3.0 ENVIRONMENTAL ANALYSIS

3.1 APPROACH

The interdisciplinary EIS study team (see Section 9.0 List of Preparers) followed a structured process to analyze the potential environmental impacts, or effects, of the:

- Proposed construction of a dam to create a reservoir at the War Fork and Steer Fork and the Sturgeon Creek sites;
- Proposed construction of a raw water transmission main leading from each proposed reservoir site to the Jackson County Water Association Treatment Plant at Tyner Lake; and
- No action alternative.

This process, called the C-E-Q, is described below.

Causes-Effects-Questions:
A Structured Analytic Process

Step 1: Identify the specific activities, tasks, and subtasks involved in the proposed action(s) and alternative(s).

Step 2: For each specific activity, task, and subtask, determine the full range of direct effects that each could have on any environmental resource. For example, removing vegetation could cause soil erosion.

Step 3: For each conceivable direct effect, identify which further effects could be caused by the direct effects. For example, soil erosion could cause stream sedimentation, which could kill stream species, which could diminish the food supply for fish, leading to decreased fish populations. This inquiry can identify multi-stepped chains of potential causes-and-effects.

Step 4: Starting at the beginning of each chain of causes-and-effects, work through a series of questions for each potential effect:

- Would this effect actually occur from this project?
  If not, why not? What would preclude it from happening?
- If the effect cannot be ruled out, characterize which types of data, other information, and analyses are needed to determine the parameters of the effect, including its extent, duration, and intensity. Identify the sources from which the data is to be obtained.

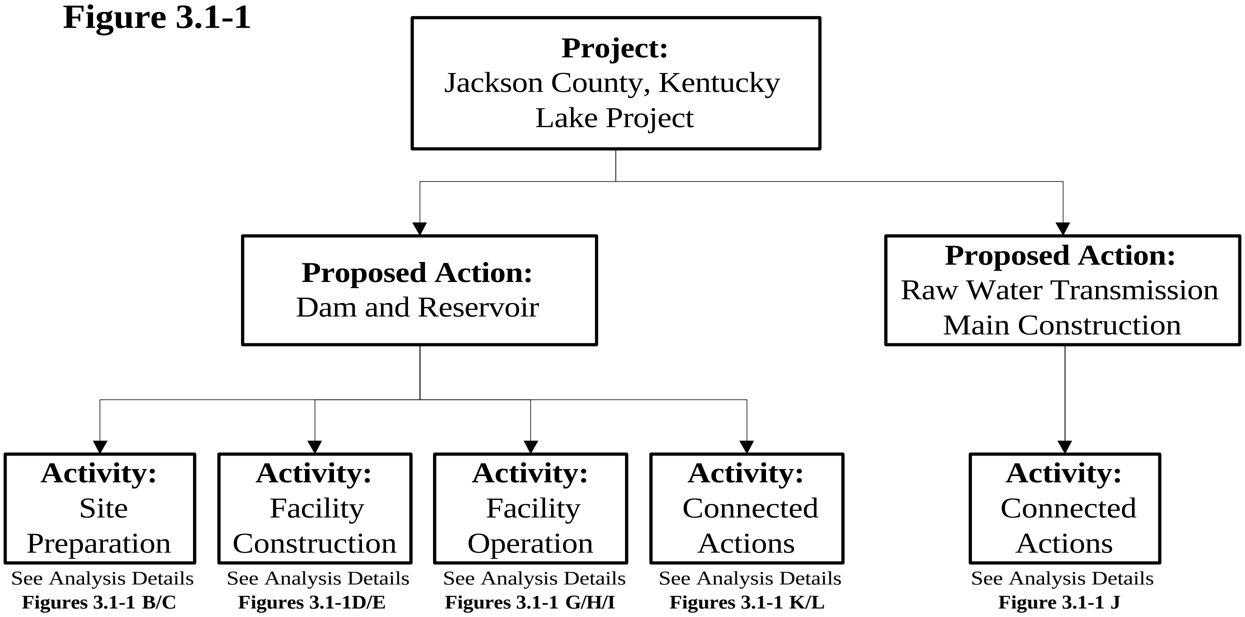
Step 5: Gather the data and conduct the analyses identified by the above steps. Gather and use only relevant information. Focus on getting sound answers to the impact questions.

Step 6: Document the results of this study process. Provide all relevant analytic information, but no extraneous encyclopedia bulk.

Figure 3.1-1 illustrates the results of this process. This figure shows the activities involved in the site preparation, construction, operation, and connected actions associated with a dam and reservoir at each alternative site, and activities involved in the construction of a raw water transmission main leading from the reservoir. It also indicates the series of effects, both direct and indirect, that was initially identified as potentially resulting from each activity.

After completing the preliminary analysis, the EIS study team proceeded to conduct the investigation and analyses by gathering the data they concluded were relevant. Using these data, the team determined which impacts would occur and assessed them as to significance based on criteria listed in Appendix C. The team also analyzed potential mitigation measures. The text of this report presents the results of this process, with cross-references to **Figure 3.1-1**. This document has been organized to be useful, informative, and reader-friendly. Accordingly, this section has been structured primarily according to environmental components or resources (i.e., soils/geology, surface water, air). An explanation of the organization of each environmental resource section is provided in Section 3.2 of this EIS.

Figure 3.1-1



About the following diagrams:

These diagrams graphically summarize the investigation of potential impacts of this project and the results of those investigations. The study team initially listed all types of impacts that could arise directly or indirectly from one or more of the project's components. the team took these as the questions to be answered, that is, "Will this impact actually occur?" "If so, how?" Thus, the team studied whether or not the types of impacts identified here would actually occur in this project.

Chart Key

Effects that were considered, but not found to be possible. Therefore, subsequent effects were also not possible.

Denotes a task, activity, or subtask.

Effects that would be prevented or minimized through mitigation measures.

Insignificant effects

Adverse, moderately significant or significant effects that cannot be mitigated.

Denotes a positive impact.

Figure 3.1-1A

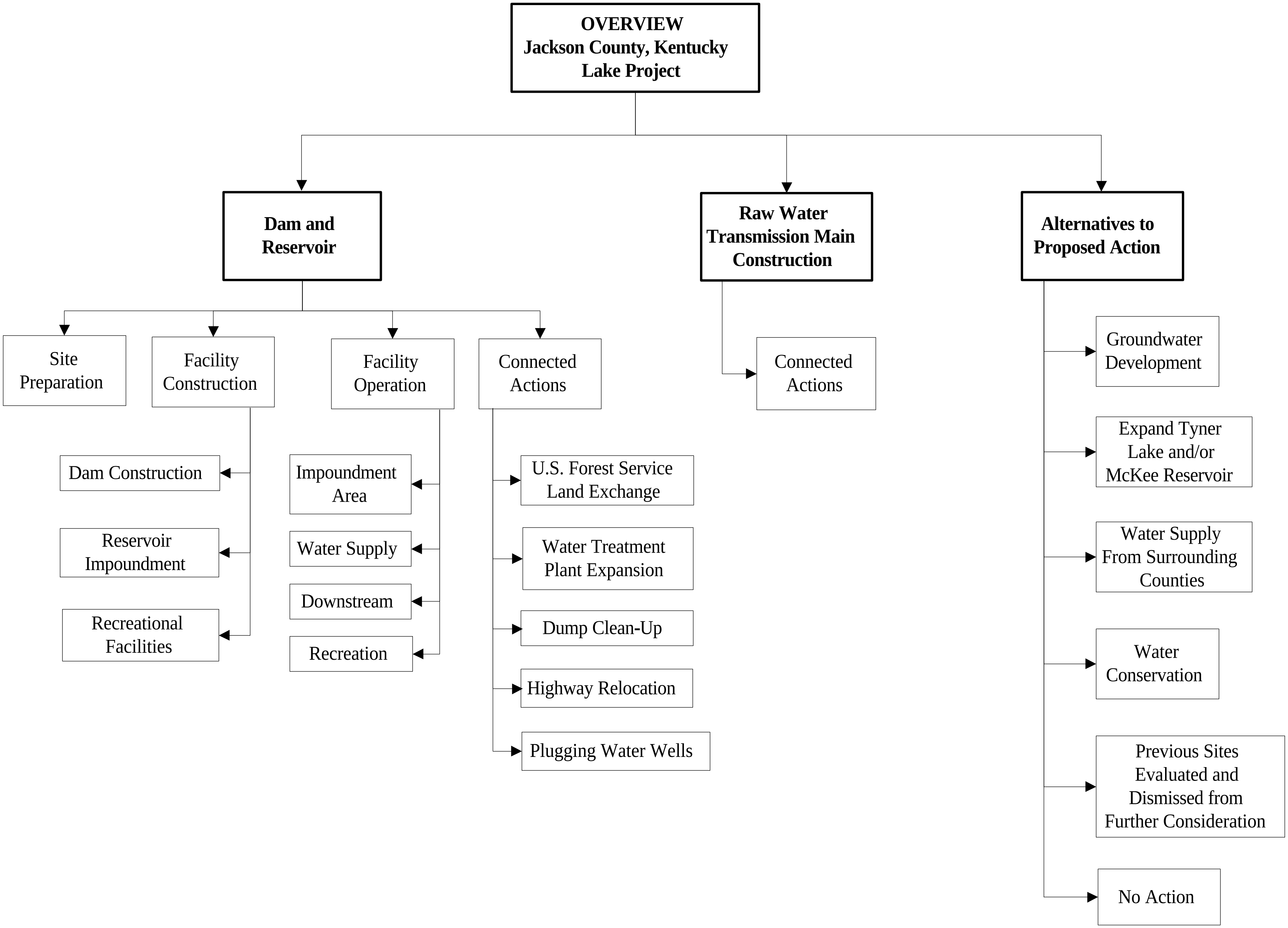

OVERVIEW
Jackson County, Kentucky
Lake Project
Dam and Reservoir
Raw Water Transmission Main Construction
Alternatives to Proposed Action
Site Preparation
Facility Construction
Facility Operation
Connected Actions
Connected Actions
Dam Construction
Reservoir Impoundment
Recreational Facilities
Impoundment Area
Water Supply
Downstream
Recreation
U.S. Forest Service Land Exchange
Water Treatment Plant Expansion
Dump Clean-Up
Highway Relocation
Plugging Water Wells
Groundwater Development
Expand Tyner Lake and/or McKee Reservoir
Water Supply From Surrounding Counties
Water Conservation
Previous Sites Evaluated and Dismissed from Further Consideration
No Action

Figure 3.1-1B

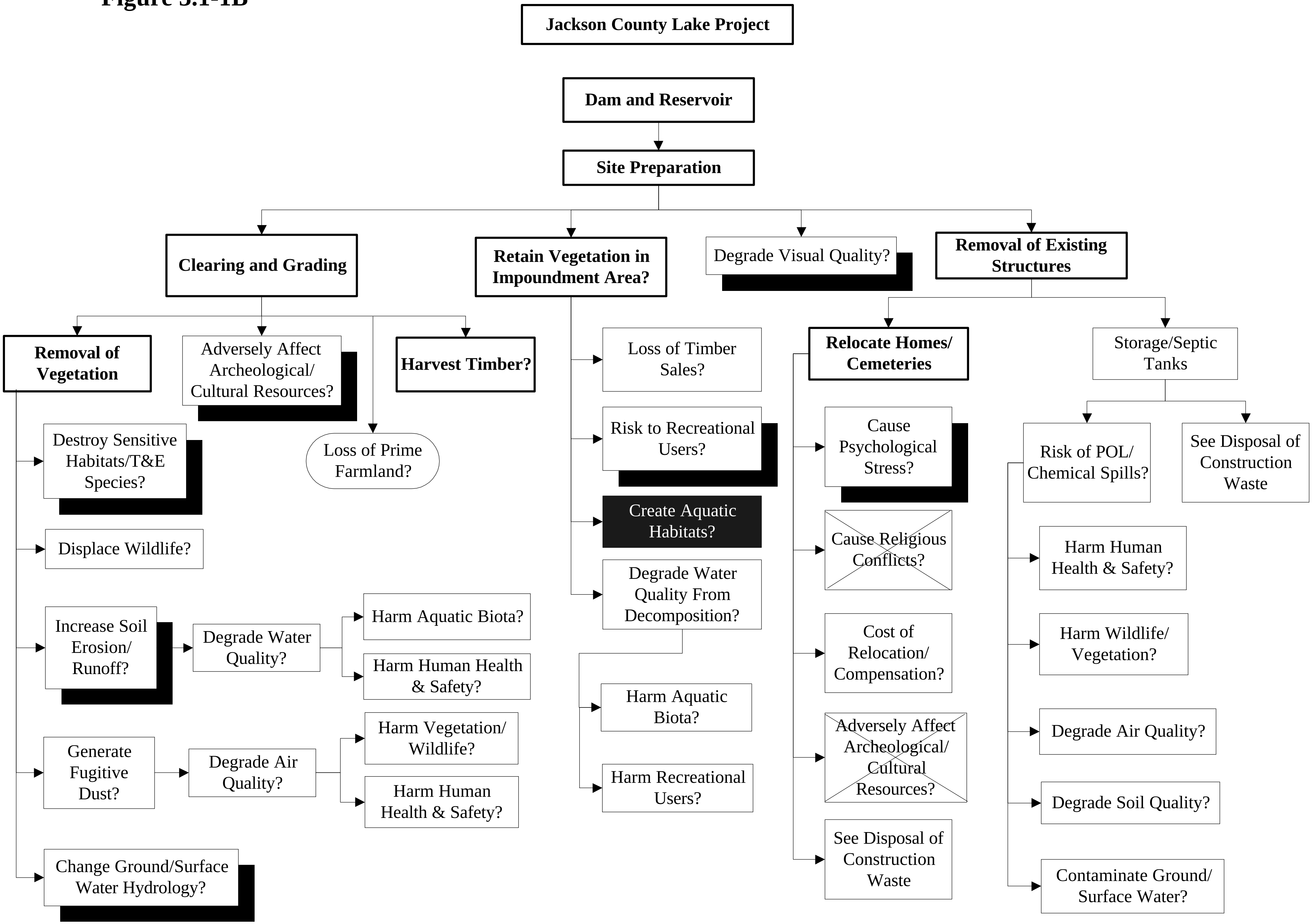

Jackson County Lake Project
Dam and Reservoir
Site Preparation
Clearing and Grading
Retain Vegetation in Impoundment Area?
Degrade Visual Quality?
Removal of Existing Structures
Removal of Vegetation
Adversely Affect Archeological/ Cultural Resources?
Harvest Timber?
Loss of Prime Farmland?
Destroy Sensitive Habitats/T&E Species?
Displace Wildlife?
Increase Soil Erosion/ Runoff?
Degrade Water Quality?
Harm Aquatic Biota?
Harm Human Health & Safety?
Generate Fugitive Dust?
Degrade Air Quality?
Harm Vegetation/ Wildlife?
Harm Human Health & Safety?
Change Ground/Surface Water Hydrology?
Loss of Timber Sales?
Risk to Recreational Users?
Create Aquatic Habitats?
Degrade Water Quality From Decomposition?
Harm Aquatic Biota?
Harm Recreational Users?
Relocate Homes/ Cemeteries
Cause Psychological Stress?
Cause Religious Conflicts?
Cost of Relocation/ Compensation?
Adversely Affect Archeological/ Cultural Resources?
See Disposal of Construction Waste
Storage/Septic Tanks
Risk of POL/ Chemical Spills?
See Disposal of Construction Waste
Harm Human Health & Safety?
Harm Wildlife/ Vegetation?
Degrade Air Quality?
Degrade Soil Quality?
Contaminate Ground/ Surface Water?

Figure 3.1-1C

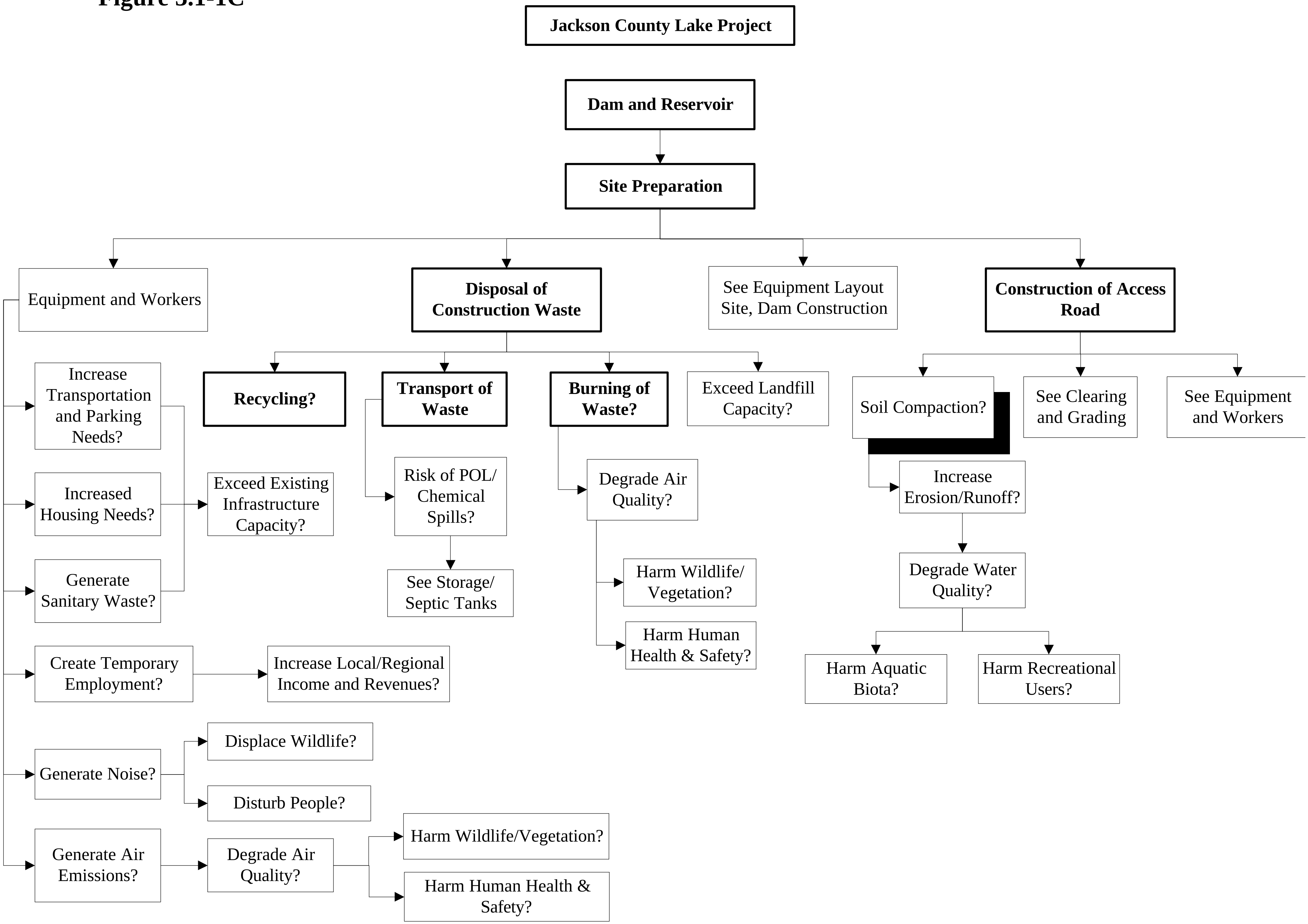

Jackson County Lake Project
Dam and Reservoir
Site Preparation
Equipment and Workers
Disposal of Construction Waste
See Equipment Layout Site, Dam Construction
Construction of Access Road
Increase Transportation and Parking Needs?
Increased Housing Needs?
Generate Sanitary Waste?
Exceed Existing Infrastructure Capacity?
Create Temporary Employment?
Increase Local/Regional Income and Revenues?
Generate Noise?
Displace Wildlife?
Disturb People?
Generate Air Emissions?
Degrade Air Quality?
Harm Wildlife/Vegetation?
Harm Human Health & Safety?
Recycling?
Transport of Waste
Risk of POL/ Chemical Spills?
See Storage/ Septic Tanks
Burning of Waste?
Degrade Air Quality?
Harm Wildlife/ Vegetation?
Harm Human Health & Safety?
Exceed Landfill Capacity?
Soil Compaction?
Increase Erosion/Runoff?
Degrade Water Quality?
Harm Aquatic Biota?
Harm Recreational Users?
See Clearing and Grading
See Equipment and Workers

Figure 3.1-1D

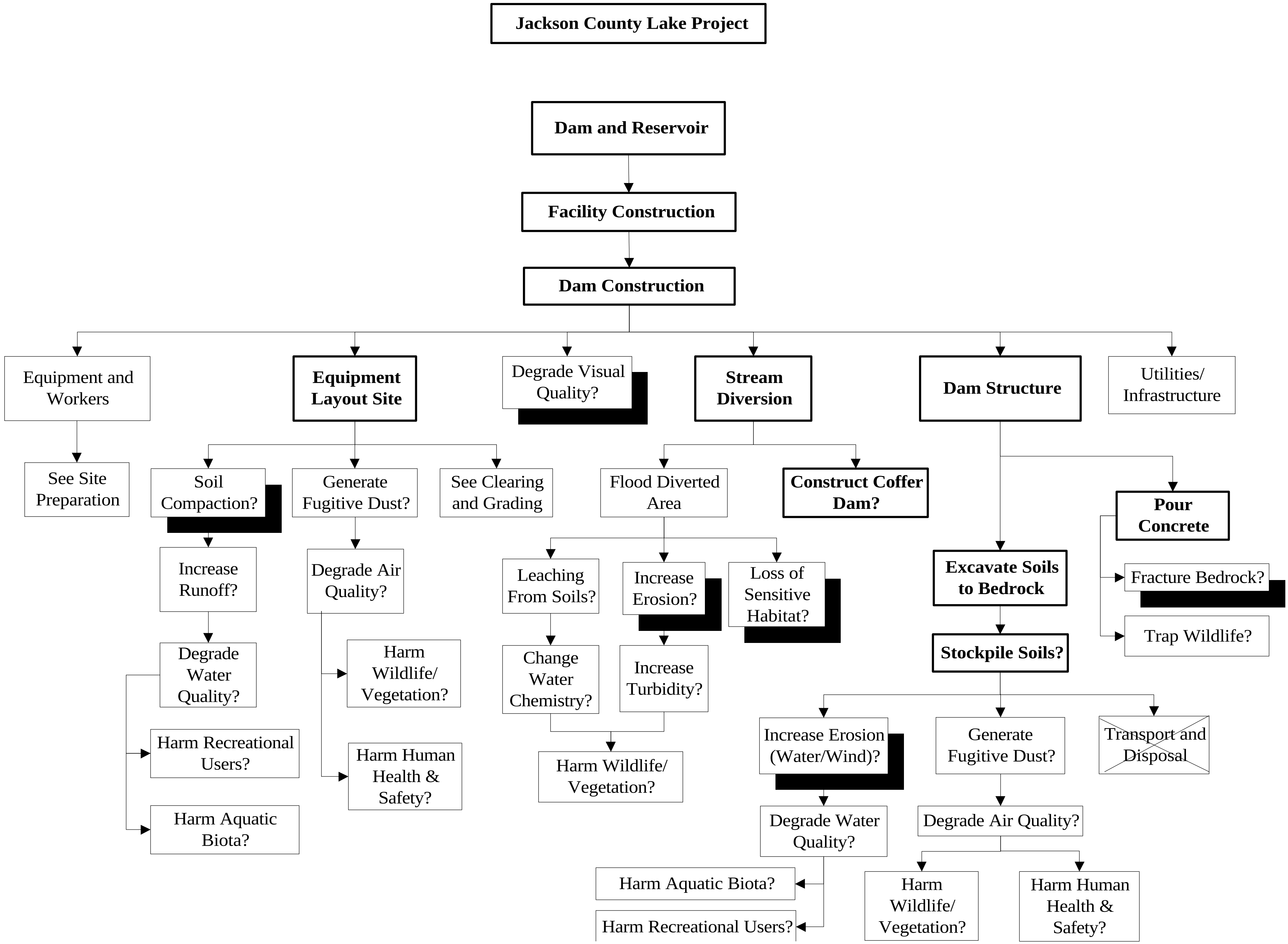
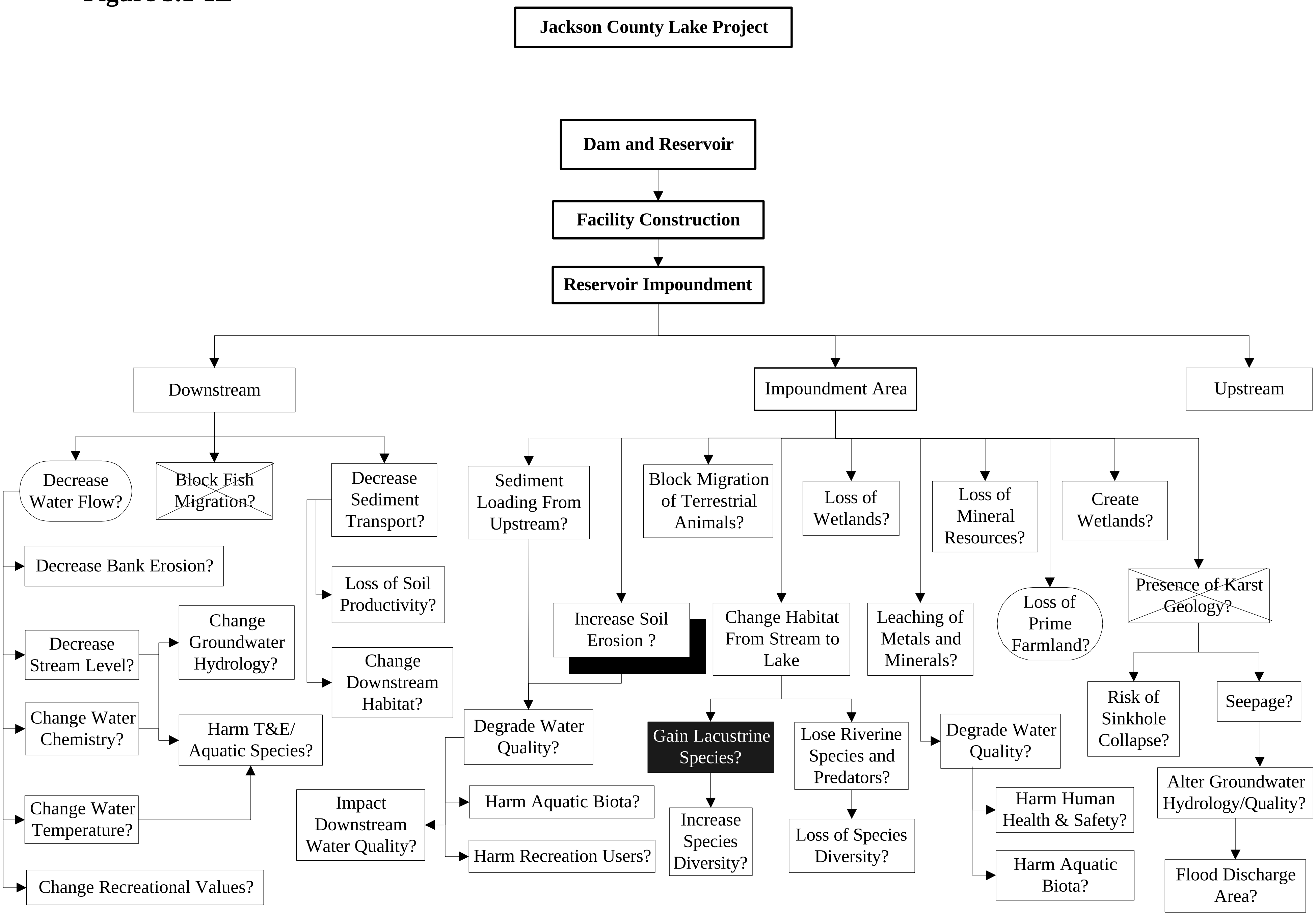

Jackson County Lake Project
Dam and Reservoir
Facility Construction
Dam Construction
Equipment and Workers
See Site Preparation
Equipment Layout Site
Soil Compaction?
Increase Runoff?
Degrade Water Quality?
Harm Recreational Users?
Harm Aquatic Biota?
Generate Fugitive Dust?
Degrade Air Quality?
Harm Wildlife/ Vegetation?
Harm Human Health & Safety?
See Clearing and Grading
Degrade Visual Quality?
Stream Diversion
Flood Diverted Area
Leaching From Soils?
Change Water Chemistry?
Increase Erosion?
Increase Turbidity?
Harm Wildlife/ Vegetation?
Loss of Sensitive Habitat?
Construct Coffer Dam?
Dam Structure
Excavate Soils to Bedrock
Stockpile Soils?
Increase Erosion (Water/Wind)?
Degrade Water Quality?
Harm Aquatic Biota?
Harm Recreational Users?
Generate Fugitive Dust?
Degrade Air Quality?
Harm Wildlife/ Vegetation?
Harm Human Health & Safety?
Transport and Disposal
Pour Concrete
Fracture Bedrock?
Trap Wildlife?
Utilities/ Infrastructure

Figure 3.1-1E



Jackson County Lake Project
Dam and Reservoir
Facility Construction
Reservoir Impoundment
Downstream
Impoundment Area
Upstream
Decrease Water Flow?
Block Fish Migration?
Decrease Sediment Transport?
Decrease Bank Erosion?
Loss of Soil Productivity?
Decrease Stream Level?
Change Groundwater Hydrology?
Change Downstream Habitat?
Change Water Chemistry?
Harm T&E/ Aquatic Species?
Change Water Temperature?
Change Recreational Values?
Sediment Loading From Upstream?
Degrade Water Quality?
Impact Downstream Water Quality?
Harm Aquatic Biota?
Harm Recreation Users?
Increase Soil Erosion ?
Block Migration of Terrestrial Animals?
Change Habitat From Stream to Lake
Gain Lacustrine Species?
Increase Species Diversity?
Lose Riverine Species and Predators?
Loss of Species Diversity?
Loss of Wetlands?
Loss of Mineral Resources?
Leaching of Metals and Minerals?
Degrade Water Quality?
Harm Human Health & Safety?
Harm Aquatic Biota?
Create Wetlands?
Loss of Prime Farmland?
Presence of Karst Geology?
Risk of Sinkhole Collapse?
Seepage?
Alter Groundwater Hydrology/Quality?
Flood Discharge Area?

Figure 3.1-1F

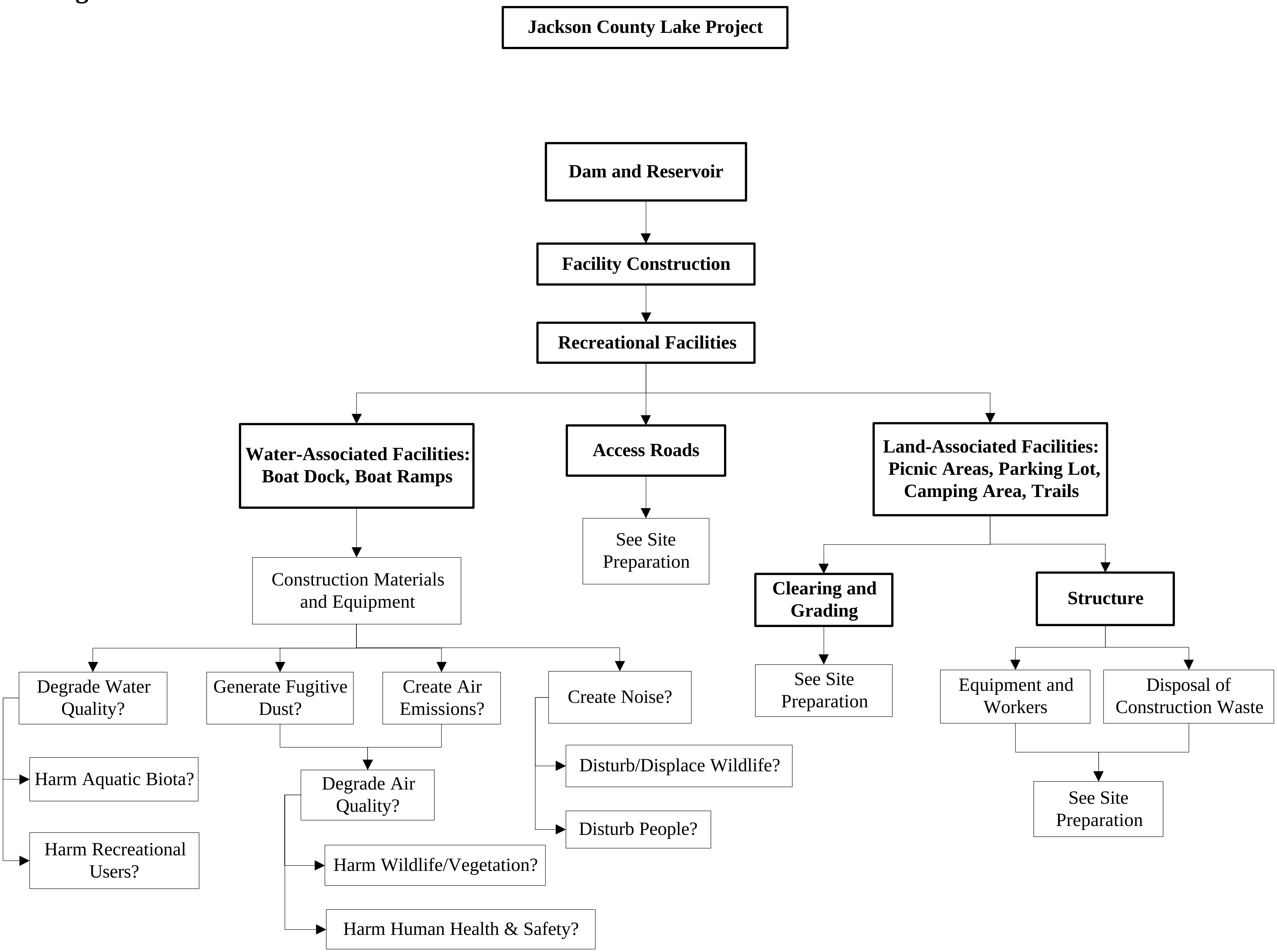
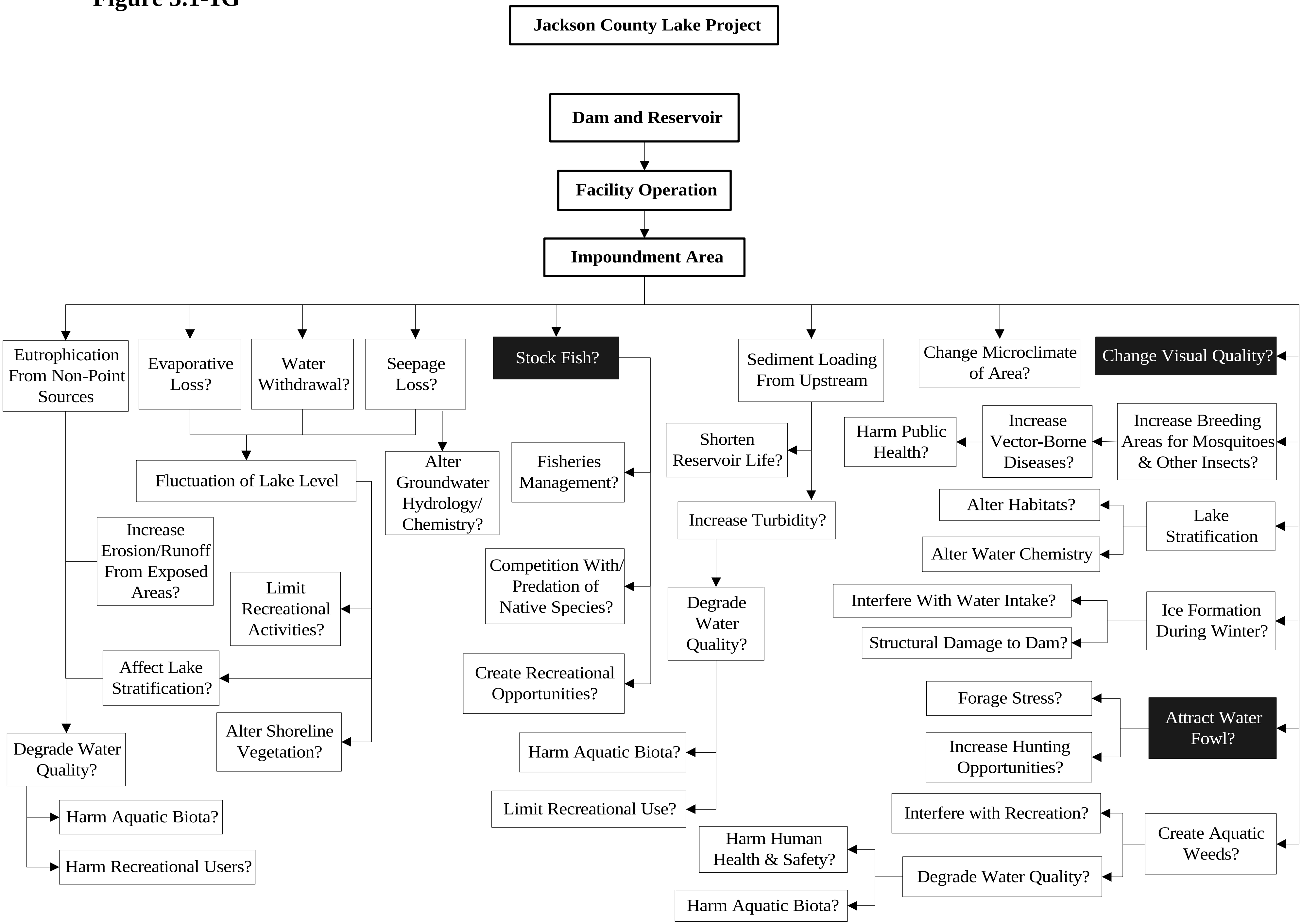

Jackson County Lake Project
Dam and Reservoir
Facility Construction
Recreational Facilities
Water-Associated Facilities: Boat Dock, Boat Ramps
Access Roads
Land-Associated Facilities: Picnic Areas, Parking Lot, Camping Area, Trails
See Site Preparation
Construction Materials and Equipment
Clearing and Grading
Structure
Degrade Water Quality?
Generate Fugitive Dust?
Create Air Emissions?
Create Noise?
See Site Preparation
Equipment and Workers
Disposal of Construction Waste
Harm Aquatic Biota?
Disturb/Displace Wildlife?
Degrade Air Quality?
See Site Preparation
Disturb People?
Harm Recreational Users?
Harm Wildlife/Vegetation?
Harm Human Health & Safety?

Figure 3.1-1G



Jackson County Lake Project
Dam and Reservoir
Facility Operation
Impoundment Area
Eutrophication From Non-Point Sources
Evaporative Loss?
Water Withdrawal?
Seepage Loss?
Stock Fish?
Sediment Loading From Upstream
Change Microclimate of Area?
Change Visual Quality?
Fluctuation of Lake Level
Alter Groundwater Hydrology/ Chemistry?
Fisheries Management?
Shorten Reservoir Life?
Harm Public Health?
Increase Vector-Borne Diseases?
Increase Breeding Areas for Mosquitoes & Other Insects?
Increase Turbidity?
Alter Habitats?
Lake Stratification
Alter Water Chemistry
Increase Erosion/Runoff From Exposed Areas?
Limit Recreational Activities?
Competition With/ Predation of Native Species?
Degrade Water Quality?
Interfere With Water Intake?
Ice Formation During Winter?
Structural Damage to Dam?
Affect Lake Stratification?
Create Recreational Opportunities?
Forage Stress?
Attract Water Fowl?
Increase Hunting Opportunities?
Degrade Water Quality?
Alter Shoreline Vegetation?
Harm Aquatic Biota?
Limit Recreational Use?
Interfere with Recreation?
Create Aquatic Weeds?
Harm Aquatic Biota?
Harm Human Health & Safety?
Degrade Water Quality?
Harm Recreational Users?
Harm Aquatic Biota?

Figure 3.1-1H

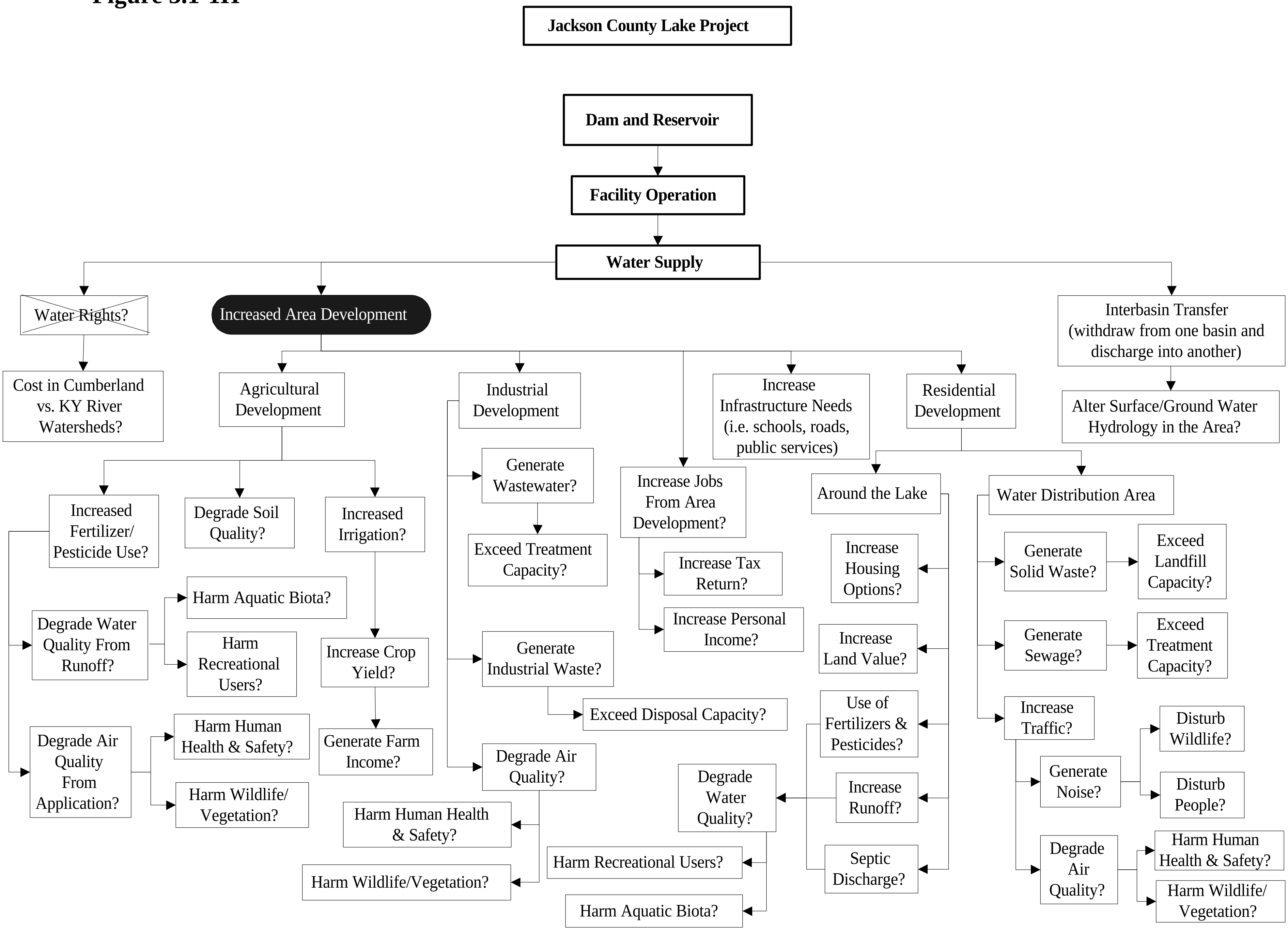

Jackson County Lake Project
Dam and Reservoir
Facility Operation
Water Supply
Water Rights?
Increased Area Development
Interbasin Transfer (withdraw from one basin and discharge into another)
Cost in Cumberland vs. KY River Watersheds?
Agricultural Development
Industrial Development
Increase Infrastructure Needs (i.e. schools, roads, public services)
Residential Development
Alter Surface/Ground Water Hydrology in the Area?
Increased Fertilizer/ Pesticide Use?
Degrade Soil Quality?
Increased Irrigation?
Generate Wastewater?
Increase Jobs From Area Development?
Around the Lake
Water Distribution Area
Exceed Treatment Capacity?
Increase Tax Return?
Increase Personal Income?
Increase Housing Options?
Generate Solid Waste?
Exceed Landfill Capacity?
Harm Aquatic Biota?
Degrade Water Quality From Runoff?
Harm Recreational Users?
Increase Crop Yield?
Generate Industrial Waste?
Increase Land Value?
Generate Sewage?
Exceed Treatment Capacity?
Exceed Disposal Capacity?
Use of Fertilizers & Pesticides?
Increase Traffic?
Disturb Wildlife?
Harm Human Health & Safety?
Degrade Air Quality From Application?
Generate Farm Income?
Degrade Air Quality?
Degrade Water Quality?
Increase Runoff?
Generate Noise?
Disturb People?
Harm Wildlife/ Vegetation?
Harm Human Health & Safety?
Degrade Air Quality?
Harm Human Health & Safety?
Harm Recreational Users?
Septic Discharge?
Harm Wildlife/Vegetation?
Harm Wildlife/ Vegetation?
Harm Aquatic Biota?

Figure 3.1-1I

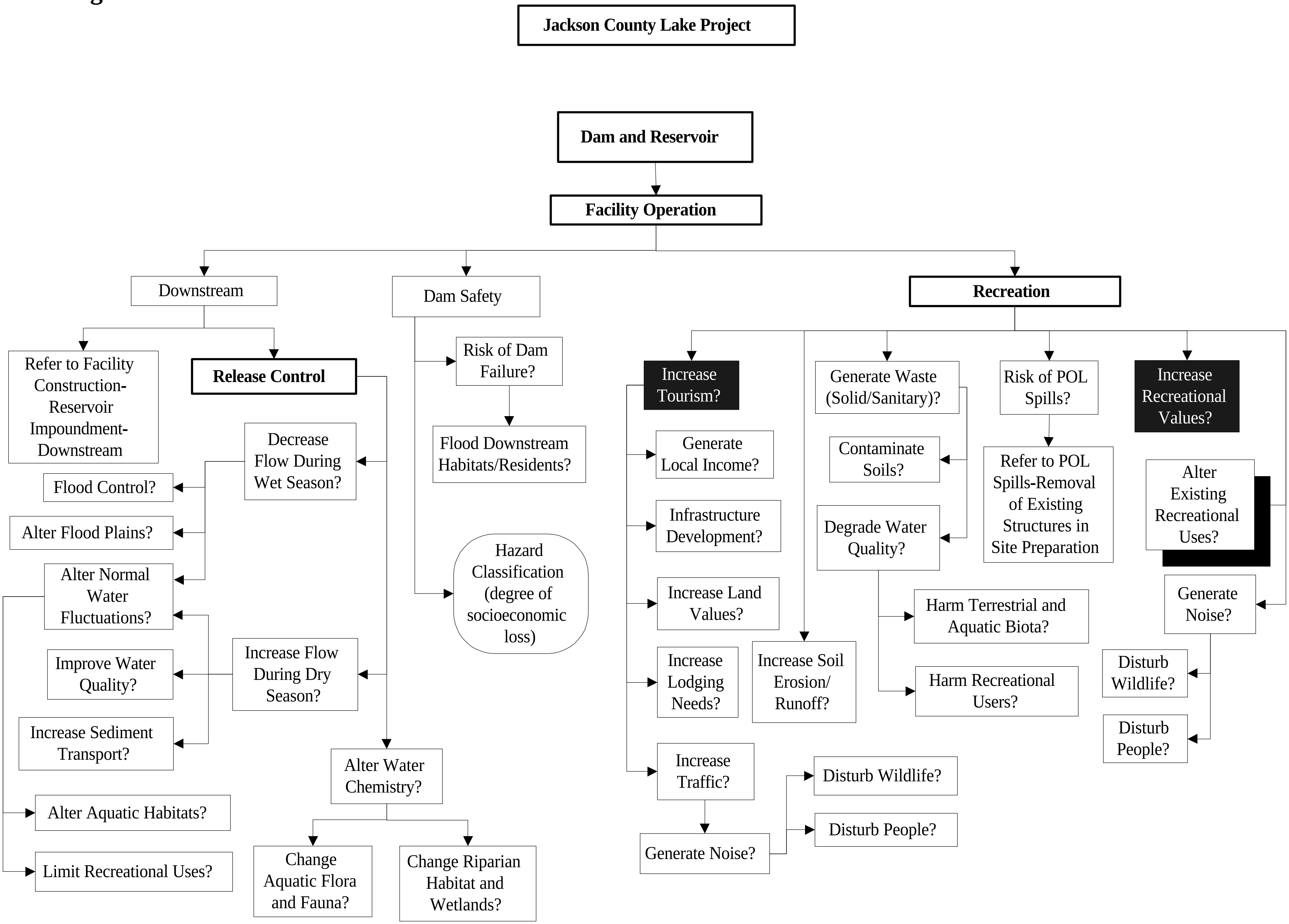

Jackson County Lake Project
Dam and Reservoir
Facility Operation
Downstream
Dam Safety
Recreation
Refer to Facility Construction-Reservoir Impoundment-Downstream
Release Control
Decrease Flow During Wet Season?
Flood Control?
Alter Flood Plains?
Alter Normal Water Fluctuations?
Improve Water Quality?
Increase Flow During Dry Season?
Increase Sediment Transport?
Alter Aquatic Habitats?
Limit Recreational Uses?
Alter Water Chemistry?
Change Aquatic Flora and Fauna?
Change Riparian Habitat and Wetlands?
Risk of Dam Failure?
Flood Downstream Habitats/Residents?
Hazard Classification (degree of socioeconomic loss)
Increase Tourism?
Generate Local Income?
Infrastructure Development?
Increase Land Values?
Increase Lodging Needs?
Increase Traffic?
Generate Noise?
Disturb Wildlife?
Disturb People?
Increase Soil Erosion/ Runoff?
Generate Waste (Solid/Sanitary)?
Contaminate Soils?
Degrade Water Quality?
Harm Terrestrial and Aquatic Biota?
Harm Recreational Users?
Risk of POL Spills?
Refer to POL Spills-Removal of Existing Structures in Site Preparation
Increase Recreational Values?
Alter Existing Recreational Uses?
Generate Noise?
Disturb Wildlife?
Disturb People?

Figure 3.1-1J

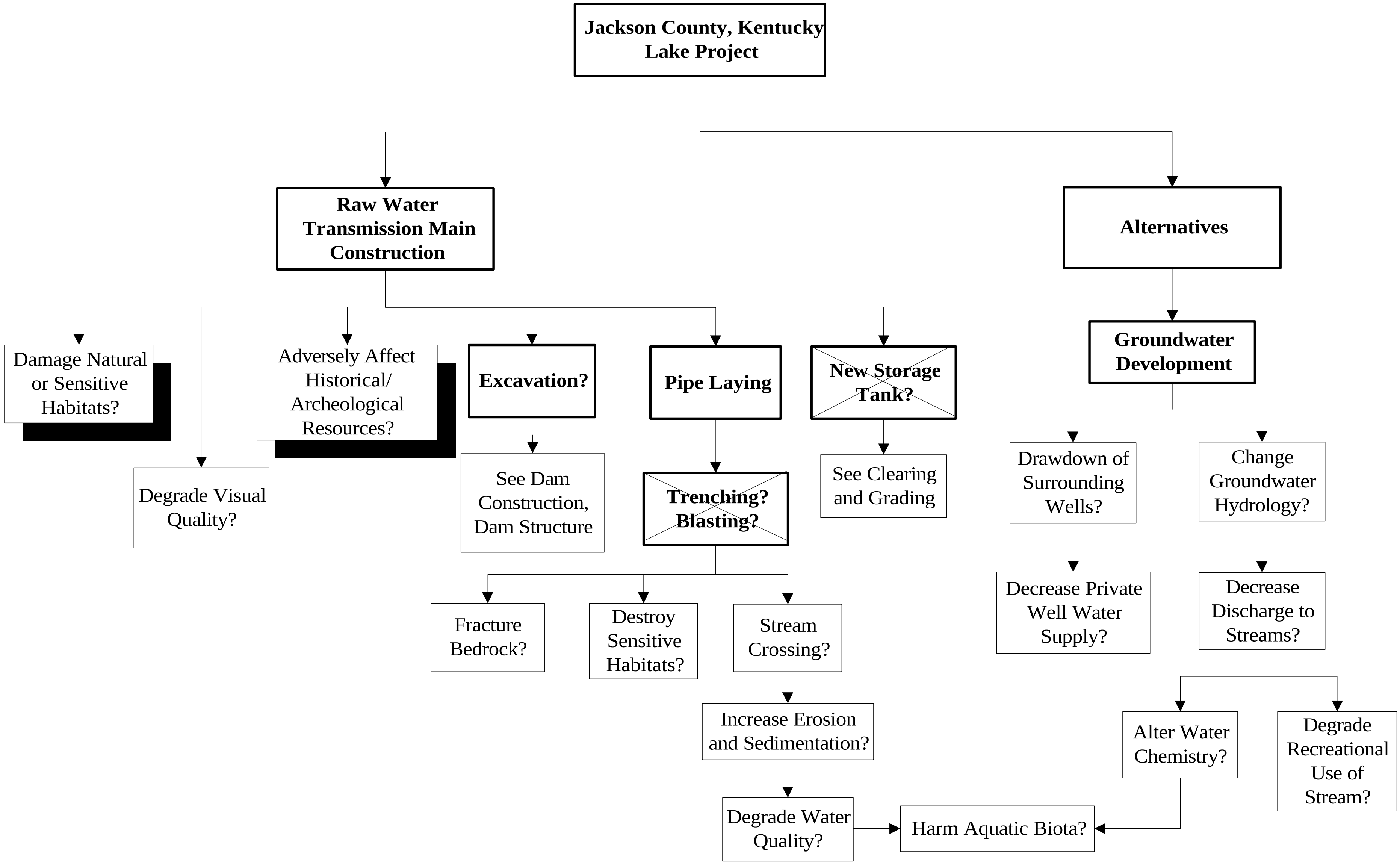

Jackson County, Kentucky Lake Project
Raw Water Transmission Main Construction
Alternatives
Damage Natural or Sensitive Habitats?
Degrade Visual Quality?
Adversely Affect Historical/ Archeological Resources?
Excavation?
Pipe Laying
New Storage Tank?
Groundwater Development
See Dam Construction, Dam Structure
Trenching? Blasting?
See Clearing and Grading
Drawdown of Surrounding Wells?
Change Groundwater Hydrology?
Fracture Bedrock?
Destroy Sensitive Habitats?
Stream Crossing?
Decrease Private Well Water Supply?
Decrease Discharge to Streams?
Increase Erosion and Sedimentation?
Alter Water Chemistry?
Degrade Recreational Use of Stream?
Degrade Water Quality?
Harm Aquatic Biota?

Figure 3.1-1K

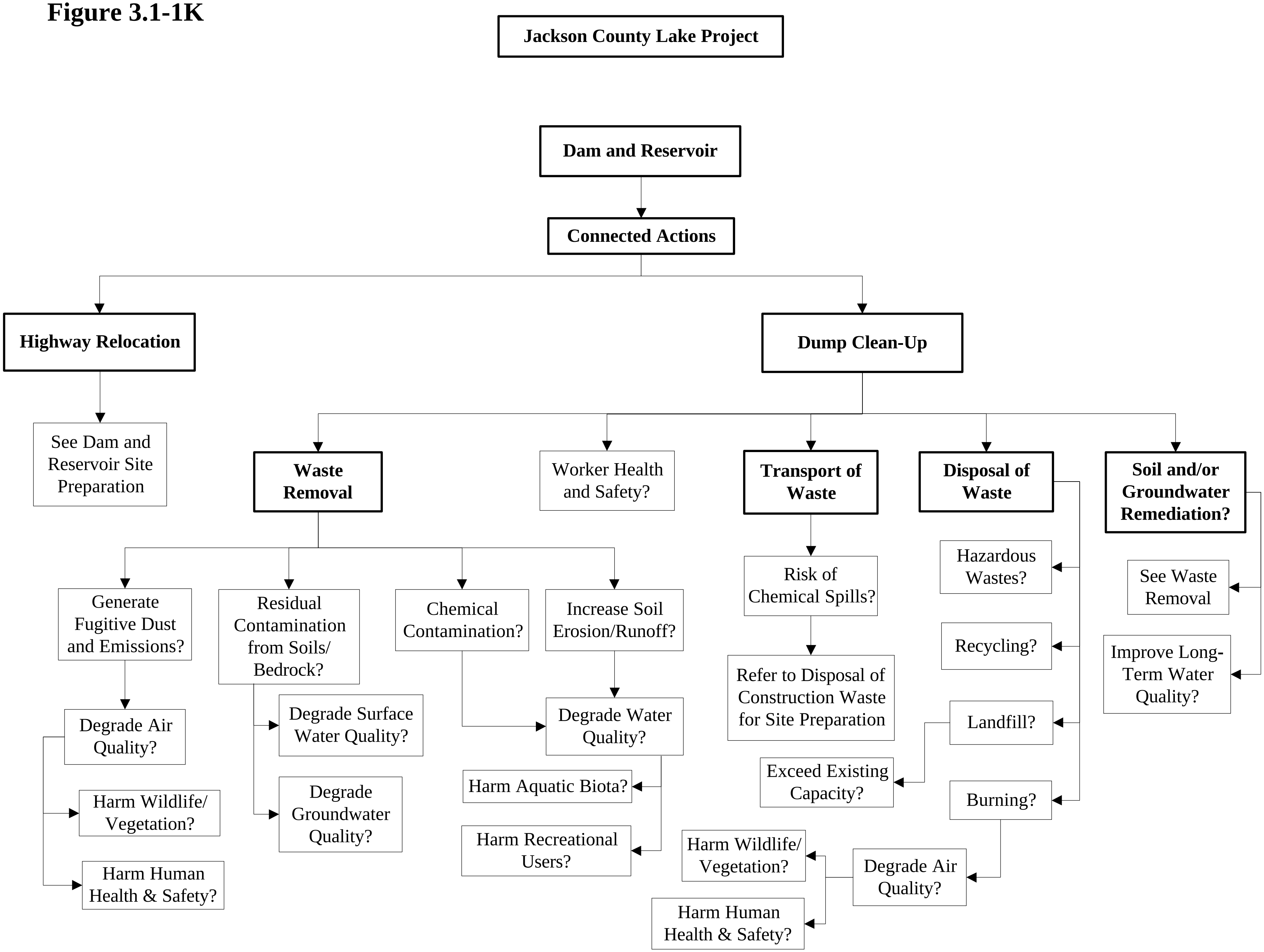
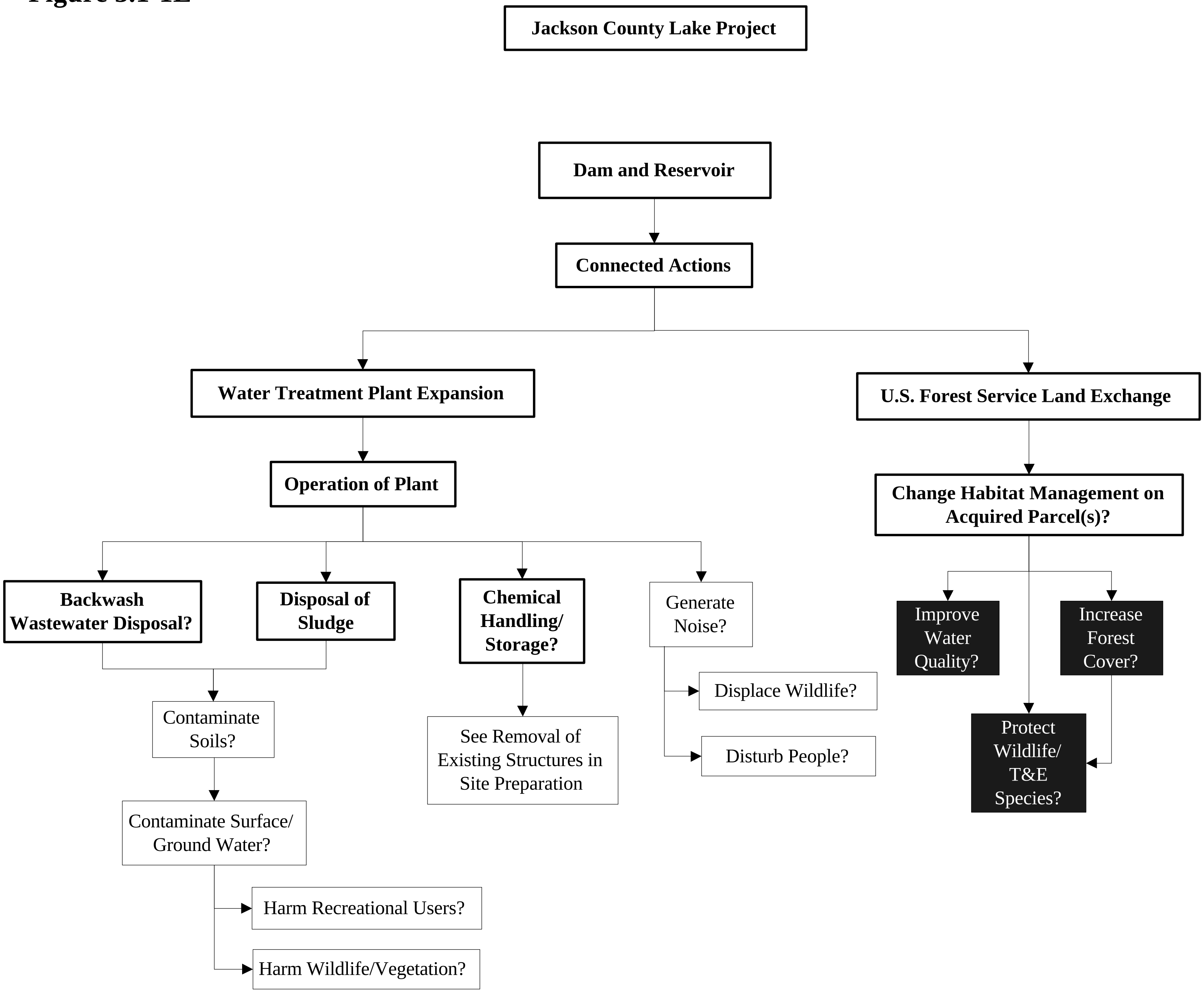

Jackson County Lake Project
Dam and Reservoir
Connected Actions
Highway Relocation
Dump Clean-Up
See Dam and Reservoir Site Preparation
Waste Removal
Worker Health and Safety?
Transport of Waste
Disposal of Waste
Soil and/or Groundwater Remediation?
Generate Fugitive Dust and Emissions?
Residual Contamination from Soils/ Bedrock?
Chemical Contamination?
Increase Soil Erosion/Runoff?
Risk of Chemical Spills?
Hazardous Wastes?
See Waste Removal
Recycling?
Improve Long-Term Water Quality?
Refer to Disposal of Construction Waste for Site Preparation
Degrade Air Quality?
Degrade Surface Water Quality?
Degrade Water Quality?
Landfill?
Exceed Existing Capacity?
Harm Aquatic Biota?
Harm Wildlife/ Vegetation?
Degrade Groundwater Quality?
Burning?
Harm Recreational Users?
Harm Human Health & Safety?
Harm Wildlife/ Vegetation?
Degrade Air Quality?
Harm Human Health & Safety?

Figure 3.1-1L



Jackson County Lake Project
Dam and Reservoir
Connected Actions
Water Treatment Plant Expansion
U.S. Forest Service Land Exchange
Operation of Plant
Change Habitat Management on Acquired Parcel(s)?
Backwash Wastewater Disposal?
Disposal of Sludge
Chemical Handling/ Storage?
Generate Noise?
Improve Water Quality?
Increase Forest Cover?
Contaminate Soils?
See Removal of Existing Structures in Site Preparation
Displace Wildlife?
Disturb People?
Protect Wildlife/ T&E Species?
Contaminate Surface/ Ground Water?
Harm Recreational Users?
Harm Wildlife/Vegetation?

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3.2 DAM, RESERVOIR, AND RAW WATER TRANSMISSION MAIN

This section has been organized according to environmental components, or resource areas in the following order:

Section Number	Resource Area
3.2.1	Geology/Soils
3.2.2	Surface and Groundwater Resources/ Quantity and Quality
3.2.3	Air Quality
3.2.4	Biological Resources
3.2.5	Noise
3.2.6	Recreation
3.2.7	Cultural Resources
3.2.8	Land Use
3.2.9	Transportation
3.2.10	Waste Management
3.2.11	Human Health and Safety
3.2.12	Socioeconomics
3.2.13	Environmental Justice
3.2.14	Aesthetics

Each resource section will contain information on the affected environment, environmental consequences, and mitigation measures for each component of the proposed action: the construction and operation of a dam and reservoir and the construction of the raw water transmission main. These two components will be separately discussed throughout each section, where possible. Within each resource section, you will find the following structure:

- ❑ **Affected Environment**
  - ➢ Describes the relevant aspects of the current condition of that resource that are common to all alternative project locations

  - ♦ **War Fork and Steer Fork**
    - ➢ Distinguishes the aspects of the current resource condition specific to the War Fork and Steer Fork project site

  - ♦ **Sturgeon Creek, 8.5 mgd**
    - ➢ Distinguishes the aspects of the current resource condition specific to the Sturgeon Creek, 8.5 mgd project site

  - ♦ **Sturgeon Creek, 3.5 mgd**
    - ➢ Distinguishes the aspects of the current resource condition specific to the Sturgeon Creek, 3.5 mgd project site

- **Environmental Consequences**
  - A list of the potential effects on that resource, regardless of project location
  - Analysis of which potential effects, common to all alternative project locations, are actually predicted by the study team to occur, and to what degree

  - **War Fork and Steer Fork**
    - Analysis of the potential effects that are predicted by the study team to occur specifically at the War Fork and Steer Fork project site

  - **Sturgeon Creek, 8.5 mgd**
    - Analysis of the potential effects that are predicted by the study team to occur specifically at the Sturgeon Creek, 8.5 mgd project site

  - **Sturgeon Creek, 3.5 mgd**
    - Analysis of the potential effects that are predicted by the study team to occur specifically at the Sturgeon Creek, 3.5 mgd project site

  - **No Action**
    - Analysis of the potential effects that are predicted by the study team to occur if no action took place, and the project did not proceed

  - **Summary of Impacts**
    - Summary of all impacts of the project, by site, on the resource area

- **Mitigation Measures (as appropriate)**

3.2.1 GEOLOGY/SOILS

Section 3.2.1 is further subdivided into three areas: geology, topography, and soils. The geology of an area encompasses all rocks present, plus the Earth's interior and surface features and processes. The topography of an area is the physical structure of the land, including hills, mountains, or other types of slopes.

3.2.1.1 Affected Environment

All three proposed project sites lie within the eastern portion of Jackson County. Section 3.2.1.1 discusses the aspects of geology, topography, and soils common to all alternative project areas. Most aspects of geology, topography, and soils in the affected environment are specific to a certain site. These site-specific aspects are discussed in Sections 3.2.1.1.1 through 3.2.1.1.3.

Geology

The bedrock below all three project sites is generally stratified, level-bedded acid sandstone, siltstone, and shale of the Pennsylvanian geologic system (Weir and Mumma, 1973; Weir, 1978).

Topography

The topography of this area of Jackson County tends to have narrow valleys and ridges with steep hillsides. The topography present at each alternative project site is distinct.

Soils

Soils within the region of all three proposed project sites belong to the Shelocta-Gilpin and Gilpin-Shelocta-Rayne soil units. Shelocta-Gilpin soil units are deep and moderately-deep, well-drained, steep to gently-sloping soils that have a loamy subsoil, and are present on long hillsides and ridgetops. Gilpin-Shelocta-Rayne soil units are moderately-deep and deep, well-drained, steep to gently-sloping soils that have a loamy subsoil, and are found on hillsides and ridges. Shelocta soils are deep and well-drained. They are found on steep to strongly-sloping side slopes. The surface soil layer is channery silt loam, and the subsoil is channery silt loam or silty clay loam. Gilpin soils are moderately-deep and well-drained. They are present on steep to gently-sloping hillsides and ridgetops. The surface soil layer is channery silt loam or silty clay loam. Rayne soils are deep and well-drained. They are found on ridgetops and hilly landscapes. The surface soil layer is silt loam, and the subsoil is silt loam, silty clay loam, or channery silty clay loam. **Table 3.2.1-1** provides specific information on these soil types and their acreages within the proposed project areas.

Table 3.2.1-1. Soil Types and Characteristics at the Proposed Project Sites

Site Acreage						Soils			Suitability Rating (How well-suited to the use)								
War Fork and Steer Fork, Normal Pool	War Fork and Steer Fork, Maximum Flood and Buffer	Sturgeon Creek, 8.5 mgd, Normal Pool	Sturgeon Creek, 8.5 mgd, Maximum Flood and Buffer	Sturgeon Creek, 3.5 mgd, Normal Pool	Sturgeon Creek, 3.5 mgd, Maximum Flood and Buffer	Soil Symbol	Soil Type	Prime Farmland	Crops	Recreational Development	Wildlife Habitat	Building Site Development	Sanitary Facilities	Construction Materials	Reservoir Areas	Earthen Dam Materials
89	308	169	560	44	272	SgF	Shelocta-Gilpin channery silt loam soil, steep	No	Not	Not	Fairly Well	Not	Not	Poorly	Not (slope)	Not (piping)
-	-	96	139	86	115	Ro	Rowdy silt loam soil, 0 to 4% slopes, occasionally flooded	Yes	Well	Somewhat	Well	Not	Not	Well	Moderately (seepage)	Not (piping)
-	-	94	114	73	94	Gv	Grigsby-Orrville Variant complex soil, 0 to 3% slope, frequently flooded	Yes	Well	Not	Well	Not	Not	Well	Not (seepage)	Not (piping)
-	-	35	121	22	68	GrD	Gilpin-Rayne-Sequoia silt loam soil, 12 to 25% slopes	No	Somewhat	Not	Fairly Well	Not	Not	Poorly	Moderately (seepage)	Not (thin layer)
-	-	40	57	15	27	AvB	Allegheny Variant silt loam soil, 2 to 6% slopes	Yes	Well	Well	Well	Well	Moderately	Fairly Well	Moderately (seepage)	Not (piping)
17	29	16	33	15	18	Gs	Grigsby fine sandy loam soil, 0 to 3% slope, frequently flooded	Yes	Well	Not	Well	Not	Not	Fairly Well	Moderately (seepage)	Not (piping)
-	-	10	28	6	13	AvD	Allegheny Variant silt loam soil, 6 to 20% slopes	No	Well	Somewhat	Well	Moderately	Moderately	Fairly Well	Moderately (seepage)	Not (piping)
-	-	6	50	3	29	BfF	Bethesda-Fairpoint complex soil, steep, benched	No	Not	Not	Poorly	Not	Not	Poorly	Not (slope)	Not (seepage, piping)
-	-	< 1	8	< 1	4	GnC	Gilpin silt loam soil, 6 to 12% slopes	No	Well	Somewhat	Well	Moderately	Not	Poorly	Moderately (seepage)	Not (thin layer)
-	-	< 1	8	< 1	2	SrF	Steinsburg and Gilpin soils and Rock outcrop, steep	No	Not	Not	Fairly Well	Not	Not	Poorly	Not (seepage)	Not (thin layer)
-	-	< 1	1	< 1	1	GpB	Gilpin-Rayne silt loam soils, 2 to 6% slopes	No	Well	Slightly	Fairly Well	Moderately	Not	Poorly	Moderately (seepage, depth to rock)	Not (piping, thin layer)

Sources: NRCS, 1983; NRCS, No date.

3.2.1.1.1 War Fork and Steer Fork

<u>Dam and Reservoir</u>

> **Alluvium**: Material transported and deposited by flowing water, such as clay, silt, and sand.

The proposed War Fork and Steer Fork reservoir would cover an estimated 116 acres at the normal pool elevation of 980 feet. About 337 acres would be required for the combined area up to maximum flood level and a 300-foot buffer surrounding the normal pool of a reservoir at this site.

<u>Geology</u>

The geology at the proposed War Fork and Steer Fork reservoir site is primarily Breathitt and Lee Formations with sandstone members, underlain by the Pennington Formation, and Newman Limestone. Alluvium occurs in some stream channels (Weir, 1973).

The Breathitt and Lee Formation in this area is composed mostly of shale, with smaller portions of siltstone and sandstone. The base of the Breathitt Formation lies at between 950 and 1000 feet above mean sea level (MSL) at the proposed War Fork and Steer Fork reservoir site. It is at least 480 feet thick. The Pennington Formation is composed mostly of shale with some siltstone, sandstone, and minor dolomite. The unit forms a moderate slope. This formation is only fully-exposed on the lower slopes of War Fork and its tributaries and the lower part of Lake Creek. It is between 35 and 110 feet thick. Sandstone members range from 0 to 35 feet thick. Newman Limestone is 90 percent limestone and 10 percent shale. This formation is only fully-exposed in the segment of War Fork north of the Turkey Foot Campground.

<u>Topography</u>

The topography within the maximum flood level of the proposed War Fork and Steer Fork reservoir is steep, with 15 percent of the area having 0 to 5 percent slope, 20 percent of the area having 5 to 10 percent slope, and 65 percent of the area having greater than 10 percent slope. The valley floor is approximately 375 feet across at the base of the proposed War Fork and Steer Fork dam, with a width of 770 feet at the maximum flood elevation of the proposed reservoir.

<u>Soils</u>

Table 3.2.1-1 provides information on the soil types and acreages present at the War Fork and Steer Fork project site. Soil units present at this site are shown in **Figure 3.2.1-1**. The proposed area of the War Fork and Steer Fork reservoir would contain an estimated 28 acres of Prime Farmland at the normal pool elevation of 980 feet. The area within the maximum flood level and the 300-foot buffer surrounding the normal pool of the proposed reservoir would contain approximately 29 acres of Prime Farmland (NRCS, No date).

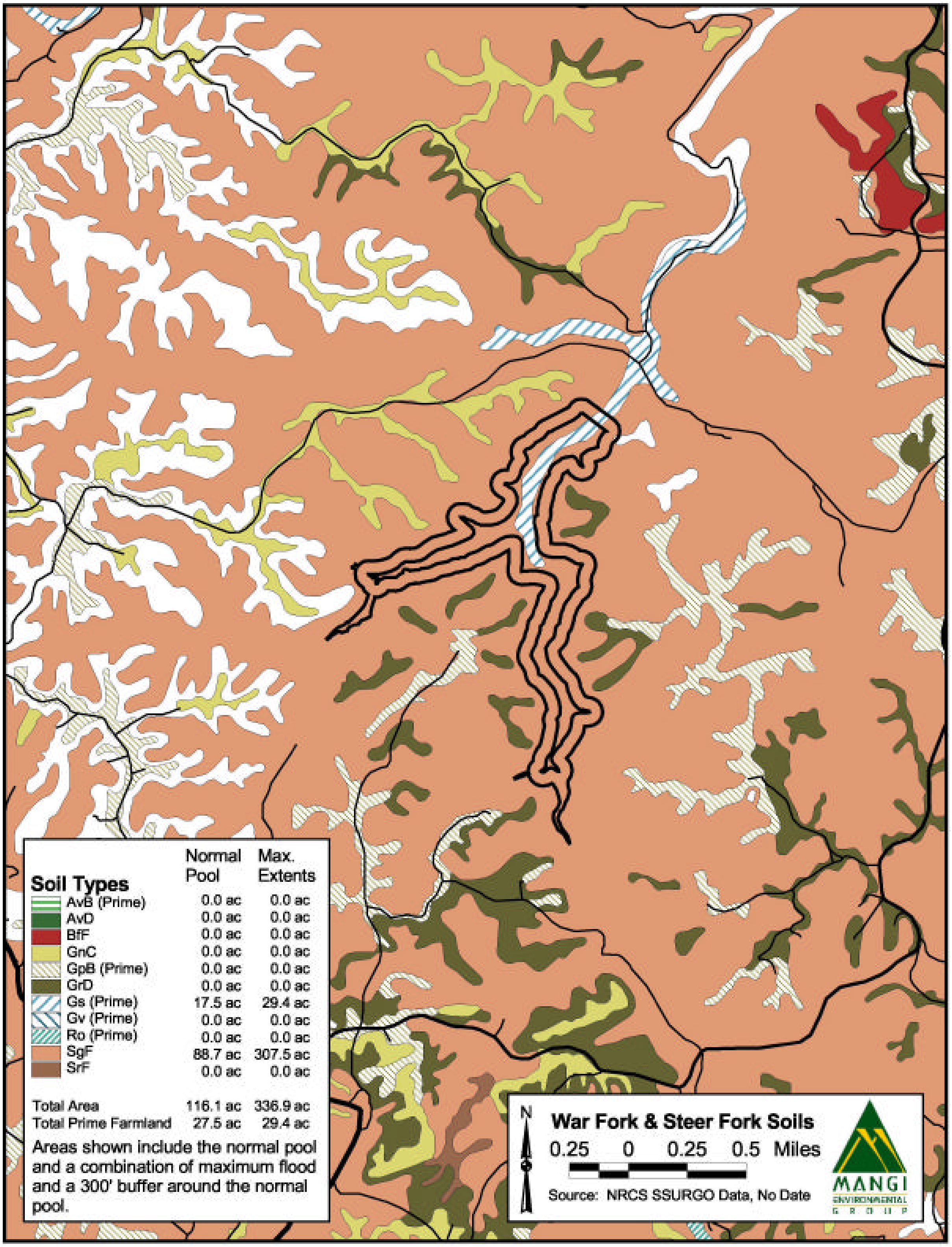

Figure 3.2.1-1. Soil Units at the War Fork and Steer Fork Project Site

Raw Water Transmission Main

The raw water transmission main leading from the proposed War Fork and Steer Fork reservoir would run about 9.5 miles to the JCWA Treatment Plant. All but approximately one mile of the route would run alongside existing roadways in the Kentucky Department of Transportation (KDOT) or County rights-of-way (ROW). Most of the route would be within the Gilpin-Shelocta-Rayne soil unit, discussed in Section 3.2.1.1. The general characteristics of the geology and topography along this route are similar to those of the War Fork and Steer Fork dam and reservoir site, discussed above.

3.2.1.1.2 Sturgeon Creek, 8.5 mgd

Dam and Reservoir

The proposed Sturgeon Creek, 8.5 mgd reservoir would cover an estimated 767 acres at the normal pool elevation of 990 feet. Approximately 1,119 acres would be required for the combined area up to maximum flood level and a 300-foot buffer surrounding the normal pool level of a reservoir at this site.

Geology

The proposed Sturgeon Creek, 8.5 mgd dam and reservoir site is underlain by the Breathitt Formation. A large portion of the valley bottom in the area is a sandstone body within the Breathitt Formation (USGS, 1978).

The Breathitt Formation in this project area is composed of shale (20 to 70 percent), siltstone (10 to 70 percent), sandstone (5 to 70 percent), coal, and underclay. It is at least 970 feet thick. At the proposed reservoir site, the base of the Breathitt Formation is identified as being about 790 feet above MSL. The sandstone bodies in this unit are zones at least 15 feet thick.

The Breathitt Formation at the Sturgeon Creek, 8.5 mgd project site includes several coal beds, including the Grey Hawk coal bed. This coal bed is 3 to 24 feet thick, and has extensive exposure within the valley at the project site. The coal bed is located between 1000 and 1040 feet above MSL in the area of the proposed reservoir. Strip mines have been developed in several locations.

Oil wells were developed in the proposed reservoir area, but most had been abandoned by the time of the geologic mapping in 1978. Most oil wells had depths of 1000 to 1300 feet.

Topography

The topography within the maximum flood level of the proposed Sturgeon Creek, 8.5 mgd reservoir is moderate. 46 percent of the area has a slope of 0 to 5 percent, 36 percent of the area has a slope of 5 to 10 percent, and 18 percent of the area has a slope of greater than 10 percent.

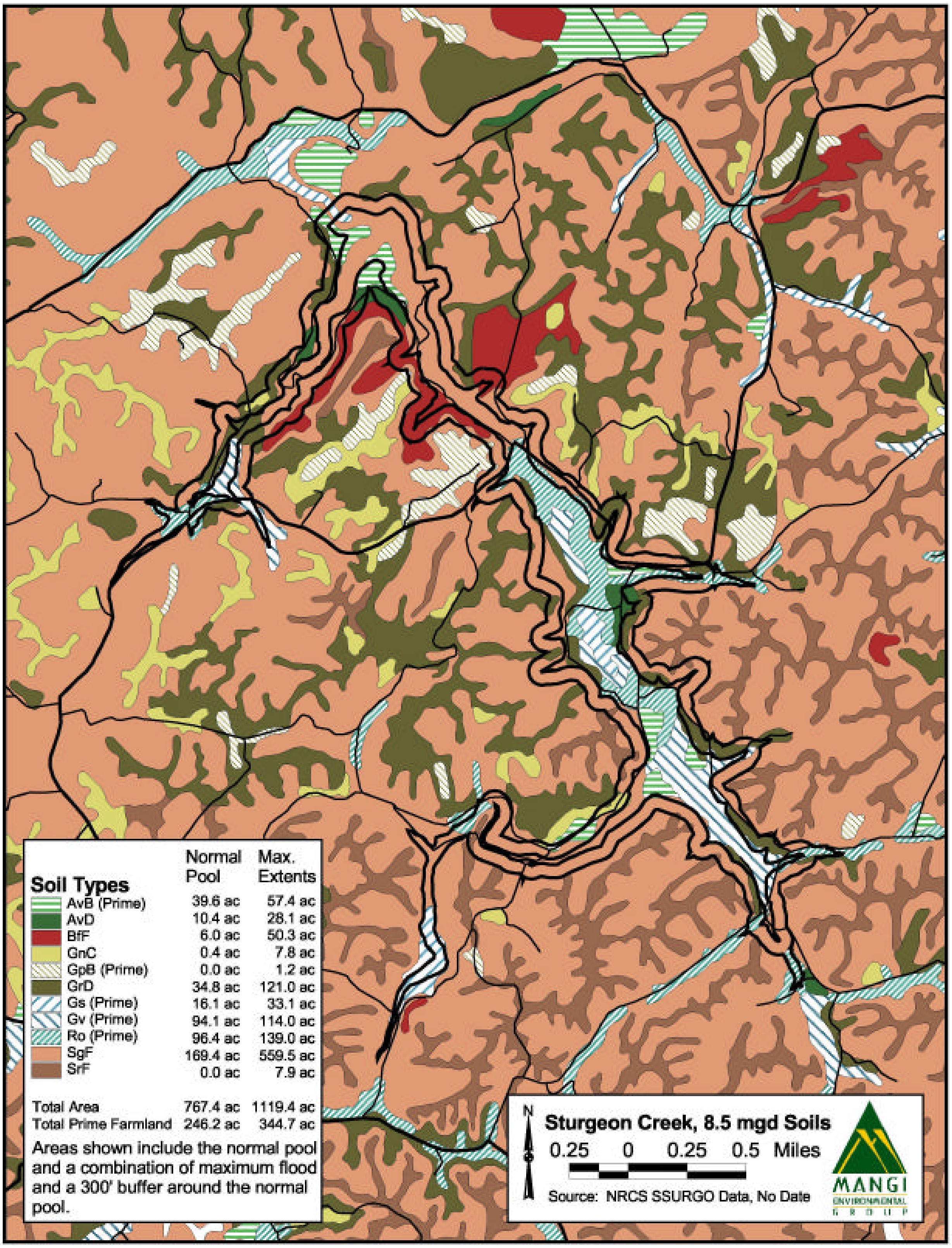

Figure 3.2.1-2. Soil Units at the Sturgeon Creek, 8.5 mgd Project Site

Soils

Table 3.2.1-1 provides information on the soil types and acreages present at the Sturgeon Creek, 8.5 mgd project site. Soil units present at the site are shown in **Figure 3.2.1-2**. The proposed Sturgeon Creek, 8.5 mgd reservoir would contain an estimated 246 acres of Prime Farmland at the normal pool elevation of 990 feet. The area within the maximum flood level and the 300-foot buffer surrounding the normal pool of the proposed reservoir at this site would contain approximately 344 acres of Prime Farmland (NRCS, No date).

Raw Water Transmission Main

The raw water transmission main leading from the proposed Sturgeon Creek, 8.5 mgd reservoir would run about 7.6 miles to the JCWA Treatment Plant. The entire route would run alongside existing roadways in the KDOT or County ROW. The route would be within the Shelocta-Gilpin and Gilpin-Shelocta-Rayne soil units. These soil units are described in Section 3.2.1.1. The general geological and topographical characteristics of this route are similar to those of the Sturgeon Creek, 8.5 mgd dam and reservoir site, discussed above.

3.2.1.1.3 Sturgeon Creek, 3.5 mgd

Dam and Reservoir

The proposed reservoir at the Sturgeon Creek, 3.5 mgd site would cover an estimated 264 acres at the normal pool elevation of 980 feet. Approximately 643 acres would be covered by the maximum flood level and 300-foot buffer surrounding the normal pool level of a reservoir at this site.

Geology

The geology of the Sturgeon Creek, 3.5 mgd project site is the same as that for the Sturgeon Creek, 8.5 mgd site, discussed in Section 3.2.1.1.2.

Topography

The topography within the maximum flood level of the proposed Sturgeon Creek, 3.5 mgd reservoir is moderate. 53 percent of the area has a slope of 0 to 5 percent, 32 percent of the area has a slope of 5 to 10 percent, and 15 percent of the area has a slope of greater than 10 percent.

Soils

Table 3.2.1-1 provides information on the soil types and acreages found at the Sturgeon Creek, 3.5 mgd project site. Soil units present at this site are shown in **Figure 3.2.1-3**. The area of the proposed Sturgeon Creek, 3.5 mgd reservoir would cover an estimated 189 acres of Prime Farmland at the normal pool elevation of 980 feet. Approximately 253 acres of Prime Farmland would be affected by the maximum flood level and 300-foot buffer surrounding the normal pool of the reservoir at this site (NRCS, No date).

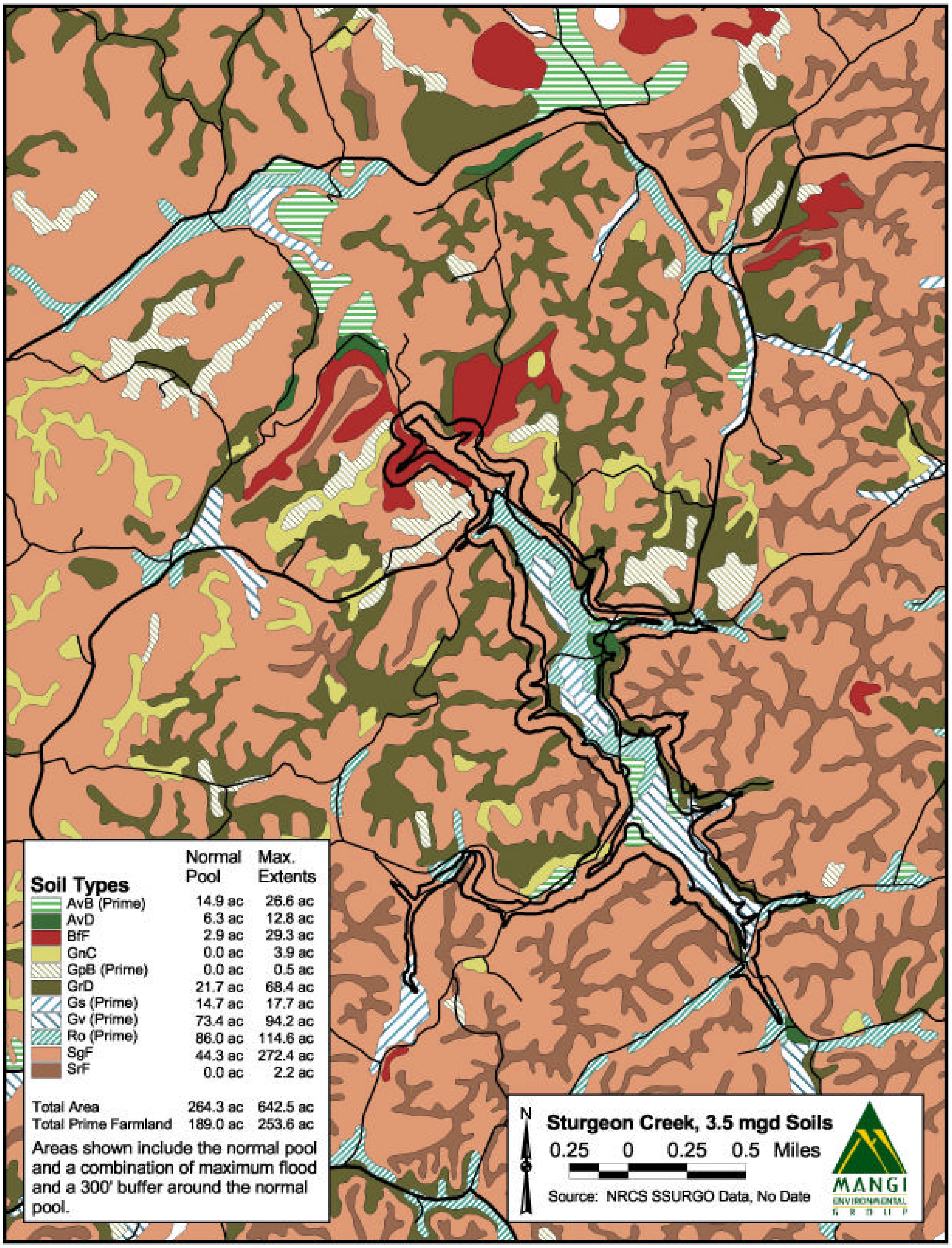

Figure 3.2.1-3. Soil Units at the Sturgeon Creek, 3.5 mgd Project Site

Raw Water Transmission Main

The raw water transmission main leading from the proposed Sturgeon Creek, 3.5 mgd reservoir would run about 5.5 miles to the JCWA Treatment Plant. Most of the route would run alongside existing roadways in the KDOT or County ROW. The route would be within the Shelocta-Gilpin and Gilpin-Shelocta-Rayne soil units. These soil units are described in Section 3.2.1.1. The general geological and topographical characteristics of the route are similar to those for the Sturgeon Creek, 3.5 mgd dam and reservoir site, discussed above.

3.2.1.2 Environmental Consequences

Potential impacts on geology were determined through evaluation of the types of geologic formations present at the proposed project sites, types of activities that would occur under the proposed action, duration of these activities, and the sizes of the affected areas. Impacts on the topography on and around each alternative project site were derived by analyzing the sites for elevation, slope, and topographic features, such as hills or sinkholes. To determine the significance of impacts on topography at each site, consideration was given to the size of the affected areas, the activities under the proposed action anticipated to affect topography, and the duration of activities. Potential impacts on soils were derived by analyzing the types of soils present at each proposed alternative site, depth of these soils, slope of the site, and the permeability and erosive tendencies of the affected soils. The amount of area affected, as well as the duration and severity of potential impacts, were also considered. Impacts common to all proposed alternative project sites are discussed in Section 3.2.1.2, while those that are site-specific are discussed in Sections 3.2.1.2.1 through 3.2.1.2.3.

As identified in the environmental diagram, **Figure 3.1-1**, the potential impacts on geology and soils from the site preparation, construction, operations, and connected actions associated with the dam, reservoir, and raw water transmission main are:

- Soil compaction at the equipment layout site, material storage area, and access road;
- Increased surface water runoff and soil erosion due to the removal of vegetation, soil compaction, exposure of land during lake level fluctuations, and from residential development around the reservoir;
- Increased soil erosion due to removal of vegetation, diversion of the existing stream, stockpiling soils, and soil compaction;
- Decreased downstream streambank erosion;
- Loss of soil productivity from decreased downstream sediment transport;
- Permanent loss of Prime Farmland from clearing and grading at the equipment layout site and access road, and from the impoundment area;
- Degradation of soil quality from potential POL/chemical spills during storage and handling;
- Degradation of soil quality due to potentially-harmful material leaching from the soil in the stream diversion area;
- Degradation of soil quality due to increased area development;
- Fracturing of bedrock during potential blasting or from the weight of the dam structure;
- Loss of mineral resources in the impoundment area; and

- Loss of wetlands in the impoundment area.

In evaluating the potential significance of impacts, the study team used the criteria listed in Appendix C.

Prior to any construction activities, as per Section 404 of the Clean Water Act, wetlands within the proposed construction and impoundment areas would be delineated. Wherever possible, wetland areas would be avoided by construction activities. When it is not possible to avoid wetland areas, impacts would be minimized and mitigated. Therefore, the impacts associated with wetlands would be insignificant.

Accidental spills of petroleum products, chemicals, or sanitary waste could degrade soil quality. However, all chemicals and POLs would be stored, transported, and disposed of in accordance with all applicable laws and regulations. During construction, the contractor would be responsible for providing adequate sanitary facilities, and these facilities would be maintained, transported, and disposed of as regulated by the State of Kentucky. Permanent sanitary facilities associated with the recreation facilities would be either storage-type systems, or would utilize septic fields outside the 300-foot buffer zone. These facilities would also be maintained according to all existing laws and regulations. Therefore, the risk of soil contamination from a chemical or sanitary waste spill would be minimal.

Dam and Reservoir

At each alternative project site, an area no larger than five acres would be cleared and graded to serve as the staging area (Kenvirons, 1999c). The proposed dam site, layout area, and a materials storage area no larger than ten acres would be cleared of woody vegetation, with stumps removed. The topsoil from the proposed dam site, layout area, and materials storage area would be removed and stockpiled. Most trees within the proposed impoundment would be cleared; some may be left in select areas to provide aquatic habitat within the reservoir. Existing utilities within the entire project area would be relocated or abandoned, as necessary, prior to the impoundment of the reservoir (JCEC, 1999). Existing structures would be removed or demolished.

The first step in construction of the proposed dam would be to build a diversion conduit for the existing stream (Kenvirons, 1999c). This conduit would be an impervious material and would not allow leaching from the surrounding soil material. Because this would be a closed conduit, there would not be any banks to erode, and erosion should be minimal.

Soil and rock would be excavated for the dam foundation. Any soil and rock not suited for use in construction would be placed within the proposed impoundment area. Construction of the proposed recreational facilities would start after the beginning of the dam construction, but could take place at any time after that (JCEC, 1999). The boat ramp and boat dock facilities would be constructed prior to the completion of impoundment. Little heavy construction would take place with the recreation facilities. Brush and some trees would be cleared, roads and parking areas would be graded, restrooms and other minor facilities would be constructed, and trails would be built. All facilities would be designed to follow the natural contours of the land and to minimize grading, where possible. The total area impacted would most likely be between 20 and 35 acres, but no more than 50 acres (JCEC, 1999).

Soil compaction would primarily occur along the access roads, at the dam construction site, in the staging area, and in the material storage area during the site preparation and dam construction phases. Some compaction would occur long-term in the recreation areas, but it would be limited to the heavily-used areas. Soil compaction could contribute to increased surface water runoff, and therefore, soil erosion.

Increased surface water runoff could result from the clearing, grading, and construction operations as vegetation is removed and soils are compacted. The staging area and the materials storage area would be revegetated following construction activities, which would minimize runoff. The dam site and access road would be permanently maintained, which would increase runoff for the life of the project. The constructed recreational facilities and roads would also increase runoff over the life of the project. Where applicable, using gravel parking lots would minimize runoff as much as possible.

Soils, especially those exposed during clearing, grading, and construction operations could suffer increased erosion. Many areas exposed during construction would be revegetated, but the areas that are consistently used during construction, such as the access road, staging area, and materials storage area, or those that are under construction may not be able to be immediately revegetated. Standard practices for erosion, runoff, and sediment control would be implemented throughout the project in accordance with the *Kentucky Best Management Practices* (BMPs) *for Construction Activities* (NREPC, 1994). The soils stockpiled during dam construction would have erosion and runoff minimized through temporary grass cover, silt fences, and/or straw bale barriers (Kenvirons, 1999c). Even with correct construction measures, failures could still occur. Unseasonably heavy rains, accidents, and bad timing can all cause short-term erosion events. The scale of the project is such that large areas would be unvegetated at any given time. Therefore, potential impacts due to soil erosion would be moderately significant.

Long-term erosion would be minimized by revegetation once construction activities have ceased. The stockpiled topsoil would be spread, fertilized, and seeded to establish permanent grass stands. Riprap lining would be applied to ditches with high-flow velocities (Kenvirons, 1999c). If revegetation does not work completely or dies in patches, small areas could be subject to erosion. If untreated, this erosion could continue indefinitely.

Prime Farmland would be permanently removed from use during the clearing and grading of the project site. Removal of Prime Farmland would constitute a moderately significant to very significant impact, depending on the extent, or amount of Prime Farmland, removed. Prime Farmland is further discussed in Section 3.2.8 of this EIS.

Geotechnical investigations have not yet been conducted at any of the proposed project sites (Kenvirons, 1999c). However, the types of bedrock found at all of the proposed dam sites typically provide high bearing strength, resistance to erosion and percolation, and offer few restrictions on the type of dam structure that could be placed on them. Once a final location for the dam and reservoir is chosen, a geotechnical investigation of the site would be conducted to determine if the existing strata is adequate for the proposed structure and to determine which, if any, foundation treatments are required (Kenvirons, 1999c). Typical foundation treatments include the removal of alluvial material and disintegrated (weathered) rock and the sealing fractures by grouting. If the selected site is properly evaluated, and correct treatments applied, the probability that bedrock would fracture due to potential blasting activities or due to the weight of the dam or impoundment would be minimal.

Any existing or abandoned oil wells within the project areas would be plugged, and the surrounding areas properly remediated, prior to impoundment of the reservoir. Any mineral resources present within the proposed project area would not be available for future development if such development would threaten the function of the reservoir or associated activities.

Most sediment flowing within the watersheds of the proposed reservoirs would be deposited in the reservoir rather than downstream of the dam (Kenvirons, 1999c). The water released from the dam would have unused sediment carrying capacity, and would strip sediment immediately downstream until equilibrium is reached (FISRWG, 1998).

During impoundment of the proposed reservoir, downstream flows would be reduced to the 7Q10, the minimum flow required to maintain water quality and aquatic life. Upon completion of impoundment, the dam would reduce the annual flow of the stream and most peak discharges, which would cause aggradation in the stream and at the mouths of downstream tributaries (FISRWG, 1998). Aggradation is the uniform collection of sediment deposits along a streambed. Floodplains would not be flooded as regularly, nor for as long. Wetlands would receive less water. The timing of the flows would also be changed. Assuming potable water is withdrawn evenly throughout the year, but more precipitation occurring in early winter and spring to early summer, the reservoir would be filled in the early winter and normal flows would occur only in the spring and early summer.

The effects of increased sediment-stripping and streambed aggradation would appear to balance each other, but this is unlikely. Fine sediment particles would most likely be stripped, but the remaining larger particles would gradually fill the stream channel until a balance is reached. These effects should be limited to the area just downstream of the dam, and diminish as the distance downstream increases. The effects would also diminish as other streams feed the channel and the proportion of the impoundment within the watershed decreases.

The infrequent nature of the maximum flood occurrence should not affect wetlands in the vicinity of the proposed reservoir. Some wetlands could be created at the edge of the proposed reservoir. However, the perimeter of each of the impoundment sites is generally steep and well-drained, which limits the size and formation of wetlands. The absence of suitable soils would result in a longer period of establishment. Also, if the water level fluctuation in the proposed reservoir is not somewhat consistent during the growing season, vegetation would have a more difficult establishment process (Levine, 1990).

Raw Water Transmission Main

The construction of the raw water transmission main leading from the pump station at the proposed reservoir to the JWCA Treatment Plant would primarily entail trench excavation, pipe laying, and backfilling of the trench (Williams, 1999a). The water main would be either 18 or 24 inches in diameter. The trench would be at least 24 to 30 inches wide and 4 to 5 feet deep. Immediately following excavation, the pipe would be laid and the trench covered with the excavated soil. Where the pipe route crosses a stream, the pipe would be placed under the stream. Only where necessary, due to steep ravines or other causes, would the pipe run above the surface. Stream crossings would be constructed at low water periods (Williams, 1999c). Some vegetation may be cleared for construction.

Soil compaction could occur due to the construction of the raw water transmission main. However, because of the transitory nature of the activity, extreme compaction is unlikely. Soil compaction could contribute to increased surface water runoff, and therefore, soil erosion. At the same time, soil density would probably be reduced at the surface of the trench, which may counterbalance any compaction generated by construction activities. Increased surface water runoff could also result from the removal of vegetation. The route of the water main trench would be revegetated following construction activities, which would minimize runoff. Where the new easement crosses forested areas, it might be permanently maintained as grass cover.

Stream crossings could produce high erosion, but construction during no flow or low water periods would minimize this. Standard practices for erosion, runoff, and sediment control would be implemented throughout the project in accordance with the *Kentucky Best Management Practices for Construction Activities* (NREPC, 1994). However, due to their moderate magnitude and large extent (greater than 100 square yards affected), potential impacts from soil erosion during construction of the raw water transmission main would be moderately significant.

Prime Farmland would not be greatly affected during construction of the raw water transmission main. Any areas considered Prime Farmland would only be impacted during the construction phase, but returned to the previous use after construction. With the longest potential run along any of the proposed routes being approximately 50,000 feet, or 9.5 miles, of water line, and an estimated maximum 10 square feet of soil disturbance at any location, no more than 11.5 acres would be disturbed. Assuming that the entire water line route was classified Prime, this extent would still be small. Therefore, impacts to Prime Farmland due to the construction of the water main along any of the routes would be insignificant.

3.2.1.2.1 War Fork and Steer Fork

Dam and Reservoir

Construction of a dam at the proposed War Fork and Steer Fork site would require about 13,000 to 16,800 cubic yards of earth to be excavated and stockpiled (Sexton, 1999a; Kenvirons, 1999a).

The proposed War Fork and Steer Fork reservoir site contains approximately 28 acres of Prime Farmland at normal pool elevation, and 29 acres within the extent of a 300-foot buffer around the normal pool and the maximum flood level. If the War Fork and Steer Fork site is chosen as the final location for the project, this Prime Farmland would be permanently removed from use. Given the small extent of the removal, less than 50 acres, impacts to Prime Farmland at this site would be moderately significant.

No wetlands are shown within the normal pool elevation of the proposed War Fork and Steer Fork reservoir on National Wetland Inventory (NWI) polygon maps (USFWSM, No date). Therefore, impacts to wetlands at this site would be minimal.

Raw Water Transmission Main

The raw water transmission main leading from the proposed War Fork and Steer Fork reservoir to the JWCA Treatment Plant would be 18 inches in diameter (Kenvirons, 1999a), requiring a trench of at least 24 inches wide. The trench would be four to five feet deep.

3.2.1.2.1 Sturgeon Creek, 8.5 mgd

Dam and Reservoir

Construction of a dam at the proposed Sturgeon Creek, 8.5 mgd site would require about 21,900 cubic yards of earth to be excavated and stockpiled (Kenvirons, 1999b).

The Sturgeon Creek, 8.5 mgd project site contains approximately 246 acres of Prime Farmland in the area of the proposed reservoir up to normal pool elevation, and 344 acres within the extent of a 300-foot buffer around the normal pool and the maximum flood level. If the Sturgeon Creek, 8.5 mgd site is chosen as the final location for the project, this Prime Farmland would be permanently removed from use. Given this extent of removal, up to 590 acres, impacts to Prime Farmland at this site would be rated very significant, based on the criteria listed in Appendix C.

Approximately 6.8 acres of wetlands are shown within the normal pool elevation of the proposed Sturgeon Creek, 8.5 mgd reservoir on NWI polygon maps (USFWSM, No date). As this is less than two percent of the region’s total acreage of wetlands, impacts to wetlands at this site would be minimal.

Raw Water Transmission Main

The raw water transmission main leading from the proposed Sturgeon Creek, 8.5 mgd reservoir to the JWCA Treatment Plant would be 24 inches in diameter (Kenvirons, 1999b), requiring a trench of at least a 30 inches wide. The trench would be four to five feet deep.

3.2.1.2.3 Sturgeon Creek, 3.5 mgd

Dam and Reservoir

Construction of a dam at the proposed Sturgeon Creek, 3.5 mgd site would require about 9,000 to 12,100 cubic yards of earth to be excavated and stockpiled (Sexton, 1999a; Kenvirons, 1999b).

The Sturgeon Creek, 3.5 mgd project site contains approximately 189 acres of Prime Farmland within the proposed reservoir up to normal pool elevation, and 253 acres within the extent of a 300-foot buffer around the normal pool and the maximum flood level. If the Sturgeon Creek, 3.5 mgd site is chosen as the final location for the project, this Prime Farmland would be permanently removed from use. Given this extent of removal, up to 442 acres, impacts to Prime Farmland at this site would be rated very significant, based on the criteria listed in Appendix C.

Approximately 5.8 acres of wetlands are shown within the normal pool elevation of the proposed Sturgeon Creek, 3.5 mgd reservoir on NWI polygon maps (USFWSM, No date). As this is less than two percent of the region's total acreage of wetlands, impacts to wetlands at this site would be minimal.

Raw Water Transmission Main

The raw water transmission main leading from the proposed Sturgeon Creek, 3.5 mgd reservoir to the JWCA Treatment Plant would be 18 inches in diameter (Kenvirons, 1999b), requiring a trench of at least a 24 inches wide. The trench would be four to five feet deep.

3.2.1.2.4 No Action

Under the No Change alternative, in which nothing is done to meet the projected water and recreation needs of Jackson County, there would be no soil erosion or contamination from the construction activities, but there could be soil erosion and contamination from the use and development of the land. There would be no loss of Prime Farmland. Impacts on geology and soils associated with the operation of the reservoir would not occur.

Under the No Action alternative, certain activities would be undertaken to increase the current water supply in Jackson County, although in insufficient amounts to meet the projected water needs. These activities may include drilling additional water wells throughout the County, constructing water transmission lines from intermittent streams within the County to the JCWA Treatment Plant, or a water conservation program. Impacts on soils and geology that would result from such activities would be minimal. Construction water lines may result in soil erosion, but this impact would be rated as insignificant according to the criteria listed in Appendix C of this EIS.

3.2.1.2.5 Summary of Impacts

The following table lists the potential impacts on soils and geology resulting from the site preparation, construction, operation, and connected actions associated with the dam, reservoir, and raw water transmission main for each of the alternative project sites.

Table 3.2.1-2. Summary of Impacts on Geology and Soils

Alternative	Impacts	Rating of Impacts
War Fork and Steer Fork	• Increased surface water runoff and soil erosion from site preparation and construction activities; • Long-term soil erosion at the reservoir; • Soil contamination from potential spills of POLs, chemicals, or sanitary waste; • Fracture bedrock during potential blasting or from the weight of the dam; • Permanent loss of Prime Farmland; and • Degradation of wetlands.	• Moderately Significant • Moderately Significant • Insignificant • Insignificant • Moderately Significant • Insignificant
Sturgeon Creek, 8.5mgd	• Increased surface water runoff and soil erosion from site preparation and construction activities; • Long-term soil erosion at the reservoir; • Soil contamination from potential spills of POLs, chemicals, or sanitary waste; • Fracture bedrock during potential blasting or from the weight of the dam; • Permanent loss of Prime Farmland; and • Degradation of wetlands.	• Moderately Significant • Moderately Significant • Insignificant • Insignificant • Very Significant • Insignificant
Sturgeon Creek, 3.5 mgd	• Increased surface water runoff and soil erosion from site preparation and construction activities; • Long-term soil erosion at the reservoir; • Soil contamination from potential spills of POLs, chemicals, or sanitary waste; • Fracture bedrock during potential blasting or from the weight of the dam; • Permanent loss of Prime Farmland; and • Degradation of wetlands.	• Moderately Significant • Moderately Significant • Insignificant • Insignificant • Very Significant • Insignificant
No Action	• Increase surface water runoff and soil erosion due to potential construction activities; and • Permanent loss of Prime Farmland due to potential construction activities.	• Insignificant • Insignificant

In many cases, potential impacts on geology and soils are incremental; some impacts, although given the same rating at each site, would be slightly more or less at one particular site than at the other sites. More detailed discussions of these variations are provided in Sections 3.2.1.2.1 through 3.2.1.2.3. These slight differences do not change the impact rating listed in the above table.

3.2.1.3 Mitigation

During the construction of the dam and reservoir, as many of the construction activities as possible should be conducted within the proposed impoundment area, rather than downstream of the dam site. Since revegetation is more difficult in compacted areas, and as the impoundment area would be flooded and not require revegetation, confining most use of heavy equipment to these areas would minimize the effects of soil compaction due to the project. Soil erosion due to construction activities could be minimized by limiting the amount of time soil is exposed without revegetation and by minimizing the size of the disturbed area wherever possible. Where applicable, the use of gravel parking lots would minimize surface water runoff.

It is recommended that proper geotechnical investigations be conducted at the site selected as the final location of the proposed dam. Any foundation treatments found to be necessary at the site should be applied in order to minimize the possibility that the underlying bedrock would be fractured.

During construction of the raw water transmission main, the amount of disturbed ground could be reduced by digging trenches of minimum width necessary for pipe-laying.

3.2.2 SURFACE AND GROUNDWATER RESOURCES/QUANTITY AND QUALITY

3.2.2.1 Affected Environment

3.2.2.1.1 War Fork and Steer Fork

__Dam and Reservoir__

War Fork discharges into Station Camp Creek, which is a tributary of the Kentucky River. The main channel of War Fork is 13.3 miles long and ranges from 675 feet to 1359 feet in elevation (Walker, 1994). Under 401 KAR 5:026, the Kentucky Natural Resources Environmental Protection Cabinet (KNREPC) has designated uses for all surface waters in Kentucky. War Fork is divided into three segments, each of which has water use designations. These segments, listed upstream to downstream, and their corresponding water use designations, are presented in **Table 3.2.2-1**.

Table 3.2.2-1. Water Use Designations for War Fork Segments

Segment	Water Use Designations
Source to River Mile 8.5 (upstream of Turkey Foot Campground)	• Warm Water Aquatic Habitat • Primary Contact Recreation (e.g., swimming) • Secondary Contact Recreation (e.g., fishing)
River Mile 8.5 to 2.0 (from Turkey Foot Campground downstream)	• Cold Water Aquatic Habitat • Primary Contact Recreation • Secondary Contact Recreation
River Mile 2.0 to Station Camp Creek	• Warm Water Aquatic Habitat • Primary Contact Recreation • Secondary Contact Recreation

War Fork drains a watershed approximately 19,050 acres (29.8 square miles) in size, of which about 60 percent is owned by the U.S. Forest Service (USFS) (Walker, 1994). The portion of the watershed draining into the proposed reservoir is 6,944 acres, or 10.85 square miles. This watershed is shown in **Figure 3.2.2-1**. Although no stream gauging stations are present on War Fork itself, there is a U.S. Geological Survey (USGS) gauging station downstream on Station Camp Creek at Wagersville, which operated from 1954 to 1976, had a 7Q10 (minimum average flow over a seven-day period with a recurrence interval of ten years) of 0.0 cubic feet per second of 0.2 cfs (Caldwell, 1999a). Preliminary engineering studies estimated a slightly higher 7Q10 of 0.03 cfs for War Fork (Kenvirons, 1999c). In an average year, the lowest discharge occurs in the late summer and early fall. During this season, War Fork may consist of pools connected by trickles of surface water, with more flowing as groundwater under the streambed in sand and gravel alluvial deposits.

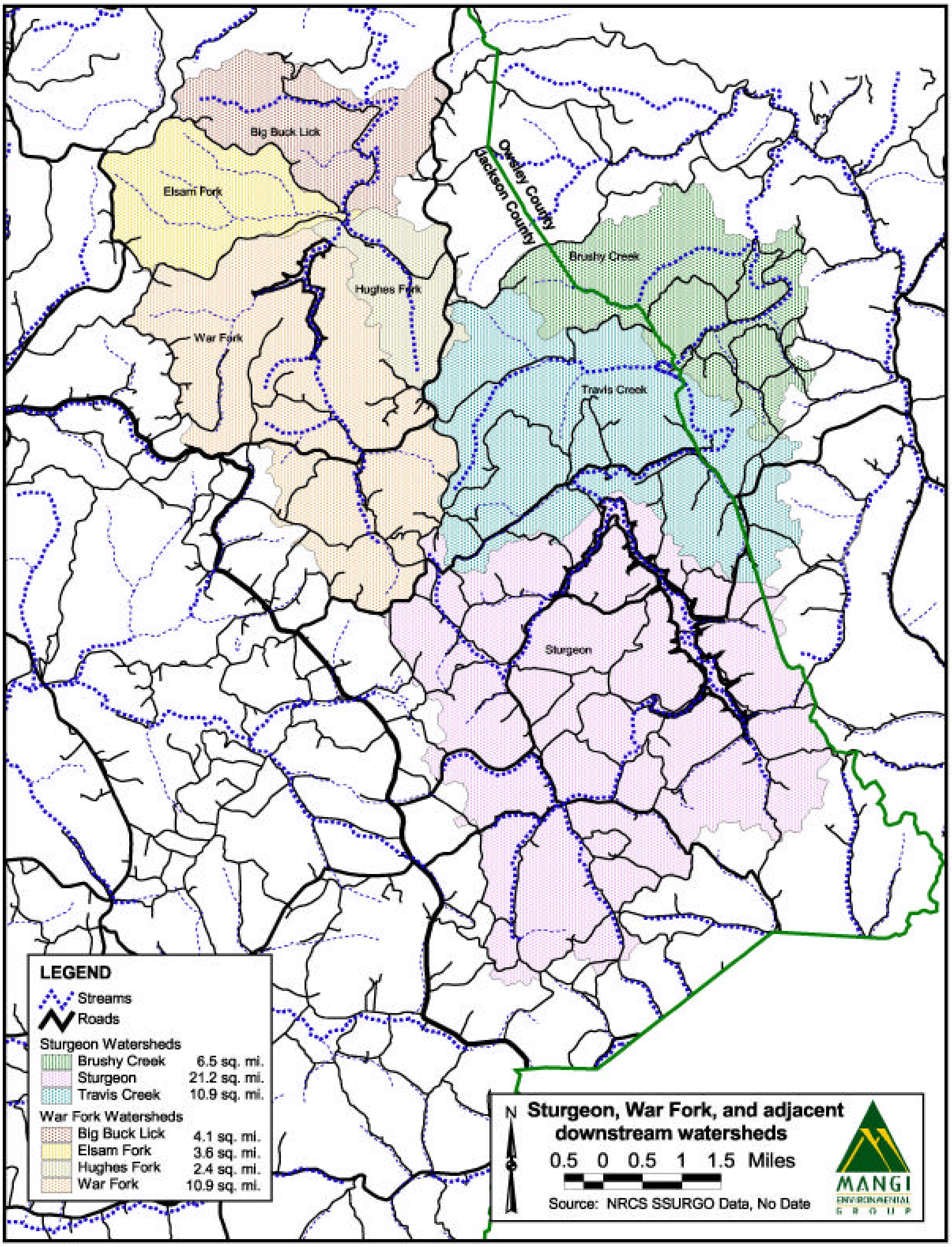

Figure 3.2.2-1. Watersheds In, Adjacent To, and Downstream of the Proposed War Fork and Steer Fork and Sturgeon Creek Project Sites

Average runoff for the basin is also unavailable, but gauges in nearby watersheds indicate a probable range of 20 to 22 inches per year, while annual precipitation averages 46 inches. Evapotranspiration and infiltration to groundwater account for the difference. The long-term average flow during average drought condition at the proposed dam site on War Fork is about 2.5 cfs (1,170 gallons per minute (gpm)) (MEG, 1999b).

The lower (northern) portion of the War Fork watershed, to approximately Turkey Foot Campground, lies in the Northern Cliff Land Type Association (LTA), which is noted for extensive, well-formed limestone or sandstone cliffs and karst topography, characterized by caves, sinkholes, sinking creeks, and subterranean drainage (Walker, 1994). Above ground, the stream channel is dominated by bedrock, with large rock rubble and narrow pools separated by well-developed riffles. **Figure 3.2.2-2** provides a picture of War Fork upstream of Turkey Foot Campground. Except during high stages, War Fork disappears underground for about one mile near Turkey Foot Campground, resurfacing at "Resurgence Cave" (Walker, 1999).

The upper (southern) portion of the War Fork watershed lies within the Low Hills Belt LTA, which is characterized by V-shaped valleys with narrow bottoms and alluvium (Walker, 1994). This portion lacks the prominent cliffs and karst topography of the lower portion. Although this LTA is marked with evidence of past coal mining activity, both surface and underground, particularly within the sub-basin of the Hughes Fork tributary one-half mile downstream of the proposed dam site, acid mine drainage does not appear to have been a problem. The proposed War Fork and Steer Fork reservoir is located entirely within the Low Hills Belt LTA.

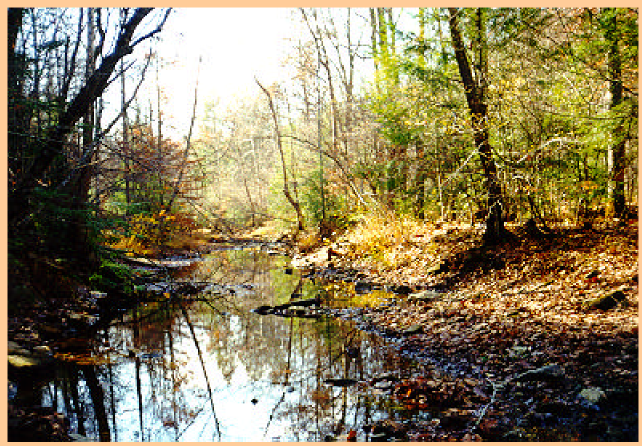

Figure 3.2.2-2. View of War Fork upstream of Turkey Foot Campground near the proposed War Fork and Steer Fork dam site.

In addition to mining, other nonpoint sources of pollution from present and past land uses within the watershed that could potentially impact water quality in War Fork include agricultural activity on private land, timber harvesting on both private and USFS land, and off-road vehicle use (Walker, 1994). In addition, solid waste deposited along stream banks poses a possible threat to water quality. As indicated below, however, none of these activities appear to have appreciably impaired water quality in War Fork.

The USFS operated six water quality stations in the War Fork basin from 1989 to 1991, two of which also collected data on macroinvertebrates and/or fish (Walker, 1994). Two of the monitoring stations were located within the proposed reservoir footprint. Water samples were analyzed by the Berea Forest Services Laboratory for the following water quality parameters: pH, conductivity, turbidity, suspended solids, total dissolved solids, hardness, alkalinity, chromium, copper, iron, nickel, lead, zinc, selenium, and sulfate.

In general, the water quality of the entire War Fork drainage was very good. The only parameter that failed to meet Kentucky standards for warm water aquatic habitat was lead, possibly from mining and agricultural runoff. Suspended sediments and turbidity, primarily due to erosion from exposed agricultural soils, and secondarily, from the road building, skid trails, and log landings associated with timber harvest, were also somewhat evident, especially in the headwaters. Nevertheless, the USFS concluded that the overall water quality of War Fork and other physical features in the area are some of the best that can be found in a karst-dominated watershed in Kentucky (Walker, 1994).

Because of its high water quality, karst topography, scenic quality, and the presence of cultural resources and Threatened and Endangered species, principally the Indiana bat, the USFS, Daniel Boone National Forest (DBNF) has recommended to the Department of Interior/National Park Service (DOI/NPS) that the stretch of War Fork between the Turkey Foot Campground and the mouth of the South Fork of Station Camp Creek be included in the National Wild and Scenic River System with the classification of Scenic (Hersel, 1999a; USFS, 1996). The upstream end of this study segment is located approximately half a mile downstream of the proposed dam site. While Federal legislation has not yet been introduced that would designate War Fork as a Wild and Scenic River, the USFS is managing the War Fork study corridor as a Scenic River (Hersel, 1999b).

According to the National Wetlands Inventory (NWI) of the U.S. Fish and Wildlife Service (USFWS), no wetlands are present at the proposed War Fork and Steer Fork project site (USFWS, No date). This nationwide survey of wetlands is based on interpretation of aerial photographs, not a ground survey, and its criteria differ somewhat from those used in jurisdictional wetlands delineations for 404 permitting with the U.S. Army Corps of Engineers (USACE). Therefore, the NWI figure should only be considered an indication of potential wetland presence; it does not substitute as a delineation. A wetlands and waters delineation would be completed prior to submitting an application for a 404 permit. This permit is described in the text box at the right. **Figure 3.2.2-3** shows the known wetlands surrounding the proposed War Fork and Steer Fork project site.

404 Permits
(Clean Water Act (CWA))

Section 404 of the CWA establishes a program to regulate the discharge of dredged and fill material into the waters of the U.S., including wetlands (USEPA, 1999c). The program prohibits dredged or fill material to be deposited if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. Applicants for a 404 permit must prove to the U.S. Army Corps of Engineers (USACE) and the Environmental Protection Agency (EPA) that they have:

- Taken steps to avoid wetland impacts, where practicable;
- Minimized potential impacts to wetlands; and
- Provided compensation for any remaining, unavoidable impacts by restoring or creating wetlands.

Individual permits are usually required for projects with potentially significant impacts. However, the USACE grants up-front general permits for most discharges that will have only minimal adverse effects. The USACE and EPA jointly administer the 404 permit program. In addition, the U.S. Fish and Wildlife Service and State resource agencies have important advisory roles.

Groundwater resources occur in deposited alluvium along stream channels and in the

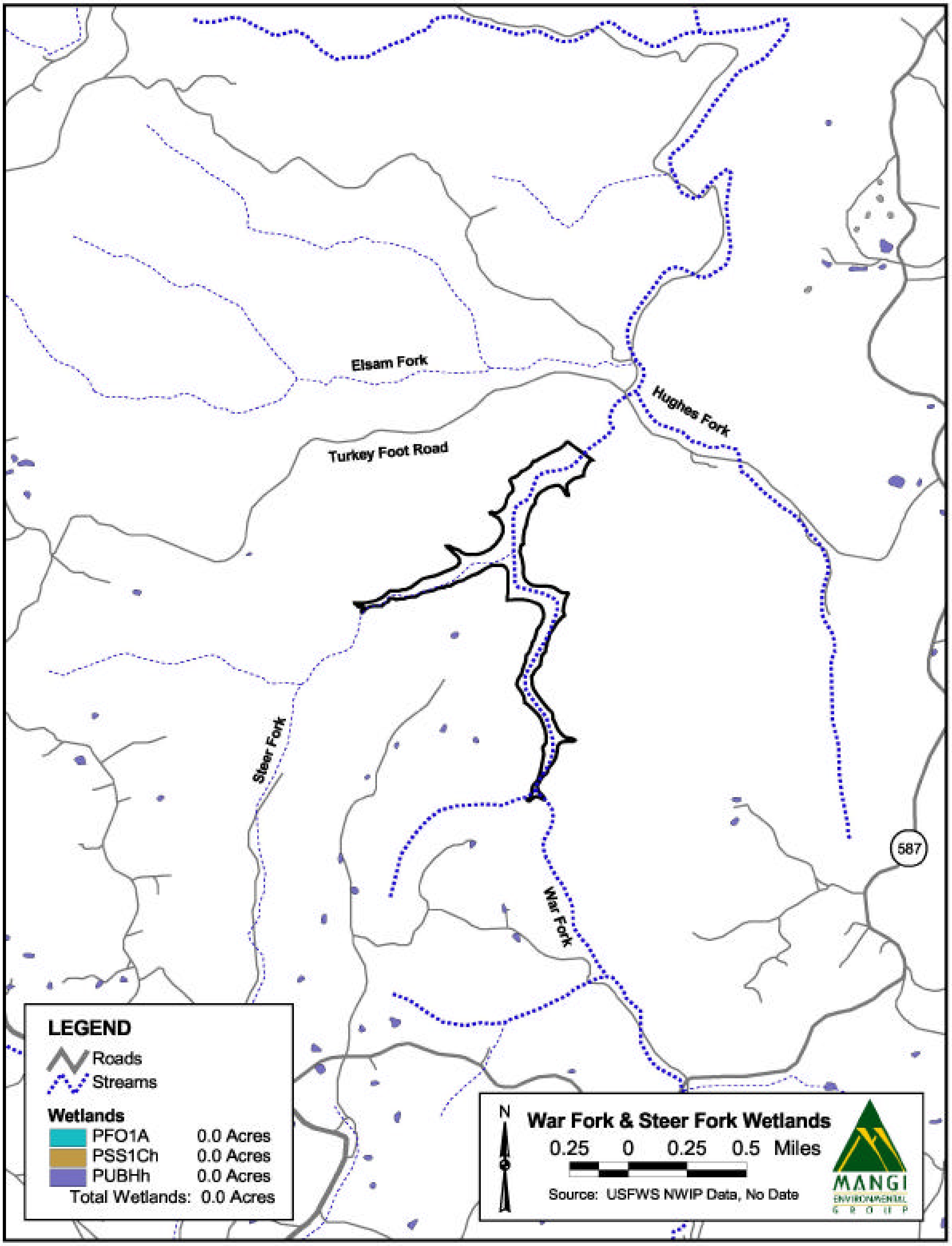

Figure 3.2.2-3. Wetlands On and Around the War Fork and Steer Fork Project Site

Pennington, Breathitt, and Lee Formations which predominate in the War Fork basin (Walker, 1994). The Corbin Sandstone Member of the Lee Formation has a wide range of permeabilities from place-to-place due to variations in grain size and the variable presence of less-permeable shale and siltstone (Weir and Mumma, 1973). The yield of wells drilled into these geologic formations is a function of depth and location. Most wells drilled in Pennington and Breathitt Formation sandstones in valley bottoms yield water quantities adequate for domestic use. The yield of ridge-top wells is less consistent, depending on formations and aquifers encountered. Groundwater quality varies by formation and strata. Most groundwater in the area is hard to very hard, containing high concentrations of dissolved calcium, magnesium, and other naturally-occurring ions. Breathitt Formation wells tend to contain noticeable amounts of iron (Weir and Mumma, 1973).

In karst regions, underground streams may serve as conduits that can swiftly carry contaminants from a given source to other water bodies some distance away (Neal, 1999). There is some evidence of contamination of private wells in Jackson County, particularly from nitrogen compounds, pesticides, and fecal coliform bacteria (MEG, 1999c; Carey et al., 1993). However, evidence of fecal coliform contamination at well sites alone proves only that these wells, and not necessarily surrounding aquifers, are actually contaminated (Goodman, 1999).

Raw Water Transmission Main

The approximately 9.5-mile proposed route for the raw water transmission main leading from the proposed War Fork and Steer Fork reservoir to the JCWA Treatment Plant would run alongside existing Kentucky Department of Transportation (KDOT) or County rights-of-way (ROW) for all but about one mile of the route. In addition to one or two crossings of Hughes Fork, a tributary of War Fork, there are a number of minor and intermittent creeks that would have to be crossed en route. Preliminary engineering analysis estimates a total of 60 linear feet of creek crossings (Kenvirons, 1999a). Much of the proposed route would follow KY 587, which runs along the high divides between several watersheds, thereby avoiding most direct contact with watercourses.

3.2.2.1.2 Sturgeon Creek, 8.5 mgd

Dam and Reservoir

The Kentucky Division of Water (KDOW) maintains a water quality and aquatic habitat monitoring station on Sturgeon Creek, four miles upstream from its confluence with the Kentucky River at Heidelberg (KDOW, 1997, 1998c; Pond, 1999), from which much information in this section is derived. In addition, the Kentucky State Nature Preserves Commission (KSNPC) maintains three habitat assessment field stations within the Sturgeon Creek watershed (Cicerello, 1999).

All four of these monitoring stations are located downstream of the proposed Sturgeon Creek, 8.5 mgd project site, the closest about eight stream miles away, 200 yards upstream of Sturgeon's confluence with Little Sturgeon Creek in Owsley County. The KDOW has designated the stretch of Sturgeon Creek from the first monitoring station at River Mile 4 up to its headwaters as a "reference reach." This designation means that it is considered to have high water quality, and is monitored and maintained as a baseline against which to compare other watercourses in eastern Kentucky (Van Arsdall, 1999). In addition, under 401 KAR 5:026, the State has designated all of Sturgeon Creek for the use of warm water aquatic habitat, primary contact recreation, secondary contact recreation, and domestic water supply.

Sturgeon Creek rises in eastern Jackson County and flows to the northeast to its confluence with the Kentucky River at Heidelberg. The stream is about 33 miles long, and its elevation ranges from about 650 ft at its mouth to about 1,200 ft at its headwaters (KDOW, 1998c). The Sturgeon watershed is 59,008 acres (92.2 square miles) in size, of which approximately 40 percent is forested, with 60 percent in agricultural, mining, residential uses, or recently cleared.

The nearest stream gauges on Sturgeon Creek are located some distance downstream of the proposed project site. Estimates of the 7Q10 and 7Q2 of Sturgeon, 2.4 miles upstream of its confluence with the Kentucky River, are 0.0 cfs and 0.3 cfs, respectively (Caldwell, 1999a). Preliminary engineering studies for the proposed reservoir project estimated a slightly higher 7Q10 of 0.06 cfs for Sturgeon Creek at the project site (Kenvirons, 1999c). Near Crestmont in Lee County, 0.5 miles upstream of Granny Dismal Creek, the lowest monthly mean flow occurs in August at 16.6 cfs; the highest monthly mean flow occurs in March at 315 cfs; and the lowest annual mean flow over a six-year period of record (1993 to 1998) was 133 cfs (Caldwell, 1999a). In an average year, the lowest discharge on Sturgeon Creek occurs in the late summer and early fall. **Figure 3.2.2-4** provides a picture of Sturgeon Creek, taken from within both the Sturgeon Creek, 8.5 mgd and Sturgeon Creek, 3.5 mgd proposed reservoir footprints.

Figure 3.2.2-4. Sturgeon Creek under very low flow conditions. This picture was taken on November 4, 1999, within both the 8.5 mgd and 3.5 mgd proposed reservoir footprints.

Since there are no stream gauging stations near the proposed Sturgeon Creek, 8.5 mgd dam site, data from a streamflow gauge on Silver Creek, which drains a comparably-sized watershed in neighboring Madison County, were extrapolated. Using this method, the long-term mean annual streamflow was estimated at 4.7 cfs (2,200 gpm) (MEG, 1999b).

The KDOW's monitoring station at River Mile 4 sampled Sturgeon Creek for 34 water quality parameters (KDOW, 1998c). In a sample from October 1994, all parameters analyzed fell within normal limits. Lead, magnesium and sulfate concentrations were somewhat elevated in other sampling, although not to limits of acute toxicity.

Both the KDOW station and the KSNPC station on the Sturgeon Creek mainstem indicate that it is excellent aquatic habitat, reflected in an abundant, diverse assemblage of fish, macroinvertebrates, and algae (KDOW, 1997). Thirty-three species of fish were found at the KDOW site, including many species intolerant of pollution. There were also 153 species of diatoms present, a class of yellow-green algae important in aquatic food chains. Both Sturgeon Creek stations scored in the excellent range on the Index of Biological Integrity, a measure of aquatic habitat quality.

The NWI (USFWS, No date) identified 6.8 acres of wetlands in several disconnected sites on the proposed Sturgeon Creek, 8.5 mgd reservoir site. The locations of these wetlands are shown in **Figure 3.2.2-5**. Three different types of wetlands recognized by the NWI were present: 3.2 acres of PFOIA (Palustrine, Forested, Broad-leaved, Deciduous, Temporarily-flooded); 1.1 acres of PSSICh (Palustrine, Scrub-Shrub, Broad-leafed Deciduous, Seasonally-flooded, Diked/ Impounded); and 2.5 acres of PUBHh (Palustrine, Unconsolidated Bottom, Permanently-flooded, Diked/Impounded). This nationwide survey of wetlands is based on interpretation of aerial photographs, not a ground survey, and its criteria differ somewhat from those used in jurisdictional wetlands delineations for 404 permitting with the USACE. Therefore, the NWI figure should only be considered an indication of potential wetland presence. A wetlands and waters delineation would be completed prior to submitting an application for a 404 permit.

Over 30 pesticides are sold in Jackson County for use in agriculture (Collins, 1999a). Tobacco is the main crop in the Sturgeon Creek watershed on which pesticides, including insecticides, fungicides, and growth regulators, would likely be applied, although none of the chemicals currently in use on this crop are persistent in the environment (Collins, 1999b). This is reflected in the healthy status of aquatic biota at the downstream monitoring stations. In addition, no pesticide, PCB (Poly-Chlorinated Biphenyls), or other contaminant residues were detected in a fish tissue analysis carried out on six specimens of the hog sucker (*Hypentelium nigricans*) (KDOW, 1997).

Oil and gas have been produced in small quantities from many wells in the Sturgeon Creek watershed (Weir, 1978). By now, these wells have been largely abandoned. While some degree of soil contamination has occurred in the immediate vicinity of oil wells (Bradbury, 1999), the overall high quality of surface water, aquatic habitat, and biological diversity downstream in Sturgeon Creek suggests that surface water contamination from this past extractive activity is not currently a significant problem.

Another former extractive land use, abandoned surface coal mines, also exists in the Sturgeon Creek watershed, even within the immediate vicinity of the proposed Sturgeon Creek, 8.5 mgd reservoir site. Although active and abandoned surface coal mines can have adverse effects on water quality (Kolankiewicz, 1982), there is no visual evidence that Sturgeon Creek has been affected by at least one of these impacts, siltation. At the project site itself, no testing has been done for elevated concentrations of such water quality parameters as acidity and dissolved heavy metals that could conceivably result from underground or surface coal mining. However, the generally high water quality downstream suggests little such contamination at the proposed project site.

Groundwater from the Breathitt Formation, which underlies the Sturgeon Creek area, can vary widely in quality and chemical attributes (Weir, 1978). Breathitt Formation sandstone along Blackwater and Sturgeon Creeks is an aquifer of importance to local residents and farms, as are wells drilled into thick alluvium present in some locations along major creek valleys. Valley-

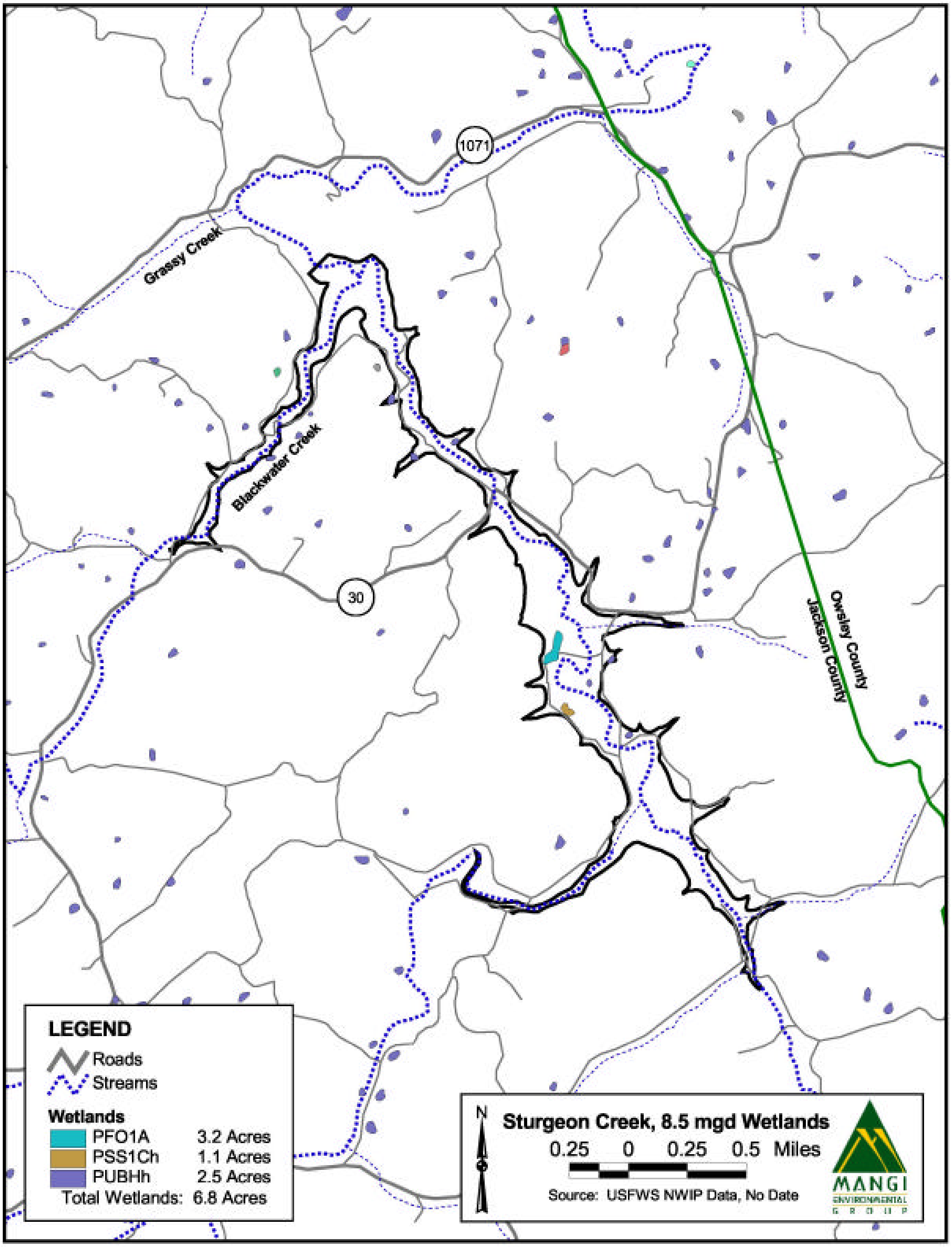

Figure 3.2.2-5. Wetlands In and Around the Sturgeon Creek, 8.5 mgd Project Site

bottom wells tapping into the Breathitt Formation shales, siltstones, and sandstones near Sturgeon Creek and its larger tributaries supply enough water for domestic use. Based on the number of dwellings that would be displaced by the proposed reservoir at this site, it can be estimated that there could be 40 to 50 domestic water wells in the Sturgeon Creek, 8.5 mgd project footprint. These wells would need to be plugged prior to impoundment, per state regulations.

Private wells in Jackson County have been reported as being contaminated with nitrogen compounds, pesticides, and fecal coliform bacteria (MEG, 1999c; Carey et al., 1993). However, evidence of fecal coliform contamination at well sites alone proves only that these wells, and not necessarily surrounding aquifers, are actually contaminated (Goodman, 1999).

Raw Water Transmission Main

The approximately 7.6-mile proposed route for the raw water transmission main leading from the proposed Sturgeon Creek, 8.5 mgd reservoir to the JCWA Treatment Plant would run alongside existing KDOT or County ROW for almost the entire distance. In addition to one crossing of Blackwater Creek, a tributary of Sturgeon Creek, a number of minor and intermittent creeks would have to be crossed en route. Preliminary engineering analysis estimates a total of 300 linear feet of creek crossings (Kenvirons, 1999b).

3.2.2.1.3 Sturgeon Creek, 3.5 mgd

Dam and Reservoir

Section 3.2.2.1.2 provides a discussion of overall Sturgeon Creek water quality and quantity information that is equally applicable to the upstream Sturgeon Creek, 3.5 mgd project site.

The proposed Sturgeon Creek, 3.5 mgd dam and reservoir is located upstream of Blackwater Creek and does not include that watershed in its drainage area. The total area draining into the Sturgeon Creek, 3.5 mgd alternative is 9,997 acres (15.62 square miles). This drainage area is 74 percent of the drainage area of the Sturgeon Creek, 8.5 mgd alternative. The average annual flow and 7Q10 for Sturgeon Creek, 3.5 mgd site are smaller than for the Sturgeon Creek, 8.5 mgd site. They are approximately 3.5 cfs and 0.05 cfs, respectively.

The NWI (USFWS, No date) identified 5.8 acres of wetlands on the proposed Sturgeon Creek, 3.5 mgd reservoir site. The locations of these wetlands are shown in **Figure 3.2.2-6**. Three different types of wetlands recognized by the NWI are present: 3.2 acres of PFOIA (Palustrine, Forested, Broad-leaved, Deciduous, Temporarily-flooded); 1.1 acres of PSSICh (Palustrine, Scrub-Shrub, Broad-leafed, Deciduous, Seasonally-flooded, Diked/Impounded); and 1.5 acres of PUBHh (Palustrine, Unconsolidated Bottom, Permanently-flooded, Diked/Impounded). The NWI is based on interpretation of aerial photographs, not a ground survey, and its criteria differ somewhat from those used in jurisdictional wetlands delineations for 404 permitting with the USACE. Therefore, the NWI figure should only be considered an indication of potential wetland presence. A wetlands and waters delineation would be completed prior to submitting an application for a 404 permit.

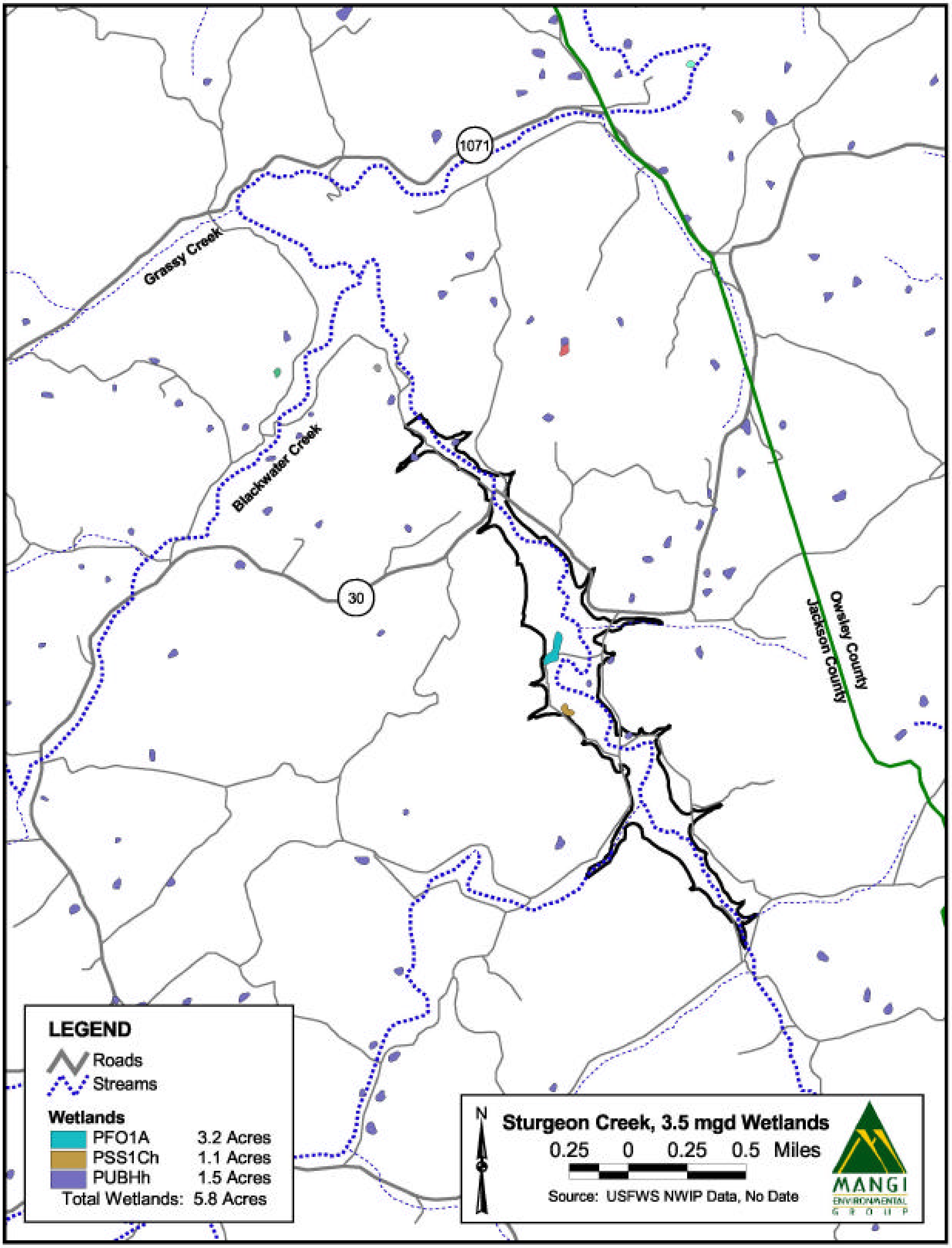

Figure 3.2.2-6. Wetlands In and Around the Sturgeon Creek, 3.5 mgd Project Site

Based on the number of dwellings that would be displaced by the proposed reservoir at this site, it can be estimated that there are approximately 30 domestic water wells in the Sturgeon Creek, 3.5 mgd project footprint. These wells would have to be plugged prior to impoundment, per state regulations.

Raw Water Transmission Main

The approximately 5.7-mile proposed route for the raw water transmission main leading from the proposed Sturgeon Creek, 3.5 mgd reservoir to the JCWA Treatment Plant would run alongside existing KDOT or County ROW for almost the entire distance. In addition to one crossing of Blackwater Creek, a tributary of Sturgeon Creek, a number of minor and intermittent creeks would have to be crossed en route. Preliminary engineering analysis estimates a total of 90 linear feet of creek crossings (Kenvirons, 1999b).

3.2.2.2 Environmental Consequences

The potential impacts on surface and groundwater resources, both flows (quantity) and water quality, were derived from evaluating features of the proposed action that could affect these parameters, as well as hydrologic characteristics of the proposed sites themselves. The associated watersheds and downstream watercourses were also considered. Sections 3.2.2.2.1 through 3.2.2.2.3 of this EIS were analyzed by the same methodology.

A number of Federal and State of Kentucky permits, approvals, and certifications relating to water resources would need to applied for and received before the project could proceed. These include a Section 404 permit (Clean Water Act) and a Section 10 permit (The Rivers and Harbors Act) from the USACE, a Floodplain Construction Permit, Dam Construction Permit, Water Withdrawal Permit, Approval to Construct Public Water Supply Facilities, Approval to Impound, and Section 401 Water Quality Certification. All permits could be obtained from the KDOW within the KNREPC (KDEP, Webpage).

As shown in the environmental diagram, **Figure 3.1-1**, the potential impacts on water quantity and quality from the site preparation, construction, operations, and connected actions associated with a dam, reservoir, and raw water transmission main leading from the reservoir are:

- Short-term increase in suspended sediments in the river resulting from soil compaction and erosion during site preparation and construction activities;
- Short-term contamination of ground/surface water from POL/chemical spills during storage and handling;
- Temporary decrease in downstream flows during impoundment;
- Permanent decrease in downstream flows due to water withdrawals from the reservoir;
- Short-term and long-term adverse impacts due to downstream water withdrawals;
- Long-term changes to downstream groundwater hydrology from decreased stream;
- Long-term changes to downstream water chemistry and temperature;
- Long-term decrease in downstream sediment transport;
- Permanent change from stream habitat to lake habitat within the reservoir area;

- Permanent elimination of some wetlands, and possible creation of new wetlands of a different type;
- Fluctuations in lake level due to evaporative and seepage loss, water withdrawals, water releases to downstream, and drought;
- Long-term sediment accumulation in the reservoir, reducing its useful life;
- Potential degradation of reservoir water quality from reduced dissolved oxygen due to decomposition of retained vegetation and soil organic matter;
- Degradation of reservoir water quality from leaching of naturally-occurring metals or minerals;
- Thermal stratification and associated water chemistry effects in the reservoir;
- Degradation of reservoir water quality due to leaching of toxins from contaminated soils near abandoned oil wells;
- Long-term eutrophication of the reservoir and degradation of reservoir water quality from surrounding and upstream point and non-point sources of pollution;
- Degradation of reservoir water quality from aquatic weeds and/or algal blooms;
- Degradation of reservoir water quality from recreational activities;
- Creation of additional surface water;
- Creation of wetlands along some sections of the reservoir shoreline; and
- Creation of wetlands along the streams just upstream of the reservoir.

In evaluating the potential significance of impacts, the study team used the criteria listed in Appendix C.

Many of these water-related issues are common to all three proposed project sites. These general effects are discussed first; site-specific impacts are discussed in Sections 3.2.2.2.1 through 3.2.2.2.3.

Dam and Reservoir

As with any large construction project involving the clearing of vegetation and the movement of substantial quantities of soil and rock, the potential exists for erosion to transport disturbed or exposed soils, and thus degrade the water quality of War Fork or Sturgeon Creek (KNREPC, 1994; Rochester et al., 1984). The potential for this adverse impact would be more pronounced during a wet season when more rain would fall on the construction site and water move through it. Construction of recreation facilities adjacent to the reservoir, if construction were to occur after water has already been impounded, could temporarily degrade water quality in the adjacent portion of the reservoir if it is not controlled.

> **Sedimentation**: The process of depositing sediment from suspension in water.

Erosion and its subsequent water quality impacts would be minimized by using the measures outlined in the *Kentucky Best Management Practices for Construction Activities* (BMPs) (KNREPC, 1994). A number of BMPs exist to stabilize soils and control runoff and sediments. The contractor would select those BMPs which are most appropriate to the circumstances. The contractor would need to submit a Notice of Intent (NOI) letter to the KDOW, Pollutant Discharge Elimination System (PDES) Branch requesting coverage under the State's stormwater general permit. Prior to the start of construction, a Stormwater Pollution Prevention Plan would be prepared and available for review by the KDOW upon site inspection. Implementation of this plan would reduce any adverse impacts from sedimentation and turbidity to a level of insignificance.

> **Turbidity**: A measure of the extent to which light passing through water is reduced due to suspended matter. Turbidity is caused by the content and shape of the suspended materials, which include clay, silt, organic and inorganic matter, plankton, and other microorganisms.

In addition, one of the first steps of construction would be to divert the existing stream from its channel into a diversion conduit, which could later be incorporated into the proposed dam structure as the reservoir drawdown pipe (Kenvirons, 1999c). This would isolate moving water from exposed soils and aid in minimizing fine sediment transport and associated turbidity.

Another potential short-term, construction-related impact to both surface and groundwater is from POL (petroleum, oil, and lubricants) and chemical spills, as well as the deposit or discharge of other substances on the construction site. When construction chemicals cause problems, it is generally through improper handling (KNREPC, 1994). Whether or not they have any affect depends on their concentration, persistence, and toxicity. Some chemicals decompose or are diluted to such an extent that their impact on water quality is undetectable. In order to minimize the risk of a POL or chemical spill, storage of vehicle operation and maintenance fluids would be confined to an area specifically designed for those purposes (Kenvirons, 1999c), in accordance with the State's BMPs.

Other potentially detrimental substances which may be found on the construction site include alkaline wash water from concrete mixers, ammonium and nitrate residues from blasting, ash from burned trees and brush, and human waste from workers. Human waste would be managed by the contractor so as to avoid pollution, most likely by means of portable toilets. None of the other sources mentioned would be likely to cause significant adverse impacts on water quality (Rochester et al., 1984).

During the approximately 1.5-year construction phase, the volume and seasonal pattern of downstream flows should not be appreciably altered. Assuming normal weather patterns, high flows would occur in the winter and spring months and low flows in summer and autumn, as is the case at present. However, once impoundment of the reservoir begins, long-term changes to water quality and quantity both downstream and in the reservoir would occur.

During the impoundment of the reservoir, downstream flows would be significantly curtailed. This phase could be as brief as several months or as long as several years, depending on rainfall (Kenvirons, 1999c). As water is impounded behind the dam, downstream flows would be reduced to the 7Q10 specified by 401 KAR 4:200 as a minimum flow needed to maintain water quality and aquatic life. Estimates of the 7Q10s range from 0.0 to 0.03 cfs for War Fork and 0.0 to 0.06 cfs for Sturgeon Creek. Presumably, the KDOW would stipulate the higher end of these ranges so as not to eliminate aquatic life altogether in reaches

> **7Q10 Flow**: The minimum average flow of water over a seven-day period, with a recurrence interval of ten years. 401 KAR 4:200 specifies the 7Q10 as the minimum flow needed to maintain water quality and aquatic life.

immediately downstream before the inflow of sizeable tributaries.

Once the impoundment of the reservoir is complete, the three factors that could potentially remove water from the watercourse would be seepage from the reservoir into underlying rock formations and groundwater, evaporation from the reservoir surface, and withdrawals for water supply. Seepage from the reservoir to groundwater would occur, and although it is unlikely, could remove water from the watershed altogether, because water movement in aquifers does not necessarily follow the same direction as surface water flow (Fredrich, 2000). The local water table would be raised in the vicinity of the reservoir and descend in a gradient to its existing level at some distance from the reservoir. Nevertheless, because none of the reservoir sites are located in karst topography, losses to groundwater seepage are not expected to be substantial (Smothers, 2000).

Due to the climate of this part of Jackson Country, losses to evaporation would be relatively insignificant (Fredrich, 1999). Net evaporative loss at other reservoirs in Kentucky were investigated, and it was found that precipitation directly into the reservoir could more than offset evaporation (Williams, 1999d). Thus, losses to evaporation could be considered inconsequential at all three reservoir sites, and the only significant removal of water from the system would be from water withdrawals.

Extrapolating from the methodology used in the *Jackson County Lake Project Final Alternatives Analysis* (MEG, 1999b; Fredrich, 1999b), estimates were made of long-term downstream reductions in flow at all three sites if dams and reservoirs of the given specifications were to be built there. The results are shown in **Table 3.2.2-2**. The percentage reductions in **Table 3.2.2-2** assume water withdrawn at the maximum rate of withdrawal for each facility, rates which, according to the *Final Water Needs Analysis* (MEG, 1999c), may not be reached for many decades.

Table 3.2.2-2. Reductions in Flows Downstream of the Proposed Project Sites

Flow Rates and Percent Reductions	War Fork (3.5 mgd)	Sturgeon Creek (8.5 mgd)	Sturgeon Creek (3.5 mgd)
Existing long-term average flow (million gallons per day (mgd))	10.8	21.1	15.5
Reduction in downstream flow under average conditions	32 %	40 %	23 %
Existing mean annual flow during average drought condition years (mgd)	5.7	11.1	8.2
Reduction in downstream flow under average drought conditions	61 %	77 %	43 %
Existing mean annual flow during worst drought condition years (mgd)	3.6	7.0	5.2
Reduction in downstream flow under worst drought conditions	97 %	100 %	67 %

It can be seen from **Table 3.2.2-2** that in an average year, mean daily downstream flows would be reduced by less than half in the case of all three alternatives. During worst drought condition years, however, at the proposed War Fork and Steer Fork and Sturgeon Creek, 8.5 mgd facilities, there would be 97 percent and 100 percent reductions, respectively. The 97 percent reduction at the proposed War Fork and Steer Fork facility would still exceed the 7Q10 for that river. However, at the Sturgeon Creek, 8.5 mgd project site, maintaining the 7Q10 would require drawing off the reservoir's stored water in relatively insignificant amounts. One month of releasing water to maintain these minimal downstream flows would drain approximately 0.03 percent of the reservoir's 11,007 acre-foot capacity when full.

Hypothetically, some of the water released from the dam to flow downstream could seep below the surface of the creek bed, and then flow underground through alluvium, necessitating releases greater than 7Q10 to maintain a 7Q10 surface flow. However, given the general impervious character of bedrock along stream courses in this part of Kentucky, this is not likely to be a significant amount (Smothers, 2000). Thus, releases to maintain the 7Q10 flow rate should be equal to or not much greater than the 7Q10.

During the low-flow season of normal years, the reservoir would be subject to Kentucky's "pass-through provision," which stipulates that outflow should be equal to inflow (Smothers, 1999). The ability to withdraw water up to the reservoir's design specifications would then depend on its ability to have retained enough water from the high-flow winter and early spring months. Analysis of stream flow data (Fredrich, 1999a) indicate that this is unlikely to be a problem.

As a result of seasonal variations in precipitation, inflow, and outflow, the proposed reservoir would experience fluctuations in the water surface level. In general, the water surface would drop to its lowest level in the late summer and early fall months. The need to maintain downstream flows at a minimum of 7Q10 during periods of low rainfall would increase these fluctuations very slightly.

All watercourses carry and push sediments downstream in a continuous process known as sediment transport. The proposed reservoir would interrupt this process, intercepting and storing those sediments that would have continued on downstream through the reservoir site. Human-made and natural lakes receive sediments transported into them by sheetwash and tributary streams. These sediments originate in soils and are eroded and transported from the drainage basin above the impoundment. Water flowing in streams and rivers transports fine sediments as suspended load, and coarser materials such as sand, pebbles, gravel, cobbles, and boulders as bed or traction load. When the water moving these particles enters the still water of a lake, the sediments settle out and accumulate on the bottom.

Sheetwash: Erosion occurring on the ground surface immediately surrounding a lake.

While erosion and sedimentation are natural processes, some human activities and land uses can intensify or accelerate them. In general, forested areas generate fewer sediments than agricultural or developed areas, and much less than areas with disturbed ground surface, such as construction sites. Because the War Fork watershed is more extensively forested than the

Sturgeon Creek watershed, War Fork is likely to be transporting proportionately less sediment than Sturgeon Creek.

Sediment accumulation in the proposed reservoir at each of the alternative sites was estimated by using the average of sedimentation rates reported by the USACE for other Kentucky reservoirs, including Buckhorn, Taylorsville, Carr Creek, and Cave Run Lake (Kenvirons, 1999c). One effect of sediment accumulation in the proposed reservoir would be to limit its useful lifetime because removing sediments from reservoirs has traditionally been considered prohibitively expensive (Collier et al., 1996). However, in the case of all alternative project sites, this limit would be far into the future. Shallow upstream portions would fill in first, although depth would be reduced throughout the reservoir. When the reservoir is half-filled with sediments, which results in depletion of half its storage capacity, it would have lost roughly half its value as a water supply source. Recreational value for such activities as swimming, fishing, and boating would also likely decline, but acreage of high-value wildlife habitat (e.g., wetlands) could actually increase.

Eliminating sediment transport through sediment accumulation within the reservoir would have two main potential environmental effects downstream. The first is on channel morphology, or the shape and structure of the stream channel. Water exiting the dam would be largely free of suspended solids and devoid of bedload. Consequently, the water would readily pick up sediments downstream of the dam. For some distance downstream of the dam, if heavy winter and early spring flows were to continue, existing sediments would likely be scoured from the streambed and banks downstream of the dam until the water was once again carrying its load, and structures such as bridges could be at risk.

However, after the dam is in place, flows would be substantially reduced from pre-impoundment flows. There would be neither the volume nor the velocity of water moving downstream of the dam that existed prior to construction, because these flows would be intercepted by the reservoir and used for recharge, storage, and water supply. Thus, the remaining water flow would have less kinetic energy and its ability to acquire and transport sediments would be reduced.

In addition, the removal of these suspended solids by the reservoir would produce clearer, less turbid water for some distance downstream until the full load of suspended solids is regained. This change would be potentially beneficial for more desirable aquatic organisms, such as stocked rainbow trout at War Fork. In addition, clearer water is considered to be more aesthetically pleasing and conducive for recreation such as swimming and fishing.

Two other potential effects of the proposed reservoir on downstream water quality would be on water temperature and dissolved oxygen (DO) levels. Both of these parameters strongly affect aquatic communities (Stephens, 1999a). Their associated impacts on such communities are discussed in Section 3.2.4 of this EIS. If water is released downstream from the bottom of the reservoir, as typically occurs with most established dams around the country, then it would be colder and more oxygen-deprived than water flowing into the reservoir or water presently on-site. The extent of temperature and DO reduction depends on residence or detention time, the

> **Dissolved Oxygen (DO)**: The amount of free oxygen found in water. DO is the most commonly used measure of water quality.

average amount of time water stays in the reservoir. The greater the detention time, the greater the chemical character of water changes (Rochester et al., 1984). In the case of all three reservoir sites, the residence time is estimated to be five months or less, which compares with days or weeks for smaller ponds and reservoirs, to many years for much larger reservoirs.

If water were released downstream from near the surface of the reservoir, it would be less likely to have low DO content, but more likely, in the warmer months, to have a higher temperature than the original stream, due to warming of the surface water layer by the sun. Both Sturgeon Creek and War Fork are well-shaded streams, which helps keep them cooler in the summer than an open lake surface would be. Since War Fork's temperature in the summer months, at 60 to 70 degrees Fahrenheit, is already marginal for stocked rainbow trout, warmer releases from the reservoir could make the stream too warm for trout-stocking to be viable (Stephens, 1999a).

Thermal Stratification: The phenomenon by which the surface water layer (epilimnion) of a water body and the deep layer (hypolimnion) do not mix because of density differences between the two layers.

All proposed alternative impoundment sites are probably deep enough to be subject to some degree of thermal stratification. During the summer, the surface water layer (epilimnion) tends to be warm, biologically active, and relatively low in toxic substances. The deep layer (hypolimnion), in contrast, is cold, and tends to contain low DO concentrations. It may also have high levels of ammonia and hydrogen sulfide, as well as toxic substances that diffuse from bottom sediments (Rochester et al., 1984). The moderate retention time and depth of the proposed reservoir alternatives are unlikely to make thermal stratification a significant issue in lake management. The spring and fall turnover of the lake, as occurs in other reservoirs in eastern Kentucky (Bishop, 1999), should mix the two layers of water twice a year, and thereby prevent extreme conditions from developing in either of the layers.

Installing a multi-level intake in the proposed reservoir would allow lake managers to withdraw and mix water from different depths for downstream release. This mixture may be able to avoid the extremes in high temperature and depressed DO which would result from a single level intake at the top, middle, or bottom of the lake. However, it may be necessary to install other means of aerating the outflow, such as aspirators or hydraulic jumps.

At all three alternative reservoir sites, riparian or streambank habitat would be eliminated and replaced with open water lake habitat. Jurisdictional wetland determinations now in progress would determine precisely the acreage of wetlands to be replaced with aquatic habitat, but the preliminary indication of NWI is that there would be little or no existing wetlands lost at War Fork, with fairly minor losses at the two Sturgeon Creek sites (Libby, 1999). The Kentucky Department of Fish and Wildlife has expressed interest in allowing trees to remain standing in at least some of the proposed reservoir's side-coves to enhance fish habitat (Stephens, 1999a), and there may be other opportunities for mitigation of wetland losses within and adjacent to the proposed reservoir. In any case, this issue would be negotiated and finalized with the USACE and other appropriate authorities during the 404 permitting process.

When water is initially impounded in a reservoir, minerals released from newly-flooded soils may increase biological productivity in the reservoir, enhancing fisheries at least temporarily

(Rochester et al., 1984). Also, organic debris, such as retained plants and trees, would decompose in the water, and cause an increase in biochemical oxygen demand (BOD). BOD can reduce DO to adverse levels; however, the proposed action would remove most trees from the reservoir footprint up to the normal pool level. DO reduction from decomposing organic debris has not been a problem with lakes elsewhere in eastern Kentucky (Stephens, 1999a).

Eutrophication: A process whereby more organic matter is produced than existing biological oxidization processes can consume.

Eutrophication, or excessive enrichment with the nutrients nitrogen and phosphorus, would be a serious long-term threat to water quality and aquatic habitat in the proposed reservoir. Nutrient enrichment can trigger algal blooms, or massive increases in lake algal populations, especially during the warm, sunny summer months. During an algal population boom, floating mats of algae cover the water surface; the combined effect of their respiration, while alive, and BOD, when they die and decompose, can deplete oxygen concentrations, causing fish kills of those species that require well-oxygenated water (Rochester et al., 1984). Boats with toilets and surrounding land uses can also contribute BOD in one form or another (Roney, 1999). Fish kills from depressed DO have been a problem elsewhere in eastern Kentucky (Bishop, 1999), such as Cave Run Lake to the northeast of Jackson County (Stephens, 1999a). In addition, algal blooms can clog filters, require more coagulants during the treatment process, and cause taste and odor problems, which must be treated with powdered activated carbon and/or potassium permanganate (Roney, 1999).

Algal blooms usually reflect watershed conditions (Roney, 1999). The risk of severe eutrophication, which leads to algal blooms, can be reduced by restrictions on lake recreation and surrounding land uses, so as to minimize loadings of BOD-causing substances, including fertilizer runoff, human sewage, and animal waste (Roney, 1999; Skaggs, 1999). Kentucky guidelines for water supply reservoirs, 401 KAR 8:020, recommend against allowing swimming, water skiing, and other contact sports and large motor-operated craft or any craft with toilets. Prohibiting boats with toilets is probably the most effective in cutting down on oxygen-demanding pollutants (Roney, 1999).

Another extremely valuable tool for reducing loadings of BOD, as well as toxic substances and fecal coliform bacteria, is to maintain a buffer zone around the reservoir in which development would be strictly restricted or prohibited altogether (Kinman, 1999; Roney, 1999; Skaggs, 1999). As recommended in 401 KAR 8:020, an area at least 100-feet horizontally from the upper pool elevation of a reservoir should be kept clear of all sources of potential contamination, including septic tanks, drain fields, livestock, and barns.

At all alternative proposed reservoir sites, there would be a 300-foot buffer zone surrounding the normal pool elevation of the reservoir. All existing structures and agricultural activity would be removed, and all future private development prohibited, except for limited recreational facilities directly associated with the reservoir. This 300-foot buffer would eliminate any possibility of straight-piping raw domestic sewage into the reservoir, and would protect water quality in the reservoir from being impacted by malfunctioning septic systems and leach fields. It would also reduce non-point sources of pollution such as pet and livestock feces, sediments from unpaved roads and construction sites, fertilizers, pesticides, and discarded motor oil residues.

Based on experience at other lakes in eastern Kentucky, the proposed reservoir in Jackson County would not be likely to serve as either a breeding site for mosquitoes or other disease vectors (Stephens, 1999a). The reservoir is also unlikely to have a significant problem with aquatic weeds (Bishop, 1999), although on occasion an emergent plant known as water shield *(Brasenia schreberi)* has been observed to virtually choke off the surfaces of ponds and smaller lakes in Kentucky (Stephens, 1999a).

Certain reservoirs in Kentucky have experienced problems with naturally-occurring manganese leaching from underlying rocks and dissolving into the water column, where it can reach elevated levels (Roney, 1999). However, manganese, unlike certain other heavy metals, does not bio-accumulate, that is, reach higher, toxic concentrations in organisms higher on the food chain. This potential problem could be actively monitored by a routine water-testing program at the reservoir.

Prior to pumping water from the reservoir to the treatment plant, 401 KAR 8:100 requires that tests be conducted to assess baseline quality of the raw, untreated water in the lake. These tests would help determine which modifications, if any, would need to be made to standard water treatment processes. Treatment technologies exist to deal with water quality issues that typically occur in a multiple-purpose reservoir (Roney, 1999; Skaggs, 1999). For example, oil and gas residues from outboard motor use in the lake can be removed by means of the powdered activated carbon process, at some additional cost. This process is a standard feature of modern treatment plants, but if especially high concentrations of these contaminants are encountered, larger quantities of powdered activated carbon may need to be added. Typical levels of bacterial contamination are treated routinely with pre- and post-chlorination.

In the event a chemical spill into the lake, it may be necessary to temporarily shut down the treatment plant. Multi-level water intakes offer the ability to avoid spills on the surface or contamination in other layers by drawing water in from other layers. Any boat ramp, dock, or marina should be placed as far away from the water intake as possible so as to avoid and minimize problems with chemical spills (Skaggs, 1999).

Raw Water Transmission Main

The construction of the raw water transmission main from any of the alternative reservoir sites would have similar impacts on water resources; there are no site-specific impacts related to this activity. Some potential exists for relatively-minor, short-term impacts on water quality during construction of the raw water transmission main due to suspended sediments, sedimentation, and POL spills.

During construction, earth-moving equipment would be used for excavation to open an approximately four-foot deep trench into which the pipeline would be laid. However, substantial quantities of soil would be exposed for only a short while, as segments of trench would be backfilled the same day they are opened (Williams, 1999b).

Soil erosion would be controlled throughout all stages of construction by using the measures outlined in the *Kentucky Best Management Practices for Construction Activities* (KNREPC, 1994). POL contamination would be avoided through several means. Fuel storage and equipment maintenance activities would be confined to areas specifically designed for those purposes (Williams, 1999e). A fuel storage tank may be present on site, and would be situated on top of a plastic liner covered by a layer of dirt or gravel. All hazardous materials, such as POLs, would be stored, transported, and disposed of in accordance with all applicable laws and regulations. Once the construction of the raw water transmission main is completed, no hazardous materials or POLs would be needed for operation of the main, and would not be handled or stored along the route.

All three proposed routes would entail some laying of pipe across streams and/or creekbeds, which may or may not contain flowing water at the time of construction. In any case, special care would have to be taken to avoid erosion, suspended sediments, and POL spills in the immediate vicinity of watercourses. A Floodplain Construction Permit from the KDOW would have to be obtained prior to breaking ground in any floodplain. A Section 404 Nationwide Permit (No. 12, Utility Line Discharges) from the U.S. Army Corps of Engineers would probably also need to be obtained (Williams, 1999b). By following BMPs, and by waiting for periods of no flow or low flow, significant degradation of water quality should be avoidable.

3.2.2.2.1 War Fork and Steer Fork

Dam and Reservoir

Approximately 116 acres of surface water, at normal pool, would be created be created behind the proposed War Fork and Steer Fork dam. As a result of seasonal variations in precipitation, inflow, and outflow, the proposed reservoir would experience fluctuations in the water surface level, down to 33 feet below the normal pool (Kenvirons, 1999a).

Although a jurisdictional wetlands and waters delineation has not yet been completed, based on the NWI, the War Fork and Steer Fork project site would have minimal impact on existing wetlands. Wetlands may be created, either inadvertently or by design, along certain sections of the reservoir shoreline, as well as along inflowing streams just upstream of the reservoir.

As discussed in Section 3.2.2.2, sediment accumulation in the proposed reservoir at War Fork and Steer Fork was estimated (Kenvirons, 1999a). After 50 years, 396 acre-feet of sediments are expected to have accumulated. This means that 7.92 acre-feet of sediments in transport would be intercepted and impounded annually. An acre-foot is a unit of volume equal to one acre (43,560 square feet) covered with water or sediments one foot deep, or about 326,000 gallons. At this estimated rate of sedimentation, it would take approximately 280 years for a reservoir at the War Fork and Steer Fork site with a water storage volume of 4,414 acre-feet to have filled halfway.

Average annual discharge at War Fork is approximately 12,085 acre-feet, equivalent to an annual average flow of about 10.8 mgd. Assuming that a reservoir at the War Fork and Steer Fork site ultimately withdraws 3.5 mgd from that stream, average annual discharge immediately downstream would be reduced by about 32 percent. During average drought years and worst drought years, annual discharge immediately downstream of the dam would be reduced by about

61 percent and 97 percent, respectively. However, these percentage reductions in flow hold for only about one-half mile because of water added by tributaries.

Two tributaries in particular, Hughes Fork and Elsam Fork, with watersheds of 2.4 square miles and 3.6 square miles respectively, empty into War Fork near Turkey Foot, approximately half a mile downstream of the proposed dam site. Downstream of Elsam Fork and Hughes Fork, reductions would be on the order of 21 percent in an average year and 63 percent during worst drought years. Another tributary with a drainage area of 4.1 square miles, Big Buck Lick, enters War Fork about 3 miles downstream of the dam site. Below this point, reductions in flow would be about 17 percent in average years and 50 percent in worst drought years.

Water withdrawals from a reservoir at the War Fork and Steer Fork site would not adversely affect downstream permitted water withdrawals, since there are none, neither existing nor pending, on either the downstream portion of War Fork or Station Camp Creek (to which it is tributary) all the way to the Kentucky River (Caldwell, 1999a).

Reduced long-term flows downstream of the proposed reservoir would introduce 21 percent less water on average to the karst region downstream, where War Fork disappears underground for about a mile. This could slow the long-term rate at which limestone is dissolved and caves formed in that area (Walker, 1999).

Impacts on water quality and quantity due to a dam and reservoir at the War Fork and Steer Fork site could affect two existing recreational resources, a stocked trout fishery and the USFS Turkey Foot Campground, due to their immediate proximity to the project. These issues are further discussed in Section 3.2.6 of this EIS. During the 1.5-year construction phase, the principal adverse effect would be on water quality, in particular, more suspended sediments and higher turbidity. Diligent implementation of BMPs should be able to control sediments and turbidity adequately, but failures are always possible that would temporarily degrade water quality and clarity for several miles downstream.

The potential exists to manage downstream water temperature, DO, and flow rates. This could be accomplished by appropriate lake releases and structures in such a manner as to mitigate downstream impacts or even enhance existing conditions. Summer water temperature can be maintained low enough and DO high enough at the outlet through multi-level intakes and by add-on aerators or hydraulic jumps, if needed. Under some conditions, there could be potential for releasing greater flows during low-flow summer months than currently exist. This would be especially true during the first few decades of the project when, according to water need projections, the entire 3.5 mgd yield capacity would not be utilized. Surplus water could then be stored in winter high-flow months and released in summer and fall low-flow months to the benefit of trout, anglers, and swimmers.

As stated in Section 3.2.2.1.1, the War Fork and Steer Fork project site is located about 0.5 mile upstream of a Wild and Scenic Study River segment. The USFS has recommended that the stretch of War Fork between Turkey Foot and Station Camp Creek be designated a Scenic River. Chapter 8 (Section 8.12) of the USFS's *Land and Resource Management Planning Handbook* (USFS, 1992) addresses the interim management of Study Rivers, including the following:

- To the extent the USFS is authorized under law to control stream impoundments and diversions, the free-flowing characteristics of the Study River cannot be modified; and

- Management and development of the Study River and its corridor cannot be modified to the degree that would affect its eligibility or classification.

Section 16(a) of the Wild and Scenic Rivers Act, as amended (PL 90-542, 16 U.S.C. 1271), defines the term "free-flowing" to mean "existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway." The USFS handbook further states that there are no specific requirements concerning minimum flows within an eligible segment (USFS, 1992).

During the approximately 1.5-year construction phase of the project, there would be some potential for degrading water quality within the upper portion of the Study River segment from turbidity and sediments. During the four-month to three-year reservoir impoundment phase, winter and spring flows into the upstream end of the Study River segment would be reduced by approximately two-thirds. A temporary flow reduction of this magnitude would constitute a moderately significant, short-term adverse impact on the hydrologic regime and character of the Study River segment. However, it should not affect the eligibility or "Scenic" classification of the segment.

Once the reservoir is full, and once withdrawals have reached the design yield of 3.5 mgd, which could take several decades, the eventual long-term impact of a dam and reservoir at the War Fork and Steer Fork site would be to reduce aggregate flows into the upstream end of the Study River segment by an average of 21 percent in a normal precipitation year and approximately 63 percent in a severe drought year. Most of the reduced flow volume would occur as a result of the upstream dam intercepting the bulk of high winter and storm flows. During the low-flow summer months, even during a drought, the flow rate would not be substantially different than at present, because of the 7Q10 and pass-through provisions. Overall, War Fork's flow regime would be moderated or regulated by truncating the high extremes and approximating the low extremes. One possible beneficial side-effect of cutting back on peak discharges are slightly-reduced suspended sediments and lower turbidity during winter and early spring flows. Thus, the magnitude of this adverse impact would be minor, its duration long term, its extent medium, and its likelihood highly probable. Although the dam would reduce aggregate downstream flow volume, it would neither modify the free flowing characteristics of the Study River segment nor impair its eligibility for inclusion in the national system as a Scenic River.

3.2.2.2.2 Sturgeon Creek, 8.5 mgd

Dam and Reservoir

Approximately 467 acres of surface water, at normal pool, would be created behind the proposed Sturgeon Creek, 8.5 mgd dam. As a result of seasonal variations in precipitation, inflow, and outflow, the reservoir would experience fluctuations in the water surface level, down to 21 feet below the normal pool (Kenvirons, 1999b).

Although a jurisdictional wetlands and waters delineation has not yet been completed, based on the NWI, which identified 6.8 acres of wetlands within the proposed reservoir normal pool footprint, the project at the Sturgeon Creek, 8.5 mgd site could replace palustrine wetlands associated with the Sturgeon Creek floodplain. These would be displaced by open water aquatic habitat throughout most of the lake. In the side coves, some timber may be left standing to enhance fish habitat. It may be possible to develop marsh or swamp-like wetlands on these areas, as well as along inflowing streams just upstream of the reservoir, and thus mitigate wetland losses on-site. Otherwise, off-site mitigation opportunities would be sought.

As discussed in Section 3.2.2.2, sediment accumulation in the proposed Sturgeon Creek, 8.5 mgd reservoir was estimated (Kenvirons, 1999a). After 50 years, 783 acre-feet of sediments are expected to have accumulated. This means that 15.66 acre-feet of sediments in transport would be intercepted and impounded annually. At this estimated rate of sedimentation, it would take approximately 350 years for a reservoir at the Sturgeon Creek, 8.5 mgd site with a water storage volume of 11,007 acre-feet to have filled halfway.

The average annual discharge of Sturgeon Creek at the 8.5 mgd project site is approximately 23,646 acre-feet, equivalent to an annual average flow rate of about 21.1 mgd. Assuming that a reservoir at this site ultimately withdraws 8.5 mgd from that stream, average annual discharge immediately downstream of the dam would be reduced by about 40 percent. During average drought years and worst drought years, annual discharge immediately downstream would be reduced by about 77 percent and 100 percent, respectively.

However, these percent reductions in average flow would be for a comparatively short distance, because of downstream tributaries. Grassy Creek, Travis Creek, and Brushy Creek, as well as smaller tributary streams, with combined drainage areas of 17.4 square miles, all empty into Sturgeon Creek within several miles downstream of the proposed dam site. Downstream of Brushy Creek, the average annual discharge on Sturgeon Creek would be reduced by about 22 percent. During average drought years and worst drought years, annual discharge below Brushy Creek would be reduced by about 42 percent and 67 percent, respectively. About 8 miles downstream of the proposed dam site, Little Sturgeon Creek discharges water from a large drainage area into Sturgeon Creek, further diminishing the effect of the proposed withdrawal on Sturgeon's flows.

Water withdrawals from the proposed Sturgeon Creek, 8.5 mgd reservoir would not adversely affect downstream permitted water withdrawals, since there are none, neither existing nor pending, on Sturgeon Creek all the way to the Kentucky River (Caldwell, 1999a).

As discussed in the Section 3.2.2.1.2, most of Sturgeon Creek has been designated a "reference reach" by the State of Kentucky. Sturgeon's high water quality and excellent aquatic habitat are considered a baseline against which to compare other streams in eastern Kentucky. Four monitoring stations are located downstream of the proposed project site, the closest about eight stream miles away, 200 yards upstream of Sturgeon's confluence with Little Sturgeon Creek. Given the distance to these stations, and the inflow of tributary discharges, it is unlikely that there would be significant change to water quality or aquatic habitat parameters, although there may be detectable changes to the latter due to somewhat reduced flows.

For several miles immediately downstream of the proposed dam site, there may be some water quality degradation from suspended sediments and turbidity during the 1.5-year construction phase. Implementation of BMPs should control sediments and turbidity adequately, but failures are always possible that would temporarily impair water clarity for several miles downstream.

Prior to impoundment of the proposed reservoir at the Sturgeon Creek, 8.5 mgd site, any residential septic or petroleum storage tanks located within the reservoir or buffer area would be closed or removed. Septic tanks, pit toilets, and cesspools would be closed by a licensed septic tank operator (Sheehan, 1999). In addition, all water wells and oil wells would be plugged in compliance with state regulations; contaminated soils around the latter would be removed and hauled to a licensed disposal facility.

Low-intensity, relatively small-scale agricultural operations are present within the proposed Sturgeon Creek, 8.5 mgd reservoir footprint, in the immediate vicinity of the proposed reservoir, and within the 21-square mile drainage area. It is likely there has been some application of pesticides, including herbicides, insecticides, and fungicides, on tobacco and corn crops in the area over the years. Of the 33 pesticides sold in Jackson County in 1998, seven are covered by Federal or State drinking water standards, which set maximum permissible contaminant levels (Collins, 1999a; EPA, 1999d; KNREPC, No date). Of these seven, the greatest sales in Jackson County (1,765 pounds) were for methyl bromide, an all-purpose fumigant. However, methyl bromide has a very short half-life upon exposure to water (TEC, 1998). Moreover, it is now being phased out for use (EPA, 1999e).

> **Half-life**: The time it takes for the concentration of a substance to fall to half its initial concentration.

The second-largest sales in Jackson County (564 pounds in 1998) were to simazine, an herbicide used to control grasses and other weeds in corn crops (PMEP, 1999). Simazine is another pesticide covered by a drinking water standard. In the purely hypothetical event that simazine were to be evenly dispersed throughout the proposed Sturgeon Creek, 8.5 mgd reservoir, it would take approximately 120 pounds to exceed EPA's maximum permissible level. This amount represents about 20 percent of annual sales across the entire County. Moreover, different studies have shown a half-life for simazine in soils ranging from 18 to 234 days, depending on the temperature and type of soil (Spectrum, No date). With this degree of decomposition and level of use in the County, it is unlikely that this herbicide could ever build to toxic concentrations in the water column at an 8.5 mgd reservoir at Sturgeon Creek. The same conclusion can be drawn for other agricultural chemicals used even in even smaller quantities around Jackson County.

In sum, pesticide residues left behind in those soils to be flooded by the proposed reservoir, or carried into the reservoir from ongoing agricultural operations in the upstream drainage basin, are not likely to reach concentrations that JCWA Treatment Plant processes are incapable of reducing to acceptable levels.

During the operational phase, there may be a long-term increase in summer water temperatures and long-term reductions in DO levels and suspended sediments in the segment of Sturgeon Creek below the dam. Unlike War Fork, Sturgeon Creek does not support especially valuable water-dependent resources just downstream. Therefore, it may not be considered necessary to actively manage DO, summer water temperatures, and low flows through releases and structural features.

As a result of more agricultural land use within the Sturgeon Creek watershed than the War Fork watershed, and a larger human population, the proposed Sturgeon Creek, 8.5 mgd reservoir would be somewhat more susceptible to eutrophication than a War Fork facility, due to potentially higher loadings of nutrients, total organic carbon, and BOD. Still, given the rather low intensity of agriculture, low residential density within the drainage area, and virtual lack of industry, loadings are not likely to be great enough to cause major water quality problems in the reservoir. Over the long term, however, if the Jackson County Lake Project succeeds in attracting residential, recreational, and commercial growth in the surrounding area, there could be greater pressure on the reservoir's water quality that would require active attention and management.

In sum, the Sturgeon Creek, 8.5 mgd alternative would generate impacts on water resources of minor magnitude, long-term duration, and localized extent.

3.2.2.2.3 Sturgeon Creek, 3.5 mgd

Dam and Reservoir

Because it is located less than a mile upstream of the proposed Sturgeon Creek, 8.5 mgd alternative, and falls within the same footprint, in general, the proposed Sturgeon Creek, 3.5 mgd alternative would have similar, but somewhat smaller, effects on hydrologic resources as the Sturgeon Creek, 8.5 mgd alternative.

Approximately 264 acres of surface water, at normal pool, would be created behind the proposed Sturgeon Creek, 3.5 mgd dam. As a result of seasonal variations in precipitation, inflow, and outflow, the reservoir would experience fluctuations in the water surface level, down to 15 feet below the normal pool (Kenvirons, 1999b).

Although a jurisdictional wetlands and waters delineation has not yet been completed, based on the NWI, which identified 5.8 acres of wetlands within the proposed reservoir normal pool footprint, the project at the Sturgeon Creek, 3.5 mgd site could replace palustrine wetlands associated with the Sturgeon Creek floodplain. These would be displaced by open water aquatic habitat throughout most of the lake. In the side coves, some timber may be left standing to enhance fish habitat. It may be possible to develop marsh or swamp-like wetlands on these areas, as well as along inflowing streams just upstream of the reservoir, and thus mitigate wetland losses on-site. Otherwise, off-site mitigation opportunities would be sought, if necessary.

As discussed in Section 3.2.2.2, sediment accumulation in the proposed Sturgeon Creek, 3.5 mgd reservoir was estimated (Kenvirons, 1999a). After 50 years, 576 acre-feet of sediments are expected to have accumulated. This means that 11.52 acre-feet of sediments in transport would be intercepted and impounded annually. At this estimated rate of sedimentation, it would take approximately 190 years for a reservoir at the Sturgeon Creek, 3.5 mgd site with a water storage volume of 4,446 acre-feet to have filled halfway.

The average annual discharge of Sturgeon Creek at the 3.5 mgd project site is approximately 17,400 acre-feet, equivalent to an annual average flow rate of about 15.5 mgd. Assuming that a reservoir at the Sturgeon Creek, 3.5 mgd site ultimately withdraws 3.5 mgd from that stream, average annual discharge immediately downstream of the proposed dam would be reduced by about 23 percent. During average drought years and worst drought years, annual discharge immediately downstream would be reduced by about 43 percent and 67 percent, respectively.

These percentage reductions in average flow, however, are for a comparatively short distance, because of downstream tributaries. Blackwater Creek, Grassy Creek, Travis Creek, Brushy Creek, and other smaller tributary streams, with combined drainage areas of 23 square miles, all empty into Sturgeon Creek within several miles downstream of the proposed dam site. Downstream of Brushy Creek, the average annual discharge on Sturgeon Creek would be reduced by about 10 percent. During average drought years and worst drought years, annual discharge below Brushy Creek would be reduced by about 17 percent and 27 percent, respectively. About 8 miles downstream of the proposed dam site, Little Sturgeon Creek discharges water from a large drainage area into Sturgeon Creek, further diminishing the effect of the proposed withdrawal on Sturgeon's flows.

Water withdrawals from the Sturgeon Creek, 3.5 mgd reservoir would not adversely affect downstream permitted water withdrawals, since there are none, neither existing nor pending, on Sturgeon Creek from the proposed dam site downstream to the Kentucky River (Caldwell, 1999a).

As discussed in Section 3.2.2.1.2, most of Sturgeon Creek has been designated a "reference entucky. Four monitoring stations are located downstream of the project site, the closest about nine stream miles away. Given the distance to these stations, and the inflow of tributary discharges, it is unlikely that there would be any significant, or even detectable change in water quality or aquatic habitat parameters due to the impoundment and associated withdrawals of water.

For several miles immediately downstream of the proposed dam site, there may be some water quality degradation from suspended sediments and turbidity during the 1.5-year construction phase. Implementation of BMPs should control sediments and turbidity adequately, but failures are always possible that would temporarily impair water clarity for several miles downstream.

Prior to impoundment of the reservoir at the Sturgeon Creek, 3.5 mgd site, any residential septic tanks or petroleum storage tanks located within the reservoir or buffer area would be closed or removed. Septic tanks, pit toilets, and cesspools would be closed by a licensed septic tank operator (Sheehan, 1999). In addition, all water wells and oil wells would be plugged in compliance with State regulations; contaminated soils around the latter would be removed and hauled to a licensed disposal facility.

During the operational phase, there may be a long-term increase in summer water temperatures and long-term reductions in DO levels and suspended sediments in the segment of Sturgeon Creek below the dam. Elevated summer water temperatures and depressed DO may be somewhat less than in the case of the Sturgeon Creek, 8.5 mgd alternative, because a shorter average residence time in the Sturgeon Creek, 3.5 mgd alternative (about 3 versus 5 months).

As a result of more agricultural land use being within the Sturgeon Creek watershed than the War Fork watershed, and a larger human population, the proposed Sturgeon Creek, 3.5 mgd reservoir, like the Sturgeon Creek, 8.5 mgd alternative, would be somewhat more susceptible to eutrophication than a War Fork and Steer Fork facility, due to potentially higher loadings of nutrients, total organic carbon, and BOD. Still, given the rather low intensity of agriculture, low residential density within the drainage area, and virtual lack of industry, loadings are not likely to be great enough to cause major water quality problems in the reservoir. Over the long term, however, if the Jackson County Lake Project succeeds in inducing residential, recreational, and commercial growth in the surrounding area, there could be greater pressure on the reservoir's water quality that would require active attention and management.

3.2.2.2.4 No Action

Under the No Change alternative, nothing would be done to meet the projected water and recreation needs of Jackson County. All short-term and long-term, direct and indirect impacts on water quality and quantity would be avoided at both War Fork and Sturgeon Creek. Both watercourses would continue to enjoy relatively-high water quality and marked fluctuations in their seasonal discharges. The quality and quantity of water resources at War Fork, in particular, would continue to yield the same benefits to downstream recreational anglers, campers, and swimmers, and the Wild and Scenic Study River segment. There would, however, be a shortage of water in Jackson County in the future.

Under the No Action alternative, certain activities would occur to increase the current water supply, although in insufficient quantities to meet the projected need. These activities include drilling additional private and public water wells throughout the County, constructing water transmission mains from existing resources in the County to the JCWA Treatment Plant, or instituting a water conservation program in Jackson County.

The drilling of water wells to help meet a projected shortfall in water supply would only be able to accommodate a portion of the growing need. Most homes and businesses in Jackson County are not located in valley bottoms, which are the only features with the geology to sustainably yield ample quantities of water for domestic use. If withdrawals from groundwater are to be sustainable they cannot exceed recharge rates, or the aquifers would be drawn down. Also, more intensive use of wells would probably lead to more encounters with fecal coliform-contaminated water. Groundwater as an alternative means to meet Jackson County's projected water needs is discussed in detail in Section 2.1.1 of this EIS. Overall, groundwater development in lieu of the proposed action would have limited consequences for surface water resources, but a moderately significant to major impact on groundwater resources themselves.

Constructing water lines from existing resources within the County may result in relatively minor, short-term impacts on water quality during construction due to suspended sediments, sedimentation, and POL spills. If construction of these water lines would entail creek crossings, special care would have to be taken to avoid these impacts in the immediate vicinity of watercourses. These impacts, however, would be rated as insignificant according to the criteria listed in Appendix C of this EIS.

Implementation of a water conservation program in Jackson County would not impact existing water resources in the County or elsewhere. As noted in Section 2.1.4, however, such a program alone would only be able to meet a fraction (approximately 10 to 30 percent) of Jackson County's projected needs.

3.2.2.2.5 Summary of Impacts

The following table lists the potential impacts to water resources from the site preparation, construction, operation, and connected actions associated with a dam, reservoir, and raw water transmission main for each alternative project site, including the No Action alternative.

Table 3.2.2-3. Summary of Impacts on Surface and Groundwater Resources

Alternative	Impacts	Rating of Impacts
War Fork and Steer Fork	• Temporarily degrade downstream water quality from turbidity and sedimentation during construction of the dam; • Temporarily degrade downstream water quality from POL/chemical spill(s) during storage and handling; • Long-term effect on downstream sediment transport; • Long-term reduction of downstream dissolved oxygen (DO) levels; • Long-term elevation of downstream summer water temperature; • Short-term reduction in downstream flows into Wild and Scenic Study River during impoundment; • Long-term reduction in downstream flows into Study River from reservoir water withdrawals; • Impacts from downstream water withdrawals; • Permanent loss of existing wetlands; • Creation of new wetlands along shorelines and inflowing streams; • Creation of 116 acres of surface water; • Long-term effect of surrounding land uses and lake-based recreation on reservoir water quality;	• Moderately Significant • Insignificant • Insignificant • Moderately Significant • Moderately Significant • Moderately Significant • Insignificant • Insignificant • Insignificant • Insignificant • Moderately Significant • Insignificant

	• Temporarily degrade water quality from turbidity and sedimentation during water main construction.	• Insignificant
Sturgeon Creek, 8.5 mgd	• Temporarily degrade downstream water quality from turbidity and sedimentation during construction of the dam; • Temporarily degrade downstream water quality from POL/chemical spill(s) during storage and handling; • Long-term effect on downstream sediment transport; • Long-term reduction of downstream DO levels; • Long-term elevation of downstream summer water temperature; • Short-term reduction in downstream flows during impoundment; • Long-term reduction in downstream flows from water withdrawals from reservoir; • Impacts from downstream water withdrawals; • Permanent loss of existing wetlands; • Creation of new wetlands along shorelines and inflowing streams; • Creation of 467 acres of surface water; • Long-term effect of surrounding land uses and lake-based recreation on reservoir water quality; • Temporarily degrade water quality from turbidity and sedimentation during water main construction.	• Insignificant • Insignificant • Insignificant • Insignificant • Insignificant • Insignificant • Insignificant • Insignificant • Insignificant • Insignificant • Moderately Significant • Insignificant • Insignificant
Sturgeon Creek, 3.5 mgd	• Temporarily degrade downstream water quality from turbidity and sedimentation during construction of the dam; • Temporarily degrade downstream water quality from POL/chemical spill(s) during storage and handling; • Long-term effect on downstream sediment transport; • Long-term reduction of downstream DO levels; • Long-term elevation of downstream summer water temperature; • Short-term reduction in downstream flows during impoundment; • Long-term reduction in downstream flows from water withdrawals from reservoir; • Impacts from downstream water withdrawals;	• Insignificant • Insignificant • Insignificant • Insignificant • Insignificant • Insignificant • Insignificant • Insignificant

	• Permanent loss of existing wetlands; • Creation of new wetlands along shorelines and inflowing streams; • Creation of 264 acres of surface water; • Long-term effect of surrounding land uses and lake-based recreation on reservoir water quality; • Temporarily degrade water quality from turbidity and sedimentation during water main construction.	• Insignificant • Insignificant • Moderately Significant • Insignificant • Insignificant
No Action	• Impact on groundwater supplies/aquifers; and • Temporarily degrade water quality from turbidity and sedimentation during construction of water transmission lines.	• Moderately Significant • Insignificant

3.2.2.3 Mitigation

Before the project could proceed at any of the alternative sites, a number of water resource-related permits, approvals, and licenses from the State and Federal government, relating to different project phases, would have to be applied for and received. As a matter of standard routine, these permissions would stipulate a number of conditions and mitigation measures, some of which apply to virtually all projects and others project-specific, that would have to be met by Jackson County and project contractors.

During construction, Kentucky's Best Management Practices would be followed. It is recommended that measures be taken to avoid contamination of water from POL/chemical spills, prevent sedimentation, and turbidity. During operation of the dam and reservoir, operators would have to comply with the State's 7Q10 and pass-through provisions for maintaining minimum downstream flows. Prior to supplying community drinking water, the reservoir would be tested for water quality. Regular monitoring of reservoir water quality for both drinking and public health purposes would continue throughout its useful lifetime.

In addition to protecting a 300-foot buffer zone around the proposed reservoir from land uses that could impair water quality and lake biota, it is recommended that preparation and implementation of a non-point source pollutant control plan be considered for the upstream watershed of the reservoir site selected. This could help prevent future problems with eutrophication in the reservoir.

Because of its location immediately upstream of important water-dependent resources and uses dependent on in-stream flows, if the War Fork and Steer Fork site is chosen as the final project location, additional mitigation measures designed to minimize changes to downstream flows and water quality could be considered. These include the following:

- Installation of a multi-level water intake structure in order to mix releases of water from different depths of the reservoir, thereby avoiding extremes of DO and water temperature in the water.

- Downstream releases of water that exceed 7Q10 or pass-through rates during low-flow months, as long as excessive drawdown in the reservoir or loss of water to withdrawal does not occur. This could be accomplished during impoundment of the reservoir and/or during the permanent operational phase.