chemical Parameters from
Cumberland River near Harlan, Harlan County, Kentucky

Parameter	Number of Obser- vations	Mean Value	Maximum Value	Minimum Value	Beginning Date	Ending Date
Temperature (°C)	33	13.2	31.0	0.0	9/15/77	5/13/81
Stream Flow (cfs)	11	1100.6	7440.0	28.0	10/4/51	9/26/52
Stream Flow (inst-cfs)	32	649.2	2660.0	38.3	10/19/77	5/13/81
Conductivity (field, micromho)	1	520.0	520.0	520.0	10/1/80	10/1/80
Conductivity (@ 25°C, micromho)	41	327.9	660.0	84.9	10/4/51	5/13/81
pH (field, SU)	29	7.7	8.3	6.7	10/4/51	5/13/81
pH (lab, SU)	4	8.0	8.3	7.6	11/25/80	5/13/81
DO (mg/L)	1	7.2	7.2	7.2	9/15/77	9/15/77
Total Alkalinity (mg/L $CaCO_3$)	18	91.8	196.0	40.0	5/21/79	5/13/81
Total Alkalinity (field, mg/L)	1	171.0	171.0	171.0	10/1/80	10/1/80
HCO_3 ion (mg/L)	11	110.0	240.0	18.0	10/4/51	9/26/52
Total Hardness (mg/L $CaCO_3$)	12	57.9	91.0	24.0	10/4/51	7/15/80
Calcium (mg/L, Ca, dissolved)	12	14.0	23.0	6.4	10/4/51	7/15/80
Magnesium (mg/L, Mg, dissolved)	12	5.5	8.1	1.9	10/4/51	7/15/80
Sodium (mg/L, Na, dissolved)	12	44.4	112.0	5.8	10/4/51	7/15/80
Total Chloride (mg/L)	12	5.1	10.0	1.6	10/4/51	7/15/80
Sulfate (mg/L, SO_4)	28	64.2	110.0	18.0	10/4/51	5/13/81
Iron (ug/L, Susp. Fe)	15	2356.0	7800.0	370.0	5/21/79	5/13/81
Iron (ug/L, Total Fe)	28	1413.9	7800.0	10.0	10/4/51	5/13/81
Iron (ug/L, Dissolved Fe)	17	56.5	130.0	10.0	5/21/79	5/13/81
Lead (ug/L, Total)	1	29.0	29.0	29.0	7/15/80	7/15/80
Dissolved Solids (Tons/day)	16	237.5	868.0	36.2	5/21/79	5/13/81
Dissolved Solids (Tons/acre-ft)	16	0.3	0.5	0.1	5/21/79	5/13/81
Suspended Sediments (Conc., mg/L)	14	71.1	235.0	4.0	5/21/79	1/13/81
Suspended Sediments (Discharge, tons/day)	12	236.0	1620.0	0.5	5/21/79	1/13/81
Coal in Bottom Material (DWT g/kg)	1	6.0	6.0	6.0	7/15/80	7/15/80

Source: U.S. Geological Survey Gage No. 03401000

EXHIBIT 4

Selected Physical and Chemical Parameters from
Clover Fork at Harlan, Harlan County, Kentucky

Parameter	Number of Obser-vations	Mean Value	Maximum Value	Minimum Value	Beginning Date	Ending Date
Temperature (°C)	27	13.5	29.0	0.0	10/19/77	3/25/81
Stream Flow (inst-cfs)	27	601.9	4950.0	22.5	10/19/77	3/25/81
Conductivity (@ 25°C, micromho)	26	304.0	560.0	120.0	10/19/77	3/25/81
pH (field, SU)	7	7.8	8.6	7.4	6/6/79	3/25/81
pH (lab, SU)	1	7.5	7.5	7.5	3/25/81	3/25/81
Total Alkalinity (mg/L $CaCO_3$)	7	77.4	133.0	37.0	6/6/79	3/25/81
Total Hardness (mg/L $CaCO_3$)	1	90.0	90.0	90.0	7/15/80	7/15/80
Calcium (mg/L, Ca, dissolved)	1	23.0	23.0	23.0	7/15/80	7/15/80
Magnesium (mg/L, Mg, dissolved)	1	7.9	7.9	7.9	7/15/80	7/15/80
Sodium (mg/L, Na, dissolved)	1	32.0	32.0	32.0	7/15/80	7/15/80
Total Chloride (mg/L)	1	4.9	4.9	4.9	7/15/80	7/15/80
Sulfate (mg/L, SO_4)	7	63.9	78.0	40.0	6/6/79	3/25/81
Iron (ug/L, Susp. Fe)	7	7158.6	29000.0	410.0	6/6/79	3/25/81
Iron (ug/L, Total Fe)	7	7324.3	29000.0	470.0	6/6/79	3/25/81
Iron (ug/L, Dissolved Fe)	7	174.3	1000.0	0.0	6/6/79	3/25/81
Lead (ug/L, Total)	1	15.0	15.0	15.0	7/15/80	7/15/80
Dissolved Solids (Tons/day)	5	197.7	574.0	37.0	3/24/80	3/25/81
Dissolved Solids (Tons/acre-ft)	5	0.3	0.4	0.2	3/24/80	3/25/81
Suspended Sediments (Conc., mg/L)	7	182.1	919.0	7.0	4/16/79	10/1/80
Suspended Sediments (Discharge, tons/day)	6	91.9	305.0	1.3	4/16/79	9/3/80
Coal in Bottom Material (DWT g/kg)	1	18.0	18.0	18.0	7/15/80	7/15/80

Source: U.S. Geological Survey Gage No. 03400990

EXHIBIT 5

Selected Physical and Chemical Parameters from Clover Fork near Shields, Harlan County, Kentucky

Parameter	Number of Obser-vations	Mean Value	Maximum Value	Minimum Value	Beginning Date	Ending Date
Temperature (°C)	7	15.0	28.0	3.5	6/5/79	3/24/81
Stream Flow (inst-cfs)	7	124.6	312.0	11.2	6/5/79	3/24/81
Conductivity (@ 25°C, micromho)	7	287.1	450.0	140.0	6/5/79	3/24/81
pH (field, SU)	7	7.6	8.1	7.2	6/5/79	3/24/81
pH (lab, SU)	1	7.6	7.6	7.6	3/24/81	3/24/81
Total Alkalinity (mg/L $CaCO_3$)	7	70.9	110.0	32.0	6/5/79	3/24/81
Total Hardness (mg/L $CaCO_3$)	1	100.0	100.0	100.0	7/17/80	7/17/80
Calcium (mg/L, Ca, dissolved)	1	27.0	27.0	27.0	7/17/80	7/17/80
Magnesium (mg/L, Mg, dissolved)	1	8.6	8.6	8.6	7/17/80	7/17/80
Sodium (mg/L, Na, dissolved)	1	39.0	39.0	39.0	7/17/80	7/17/80
Total Chloride (mg/L)	1	6.4	6.4	6.4	7/17/80	7/17/80
Sulfate (mg/L, SO_4)	7	54.9	78.0	32.0	6/5/79	3/24/81
Iron (ug/L, Susp. Fe)	7	1952.9	7000.0	290.0	6/5/79	3/24/81
Iron (ug/L, Total Fe)	7	1978.6	7000.0	300.0	6/5/79	3/24/81
Iron (ug/L, Dissolved Fe)	7	41.4	110.0	10.0	6/5/79	3/24/81
Lead (ug/L, Total)	1	10.0	10.0	10.0	7/17/80	7/17/80
Dissolved Solids (Tons/day)	5	33.8	78.4	7.2	3/25/80	3/24/81
Dissolved Solids (Tons/acre-ft)	5	0.2	0.3	0.1	3/25/80	3/24/81
Suspended Sediments (Conc., mg/L)	5	37.0	58.0	7.0	6/5/79	7/17/80
Suspended Sediments (Discharge, tons/day)	5	17.8	43.0	0.8	6/5/79	7/17/80
Coal in Bottom Material (DWT g/kg)	1	12.0	12.0	12.0	7/17/80	7/17/80

Source: U.S. Geological Survey Gage No. 03400650

EXHIBIT 6

Water Quality Data for Parameters Measured from 1977 through 1980 at Stations on Poor Fork Cumberland River, Harlan County, Kentucky

Sample Station		Water Temperature (°C)	Dissolved Oxygen (ppm)	pH	Alkalinity (mg/L)	Total Hardness (mg/L)	Turbidity (FTU)
I	1977	24.5	9.0	8.3	-	-	-
	1978	15.0	12.6	-	-	-	-
	1979	67.0	-	-	-	-	-
	1980	24.0	7.7	8.2	210	100	19
II	1977	25.0	9.8	8.5	-	-	-
	1978	15.0	13.2	-	-	-	-
	1979	68.0	-	-	-	-	-
	1980	25.0	8.7	8.3	190	100	40
III	1977	25.0	10.9	8.3	-	-	-
	1978	15.0	13.5	-	-	-	-
	1979	-	-	-	-	-	-
	1980	27.0	10.5	8.3	200	100	15
IV	1977	23.0	10.4	8.2	-	-	-
	1978	15.0	13.4	-	-	-	-
	1979	-	-	-	-	-	-
	1980	29.0	11.2	8.5	200	100	21

Source: Kentucky Department of Fish and Wildlife Resources 1981.

EXHIBIT 7

Selected Physical and Chemical Parameters from
Poor Fork at Cumberland, Harlan County, Kentucky

Parameter	Number of Observations	Mean Value	Maximum Value	Minimum Value	Beginning Date	Ending Date
Temperature (°C)	36	12.7	29.5	0.5	9/12/61	6/16/81
Stream Flow (cfs)	2	33.5	51.0	16.0	5/2/60	9/12/61
Stream Flow (inst-cfs)	36	130.2	762.0	8.8	10/6/70	6/16/81
Turbidity (ppm SiO_2)	1	20.0	20.0	20.0	9/12/61	9/12/61
Conductivity (field, micromho)	1	820.0	820.0	820.0	10/3/80	10/3/80
Conductivity (@ 25°C, micromho)	37	442.5	880.0	155.0	5/2/60	6/16/81
pH (field, SU)	23	8.1	8.8	7.5	5/2/60	6/16/81
pH (lab, SU)	6	8.0	8.4	7.5	11/25/80	6/16/81
CO_2 (mg/L)	1	1.4	1.4	1.4	8/18/72	8/18/72
Total Alkalinity (mg/L $CaCO_3$)	23	157.3	328.0	30.0	5/2/60	6/16/81
Total Alkalinity (field, mg/L)	1	328.0	328.0	328.0	10/3/80	10/3/80
HCO_3 ion (mg/L)	5	290.0	384.0	166.0	5/2/60	8/18/72
CO_3 ion (mg/L)	5	3.2	16.0	0.0	5/2/60	8/18/72
Total Hardness (mg/L $CaCO_3$)	6	108.2	140.0	69.0	5/2/60	7/15/80
Calcium (mg/L, Ca, dissolved)	1	29.0	29.0	29.0	7/15/80	7/15/80
Magnesium (mg/L, Mg, dissolved)	1	12.0	12.0	12.0	7/15/80	7/15/80
Sodium (mg/L, Na, dissolved)	1	99.0	99.0	99.0	7/15/80	7/15/80
Total Chloride (mg/L)	6	7.1	9.0	4.4	5/2/60	7/15/80
Sulfate (mg/L, SO_4)	23	76.4	130.0	30.0	5/2/60	6/16/81
Iron (ug/L, Susp. Fe)	16	2038.1	10000.0	260.0	5/24/79	6/16/81
Iron (ug/L, Total Fe)	18	1987.8	10000.0	320.0	5/24/79	6/16/81
Iron (ug/L, Dissolved Fe)	18	107.8	940.0	10.0	5/24/79	6/16/81
Lead (ug/L, Total)	1	20.0	20.0	20.0	7/15/80	7/15/80
Dissolved Solids (Tons/day)	21	56.2	163.0	11.9	5/2/60	6/16/81
Dissolved Solids (Tons/acre-ft)	21	0.4	0.68	0.1	5/2/60	6/16/81
Suspended Sediments (Conc., mg/L)	15	89.9	528.0	4.0	5/24/79	2/18/81
Suspended Sediments (Discharge, tons/day)	15	54.3	372.0	0.2	5/24/79	2/18/81
Coal in Bottom Material (DWT g/kg)	1	18.0	18.0	18.0	7/15/80	7/15/80

Source: U.S. Geological Survey Gage No. 03400500

EXHIBIT 8

Selected Physical and Chemical Parameters from Cranks Creek Tributary to Martins Fork, Harlan County, Kentucky

Parameter	June 22, 1978	October 16, 1978
Air Temperature (°C)	32	15
Water Temperature (°C)	26	8
Turbidity (NTU)	100.0	100.0
Suspended Solids (mg/L)	ND	32.5
Conductivity (umhos)	397	1140
Dissolved Oxygen (mg/L)	7.6	8.2
Alkalinity (mg/L $CaCO_3$)	ND	17.0
HCO_3 (mg/L)	87.8	0.00
Cl (mg/L)	2.8	2.8
SO_4 (mg/L)	102.8	550.5
NO_3 (mg/L)	0.4	0.5
Fe (mg/L)	0.35	23.52
Mg (mg/L)	18.59	34.02
Na (mg/L)	27.50	52.2
Ca (mg/L)	25.20	56.28
pH	8.1	3.3

Source: Harker, et al., 1979.

EXHIBIT 9

Selected Physical and Chemical Parameters from Martins Fork near Smith, Harlan County, Kentucky

Parameter	Number of Obser-vations	Mean Value	Maximum Value	Minimum Value	Beginning Date	Ending Date
Temperature (°C)	37	15.0	30.0	1.5	10/5/70	3/24/81
Stream Flow (inst-cfs)	37	139.2	755.0	0.1	10/5/70	3/2481
Conductivity (@ 25°C, micromho)	36	145.0	270.0	68.0	10/5/70	3/24/81
pH (field, SU)	11	7.1	7.5	6.5	10/5/70	3/24/81
pH (lab, SU)	1	7.3	7.3	7.3	3/24/81	3/24/81
CO_2 (mg/L)	3	2.0	2.3	1.6	9/12/72	5/6/80
Total Alkalinity (mg/L $CaCO_3$)	14	24.9	39.0	8.0	10/5/70	9/4/80
Total Acidity (mg/L $CaCO_3$)	1	5.0	5.0	5.0	3/24/81	3/24/81
HCO_3 ion (mg/L)	8	32.3	47.0	10.0	10/5/70	7/21/76
CO_3 ion (mg/L)	8	0.0	0.0	0.0	10/5/70	7/21/76
Total Hardness (mg/L $CaCO_3$)	9	56.7	88.0	32.0	10/5/70	7/17/80
Calcium (mg/L, Ca, dissolved)	6	14.9	22.0	8.5	8/29/73	7/17/80
Magnesium (mg/L, Mg, dissolved)	6	6.0	8.0	2.5	8/29/73	7/17/80
Sodium (mg/L, Na, dissolved)	2	9.0	13.0	5.0	7/21/76	7/17/80
Total Chloride (mg/L)	9	1.3	2.0	0.6	10/5/70	7/17/80
Sulfate (mg/L, SO_4)	15	41.3	75.0	15.0	10/5/70	3/24/81
Iron (ug/L, Susp. Fe)	7	1832.9	6600.0	350.0	6/5/79	3/24/81
Iron (ug/L, Total Fe)	8	1930.0	6600.0	390.0	7/21/76	3/24/81
Iron (ug/L, Dissolved Fe)	8	111.3	620.0	0.0	7/21/76	3/24/81
Lead (ug/L, Total)	1	9.0	9.0	9.0	7/17/80	7/17/80
Dissolved Solids (Tons/day)	13	14.5	124.0	0.5	10/5/70	3/24/81
Dissolved Solids (Tons/acre-ft)	13	0.1	0.2	0.1	10/5/70	3/24/81
Suspended Sediments (Conc., mg/L)	4	7.5	17.0	2.0	6/5/79	9/4/80
Suspended Sediments (Discharge, tons/day)	5	27.1	116.0	0.1	6/5/79	9/4/80
Coal in Bottom Material (DWT g/kg)	1	10.0	10.0	10.0	7/17/80	7/17/80

Source: U.S. Geological Survey Gage No. 03400800

EXHIBIT 10

Water Quality Data for the Upper Cumberland River Basin

Station Location		Poor Fork Cumberland	Martins Fork Harlan County	Martins Fork Harlan County	Cranks Creek Harlan County	Martins Fork Harlan County	Cumberland River Harlan	Clover Fork Evarts
Milepoint		719.3	694.2	694.2	694.2	694.2	694.2	694.2
			1.6	1.6	1.6	1.6		10.5
			9.3	14.4	17.1	17.5		
					8.3			
Number Samples		5	6	6	10	5	68	5
pH	min	7.6	5.6	7.1	4.2	7.2		7.6
(SU)	max	8.6	8.6	7.9	8.1	7.8		8.5
	avg	8.1	6.8	7.4	6.3	7.4		7.9
Acidity	min		0.0		0	1.0		
(mg/l)	max		88	0	325	1.0		
	avg		15		96.5			
Alkalinity	min	136	24	14	0	14		85
(mg/l)	max	315	42	38	58	20		122
	avg	243.2	32.0	28.0	26.8	16.7		103.2
Hardness	min	69	44	36	76	20		97
(mg/l)	max	140	84	51	264	38		130
	avg	105.8	59.0	41.0	152	30		114.2
Sulfates	min	56	17	12	72	8		97
(mg/l)	max	120	30	45	410	14.5		110
	avg	83.4	25.0	30.0	212	10.7		100.8
Iron	min	0.48	0.3	0.4	0.4	0.13		
(mg/l)	max	0.48	1.6	0.7	21.6	0.33		
	avg		1.0	0.6	5.6	0.33		
Manganese	min		0.0	0	0	0.0		
(mg/l)	max		0.2	0.05	4.8	0.05		
	avg		0.1	0.04	1.4	0.05		
Aluminum	min		0.0		21.4			
(mg/l)	max		2.5		48.8			
	avg		1.7		93.1			
Specific	min	424	120	80	190	50		381
Conductance	max	787	265	156	950	65		460
(micromhos)	avg	628.4	161	113.0	494			424.2
Chloride	min	4.4						3.1
(mg/l)	max	9.0						6.2
	avg	6.9						5.0
Chromium	min						0	
(mg/l)	max						0.01	
	avg						0.002	
Sodium	min							50
(mg/l)	max							50
	avg							
Nitrate	min	0.5						0.6
(mg/l)	max	0.5						1.2
	avg							1.0

Station Location		Poor Fork Cumberland	Martins Fork Harlan County	Martins Fork Harlan County	Cranks Creek Harlan County	Martins Fork Harlan County	Cumberland River Harlan	Clover Fork Evarts
Dissolved	min							262
Solids	max							262
(mg/l)	avg							
Magnesium	min							10
(mg/l)	max							10
	avg							
Cadmium	min						0	
(mg/l)	max						0.003	
	avg						0.001	
Calcium	min						8	25
(mg/l)	max						26	25
	avg						15.0	
Flouride	min	0.3					0.1	0.1
(mg/l)	max	0.7					0.9	0.2
	avg	0.43					0.5	0.12
Phosphorus	min	0.72						0.02
(mg/l)	max	1.1						0.33
	avg	0.9						0.13
Beginning Date		5-60	3-66	10-70	3-66	10-70	1-70	5-60
Ending Date		8-72	10-66	1-72	1-72	1-72	11-74	9-72
Data Source*		1	4	4	4	4	1	1

*1-Storet; 2-Appalachian Mine Drainage Pollution Report; 3-Corps of Engineers

Source: Mayes, Sudderth, and Etheredge, Inc., 1975.

EXHIBIT 11

Reported Incidents of Pollution
(Exclusive of Fish Kills)
in the Study Area

Date	Stream	Alleged Source	Type of Pollution
3/19/77	Catron Cr., Martins Fork, Cumberland River	Harlan Fuel Co.	Blackwater
3/23/77	Catron Cr., Martins Fork, Cumberland River	Harlan Fuel Co.	Blackwater
4/1/77	Martins Fork and Cumberland River	Grays Knob Coal Co.	Coal fines
6/9/77	Clover Fork and Cumberland River	Eastover Mining Co.	Mine waste
9/14/77	Poor Fork and Cumberland River	Harlan Central Coal Co.	Mud slurry
2/15/78	Poor Fork and Cumberland River	Harlan-Cumberland Coal Co.	Blackwater
2/28/79	Martins Fork and Cumberland River	Coal Resources	Coal fines from settling pond
8/10/79	Poor Fork and Cumberland River	Unknown	Crude motor oil
5/20/80	Catrons Fork, Martins Fork and Clover Fork	Liggett Coal Co.	Coal dust and waste materials
6/16/80	Foresters Creek and Cumberland River	Kentucky Harlan Coal Co.	Blackwater
10/29/80	Poor Fork and Cumberland River	Totz Coal Co.	Blackwater and mining sediment
11/7/80	Catrons Creek and Cumberland River	Liggett Coal Co.	Blackwater and mining sediment

Sources: Kentucky Department of Fish and Wildlife Resources 1978, 1979, 1980 and 1981.

EXHIBIT 12

Significant Municipal, Domestic, and Industrial Discharges in the Area of Harlan, Kentucky

Discharge Name	Location: County	Location: Segment	Receiving Water	Water Violation
Municipal				
Loyall STP	Harlan	42	CRM 691.23	none
Harlan STP	Harlan	42	CRM 693.77	none
Domestic				
Metcalf Apts.	Harlan	42	CRM 694	none
Harlan Appalachian Hospital	Harlan	43	Martins Fork, mile 3.0	none
Industrial				
Grays Knob Coal Co.	Harlan	43	Martins Fork, mile 1.6	Blackwater
Coal Resources	Harlan	43	Turtle Creek, mile 1.6	Blackwater
			mile 7.1	Iron
Shackleford Coal Co.	Harlan	44	Louder Creek, mile 31.1	Blackwater

Source: Mayes, Sudderth and Etheredge, Inc. 1975.

EXHIBIT 13

Aquatic Invertebrates Collected In or Near the Study Area in Previous Investigations

Taxa	Cranks Creek tributary Martins Creek	Martins Fork	Fugitt Creek tributary Clover Fork	Poor Fork
Nematomorpha				x
Annelida				
Oligochaeta				x
Amphipoda				
Gammaridae	x			
Decapoda				
Astacidae				
Cambarus distans		x	x	
C. robustus		x	x	
Orconectes				x
Hydracarina				x
Plecoptera				
Capniidae				
Paracapnia			x	
Leuctridae				
Leuctra	x	x		
Megaleuctra		x		
Peltoperlidae				
Peltoperla		x	x	
Perlidae				
Acroneuria		x	x	
Perlodidae				
Isoperla			x	
Pteronarcyidae				
Allonarcys			x	
Ephemeroptera				
Baetidae				x
Baetis	x		x	
Ephemerellidae				
Ephemerella		x		
Heptageniidae				
Epeorus		x		
Heptagenia			x	
Stenacron		x	x	x
Stenonema			x	x
Hexageniidae				
Hexagenia				x
Siphlonuridae				
Isonychia				x
Tricorythidae				
Tricorythodes				x
Odonata				
Aeshnidae				

Coenagriidae				x
Boyeria				x
Gomphidae				x
Gomphus				x
Lanthus		x		x
Progomphus				x
Macromiidae				
Macromia				x
Hemiptera				
Gerridae				x
Gerris	x	x	x	
Veliidae				
Rhagovelia		x		
Megaloptera				
Corydalidae				
Corydalus				x
Trichoptera				
Glossosomatidae				
Glossosoma			x	
Hydropsychidae				
Cheumatopsyche			x	x
Symphitopsyche			x	
Hydroptilidae				
Agraylea				x
Hydroptila				x
Leucotrichia				x
Limnephilidae				
Neophylax		x		
Philopotamidae				
Dolophilodes			x	
Rhyacophila		x	x	x
Polycentropodidae				x
Polycentropus		x		
Coleoptera				
Dryopidae				
Helichus			x	
Dytiscidae				
Ilybius	x			
Elmidae				x
Stenelmis		x		
Haliplidae				x
Hydrophilidae				
Enochrus	x			
Tropisternus	x			
Psephenidae				x
Ectopria			x	
Psephenus		x	x	
Diptera				
Ceratopogonidae				x
Chironomidae	x	x		
Culicidae				x
Dixidae				x

Dolichopodidae				x
Empididae				x
Phoridae				x
Rhagionidae				x
Atherix		x	x	x
Simuliidae			x	x
Tabanidae				
Tabanus				x
Tipulidae			x	x
Dicranota		x		
Hexatoma		x		
Gastropoda				x
Ancylidae				
Ferrissia				x
Pleuroceridae				
Pleurocera				x
Viviparidae				x
Data Source*	1	2	2	3

*1 - Harker, et al. 1979;
2 - Harker, et al. 1980;
3 - Kentucky Department of Fish and Wildlife Resources 1978, 1979, 1980, 1981

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VII. APPENDICES

APPENDIX 1

Potential Fauna of the Harlan, Kentucky Study Area

Symbols Used in This Appendix

A bird occurs in a given area during a particular season for many different reasons. This aspect of bird distribution is explained in the column entitled "Seasonal Abundance and Occurrence". "Spr., Sum., Fll., and Wtr.," in the title block stand for the four seasons. The couplet which appears in each column under these seasonal headings gives the abundance and explanation of occurrence, respectively, according to the following scheme:

a - abundant: regularly found in large numbers
c - common: always present
u - uncommon: infrequent and in small numbers
r - rare: irregular occurrence and usually very small numbers

R - resident: remains in the area during a given season
T - transient: passes through, does not reside
V - visitant: occurring outside its normal range, but not unusual
V̸ - vagrant: occurrence unusual, often far removed from its normal range

The inventories of reptiles, amphibians, and mammals each have a single column, labelled "A", to describe abundance. The same symbols shown in the first quartet above are used in this column; however, they are represented by capital rather than lower case letters. There is no need for an explanation of the seasonal occurrence of these animals as, with the exception of the bats, they are not migratory. Notes in the "Remarks" column discuss pertinent information concerning the seasonal occurrence of the bats.

If in the bird inventory an "X" appears in the column labelled "Breed", the bird is known or expected to breed in the study area. If an "H" appears in this column, only historical breeding records are known for the species in the general region.

The habitat descriptions which appear in the table include only comments on areas which occur in the study area. Many animals occur in habitats other than those that appear in the charts, but these habitats do not occur in the study area. Nesting habitat and/or nest placement, indicated by "N-" followed by a verbal description, are given only for those birds which have an "X" or "H" in the column labelled "Breed". In cases where the breeding habitat for reptiles, amphibians, and mammals differs from the pre- or post-breeding habitat, both habitats are indicated on the chart.

If an animal is listed on either the Fish and Wildlife Services or the Smithsonian Institution list of "Threatened or Endangered Species" it is indicated in the "Habitat and Remarks" column by use of the symbols "FW" or "S", followed by a hyphen and a "T" or "E" indicating the status. The Kentucky Nature Preserves Commission is studying the status of these Federally-listed species within the state. They are also studying many other rare, peripheral, and declining species. Animals being studied by this agency are denoted by the abbreviation E-KNPC.

REPTILES AND AMPHIBIANS

Taxonomy		A	Habitat and Remarks
ORDER ANURA: Frogs and Toads			
Family Bufonidae - Toads			
Bufo a. americanus	American Toad	C	Most habitats
B. woodhousei fowleri	Fowler's Toad	A	Same as above
Family Hylidae - Hylid Frogs			
Hyla c. crucifer	Northern Spring Peeper	C	Woods, thickets; breed-quiet streams
H. chrysoscelis and/or H. versicolor	Gray Treefrog	C	Trees, brush; breed-woods pools or streams
Pseudacris brachyphona	Mountain Chorus Frog	C	Woodlands; breed-springs and pools
Family Ranidae - True Frogs			
Rana catesbeiana	Bullfrog	C	Permanent water
R. clamitans melanota	Green Frog	C	Any aquatic habitat
R. pipiens sphenocephala	Southern Leopard Frog	U	Permanaent water or meadows in summer
R. sylvatica	Wood Frog	C	Moist woods w/at least semi-permanent water
ORDER CAUDATA: Salamanders			
Family Ambystomatidae - Mole Salamanders			
Ambystoma maculatum	Spotted Salamander	C	Woodlands; breed-woodland pools
Family Plethodontidae - Woodland Salamanders			
Desmognathus f. fuscus	Northern Dusky Salamander	C	Small rocky woodland streams
D. m. monticola	Seal Salamander	C	Small wooded streams and springs, often muddy
Eurycea l. longicauda	Long-tailed Salamander	C	Moist shale banks or rocky woodland springs
Plethodon g. glutinosus	Slimy Salamander	C	Woodland
Pseudotriton r. ruber	Northern Red Salamander	C	Clear, cold, rocky streams or spring; more terrestrial in summer

Taxonomy		A	Habitat and Remarks
Family Salamandridae - Newts			
Notopthalmus v. viridescens	Red-spotted Newt	C	Woods and woodland pools
ORDER SQUAMATA: Lizards and Snakes			
Family Iguanidae - Iguanid Lizards			
Sceloporus undulatus hyacinthinus	Northern Fence Lizard	C	Dry, open, sunny woodlands or dwellings
Family Scincidae - Skinks			
Eumeces fasciatus	Five-lined Skink	C	Mesic disturbed areas or dwellings
Leiolopisma laterale	Ground Skink	C	Wooded areas near streams
Family Colubridae - Colubrid Snakes			
Carphophis a. amoenus	Eastern Worm Snake	C	Open woods w/good cover
Coluber c. constrictor	Northern Black Racer	C	Most habitats; somewhat arboreal
Diadophis punctatus edwardsi	Northern Ringneck Snake	A	Open woods w/good cover
Elaphe o. obsoleta	Black Rat Snake	C	Most habitats; good climber
Lampropeltis t. triangulum	Eastern Milk Snake	C	Most habitats; good climber
Opheodrys aestivus	Rough Green Snake	C	Woodlands, esp. edge; arboreal
Nerodia s. sipedon	Northern Water Snake	C	Any aquatic habitat
Storeria d. dekayi	Northern Brown Snake	C	Most habitats
Thamnophis s. sirtalis	Eastern Garter Snake	C	Most mesic habitats
Heterodon p. platyrhinos	Eastern Hognose Snake	C	Wooded hillsides, esp. edges
Family Viperidae - Vipers			
Agkistrodon contortrix mokasen	Northern Copperhead	C	Woodlands, esp. rocky, bluffs, and rocky streambanks
ORDER TESTUDINATA: Turtles			
Family Chelydridae - Snapping Turtles			
Chelydra s. serpentina	Common Snapping Turtle	U	Large streams, ponds etc.; aquatic
Family Emydidae - Emydid Turtles			
Terrapene c. carolina	Eastern Box Turtle	C	Woodlands
Family Kinosternidae - Mud and Musk Turtles			
Sternotherus odoratus	Common Musk Turtle (Stinkpot)	C	Permanent water; aquatic

BIRDS

Taxonomy		Abundance and Occurrence Spr	Sum	Fll	Wtr	Breed	Habitat and Remarks
ORDER CICONIIFORMES: Long-legged Waders							
Family Ardeidae - Herons, Bitterns and Allies							
Butorides virescens	Green Heron	-	c-R	-	r-R	X	Riverine; N-low in tree or shrub
ORDER ANSERIFORMES: Waterfowl							
Family Anatidae - Swans, Geese and Ducks							
Anas platyrhynchos	Mallard	u-T	-	u-T	r-R		Riverine
A. rubripes	Black Duck	u-T	-	u-T	r-R		Riverine
A. acuta	Pintail	u-T	-	r-T	r-R		Riverine
A. discors	Blue-winged Teal	c-T	-	c-T	-	X	Riverine
Aix sponsa	Wood Duck	-	c-R	-	-	X	Riverine; N-hollow tree
Aythya collaris	Ring-necked Duck	c-T	-	c-T	-		Riverine
A. affinis	Lesser Scaup	c-T	-	c-T	-		Riverine
Oxyura jamaicensis	Ruddy Duck	u-T	-	r-T	r-R		Riverine
Lophodytes cucullatus	Hooded Merganser	r-T	-	r-T	-		Rivers, bottomlands
ORDER FALCONIFORMES: Diurnal Birds of Prey							
Family Cathartidae - American Vultures							
Cathartes aura	Turkey Vulture	c-R	c-R	c-R	u-R	X	Most habitats; N-crevice in cliff or rocky woods
Family Accipitridae - Hawks, Old World Vultures, Harriers							
Accipiter striatus	Sharp-shinned Hawk	u-T	r-R	u-T	-	X	Woodlands; N-conifer; E-KNPC
A. cooperii	Cooper's Hawk	c-R	u-R	c-R	u-R	X	Woodlands; N-tall tree; E-KNPC
Buteo jamaicensis	Red-tailed Hawk	c-R	c-R	c-R	u-R	X	Woodlands; N-cliff
B. platypterus	Broad-winged Hawk	r-T	u-R	r-T	-	X	Upland woods; N-tree

Taxonomy		Spr	Sum	Fll	Wtr	Breed	Habitat and Remarks
		Abundance and Occurrence					
ORDER GALLIFORMES: Gallinaceous Birds							
Family Phasianidae - Quails and Pheasants							
Colinus virginianus	Bobwhite	c-R	c-R	c-R	c-R	X	Wooded hillsides; brush; N-ground
ORDER GRUIFORMES: "Marsh" Birds							
Family Rallidae - Rails, Coots, and Gallinules							
Fulica americana	American Coot	r-T	-	r-T	-		Large or small rivers or reservoirs
ORDER CHARADRIIFORMES: Shorebirds, Gulls, Terns							
Family Charadriidae - Plovers and Turnstones							
Charadrius vociferus	Killdeer	c-R	c-R	c-R	u-R	X	Fields, sandbars; N-ground
ORDER COLUMBIFORMES: Pigeons and Doves							
Family Columbidae - Pigeons and Doves							
Zenaidura macroura	Mourning Dove	u-R	u-R	u-R	r-R	X	Fields; N-low conifer or shrub
ORDER CUCULIFORMES: Cuckcoos							
Family Cuculidae - Cuckoos							
Coccyzus americanus	Yellow-billed Cuckoo	-	c-R	-	-	X	Woodlands; N-thicket
C. erythropthalmus	Black-billed Cuckoo	c-T	u-R	c-T	-	X	Woodlands; N-thicket
ORDER STRIGIFORMES: Owls							
Family Tytonidae - Barn Owls							
Tyto alba	Barn Owl	r-R	r-R	r-R	r-R	X	Open areas; N-structures and hollow trees; E-KNPC

Taxonomy		Abundance and Occurrence				Breed	Habitat and Remarks
		Spr	Sum	Fll	Wtr		
Family Strigidae - Typical Owls							
Otus asio	Screech Owl	r-R	r-R	r-R	r-R	X	Wooded edges; N-any cavity
Bubo virginianus	Great Horned Owl	u-R	u-R	u-R	r-R	X	Deep woodlands; N-crotch or hollow in large tree
Strix varia	Barred Owl	u-R	u-R	u-R	r-R	X	Wooded stream valleys; N-large hollow tree
ORDER CAPRIMULGIFORMES: Goatsuckers							
Family Caprimulgidae - Goatsuckers							
Caprimulgus carolinensis	Chuck-Will's-Widow	-	u-R	-	-	X	Upland woods; N-ground
C. vociferus	Whip-Poor-Will	-	u-R	-	-	X	Mesic woodlands; N-ground
Chordeiles minor	Common Nighthawk	-	u-R	-	-	X	Open country; N-ground or rooftops
ORDER APODIFORMES: Swifts and Hummingbirds							
Family Apodidae - Swifts							
Chaetura pelagica	Chimney Swift	-	u-R	-	-	X	Open places; N-chimneys
Family Trochilidae - Hummingbirds							
Archilochus colubris	Ruby-throated Hummingbird	-	c-R	-	-	X	Most habitats; N-top of branch
ORDER CORACIIFORMES: Kingfishers and Allies							
Family Alcedinidae - Kingfishers and Allies							
Megaceryle alcyon	Belted Kingfisher	c-R	c-R	c-R	u-R	X	Stream margins; N-hole in streambank
ORDER PICIFORMES: Woodpeckers and Allies							
Family Picidae - Woodpeckers							
Colaptes auratus	Common Flicker	c-R	c-R	c-R	c-R	X	Most habitats; N-hole in tree
Dryocopus pileatus	Pileated Woodpecker	c-R	c-R	c-R	c-R	X	Dense forests; N-hole in tree

Taxonomy		Abundance and Occurrence Spr	Sum	Fll	Wtr	Breed	Habitat and Remarks
Centurus carolinus	Red-bellied Woodpecker	u-R	u-R	u-R	r-R	X	Most habitats; N-hole in tree
Sphyrapicus varius	Yellow-bellied Sapsucker	c-T	-	c-T	c-R		Open woodlands
Dendrocopos villosus	Hairy Woodpecker	r-R	r-R	r-R	r-R	X	Forested watercourses; N-hole in snag
D. pubescens	Downy Woodpecker	u-R	u-R	u-R	u-R	X	Woodlands; N-hole in dead tree
ORDER PASSERIFORMES: Perching Birds							
Family Tyrannidae - Tyrant Flycatchers							
Sayornis phoebe	Eastern Phoebe	-	c-R	-	-	X	Most habitats; N-structure or cliff
Empidonax virescens	Acadian Flycatcher	-	u-R	-	-	X	Forested watercourse; N-tip of branch
E. traillii	Willow Flycatcher	r-T	r-R	r-T	-	X	Shrubby streambanks; N-shrub
Contopus virens	Eastern Wood Pewee	-	c-R	-	-	X	Woodland; N-tree limb
Nuttallornis borealis	Olive-sided Flycatcher	r-T	-	r-T	-		Woodland edges
Family Hirundinidae - Swallows							
Riparia riparia	Bank Swallow	u-T	r-R	u-T	-	X	Watercourses; N-hole in bank
Hirundo rustica	Barn Swallow	-	c-R	-	-	X	Open lands; structures; N-any vertical surface
Petrochelidon pyrrhonota	Cliff Swallow	-	r-R	-	-	X	Bridges; N-vertical surfaces
Progne subis	Purple Martin	-	u-R	-	-	X	Cultural areas; N-artificial shelters
Family Corvidae - Jays and Crows							
Cyanocitta cristata	Blue Jay	a-R	a-R	a-R	c-R	X	Most habitats; N-tree
Corvus brachyrhynchos	Common Crow	c-R	c-R	c-R	a-R	X	Mixed farm and woodland; N-tree

Taxonomy		Abundance and Occurrence Spr	Sum	Fll	Wtr	Breed	Habitat and Remarks
Family Paridae - Titmice							
Parus carolinensis	Carolina Chickadee	c-R	c-R	c-R	c-R	X	Forest and edge; N-natural cavity
P. bicolor	Tufted Titmouse	c-R	c-R	c-R	c-R	X	Woodlands; N-artifical or natural cavities
Family Troglodytidae - Wrens							
Troglodytes aedon	House Wren	r-T	-	r-T	-		Urban areas and farmland
Thryothorus ludovicianus	Carolina Wren	c-R	c-R	c-R	c-R	X	Forest edge; N-any cavity
Troglodytes troglodytes	Winter Wren	c-T	-	c-T	u-R		Tangles and thickets in lowland forests
Family Mimidae - Mockingbirds							
Mimus polyglottos	Mockingbird	u-R	u-R	u-R	r-R	X	Clearings or urban areas; N-shrub in a clearing
Dumetella carolinensis	Gray Catbird	-	c-R	-	r-R	X	Dense shrubs; N-shrub
Toxostoma rufum	Brown Thrasher	-	c-R	-	r-R	X	Brush or forest edge; N-shrub
Family Turdidae - Thrushes							
Turdus migratorius	American Robin	c-R	c-R	c-R	c-R	X	Woodlands w/clearings; N-crotch of tree or shrub
Hylocichla mustelina	Wood Thrush	-	c-R	-	-	X	Woodlands; N-same as above
H. ustulata	Swainson's Thrush	c-T	-	u-T	-		Woodlands
H. minimus	Gray-cheeked Thrush	c-T	-	c-T	-		Woodlands and dense brush
Catharus fuscescens	Veery	c-T	-	u-T	-		Brushy edges
Sialia sialis	Eastern Bluebird	u-R	u-R	u-R	r-R	X	Open areas and woods clearings; N-any cavity
Family Sylviidae - Gnatchatchers and Kinglets							
Regulus satrapa	Golden-crowned Kinglet	c-T	-	c-T	u-R		Coniferous woodlands
R. calendula	Ruby-crowned Kinglet	c-T	-	c-T	r-R		Woodlands
Family Bombycillidae - Waxwings							
Bombycilla cedrorum	Cedar Waxwing	u-R	u-R	u-R	r-R	X	Rarely in open woods;

Taxonomy		Spr	Sum	Fll	Wtr	Breed	Habitat and Remarks
		Abundance and Occurrence					
Family Sturnidae - Starlings							
<u>Sturnus vulgaris</u>	Starling	c-R	c-R	c-R	c-R	X	Most habitats, prefers agricultural areas; N-any cavity
Family Vireonidae - Vireos							
<u>Vireo griseus</u>	White-Eyed Vireo	-	c-R	-	-	X	Shrubs of forest edge and openings; N-dense shrub
<u>V. solitarius</u>	Solitary Vireo	r-T	r-R	r-T	-		Open woods and edge
<u>V. olivaceus</u>	Red-eyed Vireo	-	a-R	-	-	X	Deciduous woodlands; N-tip of branch
<u>V. philadelphicus</u>	Philadelphia Vireo	u-T	-	c-T	-		Woodlands
Family Parulidae - Wood Warblers							
<u>Vermivora pinus</u>	Blue-winged Warbler	r-T	u-R	r-T	-	X	Shrubby woodlands; N-ground
<u>V. peregrina</u>	Tennessee Warbler	c-T	-	a-T	-		Woodlands
<u>V. ruficapilla</u>	Nashville Warbler	u-T	-	u-T	-		Young brushy forests
<u>Dendroica petechia</u>	Yellow Warbler	c-T	c-R	?	-	X	Young willow and Alder thickets; N-shrub or small tree
<u>D. magnolia</u>	Magnolia Warbler	c-T	-	c-T	-		Woodlands
<u>D. coronata</u>	Myrtle Warbler	c-T	-	c-T	r-R		Most habitats
<u>D. fusca</u>	Blackburnian Warbler	u-T	-	c-T	-		Woodlands
<u>D. pensylvanica</u>	Chestnut-sided Warbler	u-T	-	c-T	-		Woodland clearings and brush
<u>D. castanea</u>	Bay-breasted Warbler	u-T	-	c-T	-		Woodlands
<u>D. striata</u>	Blackpoll Warbler	u-T	-	r-T	-		Woodlands
<u>D. discolor</u>	Prairie Warbler	-	c-R	-	-	X	Open woodlands and shrubs; N-sapling or shrub
<u>Seiurus noveboracensis</u>	Northern Waterthrush	u-T	-	c-T	-		Alluvial woodlands
<u>Geothlypis trichas</u>	Common Yellowthroat	-	c-R	-	-	X	Streambank thickets; N-thicket
<u>Icteria virens</u>	Yellow-breasted Chat	-	c-R	-	-	X	Early successional areas; N-low brush
<u>Wilsonia canadensis</u>	Canada Warbler	u-T	-	c-T	-		Brushy woodland edge; N-ground

Taxonomy		Abundance and Occurrence				Breed	Habitat and Remarks
		Spr	Sum	Fll	Wtr		
Family Ploceidae - Weaver Finches							
<u>Passer</u> <u>domesticus</u>	House Sparrow	c-R	c-R	c-R	c-R	X	Open woodlands; N-any cavity
Family Icteridae - Meadowlarks, Blackbirds and Orioles							
<u>Sturnella</u> <u>magna</u>	Eastern Meadowlark	u-R	u-R	u-R	r-R	X	Meadows and cultivated fields; N-ground
<u>Agelaius</u> <u>phoeniceus</u>	Red-winged Blackbird	u-R	u-R	u-R	r-R	X	Open country; N-marsh grasses, esp. cat-tails
<u>Quiscalus</u> <u>quiscula</u>	Common Grackle	u-T	u-R	u-T	r-R		Open country and stream-banks
Family Fringillidae - Grosbeaks, Finches, Sparrows and Buntings							
<u>Richmondena</u> <u>cardinalis</u>	Cardinal	c-R	c-R	c-R	c-R	X	Woodland edges, brush; N-shrub
<u>Guiraca</u> <u>caerulea</u>	Blue Grosbeak	r-T	-	r-T	-		Streamside thickets
<u>Passerina</u> <u>cyanea</u>	Indigo Bunting	-	a-R	-	r-R	X	Most habitats; N-low in shrub, grass, or small tree
<u>Spinus</u> <u>tristis</u>	American Goldfinch	u-R	r-R	u-R	r-R	X	Old fields w/brush; N-low in weeds, shrub or small tree
<u>Pipilo</u> <u>erythrophthalmus</u>	Rufous-sided Towhee	u-R	c-R	u-R	u-R	X	Brushy young woodlands; N-low in thicket or tangle
<u>Junco</u> <u>hyemalis</u>	Dark-eyed Junco	c-T	-	c-T	c-R		Open woodlands or brushy fields
<u>Spizella</u> <u>arborea</u>	Tree Sparrow	-	-	-	u-R		Woodland edges and old fields
<u>S.</u> <u>pusilla</u>	Field Sparrow	u-R	u-R	u-R	r-R	X	Old fields; N-ground or low shrub
<u>Zonotrichia</u> <u>albicollis</u>	White-throated Sparrow	c-T	-	c-T	u-R		Open woodlands, edges, and old fields

Taxonomy		Abundance and Occurrence				Breed	Habitat and Remarks
		Spr	Sum	Fll	Wtr		
Passerella iliaca	Fox Sparrow	c-T	-	c-T	u-R		Same as above, esp. near water
Melospize lincolnii	Lincoln's Sparrow	u-T	-	u-T	-		Old fields and edges
M. georgiana	Swamp Sparrow	u-T	-	u-T	u-R		Old fields (wet), edges, and brushy streambanks
M. melodia	Song Sparrow	c-R	c-R	c-R	c-R	X	Brushy streambanks and forest edges; N-ground or low shrub

MAMMALS

Taxonomy		A	Habitat and Remarks
ORDER MARSUPIALIA: Marsupials			
Family Didelphidae - New World Opossums			
Didelphis v. virginiana	Virginia Opossum	C	Most habitats; primarily nocturnal
ORDER INSECTIVORA: Insectivores			
Family Soricidae - Shrews			
Blarina brevicauda kirtlandi	Short-Tailed Shrew	A	Mixed hardwood forest; constantly active
Family Talpidae - Moles			
Parascalops breweri	Hairy-tailed Mole	C	Woodlands and most high ground
Scalopus aquaticus machrinus	Eastern Mole	U	Loose soil, floodplains and stream-banks
ORDER CHIROPTERA: Bats			
Family Vespertilionidae - Vespertilionid Bats			
Myotis leibii leibii	Small-footed Myotis	R	Caves; very poorly known; common western sp.; E-KNPC
Pipistrellus s. subflavus	Eastern Pipistrelle	A	Caves, trees; very small bat
Eptesicus f. fuscus	Big Brown Bat	A	Caves and buildings
Lasiurus b. borealis	Red Bat	A	Trees and shrubs; consumes large quantities of insects
ORDER LAGOMORPHA: Rabbits			
Family Leporidae - Rabbits			
Sylvilagus floridanus mearnsii	Cottontail Rabbit	C	Most habitats; very prolific
ORDER RODENTIA: Rodents			
Family Sciuridae - Squirrels and Relatives			
Tamias s. striatus	Eastern Chipmunk	C	Hardwood associations w/cliffs, logs, brush, etc.

Taxonomy		A	Habitat and Remarks
Marmota m. monax	Woodchuck	U	Edges of fields and forest; game mammal
Sciurus c. carolinensis	Gray Squirrel	C	Hardwood stands, mostly oak-hickory; game mammal
Glaucomys v. volans	Southern Flying Squirrel	C	Woodlands, esp. near streams; nocturnal; cavity during day
Family Cricetidae - New World Rats and Mice			
Peromyscus leucopus novaboracensis	White-footed Mouse	A	Dense hardwood w/cliffs, boulders, logs, etc.
Ochrotomys nuttalli aureolus	Golden Mouse	C	Thickets, esp. brier; arboreal nester and feeder
Ondatra z. zibethicus	Muskrat	U	Streams and rivers, nest cavity in bank
Family Muridae - Old World Rats and Mice			
Rattus norvegicus	Norway Rat	U	Around dwellings; pest, v. destructive
Mus musculus	House Mouse	U	Same as above
ORDER CARNIVORA: Carnivores			
Family Canidae - Wolves, Coyotes, and Foxes			
Vulpes vulpes fulva	Red Fox	U	Wooded fields and farmlands; den in woodchuck hole or rock crevice; nocturnal; furbearer
Urocyon c. cinereoargenteus	Eastern Gray Fox	C	Hardwood forests, otherwise same as above
Family Procyonidae - Raccoons			
Procyon l. lotor	Raccoon	A	Dense woods, esp. alluvial; cavity in tree is home; mostly nocturnal; furbearer; game species

Taxonomy		A	Habitat and Remarks
Family Mustelidae - Minks, Weasels, Otters, and Skunks			
Mustela frenata noveboracensis	Long-tailed Weasel	C	Forest edge and streambanks; crevice or hole in anything for nest; nocturnal; furbearer
M. vison mink	Mink	C	Along streams and creeks; any burrow or cavity; mostly nocturnal; E-KNPC
Mephitis mephitis nigra	Striped Skunk	C	Most habitats, rugged favored; den in ground; nocturnal; furbearer
ORDER ARTIODACTILA: Even-toed Ungulates			
Family Cervidae - Deer			
Odocoileus v. virginianus	White-tailed Deer	U	Regrowth forests, edge, and clearings; second ranking game mammal in Kentucky

APPENDIX 2

Flora of the Harlan, Kentucky Study Area

Trees

Acer negundo	Box Elder
A. rubrum	Red Maple
A. saccharinum	Silver Maple
Ailanthus altissima	Tree of Heaven
Betula nigra	River Birch
Carpinus caroliniana	Ironwood
Cercis canadensis	Redbud
Cornus florida	Flowering Dogwood
Crataegus spp.	Hawthorn
Diospyros virginiana	Persimmon
Fagus grandifolia	Beech
Fraxinus spp.	Ash
Ilex opaca	American Holly
Jumperus virginiana	Red Cedar
Liquidambar styraciflua	Sweetgum
Liriodendron tulipifera	Tulip Poplar
Magnolia macrophylla	Bigleaf Magnolia
M. tripetala	Umbrella Tree
Nyssa sylvatica	Blackgum
Ostrya virginiana	Hop Hornbeam
Oxydendram arboreum	Sourwood
Paulownia tomentosa	Princess Tree
Pinus strobus	White Pine
Plantanus occidentalis	Sycamore
Prunus serotina	Black Cherry
Quercus alba	White Oak
Robinia pseudo-acacia	Black Locust
Salix babylonica	Weeping Willow
S. nigra	Black Willow
Sassafras albidum	Sassafras
Tilia americana	American Basswood
T. heterophylla	White Basswood
Ulmus americana	American Elm

Shrubs and Vines

Alnus serrulata	Alder
Anisostichus capreolata	Crossvine
Aralia spinosa	Devil's Walking Stick
Asimina triloba	Pawpaw
C. amomum	Silky Dogwood
Corylus americana	Hazlenut
Euonymus americanum	Strawberry-bush
Hamamelis virginiana	Witch-hazel
Hydrangea arborescens	Wild Hydrangea
Lindera benzoin	Spicebush
Menispermum canadense	Moonseed

Parthenocissus quinquefolius	Virginia Creeper
Puerla lobata	Kudzu
Rhus copallina	Winged Sumac
R. glabra	Smooth Sumac
R. radicans	Poison Ivy
Sambucus canadensis	Elderberry
Smilax spp.	Catbrier
Vitis rotundifolia	Muscadine
Xanthorhiza simplicissima	Yellowroot

Herbaceous Plants

Ambrosia trifida	Giant Ragweed
Andropogon spp.	Broomsedge
Arisaema triphyllum	Jack-in-the-Pulpit
Aster spp.	Aster
Boehmeria cylindrica	False Nettle
Carex spp.	Carex
Collinsonia caradensis	Horse-balm
Commelina virginica	Woods Dayflower
Daucus carota	Queen Anne's Lace
Desmodium spp.	Beggar Lice
Eupatorium spp.	Joe-pye-weed
Galium spp.	Bedstraw
Geranium carolinianum	Cranesbill
G. maculatum	Wild Geranium
Helianthus spp.	Sunflower
Hypericum gentianoides	Pineweed
Impatiens capensis	Spotted Jewelweed
I. pallida	Pale Jewelweed
Juncus effusus	Soft Rush
Laportea canadensis	Wood Nettle
Lespedeza spp.	Lespedoza
Lobelia spp.	Cardinal Flower
Ludwigia spp.	Ludwigia
Lycopus virginicus	Bugleweed
Onoclea sensibilis	Sensitive Fern
Osmunda cinnamomea	Cinnamon Fern
O. regalis	Royal Fern
Panicum spp.	Panic Grass
Phlox spp.	Phlox
Phytolacca americana	Pokeweed
Podophyllum peltatum	May-apple
Polygonatum biflorum	Solomon's Seal
Polygonum sagittatum	Tearthumb
Polystichum acrostichoides	Christmas Fern
Potentilla canadensis	Five-fingers
Ranunculus spp.	Buttercup
Sanguinaris canadensis	Bloodroot
Scirpus spp.	Sedge
Senecio spp.	Squaw-weed
Smilacina racemosa	Solomon's Seal
Solidago spp.	Goldenrod

<u>Thalictrum</u> spp.	Meadow Rue
<u>Vernonia</u> spp.	Ironweed
<u>Viola</u> spp.	Violet

APPENDIX 3

Endangered, Threatened, and Special Concern Plant Species Which Occur in Harlan County, Kentucky

Ferns

Botrychium oneidense — Blunt-lobed Grapefern
Habitat: grassy balds at high elevations
Status: Endangered Ky.

Monocots

Lilium superbum — Turk's-cap Lily
Habitat: rich mesic woods
Status: Threatened Ky.

Maianthemum canadense — Wild Lily of the Valley
Habitat: rich mesic woods at high elevation
Status: Threatened Ky.

Platanthera psycodes — Small Purple Fringed Orchid
Habitat: open wet woods
Status: Endangered Ky.

Trillium undulatum — Painted Trillium
Habitat: rich mesic woods
Status: Special Concern Ky.

Veratrum parviflorum — False Hellebore
Habitat: mesic slopes
Status: Threatened Ky.

Dicots

Adlumia fungosa — Alleghany Vine
Habitat: base of cliffs
Status: Endangered Ky.

Boykinia aconitifolia — Brook Saxifrage
Habitat: margins of high-gradient streams in rock crevices
Status: Threatened Ky.

Castanea pumils — Chinqua Pin
Habitat: dry woods
Status: Endangered Ky.

Chelone obliqua var. obliqua — Pine Turtlehead
Habitat: rich wet woods
Status: Endangered Ky.

Chrysosplenium americanum — Golden Saxifrage
Habitat: shady trickling stream beneathe hemlock
Status: Endangered Ky.

Corydalis sempervirens — Pale Corydalis
Habitat: sandstone outcrops
Status: Special Concern Ky.

Halesia carelina — Silverbell
Habitat: rich mesophytic woods
Status: Endangered Ky.

Hydrastis canadensis — Goldenseal
Habitat: rich mesophytic and alluvial woods
Status: Special Concern Ky.

Hydrophyllum virginianum — Virginia Waterleaf
Habitat: rich mesophytic woods
Status: Threatened Ky.

Minusartia glabra — Sandwort
Habitat: sandstone outcrops
Status: Endangered Ky.

Panax quinquefolius — Ginseng
Habitat: rich mesic woods
Status: Threatened Ky.

Paronychia argyrocoma — Silver Whitlow-wort
Habitat: sandstone ledges
Status: Endangered Ky

Sambucus pubens — Red-berried Elder
Habitat: rich mesophytic woods
Status: Threatened Ky.

Saxifraga michauxii — Michaux's Saxifrage
Habitat: wet cliffs and ledges
Status: Threatened Ky.

Silene ovate — Giant Catchfly
Habitat: mesophytic woods
Status: Threatened Ky.

Solidago curtisii — Curtis' Goldenrod
Habitat: mesic woods
Status: Threatened Ky.

Solidago puberula — Puberulent Goldenrod
Habitat: sandy woods
Status: Threatened Ky.

Solidago roanensis Slender Goldenrod

Habitat: meadows and clearings in high elevation woods

Status: Threatened Ky.

APPENDIX 4

Endangered, Threatened, Special Concern, and Status Undetermined Wildlife Which Potentially Occurs in Harlan County, Kentucky

Reptiles

Pituophis melanoleucus — Pine Snake
Habitat: dry sandy pine woods
Status: Undetermined Ky.

Birds

Accipiter cooperi — Cooper's Hawk
Habitat: heavily forested areas
Status: Undetermined Ky.

Accipiter striatus — Sharp-shinned Hawk
Habitat: heavily forested areas
Status: Undetermined Ky.

Mammals

Myotis leibii — Small-footed Myotis
Habitat: around caves, old mines, and abandoned buildings
Status: Undetermined Ky.

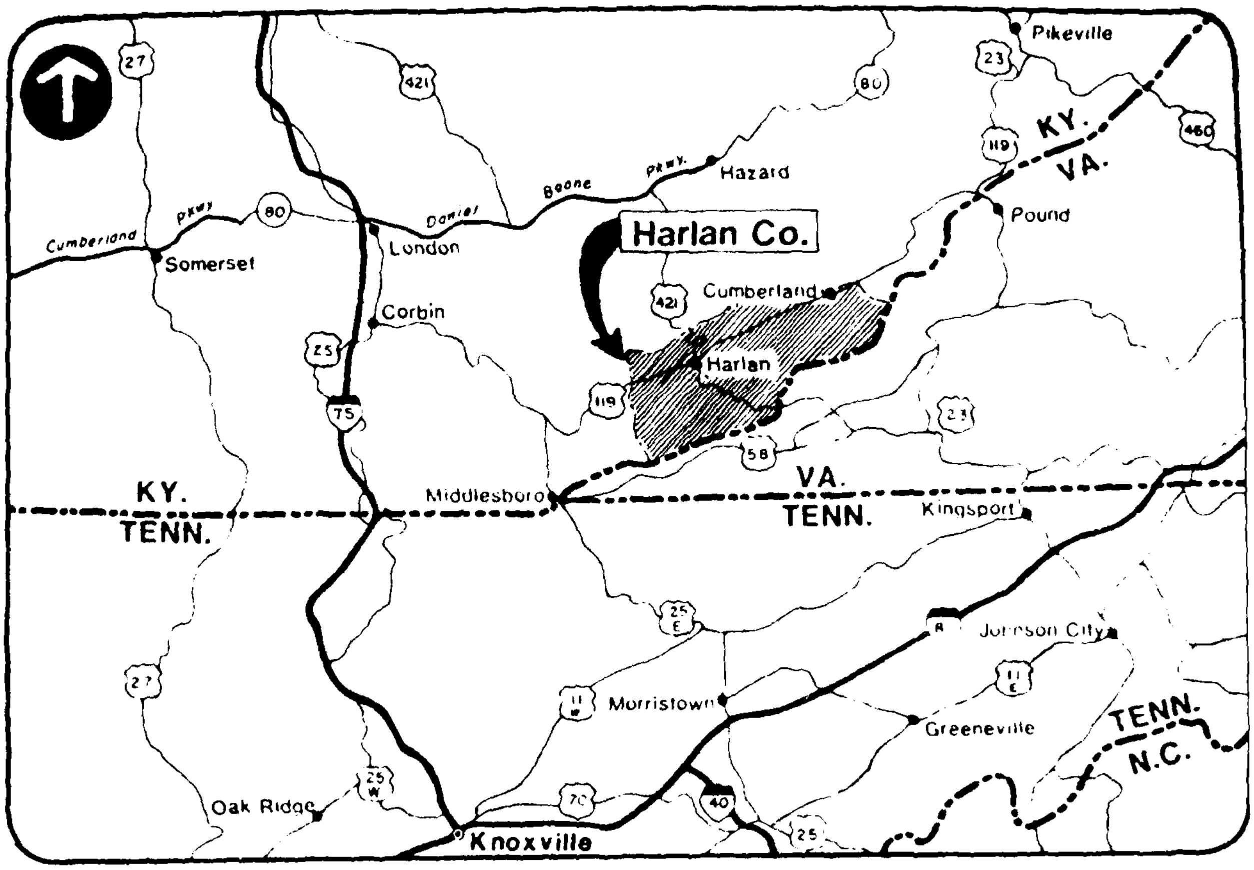

Figure 1. LOCATION AND VICINITY MAP

ENVIRONMENTAL INVENTORY
Section 202 PL 96 - 367
Harlan, Kentucky

AD-A131 397 ENVIRONMENTAL INVENTORY UPPER CUMBERLAND RIVER HARLAN KENTUCKY(U) SOIL SYSTEMS INC MARIETTA GA DEC 81 2/2

UNCLASSIFIED F/G 6/3 NL

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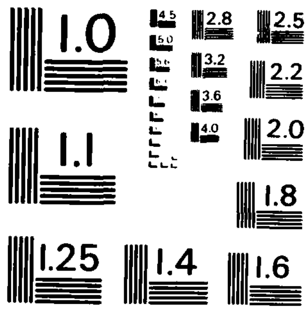
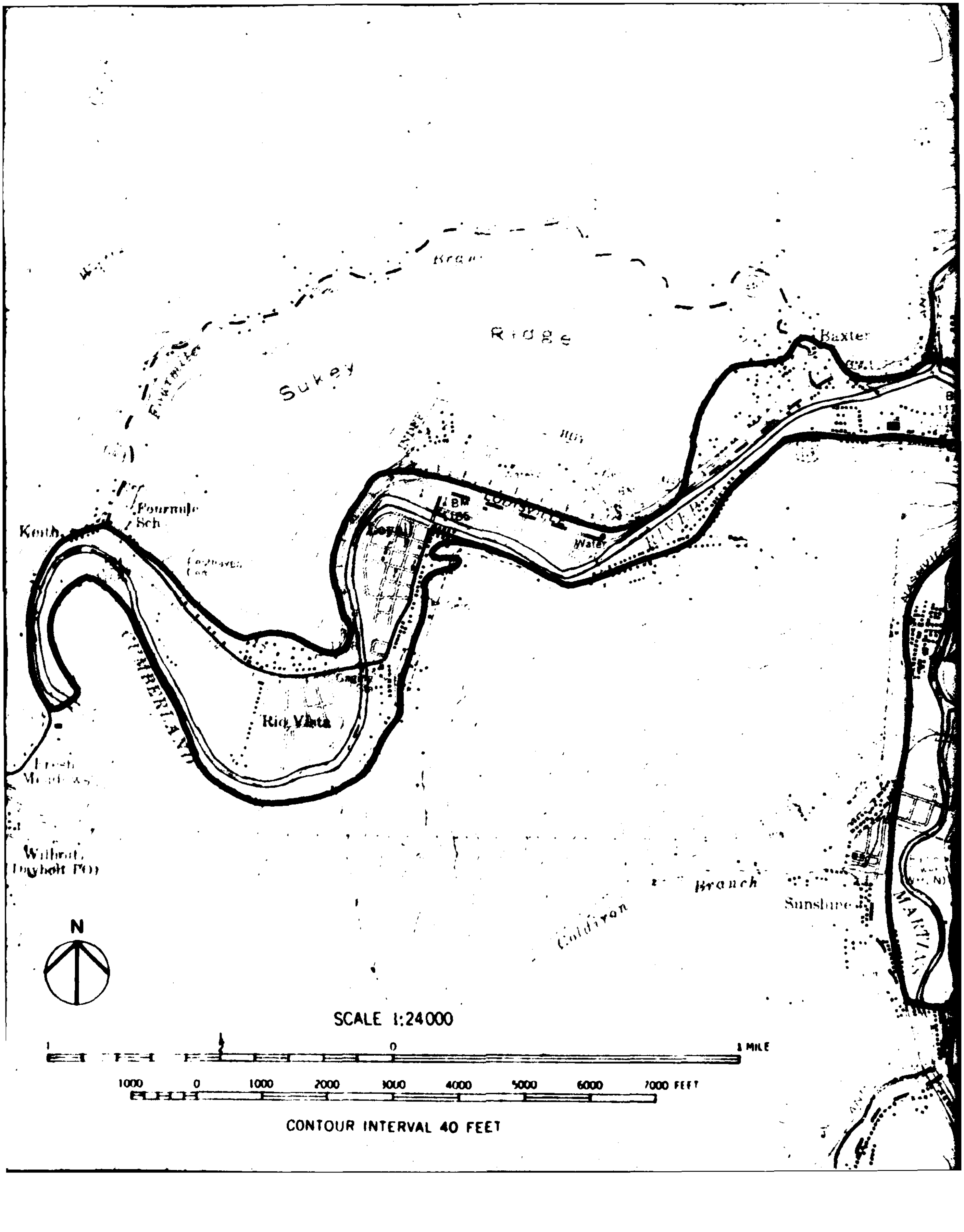


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A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Baxter
Fourmile Sch
Keith
Logan
Water
RIVER
CUMBERLAND
Rio Vista
Fresh Meadows
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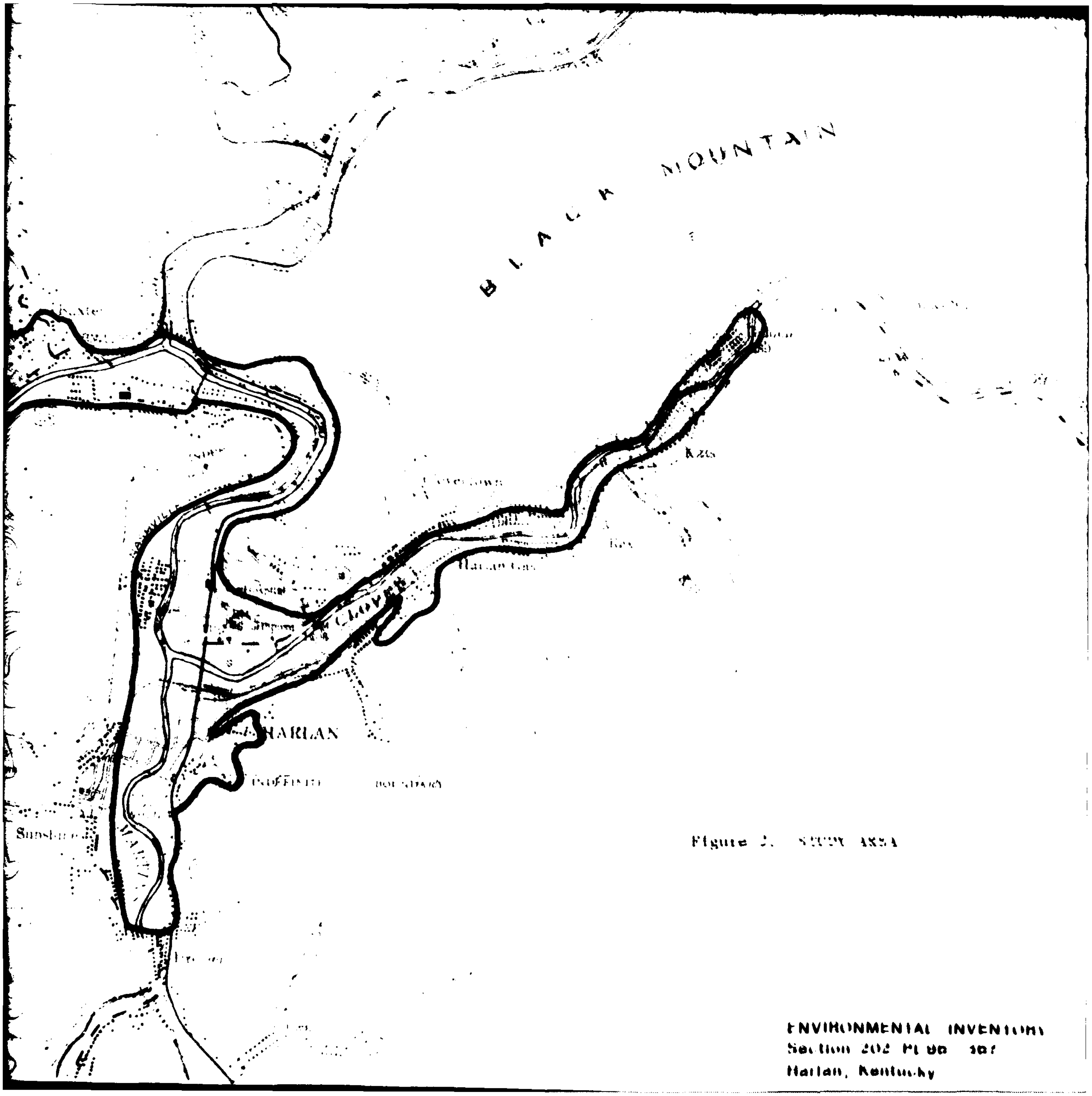

Figure 2. STUDY AREA

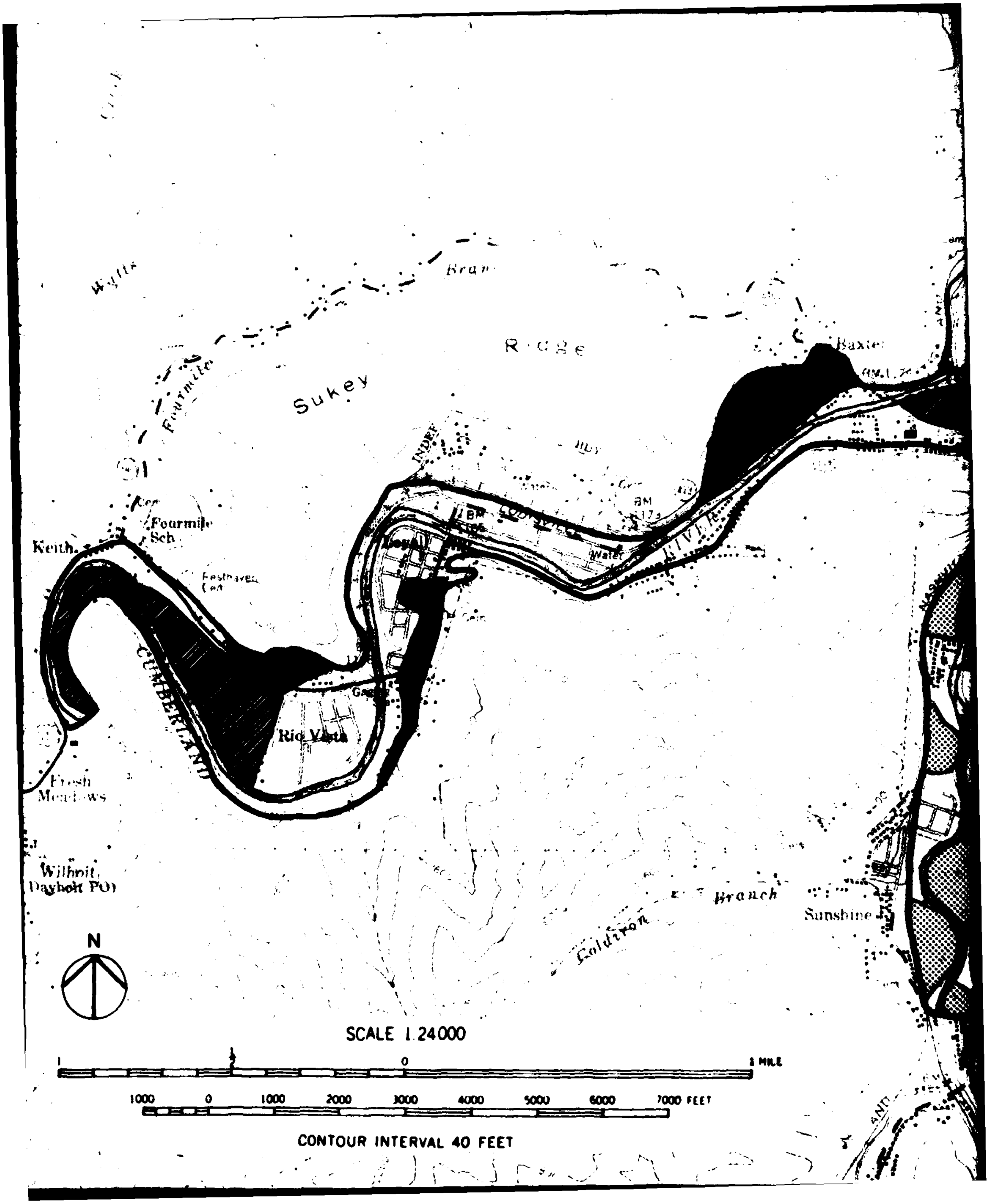

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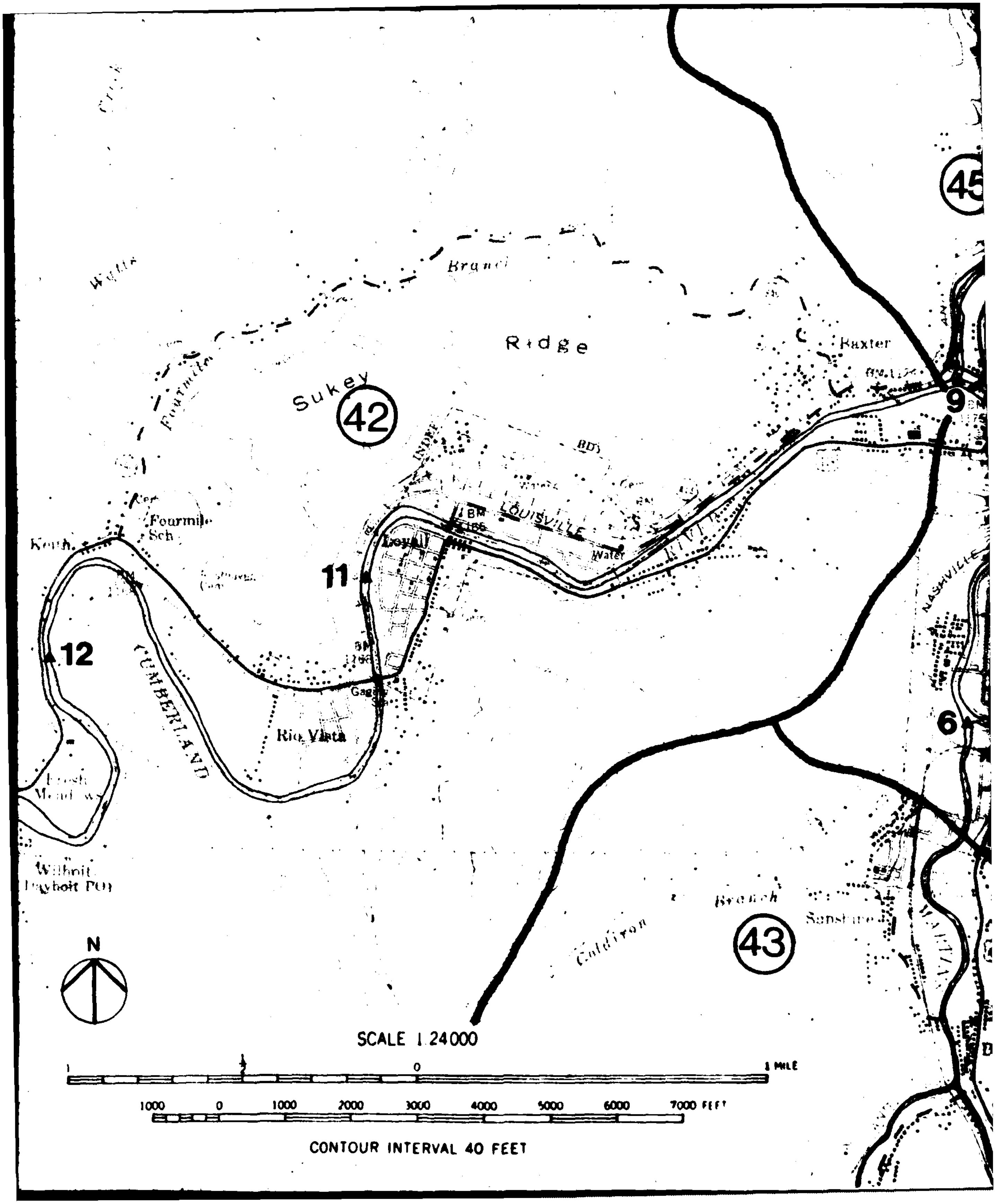
Figure 3. MAP OF SOILS AND FARMLANDS FOR HARLAN STUDY AREA



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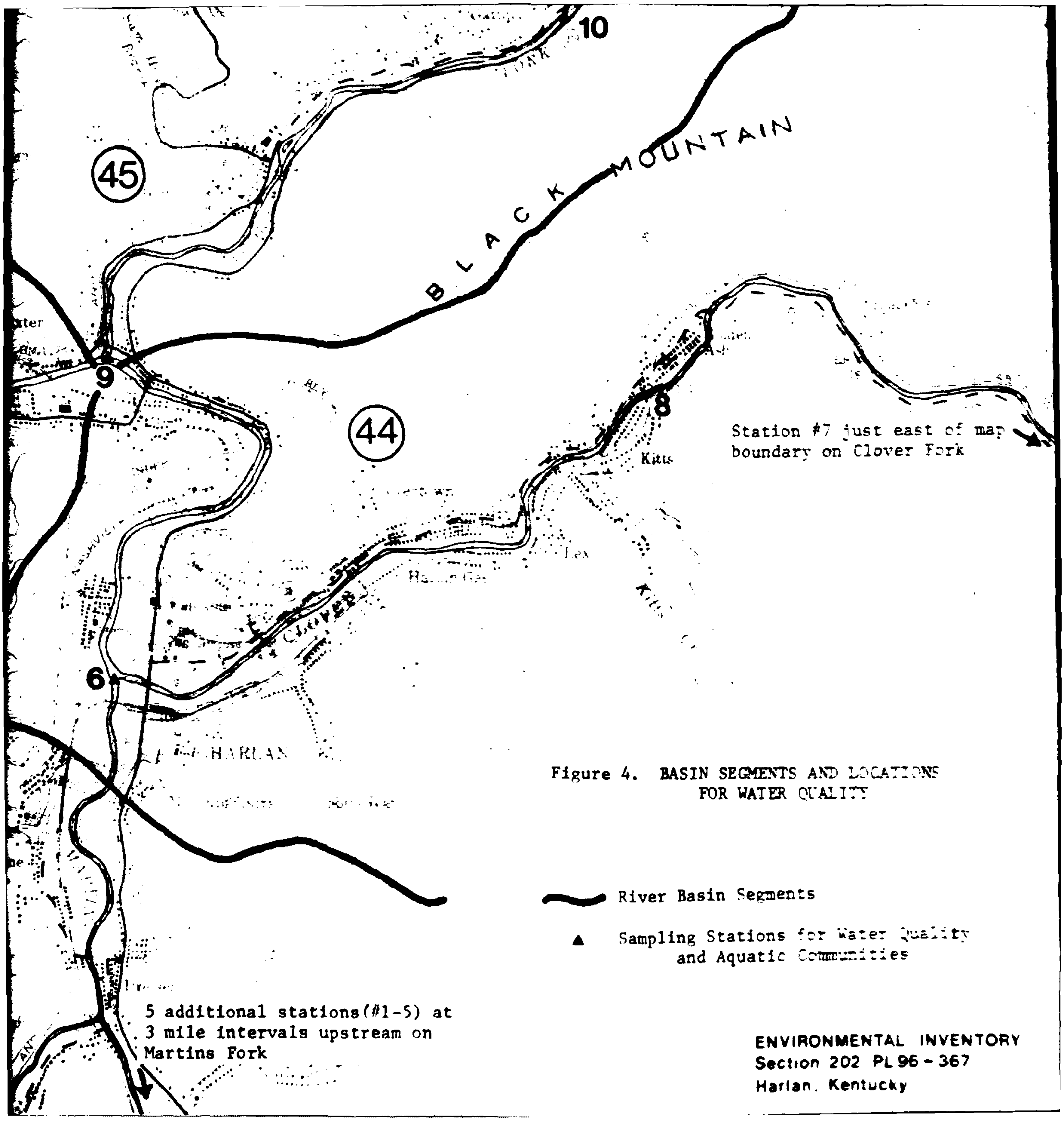
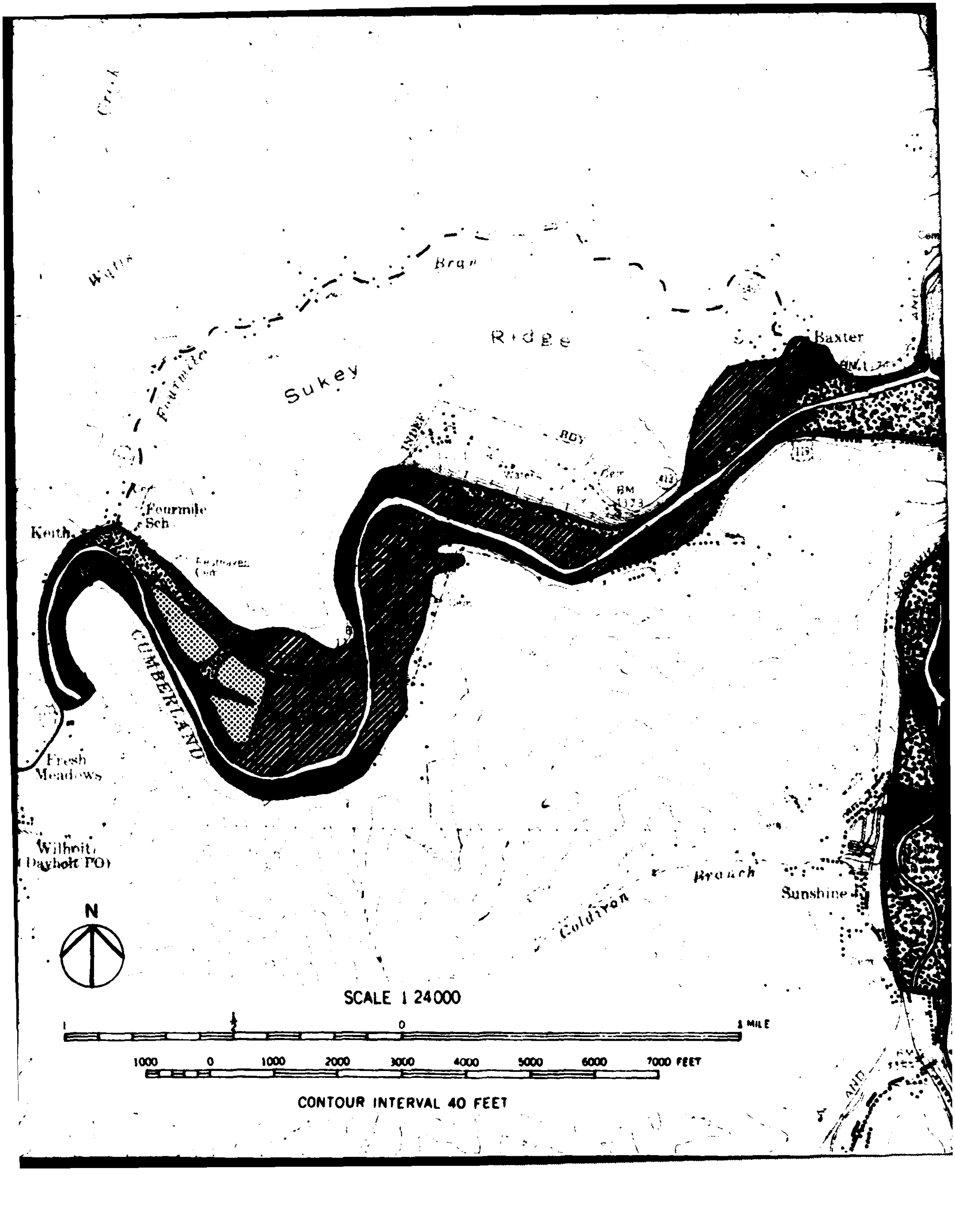


Figure 4. BASIN SEGMENTS AND LOCATIONS FOR WATER QUALITY



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Fresh Meadows
Wilhoit (Dayholt PO)
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Goldiron
Branch
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CONTOUR INTERVAL 40 FEET

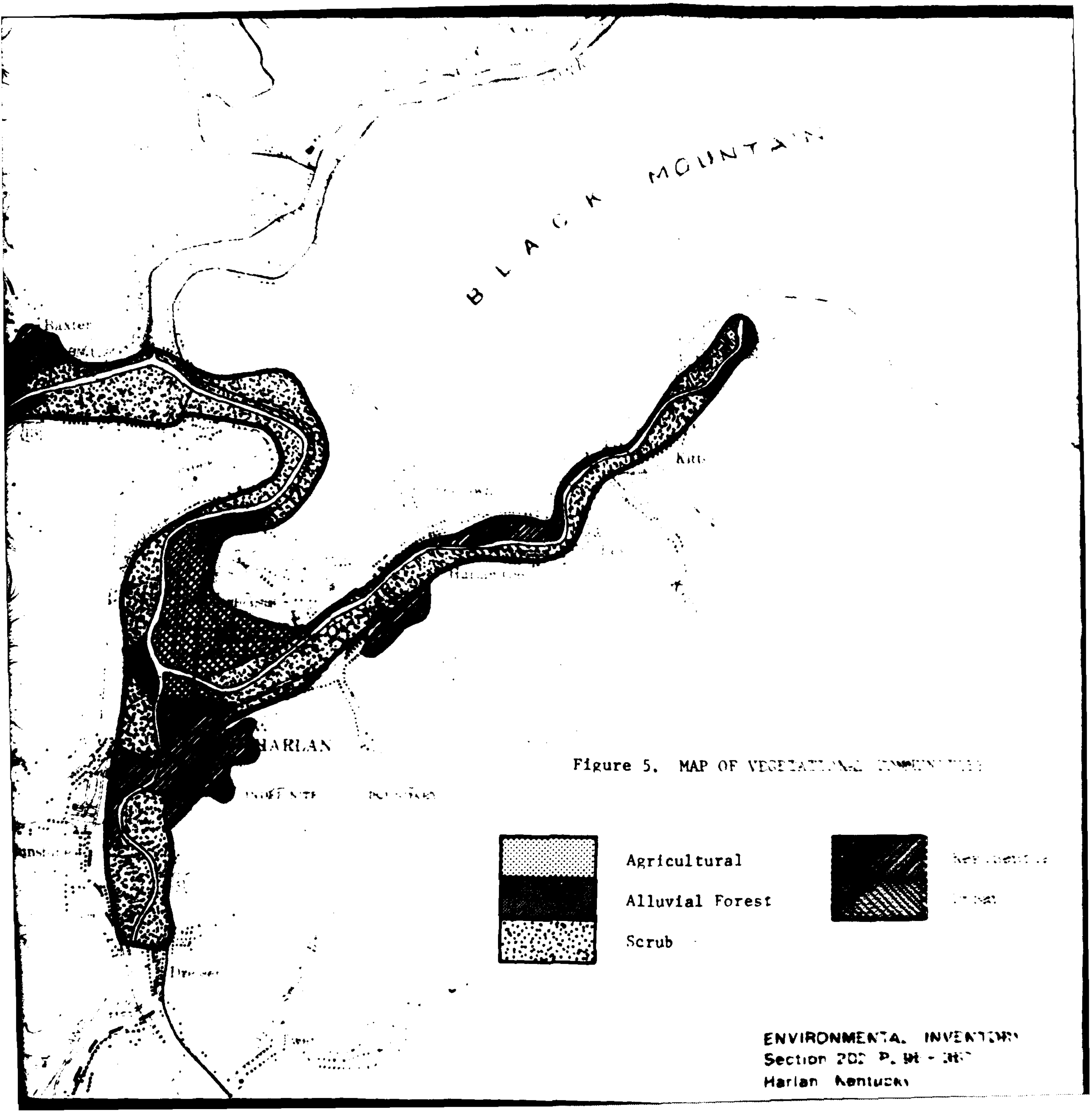
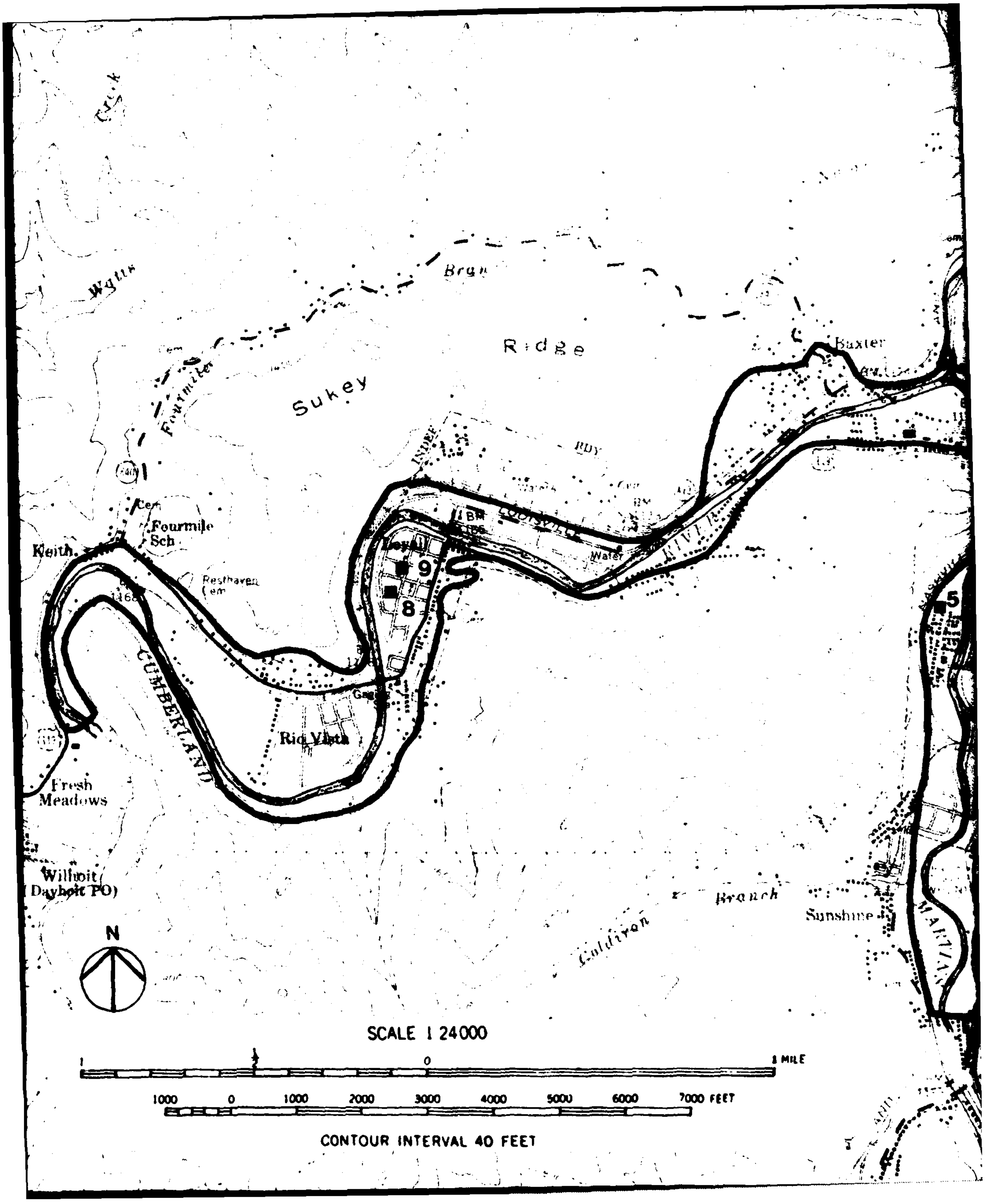


Figure 5. MAP OF VEGETATIONAL COMMUNITIES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Ridge
Fourmile
Baxter
Keith
Fourmile Sch
Resthaven Cem
CUMBERLAND
RIVER
Water
9
8
5
Rio Vista
Fresh Meadows
Willhoit (Dayhoit PO)
Coldiron
Branch
Sunshine
N
SCALE 1 24000
1 MILE
0
1000
0
1000
2000
3000
4000
5000
6000
7000 FEET
CONTOUR INTERVAL 40 FEET

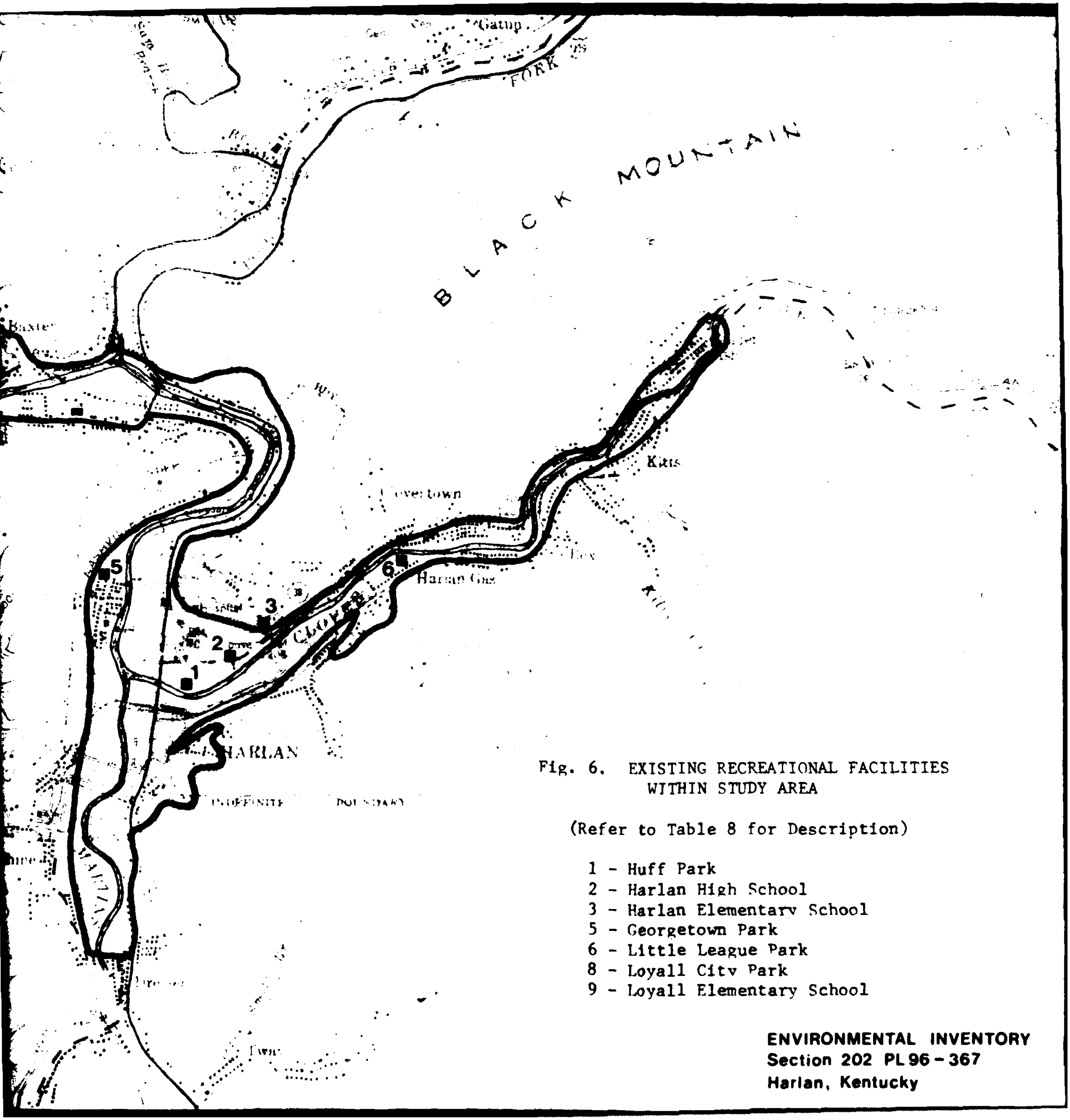

Fig. 6. EXISTING RECREATIONAL FACILITIES WITHIN STUDY AREA

(Refer to Table 8 for Description)

1 - Huff Park
2 - Harlan High School
3 - Harlan Elementary School
5 - Georgetown Park
6 - Little League Park
8 - Loyall City Park
9 - Loyall Elementary School

ENVIRONMENTAL INVENTORY
Section 202 PL 96 - 367
Harlan, Kentucky

END

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