III. ASSESSMENT APPROACH

A. Study Team Formation. A core Habitat Assessment Team (HAT) was formed at the outset of the study in May 1995. This team consisted of representatives from the U.S. Fish and Wildlife Service-Rock Island Field Office; the Rock Island and St. Louis Districts of the U.S. Army Corps of Engineers; and the National Biological Service (now U.S. Geological Survey), Ft. Collins, Colorado. The team coordinated on a regular basis with State and Federal resource agencies and other interested parties.

B. Available Assessment Tools/Selection. A number of habitat evaluation tools were considered for use in this study. These were Habitat Evaluation Procedures (HEP), Instream Flow Incremental Methodology (IFIM), Wildlife Habitat Appraisal Guide (WHAG), and Aquatic Habitat Appraisal Guide (AHAG). Mr. Richard Stiehl of the U.S. Geological Survey (USGS) compared these methods for applicability to this study and recommended the use of HEP. Appendix B contains the full text of his comparison. Briefly, HEP was chosen because of its rich base of species evaluation (blue book) models, the robustness of its variable aggregation formulas, and its ability to be reconfigured into a spreadsheet format for ease of calculation and scenario running.

C. Agency Coordination. Extensive coordination was conducted with resource agency personnel throughout the study, while direct agency participation varied by study phase. The main types of coordination activities included formal and informal meetings, initial site visits and field data collection, ongoing correspondence, and progress reports given to coordination groups such as the Navigation Environmental Coordination Committee (NECC) or Governors' Liaison Committee (GLC). These activities are too numerous to adequately summarize in a single section; as such, they will be included and summarized in pertinent sections of this report. In addition to documentation based on agency coordination, the HAT compiled a Reference Book comprised of frequently used study information such as the study plan, species model information, analysis area maps, and field sampling information. This book serves as additional documentation of the study process and will be incorporated in this report by reference. Pertinent portions of that book related to species models, including citations, have been included within Appendix C.

D. Resources of Concern/Evaluation Species Selection. The HAT set out to conduct a biologically sound assessment while realizing that constraints on time and resources would limit the number of species evaluated. Evaluation species were selected through a process similar to that described in Chapter 4 of the Habitat Evaluation Procedures Workbook (National Biological Survey, 1994). In a series of multi-agency meetings lasting over a period of months, lists of fish and wildlife resources of concern, species, and habitats were discussed, evaluated, and debated. Although a ranking process was utilized to select evaluation species, the agencies involved did not concur with each species chosen by the ranking criteria. Therefore, changes to that species list were made through recommendations from participating agencies. For example, the nature of the ranking criteria placed scarce species at the top of the list. Scarcity, though an important consideration in impact assessment, does not necessarily select species suitable to reflect habitat impacts. The selection process provided direction and a thought process for selecting evaluation species, and enabled initial lists to be developed for consideration by the agencies. Groups of species were chosen to represent each of the habitat types of concern and were agreed upon by the multi-agency team.

As a starting point, the HAT developed a preliminary list of resources of concern within the study area. That list was then coordinated with the other participating agencies. The initial list of resources of concern consisted of:

1. Native Mussels
2. Backwater/Side Channel Habitat
3. Wetlands
4. Bottomland Forests
5. Migratory Waterfowl
6. Neotropical Migrants
7. Commercial/Recreational Fishes and Fish Species of Concern

Further discussion of this list in a brainstorming session resulted in its expansion as well as the addition of associated species (Table 2).

This list was accepted as the starting point for consideration by the cooperating agencies and was presented to the NECC on June 27, 1995, with a request for review and comment by the next meeting in August. No comment was received until the September 20, 1995, meeting in Burlington, Iowa. The goal of that meeting was to gain consolidated input on the species list and begin the process of refining and focusing the list. The list that resulted from the September meeting is shown as Table 3.

Initial site visits were conducted in October 1995. Those visits included discussion of evaluation species (Table 3) appropriate to individual lock and dam sites. Each of these lock-specific lists added and deleted some species; however, the focus was kept on the originally identified resources of concern to guide the decision-making process. Simultaneously, the HAT conducted an extensive exercise to develop a list of evaluation criteria to aid in evaluating and further refining the list of species. The HAT applied six criteria based on existing information on resource significance and evaluation. Those criteria were scarcity, population trend, susceptibility, recoverability, recreational importance, and commercial importance. Using these criteria, a ranking process was conducted, and the ranked list was then cross-referenced with available model variables, habitat types, and the identified resources of concern to produce a list deemed to best represent each of these categories. The species list resulting from this process was then presented at a second meeting with agency personnel on February 6, 1996. Table 4 shows that list with recommended changes noted.

TABLE 2: Initial List of Resources of Concern and Potential Evaluation Species Identified by the HAT

Resources	Species	Threatened & Endangered
Native mussels		Higgins' eye
-mussel bed habitat		fat pocketbook
*population density		
*species richness		
Zebra mussel habitat (neg.)		
Backwater lakes		
Side channel habitat		
Wetlands		
-backwater lakes		
-bottomland hardwoods		
*mast producers		
-forested		
-non-forested		
Migratory waterfowl	wood duck	
-reproductive/migration habitat		
-colonial nesting birds		
Shore/wading birds habitat		least tern
		piping plover
Neotropical migrants	prothonotary warbler	
-fragmentation		
Recreational fishes	walleye/sauger	
	centrarchids	
	catfish spp.	
Fish species of concern	sturgeon	pallid sturgeon
	paddlefish	
Commercial fish	buffalo/catfish/carp	
Fish passage		
Main channel border		
Water quality		
-contaminant load		
-dissolved oxygen		
-turbidity		
-flow regime		
-temperature		
Raptors	red-shouldered hawk	bald eagle
	osprey	peregrine falcon
Furbearers	river otter	
Shoreline erosion/accretion		
		Indiana bat
		gray bat
		decurrent false aster
		Iowa Pleistocene snail

TABLE 3: Interim List of Resources of Concern and Potential Evaluation Species Identified by the HAT and Agency Personnel in Burlington, Iowa, September 1995

SITE-SPECIFIC ASSESSMENT - RESOURCES OF CONCERN

Resource	Representative Species
Native mussels	because native mussels use a wide variety of habitats, conducting population surveys and developing SIs for such characteristics as population density and species richness may be preferable to selecting representative species and using habitat variables
Zebra mussel habitat (neg.)	
Backwater habitat	black crappie, paddlefish, Western painted turtle, bullfrog, great blue heron, mallard, beaver, muskrat
Side channel habitat	channel catfish, walleye, sauger, buffalo, flathead catfish, great blue heron, beaver
Backwater lakes	peeper, tree frog, bullfrog, sora, Virginia rail, marsh wren, mallard, great blue heron, muskrat, mink
Bottomland hardwood forest	tree frog, red-headed woodpecker, pileated woodpecker, turkey, wood duck, great blue heron, gray squirrel, Indiana bat, gray bat, deer
Non-forested wetland	sora, Virginia rail, mallard, meadow vole
Migratory waterfowl	canvasback, wood duck, mallard, lesser scaup
Colonial-nesting birds	great blue heron, great egret
Shore/wading bird habitat	least tern, piping plover, pectoral sandpiper
Neotropical migrants	prothonotary warbler
Recreational fish	walleye, sauger, bluegill, white bass, flathead catfish, channel catfish, blue catfish
Commercial fish	smallmouth buffalo, bigmouth buffalo, channel catfish, freshwater drum
Migratory fish/fish passage	lake sturgeon, paddlefish, skipjack herring
Other fish	blue sucker
Main channel border	mussels, walleye, sauger, channel catfish; representative minnow(s) will be added
Cutbanks	flathead catfish, smallmouth buffalo
Water quality	(covered in fish models)
Raptors	red-shouldered hawk, bald eagle, osprey, peregrine falcon, barred owl
Furbearers	muskrat, beaver, mink

TABLE 4: Interim List of Selected Evaluation Species with Recommended Changes

HAT Selected Species	Additions/Substitutions per 2/6/96 Meeting
Bottomland Hardwood Forest	
red-shouldered hawk	wood duck
pileated woodpecker	great blue heron
red-headed woodpecker	hairy woodpecker (replacement)*
wild turkey	herp. sp. *

***Hairy woodpecker -** This species was recommended as a replacement to red-headed woodpecker because of the similarity in their habitat requirements which will cover intermediate aged forest. Variables key on canopy cover, overstory dbh, and medium sized snags.

***Herp.** - If there is a need to evaluate the ephemeral pools/seasonal water levels, a representative will be selected.

HAT Selected Species	Additions/Substitutions per 2/6/96 Meeting
Cutbank	
flathead catfish	
Main Channel	
paddlefish	lake sturgeon
sauger	walleye
	skipjack herring
Main Channel Border	
emerald shiner	
channel catfish	
Mudflat	
lesser yellowlegs	
Backwater	
marsh wren	great blue heron
black crappie	paddlefish
bullfrog	largemouth bass
Backwater Lakes	
bullfrog	lesser scaup
bluegill	muskrat
Sandbar	
least tern	representative turtle (replacement)*

***Representative turtle -** A turtle species was recommended to evaluate sandbar habitat. Model variables will be dependent upon the species selected and may include shrub and herbaceous vegetation cover, substrate type, and water availability.

HAT Selected Species	Additions/Substitutions per 2/6/96 Meeting
Non-Forested Wetland	
mallard	
bullfrog	chorus frog (replacement)*

***Chorus frog** - This species was recommended as a replacement to bullfrog because of the emphasis of the bullfrog on the permanence and quality of water. Ephemeral wetlands are included in the non-forested wetland definition and the chorus frog will provide a suitable species to evaluate that component.

HAT Selected Species	Additions/Substitutions per 2/6/96 Meeting
Side Channel	
channel catfish	river otter
beaver	representative minnow
smallmouth buffalo	

Following the February meeting, further input and justification for suggested changes to the evaluation species list was solicited from agency partners. Based upon this input, the list of evaluation species was finalized in late March, as shown in Table 5. The same list with habitat definitions and selection considerations explained can be found in Appendix C. Resource categories not carried forward in the evaluations include sandbar, mudflat, and cutbank habitats, as well as native mussels. Cutbank, mudflat, sandbar habitat and rookeries were not found in any of the analysis areas (as the analysis proceeded, this was found to be the case with backwater/backwater lake habitat as well). Native mussels, though discussed within this report separately, were not included in the HEP analysis.

TABLE 5: Final List of Evaluation Habitats and Associated Species

BOTTOMLAND HARDWOOD FOREST		
pileated woodpecker	prothonotary warbler	wild turkey
hairy woodpecker	wood duck	Western chorus frog
gray squirrel		
ROOKERY		
great blue heron		
MAIN CHANNEL/MAIN CHANNEL BORDER		
lake sturgeon	paddlefish	walleye
channel catfish	sauger	emerald shiner
NON-FORESTED WETLAND		
mallard	sora	Western chorus frog
muskrat		
CUTBANK		
flathead catfish		
BACKWATER / BACKWATER LAKE		
paddlefish	largemouth bass	black crappie
lesser scaup	sora	bullfrog
red-eared slider	muskrat	
SIDE CHANNEL		
channel catfish	smallmouth buffalo	emerald shiner
river otter	beaver	

E. Model Building/Review and Modification. The next major step in the evaluation process was to secure habitat models for the chosen evaluation species. Existing models were available for all but two of the chosen species. The two exceptions were the sora and the Western chorus frog. Species and HEP/modeling experts met in a workshop setting in early May 1996. Participants included recognized species experts from two regional universities and State/Federal agencies, as well as study participants from the U.S. Fish and Wildlife Service and U.S. Geological Survey, Biological Resources Division.

1. Model Workshops. Each workshop began with a discussion of the species' life history and habitat requirements. That information was then formulated into a series of variables representing the most important habitat requirements of the species. The variables were defined and suitability index curves were devised to demonstrate the relationship between the measured value of each variable and the corresponding rating of habitat quality based on that particular parameter. An aggregation formula was then constructed to mathematically combine the suitability values for the individual variables to arrive at a single rating for the overall suitability of the habitat. The resultant models were considered very basic, but workable, for the site-specific analyses. After a comment/revision process involving both workshop participants and resource agency personnel, the models were finalized in December 1996.

2. Model Review. Concurrent with the model-building process, efforts were under way to conduct a review of the existing models. Begun in early March 1996, State and Federal agency points of contact were provided models (as necessary, if they did not already have them on hand) and asked to facilitate their review by appropriate species experts within their respective agencies. Different batches of models were reviewed separately, as not all evaluation species were finalized at the outset of the review process. The review/comment process and necessary modification of the models were completed in late 1996. Although a formal comment/response summary was not prepared, these considerations are summarized in the "Species Models" section of the HAT Reference Book and Appendix C.

F. Data Collection. Due to the magnitude of this study and the number of alternatives and sites involved, the team did not set out to perform statistically rigorous sampling with precise measurements of each variable. The team did attempt to collect sufficient data within spatial and temporal restraints. Data were categorized as either pre-field or field, and forms listing all the species variables, by habitat type, were prepared for each category. Pre-field data included all that could be obtained from existing information such as geomorphic, planimetric or vegetation cover type data obtained from maps, stage/discharge records, and much of the water quality, water control, and hydraulics data. Field data included all which required collection at designated sample sites within each of the analysis areas. The bulk of the pre-field data consisted of water/quality and hydraulics data, and the sources of this information are described below.

1. Water Quality Data. Existing data sources were utilized to provide baseline values for those variables related to water quality parameters such as dissolved oxygen, turbidity, velocity and pH. Water quality data were obtained from two main sources: the Mississippi River Water Quality data base maintained by the Rock Island District of the U.S. Army Corps of Engineers; and the Long Term Resource Monitoring Program (LTRMP) Water Quality data base maintained by the USGS Environmental Management Technical Center (EMTC). The Rock Island District data base has a period of record of approximately 10 years and was used for the Mississippi River L/Ds 20-22. The LTRMP data base, which has a shorter period of record (approximately 5 years), was used for L/Ds 24, 25, Peoria and La Grange.

Sampling locations for these data were in the general vicinity of the pertinent lock and dam sites, but were confined to the main channel. Where model variables required information in off-channel areas, other data sources were used where available or correlations were developed based on main channel data.

2. Hydraulics Data. Flow velocity and depth information for L/Ds 20-25 was obtained from two-dimensional hydrodynamic models constructed as part of the Engineering Work Group effort to examine approach and exit conditions for the existing and alternative lock locations. The Environmental Work Group further extended the scope of this numerical modeling effort to aid in the assessment of site-specific environmental impacts associated with large-scale navigation improvements. Unless prohibited by conditions at a specific site, lock Locations 1 through 4 were investigated. All new locks modeled consisted of a 110-foot by 1,200-foot chamber, a 1,200-foot upstream ported guardwall, and a 1,200-foot downstream guidewall.[1]

For the purpose of the modeling effort, it was assumed that any loss in gated capacity due to construction of a Location 4 lock would be replaced by adding new gates, on a one for one basis, in the overflow section of the dam. The models were constructed based on the most recent hydrographic survey data available, as well as detailed scour surveys conducted in the vicinity of the dam and topographic information taken from USGS maps. A complete description of the numerical modeling effort is contained in an Engineering Work Group interim report entitled "Hydraulic Impacts of New Lock Construction" (July 1996).

Velocity and depth information was determined based on steady-state simulations of flows representing typical high and low flow conditions. The high flow represented typical flow conditions during spring (March-May) and the low flow represented conditions during the late summer months (June-August) as well as closely approximating the typical annual flow. The modeled flows were selected based on an elevation-duration analysis (period of record varies but approximately 60 years), with the modeled flow selected as that corresponding to the 50% elevation for the season of interest. The model output was provided to the study team in the form of velocity vector diagrams and maps of depth contours for base and with-project conditions for each lock and dam site. Using this information, a direct comparison of flow conditions between baseline and with-project conditions could then be made.

3. Field Data Collection. Prior to initiating fieldwork, a number of preparatory steps were necessary. These are summarized as follows:

a. <u>Selection of Sampling Techniques</u>. Existing literature and reference material (Schemnitz, 1980; U.S. FWS, 1980; Hays et al., 1981; Hamilton & Bergersen, 1984) were reviewed for potential methods. Emphasis was placed on simplicity, time-

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[1] A guardwall is a wall extending upstream or downstream, riverside of the lock, which protects vessels from the force of river currents entering or discharging from the dam. A guidewall is a long wall extending upstream or downstream of a lock approach, located on the landside of the approach channel, used to guide tows into the lock chamber or temporarily moor tows or cuts.

effectiveness and consistency, while limiting bias and inaccuracy. Field data collection was carried out with an interagency and interdisciplinary team consisting of representatives from the Corps of Engineers, the U.S. Fish and Wildlife Service, the Missouri Department of Conservation, and the Illinois Department of Natural Resources.

b. Sample Sites. Sample sites were delineated on planning maps and marked in the field with flagging. The sites were chosen by an interagency team including Federal and State agency biologists familiar with the areas. Sites were visually surveyed and, when found homogenous, one transect or set of samples was deemed accurate to reflect the site conditions. If heterogeneity was detected or expected within the sample site, more samples were taken. Terrestrial data collection relied most heavily on accepted, standardized techniques; the approach chosen was to use a belted transect of approximately 0.1 ha [0.2471 acre] in total area. For example, herbaceous vegetative cover was sampled with a 1 m^2 [10.8 ft^2] frame, with 10 samples per transect; canopy height was measured with a clinometer at 10-meter [32.8-foot] intervals on a transect, etc. Aquatic variables required both collection and visual estimation of data not readily available. This included substrate sampling with a petite ponar, visual estimation of percent shoreline riprapped, and visual estimation/professional judgment of percent cover.

c. Rights of Entry. Coordination was necessary with the Rock Island and St. Louis Districts' Real Estate Divisions to secure permission for entry onto private land. This process involved providing real estate personnel with planning maps showing delineated sample sites, from which they determined ownership and secured written right-of-entry documentation via either telephone coordination or personal visits.

d. Sampling Protocol and Agency Coordination. A simple protocol was established for completion of data forms. This protocol included consistent listing of personnel, particularly the data recorder, general sampling location name (e.g., "L/D xx, River Island, RDB"), and specific sample location designation (a sequential number followed by "U" or "D" for upstream or downstream). Every effort was made to inform resource agency personnel in advance of the initiation of fieldwork. Given the fluid and busy nature of schedules, participation was generally good. Field data collection commenced on July 31st and was completed on September 12, 1996. A compilation of sample sites, by habitat type and sampling dates, is found on page 39 of the HAT Reference Book.

G. Future Prediction Exercises. Prediction exercises included participation of resource agency personnel to take advantage of on-the-ground knowledge of the sites as well as to assure critical, multi-agency input into the predictions. In the only case where agency participation was not possible due to a last-minute schedule conflict, completed sheets were provided for review. The actual process of making predictions relied heavily on the acquisition of as much background information as possible, as well as professional judgment.

Predictions were made of the future condition of these habitats, both with-project (as affected by a potential construction measure or measures) and without-project (under natural conditions). Assembled information consisted of pertinent project or research reports, existing datasets, and consultation with in-house or outside agency personnel with specific areas of expertise. Hydraulic modeling data provided by the Rock Island District (essentially depth and velocity figures) consisted of both baseline conditions (values which were averaged over the period of record) and with-project conditions for various lock options. A “typical” low and high river discharge facilitated the exercises for main channel/channel border habitats. The collected field data, along with pre-field information, formed the “baseline” habitat condition for the species and habitats being evaluated.

Any HEP analysis requires the selection of target years (TYs) for which reasonable predictions as to changes in habitat conditions can be made. The following target years were chosen for this study: TY0, 1, 2, 5, 10, 25, and 50. Baseline is TY0, TY1 is the first year in which construction is expected to begin, and TY 50 is the end of the planning horizon on this study. It is projected that a new lock would require approximately 2 years to construct and therefore TY 2 was chosen to represent this. Years 5, 10, and 25 were selected to represent points in time that the team assumed habitat changes would become apparent within with- and without-project conditions.

To guide the discussions and facilitate record keeping, prediction spreadsheets were developed by habitat type and sample site. An example is provided in Table 6. Each sheet contained the appropriate species variables and units of measure, baseline (TY0) variable value, and columns to carry out the future predictions. If no change was predicted over the planning period, or portion thereof, “NC” was entered on the sheet. These sheets, along with the project planning maps, comprised the main “tools” upon which the discussions centered.

Numerous assumptions were made in making future predictions, many of which were very specific to a particular sample site or variable. These were recorded to the extent possible during each meeting, and though not included in this report, they constitute a large part of the project documentation and are available for review at the Rock Island District office. A set of general “systemic rules” (Table 7) was developed for the aquatic variables to allow quick consideration of those variables that were reasonably expected not to change or to change in a predictable, consistent manner. Many questions arose related to aquatic variables and often led to extensive discussion. The majority of the discussion pertained to perception of inaccuracies in hydraulic data. In most cases, data were re-calculated; in others, a simple confirmation of the data source or assumptions was all that was necessary.

Terrestrial variables were projected using estimated succession rates, growth rates, and site-specific conditions, including flood frequency and local management practices. They are also based upon site conditions such as forest age and composition. Examples of specific assumptions include the following: forest canopy cover generally increases to approximately 70% by TY 20 and stabilizes; frequent flooding will induce tree mortality, also increasing the number of snags available.

TABLE 6: Example of Future Prediction Sheet for Main Channel/Main Channel Border

Main Channel HABITAT Enter the future value for each variable for each target year

	Variable	**Units**	**TY 0**	**TY 1**	**TY 2**	**TY 5**	**TY 10**	**TY 25**	**TY 50**
ls1	predominate substrate for foraging; adult	menu							
ls2	predominate substrate for foraging; juv	menu							
ls3	mean water depth for foraging; juv	m							
ls4	mean water velocity for foraging; juv	cm/s							
ls5	mean water temp. during spawning	deg. C.							
ls6	mean velocity during spawning	cm/s							
ls7	predominate substrate for spawning	menu							
ls8	mean water depth during spawning	m							
cc01	% pool during average summer flow	%							
cc02	% cover during summer in pools etc.	%							
cc04	food production potential	menu							
cc05	mean midsummer temp (pools - bkwater)	deg. C.							
cc06	length of agric growing season	days							
cc07	max monthly mean turbidity in summer	ppm							
cc08	mean min d.o. in pool/back/lit in summer	mg/l							
cc09	max salinity in summer	ppt							
cc10	mean water temp - p/b/l - spawn/embryo	deg. C.							
cc11	max salinity - spawn/ embryo	ppt							
cc12	mean midsummer temp pools - fry	deg. C.							
cc13	max salinity summer - fry	ppt							
cc14	mean midsummer temp in pools - juvenile	deg. C.							
cc18	mean velocity in cover areas-avg summ flow	cm/sec							
pa01	annual freq of incr water temp 10-17 C (21 days)	years							
pa02	annual frequency of 2 week dam open period	years							
pa03	accessible area of gravel/cobble substrate	hectares							
pa04	mag spr water rise over midwinter flow	meters							
pa05	mean velocity during spring water rise	m/sec							
pa06	min DO when air temp = 10-17C	mg/l							
pa07	area of possible summer & winter habitat	ha(10K)							
pa08	mean width of inhabited river	meters							
pa09	%of area in backwater	%							
pa10	No of eddies in summer & winter habitats	number							
sa01	% of 2 mi diam circle with water > 8ft deep	%							
sa02	% emerg, submerg, and floating veg	%							

TABLE 6 (Continued)

	Variable	Units	TY 0	TY 1	TY 2	TY 5	TY 10	TY 25	TY 50
sa03	substrate composition	menu							
sa04	submerged bank covered by rip-rap	%							
sa05	% of main channel < 8 ft deep	%							
sa06	mean velocity at normal flows	fps							
sa07	water level stability	menu							
sa08	mean non-flood turbidity	secchi in							
sa09	dist to gravel substrate or gravel shoreline	mi							
sa10	dist to emerg veg with 1-4 ft depth	mi							
wa01	mean transparency (summer)	m							
wa02	rel abund of small forage fish - spr/sum	mg/m3							
wa03	% of area w/ cover & D.O. spr/sum	%							
wa04	least suitable pH during the year	number							
wa05	min D.O. in pools & runs - summer	mg/l							
wa06	min D.O. sum/fall - shallow shorelines	mg/l							
wa07	min D.O. spawning areas - spring	mg/l							
wa08	mean weekly temp - pools - summer	deg. C.							
wa09	mean weekly temp shallow shore ltsp/sum	deg. C.							
wa10	mean weekly temp - spawning/spring	deg. C.							
wa11	deg-days (4-10C) - 10/30 - 04/15	number							
wa12	spawning habitat index	number							
wa13	water level - spawning & embryo devel	menu							
waw1	mean winter water temp.	deg. C.							
waw2	min. winter water depth	m							
waw3	winter water velocity	m/sec							
es01	mean water temperature	deg. C.							
es02	mean turbidity	JTU							
es03	minimum dissolved oxygen	mg/l							
es04	% of shoreline riprapped	%							
es05	dominant substrate	menu							
es06	% cover	%							
es07	degree of water level fluctuation	menu							
es08	mean water velocity	cm/sec							
es09	% of area <= 5 feet deep	%							
es10	% of backwater with suitable overwintering	%							

The exercises also pointed out gaps where data were unavailable or yet to be obtained, as well as certain variables that required collection in the late spring time frame, thus necessitating an additional round of fieldwork in May/June 1997. The future prediction exercises for the Mississippi River locks and dams were conducted between February and May 1997. Those for the Illinois River were concluded in mid-August 1997.

TABLE 7: UMRS Navigation Study HEP Forecasting Rules

THESE RULES DO NOT CHANGE WITH OR WITHOUT PROJECT:

1. Area of possible summer and winter habitat and accessible area of gravel/cobble substrate are always ok (all projects with or without condition). **pa03, pa07**

2. The annual frequency of 2-week dam open period will not change through time (all projects with or without condition). **pa02**

3. Degree days will not change (all projects with or without condition). **wa11**

4. Degree of water level fluctuation will not change because it is driven by floods or water level regulation, not site-specific impacts (all projects with or without condition). **wa13, es07**

5. Length of agricultural growing season will not change (all projects with or without condition). **cc06**

6. Salinity is always 0 (all projects with or without condition). **cc09, cc11, cc13**

THESE RULES DO NOT CHANGE IN THE WITHOUT-PROJECT CONDITION, AND UNLESS OTHER CHANGES ARE DETERMINED, THESE RULES ALSO APPLY IN THE WITH-PROJECT CONDITION:

1. The inhabited channel will decrease by 1% due to accretion at TY25 and 1% at TY50. **pa08**

2. Systemic turbidity will increase by 5% at TY25 and 5% at TY50. **cc07, es02**

3. Systemic water clarity will decrease by 5% at TY25 and 5% at TY50. **sa08, wa01**

4. Systemic water depths will increase 1% at TY25 and 1% at TY50. **1s3, 1s8**

5. Systemic velocities will increase 2.5% at TY25 and 2.5% at TY50. **1s4, 1s6, cc18, pa05, sa06, es08**

6. Systemic winter water velocities will increase 1% at TY 25 and 1% at TY50. **waw3**

7. *Systemic water temperatures will not change. **1s5, cc05, cc10, cc12, cc14, wa08, wa09, wa10, waw1, es01**

8. *Systemic DO levels will not change. **cc08, pa06, wa05, wa06, wa07, es03**

9. *Substrate will not change. **1s1, 1s2, 1s7, sa03, es05**

10. Systemic spring water rise will increase by .1m at TY25 and .2m TY50. **pa04**

* These rules are only for areas with flow and with no accretion greater than that expected for the entire system, i.e., directly downstream of the lock, directly upstream of the lock chamber, and in the overflow area near the last gate.

H. Spreadsheet Development/Computation. A Windows-based program, Spreadsheet HEP (SHEP), was used for all data accounting. SHEP is a spreadsheet version of the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (HEP) and Habitat Suitability Index (HSI), two commonly used and accepted DOS-based assessment programs. SHEP offers all the accounting tools of the older HEP program (which includes HSI), but in a much quicker and user friendly format. SHEP was designed for use with a single habitat type. For this project, individual spreadsheets were built for each type of habitat potentially impacted by lock improvements. Grouped within each habitat type was a set of species models selected by the HAT. Each species model has a unique set of variables that define the habitat requirements of the species. Species models were selected to assess variables considered important and relevant to the habitat type. Spreadsheets were developed for the following habitats: main channel/main channel border (6 species), backwater/backwater lake (8 species), non-forested wetland (4 species), bottomland hardwood forest (7 species), cutbank (1 species), and side channel (5 species). Spreadsheets were checked for accuracy by the author and then rechecked by a Corps of Engineers biologist.

Data collected during field visits and generated by the future prediction meetings were entered into the spreadsheets. The acreage of the impacted area, at each target year, was also entered. Using these data, SHEP produced two types of output—HSIs and Habitat Units (HUs). HSI values were produced for each species at designated target years. HSI values are a measure of the habitat quality of the potentially impacted area and range from one (optimal habitat) to zero (no available habitat). SHEP also computed HUs, which are determined using a formula incorporating the acreage of the impacted area and HSI values at the target years. Annual HUs were computed for each species and averaged over the 50-year life of the project (AAHUs). Net project impacts were determined by subtracting the with-project AAHU values from the without-project AAHU values. These net project impacts provide a way to quantify the change that occurs in a habitat due to lock improvements. Net project impacts, by species, were produced for each site potentially impacted by lock improvements (Appendix D).