

IV. RESULTS AND DISCUSSION

A. Site-Specific Habitat Evaluations (HEP). Results of the HEP performed at L/Ds 20-25, Peoria and La Grange are shown below. Combinations of alternatives and the habitat impacts resulting from each lock location are discussed. AAHU changes at each site and each alternate lock location are summarized in tabular format.

AAHUs have been summed by lock location and habitat type. This summary is intended to clearly describe the relative change in habitat types resulting from construction in alternative lock locations. This summing of AAHUs assumes that HUs are equal within each habitat type. No trade-off between habitats or species is proposed with this representation. The results are being utilized to assist in selecting alternative lock locations during plan formulation. Though estimated habitat replacement costs are described later in this report, there is no mitigation planning taking place at this time and no proposed trade-off between habitats. Appendix D provides detailed results, and species-specific impacts are discussed in more detail below. Appendix D includes acres, HSI, and AAHU by species for both the with- and without-project conditions. Potential small-scale measures at each lock are discussed. However, small-scale measures were not evaluated with the use of HEP.

1. Lock and Dam 20.

a. Construction Alternatives. Alternatives at this site are described in detail in the Engineering Appendix (Engineering Work Group Draft, 1998) and include lock extensions (to 1,200 feet); 1,200-foot guardwall or guidewall construction at Locations 2, 3, or 4; and a wicket gate on the Illinois side of the dam.

Location 2 - The bankline would be straightened and channel widened above the existing lock following a straight extension of the landside guidewall. The Buck Run Creek outlet, which is downstream of the existing lower guidewall, would be relocated downstream to outlet below a new 1,200-foot guidewall. There would also be associated channel dredging downstream of the guidewall along the Missouri bank.

Location 3 - The bankline would be straightened above the existing lock similar to Location 2 but would involve less clearing and widening of the channel. The Buck Run Creek outlet would not be changed.

Location 4 - This alternative includes placement of a lock in the gated section of the dam. Existing dam/flow gates lost to new lock construction would possibly be replaced with new gates in the existing auxiliary gate bay (Location 3) since there is no overflow section at this dam. The Buck Run outlet would not be changed.

Open Pass with Wicket Gates - L/D 20 is one of the first dams to go to open river conditions (dam gates out of the water) during higher than normal river flows.

Wicket gates, which can be lowered as the head differential approaches zero between the upper and lower pools, would be incorporated into the dam structure on the Illinois side of the dam. This would allow tows to pass through the dam and bypass the locking process an estimated 30% of the time. The pass width would be 480 feet at the dam with the approach channel narrowing to 300 feet above and below the dam. This improvement would include removal of an island and side channel immediately below the dam, as well as dredging of a channel for over a mile below the dam.

Staging Area - The proposed staging area during construction includes an area along the Missouri shoreline from one-half mile above the lock to approximately one mile below the lock.

Small-Scale Measures - The site has relatively moderate outdraft conditions (outdraft is a current along the upstream guidewall that tends to pull a towboat away from the wall and towards the dam). Tows tend to be drawn into the riverbank on downbound approaches. All of the remaining small-scale measures (outlined in Section I.D.) are under consideration at this site. As is the case at all of the sites described in this section, approach improvements, adjacent mooring facilities, or remote remake areas are the only measures with potential environmental effects. Small-scale measures were not included in the HEP evaluations.

Summary of AAHU Changes at Lock and Dam 20

Habitat Type	Location 2	Location 3	Location 4	Wicket Gate
Bottomland Forest	-21.55	-10.05	No Evaluation	-16.00
Side Channel	3.22	3.22	3.22	-13.06
Main Channel Border	U = 73.68* D = -1.71	U = 32.38* D = -20.85	U = -3.56 D = -20.78	D = 68.09*

*Equates to an increase in AAHUs resulting from a habitat conversion from bottomland forest and side channel to main channel border.

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at L/D 20 include losses of bottomland forest and side channel habitats and alteration of main channel border. The results are summarized below and displayed in more detail in Appendix D (HEP outputs). These results are summarized by lock location and include staging areas. The wicket gate

measure is summarized separately. Mussels were located in most areas of impact at L/D 20; however, large concentrations that would suggest the presence of mussel beds were not found. Section V.C. of this report contains a more detailed description of the mussel survey and succeeding information on mussel resources.

Location 2

Bottomland Forest - Widening of the channel upstream would include the permanent loss of 15 acres of bottomland forest through conversion to main channel border. Impacts to bottomland forest include a loss of 21.55 AAHUs. The majority of this loss was one species—the hairy woodpecker (-13.36 AAHUs). Four other species, the pileated woodpecker, wood duck nesting, gray squirrel, and prothonotary warbler, also had small losses (<3 AAHUs each). The bottomland forest to be cleared consists of a strip of the existing forest adjacent to the river for approximately 2 miles upstream from the lock.

Side Channel - The outlet of Buck Run would be relocated downstream of the guidewall. Other than the temporary impacts caused by relocation of the outlet, there is no adverse impact to side channel by construction at Location 2. The HEP showed an increase of 3.22 AAHUs due to revegetation of the area used for staging. This increase resulted entirely from the beaver HSI, with the remaining species unchanged. The evaluation also assumed that an implemented Section 1135 Environmental Restoration project upstream would maintain flow in Buck Run.

Main Channel Border - Main channel border area upstream from the lock would increase by 15 acres due to the conversion of bottomland forest to aquatic habitat. That increase in area accounts for the majority of the 73.68 AAHU increase. Downstream, approximately 14 acres of main channel border would be deepened and another 8 acres would have velocities altered by the placement of the lock and guidewall. This accounts for a net loss of 1.71 AAHUs, the majority of which are for channel catfish (-1.1 AAHUs). Minor changes (<1 AAHU) would be seen in the remainder, including walleye reproduction, emerald shiner, and lake sturgeon reproduction AAHUs. The exception is sauger, which actually increases 0.24 AAHU downstream.

Location 3

Bottomland Forest - Widening of the channel upstream would include the permanent loss of 7 acres of bottomland forest through conversion to main channel border. Impacts to bottomland forest include a loss of 10.05 AAHUs, the majority of which were hairy woodpecker (-6.23 AAHUs). Four other species, the pileated woodpecker, wood duck nesting, gray squirrel, and prothonotary warbler, also had small losses (<2 AAHUs each).

Side Channel - The outlet of Buck Run would not be relocated downstream of the guidewall. The HEP analysis showed an increase of 3.22 AAHUs due to revegetation of the area used for staging. This increase resulted entirely from the beaver HSI, with the remaining species unchanged. The evaluation also assumed that an implemented Section 1135 Environmental Restoration project upstream would maintain flow in Buck Run.

Main Channel Border - Main channel border area upstream from the lock would increase by 7 acres due to conversion of bottomland forest to aquatic habitat. The increase in area accounts for an increase in 31.51 AAHUs. Specific species changes can be seen in Appendix D. An adjacent 12 acres of main channel border would be slightly deepened and have an increase of 0.87 AAHU made up of slight AAHU increases for lake sturgeon reproduction and channel catfish and a decrease for paddlefish spawning.

Downstream, approximately 14 acres of main channel border would be deepened and emerald shiner would lose 0.07 AAHU. None of the other species would be affected. Placement of the lock and guidewall extension would decrease velocities and presumably increase sedimentation behind the guidewall. The area includes approximately 17 acres inside the wall and 9 acres outside the wall. A total loss of 20.78 AAHUs results from the measure, the majority of which comes from paddlefish spawning losses (14.19 AAHUs). Lake sturgeon reproduction would have a 3.75 AAHU loss. The remaining species showed changes <3 AAHUs. Changes outside the wall resulted in a loss of 1.58 AAHUs. Specific species changes can be seen in Appendix D.

Location 4

Bottomland Forest - No upstream channel widening is required with this lock location and no bottomland forest impacts would result.

Side Channel - The outlet of Buck Run would not require relocation with this lock location. The HEP showed an increase in 3.23 AAHUs (beaver) due to revegetation of the area used for staging and assumption that the Section 1135 project upstream would maintain flow in Buck Run.

Main Channel Border - A total of 54 acres of main channel border area upstream from the lock would lose 3.56 AAHUs due to increased depth, velocity, and riprapping of the bank. The majority of that loss is due to sauger losing 3.55 AAHUs. The remaining species show changes ± 2 AAHUs or no change at all.

Placement of the lock and guidewall extension would decrease velocities and presumably increase sedimentation behind the guidewall. The area includes approximately 17 acres inside the wall and 9 acres outside the wall. A total loss of 20.78 AAHUs would result from the measure, the majority of which comes from paddlefish spawning losses (-14.19 AAHUs). Lake sturgeon reproduction would

have a 3.75 AAHU loss. The remaining species showed changes <3 AAHUs. Changes outside the wall resulted in a loss of 1.58 AAHUs. Specific species changes can be seen in Appendix D.

Wicket Gate

Bottomland Forest - The bottomland forest impacts are from the loss of an island immediately below the dam. Approximately 7 acres of bottomland forest would be permanently lost with the measure. The clearing would result in the loss of 16.00 AAHUs made up of pileated woodpecker (-5.21 AAHUs), hairy woodpecker (-4.99 AAHUs), and wild turkey (-3.32 AAHUs). The remaining species would lose <2 AAHUs.

Side Channel - In conjunction with removal of the island, the side channel (7 acres) between the island and the Illinois bankline would be permanently lost. A total of 13.06 AAHUs consisting of emerald shiner (-5.34 AAHUs), beaver (-3.24 AAHUs), channel catfish (-3.06 AAHUs), and river otter (-1.42 AAHUs) would be lost.

Main Channel Border - The combination of area converted from bottomland forest and side channel and the velocity and depth changes would create an increase of 68.09 AAHUs. Species-specific changes can be found in Appendix D, but those with large AAHU gains include walleye winter (11.41), paddlefish spawning (11.03), and emerald shiner (9.75).

c. Conclusions. Results of the HEP show that Location 4 has the least adverse environmental impacts. It does not impact bottomland forest habitat or negatively affect side channel habitat, but does include the loss of HUs in main channel border. Although a decrease in value of any habitat is undesirable, main channel border is considered abundant throughout the system. Loss of bottomland forest from construction at Locations 2 or 3 is permanent. The measure to construct a wicket gate has the most detrimental environmental effects. It includes the permanent loss of an island, which affects bottomland forest and side channel habitat.

Regarding small-scale measures, mooring cells are proposed both upstream and downstream. The downstream cells would be especially valuable in alleviating shoreline impacts from tows that currently push into the bank adjacent to Canton. If implemented, selected mooring cell locations would be evaluated in detail for potential environmental impacts. Remote remake areas would be in the same general locations as mooring cells, but would involve different structures. The nature of proposed dredge areas and lockwall extensions is virtually identical to those associated with the large-scale measures, thus habitat impacts to channel border and shoreline areas are expected to be similar. Three submerged wing dikes are also proposed upstream of the lock to help alleviate outdraft conditions. These wing dikes would require detailed evaluation if implemented, but their effects would probably mirror those predicted at other sites, likely increasing sedimentation and decreasing flow velocity.

2. Lock and Dam 21.

a. Construction Alternatives. Construction alternatives at this site are described in detail in the Engineering Appendix and include lock extensions (to 1,200 feet), and 1,200-foot guardwall or guidewall construction at Locations 2, 3, or 4.

Locations 2, 3, or 4 - The bankline would be straightened above the existing lock and a series of submerged wing dikes would be placed extending from the bankline to just beyond the far edge of the approach channel. These dikes would be spaced at 500-foot intervals with the top at least 15 feet below flat pool. They would be placed from the river with floating plant equipment. Their purpose is to reduce the magnitude of outdraft or flow from the bankline to the dam gates which misaligns downbound tows with the lock chamber. Placement of a new lock in Location 4 would involve replacing gates in the overflow section of the dam.

Staging Area - The staging area at this site includes the bankline from a point adjacent to the upstream bank excavation area to below the lock near the existing boat ramp. The staging area would involve some clearing of bottomland forest but the majority is already developed.

Small-Scale Measures - Significant outdraft conditions exist at this site, particularly on downbound approaches. All remaining measures are currently under consideration.

Summary of AAHU Changes at Lock and Dam 21

Habitat Type	Location 2	Location 3	Location 4
Bottomland Forest	-60.24	-60.24	-30.34
Main Channel	No Evaluation	No Evaluation	-0.23
Main Channel Border	U = 48.67* D = -59.78	U = 48.31* D = -23.12	U = 0.75 D = -27.45

* Equates to an increase in AAHUs resulting from a habitat conversion from bottomland forest to main channel border.

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at L/D 21 include losses of bottomland forest and alteration of main channel border. The results are summarized below and described in more detail in Appendix D. Results are reported by lock location and include some

discussion of species-specific results. Since there were previous surveys in the vicinity, no mussel surveys were conducted at L/D 21 in 1997. The entire right bank has a high potential for mussel beds.

Location 2

Bottomland Forest - Construction in Location 2 would require the permanent clearing of 8 acres of bottomland forest and subsequent conversion to main channel border habitat. An adjacent 4.5 acres would be cleared but re-planted after construction. A total of 29.90 AAHUs would be lost in that area and include hairy woodpecker (-11.61), prothonotary warbler (-10.43), and pileated woodpecker (-6.09). Wood duck nesting and gray squirrel would have losses <2 AAHUs. Wild turkey showed a slight increase (1.13 AAHUs). Staging area impacts downstream would include the temporary clearing of 11.3 acres of bottomland forest and result in a loss of 30.34 AAHUs. This includes pileated woodpecker (-7.62), prothonotary warbler (-7.73), hairy woodpecker (-6.52), wild turkey (-5.03) and the remaining species with losses <3 AAHUs.

Main Channel - There are no impacts to main channel with construction at Location 2.

Main Channel Border - Upstream, an 8-acre increase in main channel border habitat resulting from the conversion of bottomland forest, and changes in habitat provided by the wing dikes resulted in an increase of 48.56 AAHUs. With the exception of lake sturgeon (reproduction), which showed no increase in habitat, all of the other species exhibited an increase in AAHUs. Channel catfish would show the largest gains (10.56 AAHUs). The other species would gain anywhere from 0.36 to 6.87 AAHUs (Appendix D).

Downstream, an area of 12.5 acres behind the guidewall would be assumed lost to sedimentation and would result in a loss of 59.00 AAHUs. Those losses would include lake sturgeon forage (-9.70), emerald shiner (-9.58), and paddlefish spawning (-10.18), with other species showing losses ranging from -0.30 to -6.91 AAHUs. The area outside the wall would lose only 0.78 AAHU with all species changes less than 0.25 AAHU.

Location 3

Bottomland Forest - Construction in Location 3 would require the permanent clearing of 8 acres of bottomland forest. That area would be converted to main channel border. An adjacent 4.5 acres would be cleared but re-planted after construction. A total of 29.90 AAHUs would be lost upstream and consist largely of hairy woodpecker (-11.61), prothonotary warbler (-10.43), and pileated woodpecker (-6.09). The other species would lose <2 AAHUs. Wild turkey would show a gain of 1.13 AAHUs with the project.

Staging area impacts downstream would include the temporary clearing of 11.3 acres of bottomland forest and result in a loss of 30.34 AAHUs. This includes the pileated woodpecker (-7.62), prothonotary warbler (-7.73), hairy woodpecker (-6.52), and wild turkey (-5.03). All other species had losses <3 AAHUs.

Main Channel - There is no impact to main channel with construction at Location 3.

Main Channel Border - Upstream, an increase in 8 acres of habitat from the conversion of bottomland forest and the habitat provided by the wing dikes resulted in an increase in 48.56 AAHUs. Of this increase, channel catfish would gain 10.56 AAHUs and the other species would gain anywhere from 0.36 to 6.87 AAHUs. Lake sturgeon reproduction showed no change.

Downstream, an area of 27.4 acres behind the guidewall is assumed to be affected by velocity and depth changes, resulting in a loss of 19.24 AAHUs. Unlike Location 2, the assumption is that the area would remain aquatic. Gains were shown for walleye winter (14.96), walleye reproduction (0.19), and channel catfish (5.68). Losses occurred for the remaining species, with paddlefish spawning (-22.26), sauger (-6.54), and lake sturgeon (-5.51) losing the most AAHUs, followed by the other species with losses <2 AAHUs. The area outside the wall would lose 3.88 AAHUs, the majority of which (-2.67 AAHUs) would be attributed to lake sturgeon forage, with others losing <0.25 AAHU.

Location 4

Bottomland Forest - Construction in Location 4 would not require the permanent clearing of bottomland forest. Staging area impacts downstream would include the temporary clearing of 11.3 acres of bottomland forest and result in a loss of 30.35 AAHUs. This includes pileated woodpecker (-7.62), prothonotary warbler (-7.73), hairy woodpecker (-6.52), and wild turkey (-5.03) AAHU decreases. The other species would have losses of < 3 AAHUs.

Main Channel - Impacts to main channel habitat with construction would consist of dredging in an area of approximately 11 acres downstream from the lock at approximately River Mile 324. A temporary increase in turbidity and increased

depth result in a loss of 0.23 AAHU, with a slight gain for paddlefish adult and a slight loss for lake sturgeon reproduction.

Main Channel Border - The addition of submerged wing dikes upstream results in a gain of 5.39 AAHUs, the majority of which are seen in channel catfish AAHUs (4.44) with the other species showing changes ± 2 AAHUs. Gate replacement in the overflow section of the dam would cause the loss of 4.39 AAHUs, including (-3.01) walleye winter with other species changing ± 1.0 AAHU. In the immediate vicinity of a new lock, -0.25 AAHU would be lost.

Downstream, 27.4 acres behind the guidewall would be subjected to reduced velocity and increased turbidity. This would create a summed loss of -17.44 AAHUs. Species-specific results include AAHU gains for walleye winter (18.09) and channel catfish (2.17), and two other species gaining <1.0 AAHU. Species such as paddlefish spawning (-22.26), lake sturgeon forage (-7.63), and lake sturgeon reproduction (-4.24) account for the majority of the losses. Specific results are found in Appendix D. The area outside the wall showed a loss of 3.89 AAHUs. This includes lake sturgeon forage (-2.67), with changes of <1.0 AAHU for other species.

The increased velocity below the overflow section, where a new gate would be placed, has a -6.12 AAHU sum. This can be attributed to losses in walleye winter AAHUs (-3.01) and lake sturgeon forage AAHUs (-2.69), with others losing <1.0 AAHU. Three species also had small gains.

c. Conclusions. Location 4 at this site has the least adverse environmental impacts to bottomland forest; however, it does impact main channel border habitat. Gate replacement within the overflow section could also impact mussel beds on the right descending bank. Location 3 has fewer impacts to main channel border but includes twice the magnitude of impacts to bottomland forest.

Mooring or remote remake facilities are proposed both upstream and downstream of the lock. Currently, Orton Island, approximately 1.5 river miles downstream, experiences shoreline damage from mooring tows. Mooring cells would be beneficial at this location. With the exception of the downstream, mid-channel dredge area, proposed approach channel improvements are identical to those included in the large-scale measures. These improvements include bankline excavation and a series of five submerged dikes on the upstream approach. The SHEP analyses indicated a small gain in main channel border HUs, assuming reduced velocity due to the dikes, but at the same time a loss in bottomland hardwoods due to the excavation. Other velocity-related effects associated with new lock construction are projected to be similar with small-scale construction, as they are primarily related to guidewall or guardwall construction. Lockwall extensions are also included under the proposed approach improvement measures.

3. Lock and Dam 22.

a. Construction Alternatives. Construction alternatives at this site are described in detail in the Engineering Appendix and include lock extensions (to 1,200 feet) and 1,200-foot guardwall or guidewall construction at Locations 2, 3, or 4.

Location 2 - Upstream, a system of five emergent wing dikes would be constructed from the river using floating plant equipment. These rock dikes would be spaced about 1,000 feet apart with a top elevation 2 feet above flat pool. The dikes would extend from the riverbank to the near edge of the approach channel. Their purpose is to control the currents along the right descending bank, aligning them more with the lock chamber, which will benefit tows on their downbound approach.

Location 3 - The same dike system would be used upstream as described above for Location 2. The right descending riverbank immediately downstream of the existing lock would be straightened to reduce the size and intensity of eddy currents that may form between the downstream approach wall of the new lock and the right bank.

Location 4 - The same dike system would be used upstream as described for Location 2. The right descending riverbank would be straightened immediately downstream of the existing lock as described for Location 3.

Staging Area - The staging area at this site includes an area along the bankline both upstream and downstream from the existing facility. Temporary clearing of bottomland forest would be required for staging.

Small-Scale Measures - This site has some of the most severe outdraft conditions on the entire Upper Mississippi. Downbound tows fight a severe outdraft and helper boat assistance is often needed. These conditions also force tows to wait almost 3 miles upstream to allow passage of upbound tows. All small-scale measures are currently under consideration.

Summary of AAHU Changes at Lock and Dam 22

Habitat Type	Location 2	Location 3	Location 4
Bottomland Forest	-48.90	-48.90	-48.90
Main Channel	No Evaluation	No Evaluation	U = -0.29 D = 1.38
Main Channel Border	U = -284.07 D = -33.22	U = -284.42 D = -31.96	U = -292.44 D = -41.61

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at L/D 22 include clearing of bottomland forest for staging, impacts caused by the placement of wing dikes in the main channel border upstream from the lock and by channel changes/dredging in locations upstream and downstream. A known mussel bed and State-designated sanctuary exist downstream from the lock outside the impact area. Additional surveys were conducted within proposed construction areas in October 1997. Those surveys found a possible mussel bed located on the right descending bank upstream from the lock where the series of wing dikes is proposed. Mussels were collected in other areas but not in large concentrations or in densities that would suggest a bed exists.

Location 2

Bottomland Forest - Construction would involve the clearing of approximately 22 acres of bottomland forest for staging and equate to a total loss of 48.90 AAHUs. This would include impacts to two separate areas of bottomland forest. The upstream area is approximately 12 acres and loses 32.66 AAHUs. The majority of losses would be for hairy woodpecker (-10.34), prothonotary warbler (-11.35), and pileated woodpecker (-5.99). Of note at this location is wood duck brood rearing with a result of -3.68 AAHUs. This is one of the few bottomland forest sites in the analysis where the brood rearing habitat was impacted. The 10 acres downstream that would be cleared for staging would lose 16.24 AAHUs. This loss is made up of pileated woodpecker (-5.42), hairy woodpecker (-4.36), and wild turkey (-3.91), and other species losing <2.0 AAHUs.

Main Channel Border - It was projected from looking at TABS models that the impacts to the main channel border from the upstream wing dikes would include the transition to frequently inundated and moving sand substrate but not creation of land. Given this assumption, a total of 73 acres of main channel border would be affected, resulting in a loss of 284.04 AAHUs. Species with the largest AAHU losses would be paddlefish spawning (-41.02), emerald shiner (-39.03), and walleye winter (-36.43) AAHUs. Only one species, walleye reproduction (-2.41 AAHUs), would have losses less than 15 AAHUs. Complete results can be found in Appendix D. An additional 0.03 AAHU would be lost due to the upstream guidewall where sauger shows a minor loss while channel catfish shows a minor gain.

Downstream, an area of 6.5 acres behind the guidewall would be filled and result in a loss of 31.19 AAHUs. This includes paddlefish spawning (-5.30), lake sturgeon forage (-5.04), and emerald shiner (-5.18), with other species losing from 0.10 to 3.9 AAHUs. An additional 2.02 AAHUs would be lost due to the effect of the lock itself on a 7-acre area. Walleye winter (-1.93) contributes the majority of that loss.

Location 3

Bottomland Forest - Impacts are identical to those described for Location 2 as the same staging area would be required for each.

Main Channel Border - Upstream, the changes are identical to those described for Location 2.

Downstream, an area of 6.8 acres behind the guidewall would be altered by decreased velocity and increased turbidity but would not result in an area loss. This causes the loss of 25.77 AAHUs. Contributing to this are gains for walleye winter (12.49) and channel catfish (4.36), and losses for paddlefish spawning (-18.82) and lake sturgeon reproduction (-12.57). An additional 6.19 AAHUs are lost due to the effect of the lock itself on 11 acres. Contributing to this are walleye winter (-3.14) and lake sturgeon forage (-2.51) AAHU losses.

Location 4

Bottomland Forest - Impacts are identical to those described for Location 2 as the same staging area would be required for each.

Main Channel Border - The upstream impacts due to the dike field are the same as for Locations 2 and 3. The need to replace gates in the overflow section of the dam would cause a loss of 7.69 AAHUs. This loss would be made up of lake sturgeon forage (-2.71), walleye winter (-2.33), and channel catfish (-1.14). The other species would have changes <1.0 AAHU. The lock upstream causes a <1.0 AAHU loss.

On the downstream side below that new gate, 12.41 AAHUs would be lost, with the largest losses seen in walleye winter (-4.16) and lake sturgeon forage (-3.77) AAHUs. Downstream, an area of 23.1 acres behind the guidewall would be altered by decreased velocity and increased turbidity resulting in a loss of 24.63 AAHUs. Walleye winter shows a 15.13 AAHU increase. Channel catfish, paddlefish, and emerald shiner also would show small gains (<3 AAHUs). Losses would be seen in paddlefish spawning AAHUs (-18.82) and lake sturgeon forage AAHUs (-12.57). Smaller losses were seen in the remaining species. An additional 4.57 AAHUs would be lost due to the effect of the lock itself, of which (-3.27) would come from walleye (winter).

Main Channel - Areas of main channel both upstream and downstream would require deepening and result in -0.29 AAHU upstream (walleye winter, lake sturgeon forage) and a gain of 1.39 AAHUs downstream (lake sturgeon forage, paddlefish adult).

c. Conclusions. Each lock location alternative has equal HU impacts for bottomland forest because each includes impacts to the same areas for staging. If the staging area were relocated or reduced in size, those impacts could be avoided or

minimized. Upstream impacts to main channel border are quite large due to the dike field proposed for the area and occur equally for each proposed lock option. In addition to the large number of HUs lost from that measure, a mussel bed would potentially be impacted. Downstream impacts to main channel border are similar and all result from the guidewall extension and reduced velocities associated with it. Unlike Locations 2 or 3, the Location 4 alternative includes impacts to main channel habitat with a downstream increase in AAHUs and minor upstream loss.

Pertinent small-scale measures include mooring cells or remote re-make facilities both upstream and downstream. Shoreline damage would be particularly alleviated along the Missouri shoreline downstream of the lock. If proposed for implementation, these facilities would be evaluated in detail. Approach improvements duplicate those proposed as large-scale measures, but do not include the main channel dredge areas. Hence, estimated habitat impacts would likely be the same for the upstream dike field (a large loss due to eventual conversion to semi-terrestrial habitat) and lockwall extensions (velocity reductions landside of the wall).

4. Lock and Dam 24.

a. Construction Alternatives.

Locations 2, 3, or 4 - Construction alternatives at this site are described in detail in the Engineering Appendix and include lock extensions (to 1,200 feet), 1,200-foot guardwall construction, and 1,200-foot guidewall construction at Locations 2, 3, or 4. Placement of a new lock in Location 4 would involve the removal of two existing gates and subsequent gate replacement in either the overflow section of the dam or in the auxiliary lock, or both. **NOTE:** The series of upstream wing dikes depicted on the site map (Appendix A) is no longer under consideration.

Staging Area - The staging area at this site includes the bankline below the lock. The staging area would involve some clearing of bottomland forest, but the majority is already developed for municipal or residential use.

Small-Scale Measures - Severe outdraft conditions exist in the upper lock approach, but this problem is currently being addressed as part of major rehabilitation work at this site. Therefore, the series of wing dikes proposed as both a large- and small-scale measure is no longer under consideration. All other small-scale measures are being evaluated for this site.

Summary of AAHU Changes at Lock and Dam 24

Habitat Type	Location 2	Location 3	Location 4 with Gate in Auxiliary Bay	Location 4 without Gate in Auxiliary Bay
Bottomland Forest	-4.71	-4.71	-4.71	-4.71
Main Channel Border	U = 0.08 D = -29.47	U = 0.11 D = -44.19	U = -7.84 D = -34.97	U = -5.24 D = -59.10

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at L/D 24 include losses of bottomland forest and alteration of main channel border. Initially, placement of “L” dikes along the upstream right descending bank was evaluated for non-forested wetland impacts. However, these measures have been removed from consideration. The results are summarized in general below and described in more detail in Appendix D (SHEP outputs). The following results are summarized by lock location and all include staging areas. A concentration of mussels was found downstream of the lock near the Clarksville, Missouri, shoreline.

Location 2

Bottomland Forest - Staging area impacts would include the temporary clearing of a 5.84-acre strip of bottomland forest and result in a loss of 4.71 AAHUs. These impacts would include pileated woodpecker (-3.07), hairy woodpecker (-2.42), and an increase in gray squirrel AAHUs (1.60). Other changes were <1.0 AAHU. Gray squirrel increases can be attributed to the low HSI in without-project conditions and projected habitat value after 25 and 50 years of regeneration.

Main Channel Border - The presence of a new upstream guardwall resulted in an increase of 0.08 AAHU for paddlefish spawning.

Downstream, an area of 14.67 acres behind the guidewall would be impacted by decreases in velocity and increases in sedimentation, resulting in a loss of 19.4 AAHUs. Walleye winter AAHUs increase with this change and have an increase of 5.22 AAHUs. Losses include paddlefish spawning (-12.31) and lake sturgeon forage (-7.05). All other species had changes <3.0 AAHUs. The 9.5-acre area affected by the lock and riverward of the guidewall would lose 10.07 AAHUs, the majority of which would be lake sturgeon forage (-6.55) and walleye winter (-2.54) AAHUs.

Location 3

Bottomland Forest - Staging area impacts with this lock location are identical to those described above in Location 2.

Main Channel Border - The presence of a new upstream guardwall resulted in an increase of 0.11 AAHUs with losses in channel catfish habitat and gains in lake sturgeon forage habitat.

Downstream, an area of 33.62 acres behind the guidewall would be impacted by decreases in velocity and increases in sedimentation and result in a loss of 31.52 AAHUs. Walleye winter habitat would have a gain of 11.97 AAHUs and channel catfish would have a gain of 1.11 AAHUs. Paddlefish spawning would have a loss of -28.22 AAHUs, lake sturgeon reproduction -6.82 AAHUs, and sauger -6.59 AAHUs. Other species record changes of <3 AAHUs. The 8.5-acre area riverward of the guidewall would lose 12.67 AAHUs, of which the majority would be lake sturgeon forage (-5.90) and walleye winter (-4.62) AAHUs, with the other species recording changes <1.0 AAHU.

Location 4 with Gate in Auxiliary Bay

Bottomland Forest - Staging area impacts would be the same as those described above in Location 2.

Main Channel Border - Upstream changes in velocity and depth resulting from construction of a replacement gate in the overflow section of the dam resulted in a decrease of 4.68 AAHUs. Lake sturgeon (-1.47) and channel catfish (-1.02) contributed to this, as did other species with changes <1.0 AAHU. The presence of a new upstream guardwall resulted in a decrease of 3.16 AAHUs, of which the majority were walleye winter AAHUs (-1.91) with others registering changes <1.0 AAHU.

Downstream from the replacement gate within the overflow section, 10.68 AAHUs would be lost in a 7-acre area. Lake sturgeon forage (-6.92) and walleye winter (-6.38) registered the largest losses, while changes in the other species were < 1.0 AAHU. Lake sturgeon reproduction (2.35) and paddlefish spawning (1.63) registered gains with the new gate. An area of approximately 34 acres would have altered velocity landward of the downstream lock and guardwall. This area would lose 11.93 AAHUs, of which lake sturgeon forage (-8.53) and walleye winter (-5.43) contributed the majority. Channel catfish (2.44) and walleye summer (1.93) registered AAHU gains in the area. The area of approximately 9 acres affected by the lock and guardwall lost a sum of 12.36 AAHUs. The majority of these were lake sturgeon forage (-5.9) and walleye winter (-4.62) AAHUs.

Location 4 without Gate in Auxiliary Bay

Bottomland Forest - Staging area impacts would include the same impacts as described above in Location 2.

Main Channel Border - Upstream changes in velocity and depth resulting from construction of a replacement gate in the overflow section of the dam resulted in a decrease of 4.68 AAHUs. Lake sturgeon (-1.47) and channel catfish (-1.02) AAHUs contributed to this, as did other species with changes <1.0 AAHU. The presence of a new upstream guardwall resulted in a loss of 0.56 AAHU. That includes loss of emerald shiner AAHUs (-2.28) and gains in walleye winter (1.18) and lake sturgeon reproduction (0.52) AAHUs.

Downstream, due to velocity changes behind the guidewall, an area of approximately 34 acres would lose 36.07 AAHUs. Similar to other sites where this occurs, walleye and channel catfish register increases in AAHUs while paddlefish spawning (-28.22), lake sturgeon reproduction (-16.15), sauger (-7.63), and lake sturgeon forage (-4.12) show AAHU losses. The area impacted by the lock and guidewall is approximately 8.5 acres and shows a loss of 12.36 AAHUs. This is mainly made up of walleye winter (-4.62) and lake sturgeon forage (-5.90) AAHUs, with others registering changes <1.0 AAHU. Downstream from the replacement gate within the overflow section, 10.68 AAHUs would be lost in a 7-acre area. Lake sturgeon forage (-6.92) and walleye winter (-6.38) registered the largest AAHU losses while other changes were < 1.0 AAHU. Lake sturgeon reproduction (2.35) and paddlefish spawning (1.63) AAHUs registered gains with the new gate.

c. Conclusion. Each lock location has the same impact to bottomland forest resulting from the staging area. If the staging area could be relocated or reduced in size, those impacts could be avoided or minimized. Location 2 has the fewest impacts to main channel border resulting from impacts behind the guidewall, but these could potentially be decreased by measures to provide flow behind that wall.

Mooring facilities are generally adequate upstream. Downstream mooring cells would be beneficial on the Clarksville riverfront and on the opposite shoreline along Clarksville Island. These and any remote re-make facilities would be evaluated on a case-by-case basis. Remaining channel improvements include lockwall extensions and re-shaping of the bankline immediately above the existing guidewall. Loss of AAHUs would be expected due to velocity reductions and sedimentation behind the walls. The bank excavation would primarily be in a developed area, and impacts would likely be minimal.

5. Lock and Dam 25.

a. Construction Alternatives. Construction alternatives at this site are described in detail in the Engineering Appendix and include a new 1,200-foot lock at Location 1 and lock extensions (to 1,200 feet) at Locations 2, 3, or 4. All locations include construction of a 1,200-foot guidewall downstream of the lock and a 1,200-foot guardwall upstream of the lock.

Location 1 - At this location, a 1,200-foot lock would be constructed through the downstream tip of Sandy Island adjacent to the lock. This location would require extensive channel excavation upstream and downstream of the island, as well as extensive excavation of the island itself. The wing dam upstream of the lock would be removed. The upstream levee would have to be realigned. Creating a downstream approach would require both channel and land excavation.

Location 2 - No land excavation would be required upstream but some land excavation, though not to the extent as for Location 1, would be required to improve the downstream lock approach. No channel excavation is needed.

Location 3 - Neither channel nor bankline excavation is required. The removal of the existing downstream landside guidewall would be needed to provide access to the existing lock.

Location 4 - No excavation for the lock would be required. Placement of a new lock in Location 4 would involve the removal of two existing gates and subsequent gate replacement in either the overflow section of the dam or in the auxiliary lock, or both. Placement of the gate would require some dredging in the overflow area.

Staging Area - The proposed construction staging area includes the existing lock island and an agricultural field just west of the adjacent Sandy Slough bridge.

Small-Scale Measures - Outdraft varies from moderate to severe and is aggravated by trash accumulation in the ports of the upper guardwall. All measures are currently under consideration.

Summary of AAHU Changes at Lock and Dam 25

Habitat Type	Location 1	Location 2	Location 3	Location 4 with Gate in Auxiliary Lock	Location 4 without Gate in Auxiliary Lock
Bottomland Forest	-51.61	-5.39	-13.57	-14.56	-14.56
Main Channel Border	U = 40.96* D = 78.13*	U = -0.02 D = -36.08	U = -0.25 D = -41.30	U = -2.2 D = -15.52	U = -1.52 D = -28.01
Non-Forested Wetland	No Evaluation	No Evaluation	No Evaluation	-.04	-.04
Side Channel	-3.79	No Evaluation	No Evaluation	No Evaluation	No Evaluation

*Equates to an increase in AAHUs resulting largely from a habitat conversion from bottomland forest to main channel border.

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. **Habitat Impacts.** Impacts at L/D 25 include losses of bottomland forest and non-forested wetland habitats, as well as alteration of side channel and main channel border habitat. The results are summarized below and described in more detail in Appendix D (SHEP outputs). The following results are summarized by lock location and all include staging area impacts. A mussel survey located a possible bed on the right descending bank that would be impacted by construction at Location 1. There was also a concentration of mussels found near the first dam gate upstream from the overflow section of the dam; this area would be impacted by a replacement gate.

Location 1

Bottomland Forest - Construction of a new lock in Location 1 would include the permanent loss of 24 acres of bottomland forest. Most of it would be converted to main channel border or the lock itself. The clearing in the immediate vicinity of the lock facility includes approximately 15 acres and the loss of nearly 30 AAHUs. This can be seen in the Appendix D (sites 6U and 7U). The majority of those AAHU losses are for hairy woodpecker (-14.31), pileated woodpecker (-7.67), and wood duck nesting (-5.7).

An additional 8.83 acres adjacent to the river approximately 1/2 mile downstream from the lock would be cleared and converted to main channel border for the lock approach. That clearing would cause a loss of 22.15 AAHUs made up of hairy woodpecker (-6.75), pileated woodpecker (-4.56), wild turkey (-4.30), wood duck nesting (-4.10), gray squirrel (-2.32), and prothonotary warbler (-0.12) AAHUs.

Side Channel - The upstream levee would be relocated along the east bank of Sandy Slough. The SHEP output showed a decrease of 3.79 AAHUs due largely to loss of streamside shrub and tree canopy cover. The majority of this loss (-3.78) would be for beaver.

Main Channel Border - Construction in Location 1 causes a large increase in main channel border habitat area resulting from the conversion of bottomland forest. Upstream impacts include the removal of an "L" dike for creation of the lock approach. Two sample areas were evaluated, one upstream of the dike and one downstream. The upstream area exhibited a loss in 1.42 AAHUs. This is made up of changes <1.0 AAHU per species and can be seen in Appendix D. Downstream of the "L" dike, there is a gain of 3.15 AAHUs. This change is made up of a combination of gains [lake sturgeon reproduction (5.97) and gains of <1.0 AAHU for sauger, walleye reproduction, and emerald shiner] and losses [lake sturgeon forage (-2.37), channel catfish (-1.29), with other species losing <1.0 AAHU]. Significant gains (39.23 AAHUs) would be seen in the area where 8.6 acres of terrestrial habitat would be converted to the channel approach. This includes walleye winter (7.70), emerald shiner (7.67), lake sturgeon forage (6.67), and sauger (5.91) AAHUs, as well as gains by other species.

Downstream, the gain of 78.13 AAHU can largely be attributed to the 15-acre gain in aquatic habitat. The conversion of bottomland forest to aquatic area for a lock approach downstream contributes 45.93 AAHUs, of which paddlefish spawning (7.81), walleye winter (7.91), and lake sturgeon forage (6.85) show the largest increases. Immediately adjacent to the lock where 6.9 acres would be converted to aquatic habitat, a gain of 29.63 AAHUs is seen. Walleye winter (6.18), lake sturgeon forage (5.35), and emerald shiner (4.93) AAHUs show the largest gains in this area. An additional area between the two described above would be deepened and would account for a 2.57 AAHU increase. At this site, the majority of change is in lake sturgeon reproduction (3.48), with the other species showing smaller changes.

Location 2

Bottomland Forest - With construction in Location 2, the bottomland forest adjacent to the existing facility would be cleared for staging. Staging area impacts would include the temporary clearing of 15.5 acres of bottomland forest and result in a loss of 13.57 AAHUs. This consists of losses for pileated woodpecker (-5.73), hairy woodpecker (5.74), and wood duck nesting (-4.52). Increases would be seen in gray squirrel AAHUs (2.67). Other species showed changes <2.0 AAHUs.

Immediately downstream, predicted changes in habitat from main channel border to bottomland forest 25 years after project completion, due to a loss of velocity and subsequent increases in sedimentation behind the guidewall, resulted in an increase of 8.18 AAHUs. This includes hairy woodpecker (2.53), pileated woodpecker (1.71), wild turkey (1.60), and wood duck nesting (1.32) AAHUs. Overall, bottomland forest AAHUs decreased by 5.39 at Location 2.

Main Channel Border - Main channel border habitat upstream from the lock would decrease by a very modest 0.02 AAHU, all from channel catfish. Downstream main channel border habitat decreased by 36.08 AAHUs. Most of this decrease (-30.41 AAHUs) was caused by the aforementioned conversion of 4.96 acres of main channel border to bottomland hardwood forest 25 years after project completion. This change includes paddlefish spawning (-6.28), walleye winter (-5.96), and lake sturgeon forage (-4.85) AAHUs. The result of a slight increase in depth and velocity riverward of the guidewall caused a loss of 2.77 AAHUs made up of small decreases <1.0 AAHU per species. Downstream of the guidewall, 2.9 AAHUs were lost, with walleye winter (-1.93) making up the majority.

Location 3

Bottomland Forest - Staging area impacts would be the same as those described above in Location 2 (-13.57 AAHUs). There would, however, be no other bottomland forest impacts.

Main Channel Border - The presence of a new upstream guardwall resulted in a minor decrease of 0.25 AAHU. Sauger (-0.73) made up the majority of this loss, while several other species showed minor gains of <0.5 AAHU.

Downstream, an area of 14.81 acres behind the guidewall would be impacted by decreases in velocity and increases in sedimentation, resulting in a loss of 14.07 AAHUs. Of this, paddlefish spawning (-13.10) showed the largest loss, while an increase was seen for walleye winter (3.35) AAHUs. The area (15.22 acres) riverward of the guidewall would lose 24.66 AAHUs due to increases in velocity and depth. Lake sturgeon forage (-11.81), and walleye winter (-7.54) made up the majority of this AAHU loss, with other species showing changes of <2.0 AAHU. Similar increases in velocity and depth resulted in a loss of 2.57 AAHUs downstream of the guidewall on the right descending bank. Of this change, walleye winter (-1.93 AAHUs) made up the majority. Overall main channel border habitat decreased downstream by 41.3 AAHUs.

Location 4 with Gate in Auxiliary Bay

Bottomland Forest - Staging area impacts would be the same as those described above in Location 2. For the replacement of gates in the overflow section, a 2.2-acre area of bottomland forest would be removed. This forest was low quality and had little habitat value to begin with due to frequent flooding and heavy erosion. However, 0.99 AAHUs would be lost from a combination of hairy woodpecker, prothonotary warbler, and gray squirrel AAHUs.

Non-Forested Wetland - This 0.65-acre area is adjacent to the bottomland forest to be cleared for the replacement gates. Again, this location is subjected to water level fluctuations and flooding and has little existing habitat value. The evaluation showed that a loss of 0.04 AAHU would occur in mallard habitat.

Main Channel Border - The presence of a new upstream guardwall resulted in a decrease of 0.65 AAHU. This includes small losses for lake sturgeon and channel catfish, with a slight gain for paddlefish, all of which are <1.0 AAHU. Upstream changes in velocity and depth resulting from construction of a replacement gate in the overflow section of the dam resulted in a decrease of 1.55 AAHUs. The majority of those were for channel catfish (-0.72) and lake sturgeon reproduction (-0.50) AAHUs.

Downstream, a decrease of velocity landward from the guidewall caused a loss of 2.52 AAHUs. Walleye winter (-2.98) and lake sturgeon reproduction (-1.06) AAHUs accounted for the majority of this loss, with gains of <1.0 AAHU seen for several species. Increases in velocity and depth riverward of the guidewall caused a loss of 26.75 AAHUs. Lake sturgeon forage (-11.91) and walleye winter (-9.35) AAHUs made up the majority of this loss, while others would lose <2.0 AAHUs. Construction of a new overflow gate resulted in an increase of 13.75 AAHUs, of which lake sturgeon reproduction (3.70), emerald shiner (2.27) and paddlefish spawning (2.43) would make up the majority. This increase was due to a change of

2.2 acres of bottomland forest and 0.65 acre of non-forested wetland to main channel border habitat. Overall, there was a 15.52 AAHU loss downstream of the lock and dam.

Location 4 without Gate in Auxiliary Bay

Bottomland Forest - Staging area impacts would include the temporary clearing as is described above in Location 2. For the replacement of gates in the overflow section, a 2.2-acre area of bottomland forest would be removed. This forest was low quality and had little habitat value to begin with due to frequent flooding and heavy erosion. However, 0.99 AAHU would be lost from a combination of hairy woodpecker, prothonotary warbler, and gray squirrel AAHUs.

Non-Forested Wetland - The impacts would be the same as those described above in Location 4 without the gate in the auxiliary bay.

Main Channel Border - Upstream changes in velocity and depth resulting from construction of a replacement gate in the overflow section of the dam resulted in a decrease of 1.55 AAHUs. The majority of those were for channel catfish (-0.72) and lake sturgeon reproduction (-0.50) AAHUs. The presence of a new upstream guardwall resulted in a minor increase in lake sturgeon reproduction (-0.03) AAHUs.

Downstream, changes in velocity and depth behind the guidewall caused a decrease of 15.01 AAHUs. The majority of this would be paddlefish spawning (-13.10) and lake sturgeon reproduction (-7.06). However, lake sturgeon forage, channel catfish, and walleye winter exhibited gains. Increases in velocity and depth riverward of the guidewall caused a decrease of 26.75 AAHUs. The majority of this was lake sturgeon forage (-11.81) and walleye winter (-9.35) AAHUs. Construction of a new overflow gate resulted in an increase of 13.75 AAHUs. This increase was largely due to a change of 2.2 acres of bottomland forest and 0.65 acre of non-forested wetland to main channel border habitat. Lake sturgeon reproduction (3.70), emerald shiner (2.27), and channel catfish (1.85) AAHUs were the largest gains.

c. Conclusions. Location 1 has the most extensive impacts resulting from lock construction landward of the existing lock. Impacts to bottomland forest would be the greatest with construction at Location 1 and include removal of trees utilized by the bald eagle during feeding. That measure also impacts the side channel (Sandy Slough) and impacts the mussel bed located upstream. There are increases in main channel border AAHUs, however, they are the result of the conversion from bottomland forest to main channel border. Of the alternative lock locations, Location 4 with gate replacement through the auxiliary lock is the least environmentally damaging. It has the least impacts to bottomland forest and no side channel impacts. Impacts to bottomland forest could be minimized through relocation of the staging area. Non-forested wetland impacts are minimal, and losses to main channel border could be minimized.

Regarding small-scale measures, mooring and remote re-make facilities are proposed both upstream and downstream. The Missouri shoreline downstream of the lock would be spared damage with mooring cell placement. Channel excavation would be significantly reduced, particularly upstream, due to the absence of new lock construction at Location 1. Lockwall extensions are proposed, as well as a small area of bank re-shaping adjacent to the upstream guardwall. Downstream wall extension and bank excavation would likely result in the same negative impacts as observed in the large-scale analysis.

6. Peoria Lock and Dam.

a. Construction Alternatives. Alternatives at this site are described in detail in the Engineering Appendix and include new lock construction or lock extension (to 1,200 feet), as well as an upstream guardwall and downstream guidewall.

Location 1 - The upstream riverward approach wall would begin about 400 feet upstream of the I-474 Bridge. This would locate the upper lock gates about 800 feet downstream of the bridge. A 200-foot-wide canal would be excavated starting just upstream of the bridge and would narrow to 150 feet wide at the lock. The I-474 Bridge piers just landward of the canal would be reinforced and the landward slope of the canal riprapped. Downstream, the existing navigation channel would be widened from the lower lock gates downstream for a distance of about 3,600 feet back to the existing channel and the landward slope would be riprapped. This location impacts pipeline crossings and three commercial docks.

Location 2 - An upstream lock extension gives a better open pass condition and requires no dredging above or below the lock. A downstream extension requires about 30,000 cubic yards of channel dredging just below the lock.

Staging Area - The area required for staging at this site extends in a strip from just upstream from the I-474 Bridge to downstream of the lock at approximately River Mile 157. It includes both bottomland forest and developed (commercial/ industrial) areas.

Small-Scale Measures - Open pass conditions exist approximately 40% of the time. At low to normal flows, approach conditions are good. Most small-scale measures are under consideration here.

Summary of AAHU Changes at Peoria Lock and Dam

Habitat Type	Location 1	Location 2
Bottomland Forest	-14.45	-14.45
Main Channel Border	U = -0.28 D = 0.34	U = -0.04 D = -12.68

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at Peoria Lock and Dam include the temporary clearing of bottomland forest for staging and main channel border impacts due to placement of the lock. Existing mussel surveys were not available for the immediate vicinity. Rock Island District staff conducted exploratory bivalve surveys but did not find any concentrations in the area.

Location 1

Bottomland Forest - A total of approximately 12.5 acres would be temporarily cleared for staging and result in the loss of 14.45 AAHUs. The majority of losses would be in hairy woodpecker (-9.83) and pileated woodpecker (-5.67) AAHUs. With the regeneration of the habitat, wild turkey (3.12) and prothonotary warbler (0.66) would gain AAHUs.

Main Channel Border - Construction would convert land to a lock but still result in a minor loss in main channel border habitat value. Upstream, a loss of -0.28 AAHU would result from velocity changes induced by the lock and guidewall. These are made up of small losses to sauger, walleye, and emerald shiner. Downstream, placement of riprap on the bank resulted in a 0.34 AAHU increase, mainly a result of sauger AAHU increases (0.55).

Location 2

Bottomland Forest - Bottomland forest impacts would be the same as those discussed with Location 1.

Main Channel Border - Construction would affect main channel border habitat upstream by altering velocities around the lock and guardwall, resulting in a loss of 0.40 AAHU. These consist of small losses to sauger, walleye, and emerald shiner. Downstream, the lock, guardwall, and dredging would result in a loss of 12.68 AAHUs. The majority of this AAHU loss would be in lake sturgeon reproduction (-5.13) and paddlefish spawning (-5.50).

c. Conclusions. Impacts to bottomland forest habitat are the same for both alternatives and are a result of staging area requirements. The impacts could be avoided or minimized with relocation or resizing of the staging area. Location 2 has greater impacts to main channel border due to velocity changes behind the guidewall downstream of the lock. Those impacts may be minimized by maintaining flow in that area.

Upstream of the lock there are limited opportunities for mooring or re-make facilities. The downstream bankline would be protected from current damage with the placement of mooring cells. Guidewall extensions are limited upstream due to the highway bridge; there is the possibility of constructing wing or vane dikes in this area to re-align currents and protect the bridge piers. These would need further environmental evaluation if implemented. There is no proposed channel realignment related dredging.

7. La Grange Lock and Dam.

a. Construction Alternatives. Construction alternatives at this site are described in detail in the Engineering Appendix and include new lock construction or lock extensions (to 1,200 feet), an upstream guardwall, and a downstream guidewall. Extensive channel work would be needed upstream of the lock to provide an efficient approach to the lock, particularly if a riverside approach wall is used above the lock to increase safety as tows approach to the lock. The dredging depth would be 12 feet below flat pool.

Location 1 - Shifting the lock downstream approximately 200 feet in relation to the existing lock would reduce the channel work somewhat, but dredging would still be extensive and require a longer 200-foot-wide approach canal to the upper lock gates. Approximately five river training structures (wing dikes) would be required along the left descending riverbank above the lock to direct river current to the right bank. These dikes would be about 200 feet long and spaced at 500-foot intervals. The dikes would have a top elevation 2 feet above flat pool and would be constructed from the river with floating plant equipment. Downstream, the existing navigation channel would be widened at the lower lock gates and return to the existing channel. The landward slope of the navigation channel and canal would be ripped.

Location 2 - Upstream, with a 1,200-foot approach wall on the river side of the lock, extensive channel widening would be required, though not to the extent as for Location 1. The five wing dikes described in Location 1 would be needed along the left descending riverbank. Channel widening downstream of the lock is not required.

Staging Areas - Staging would take place in a narrow strip adjacent to the existing lock that is now under cultivation.

Small-Scale Measures - Approach conditions are generally good, although tows can be pinned to the bank by natural currents since the lock is on an outside bend. Most small-scale measures remain under consideration.

Summary of AAHU Changes at La Grange Lock and Dam

Habitat Type	Location 1	Location 2
Bottomland Forest	-61.15	-50.98
Main Channel Border	U = 104.32* D = 65.48*	U = 29.36* D = -0.08
Non-Forested Wetland	-9.57	-9.57

* Equates to an increase in AAHUs resulting from a habitat conversion from bottomland forest.

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at this site include extensive clearing of bottomland forest and conversion to main channel border, a levee setback that impacts wetlands, and conversion of agricultural fields to main channel border. No known mussel beds exist in the area.

Location 1

Bottomland Forest - Construction at Location 1 would include the permanent clearing of approximately 24 acres and temporary clearing of 19 acres. The area permanently cleared would be converted to main channel border and the remainder was assumed to regenerate to bottomland forest. The result is a loss of 61.15 AAHUs. These results are from a combination of three different sampling areas, each of which is detailed in Appendix D. Impacts to wild turkey (-18.02), wood duck nesting (-19.5), and hairy woodpecker (-19.14) AAHUs comprise the majority of those losses.

Non-Forested Wetland - A total of 16 acres would be affected by the project; 9.5 acres would be permanently lost due to widening of the navigation channel and associated levee setback. The remainder was assumed to eventually revert to wetland habitat. This would result in a loss of 9.57 AAHUs including sora rail (-4.37), mallard (-2.06), Western chorus frog (-1.79), and muskrat (-1.35) AAHUs.

Main Channel Border - Due to channel widening and conversion of bottomland forest to main channel border, approximately 24 acres would be gained equating to a gain of 100.76 AAHUs. Species with large AAHU gains include: lake sturgeon forage (19.14), paddlefish spawning (19.35), and walleye winter (17.96). The wing dikes placed on the opposite bank would result in an increase of 3.56 AAHUs, most of which would be lake sturgeon forage AAHUs (2.39).

Downstream, approximately 18 acres would be converted from agricultural to main channel border and cause a gain of 65.48 AAHUs. The largest gains would be in paddlefish spawning (17.86), lake sturgeon forage (10.71), and sauger (9.96) AAHUs.

Location 2

Bottomland Forest - Construction at Location 2 would include the permanent clearing of approximately 5 acres and temporary clearing of 37 acres. The area permanently cleared would be converted to main channel border and the rest was assumed to regenerate to bottomland forest. The result of these actions would be a loss of -50.98 AAHUs, including wood duck nesting (-19.49), wild turkey (-14.27), and hairy woodpecker (-15.76).

Non-Forested Wetland - Habitat impacts would be identical to those described for Location 1.

Main Channel Border- Upstream main channel border area will be increased due to widening and conversion from bottomland forest. Approximately 5 acres will be gained through construction in Location 2, resulting in a gain of 25.85 AAHUs. The majority of this increase would be in walleye winter (7.96), paddlefish spawning (4.23), and lake sturgeon forage (4.19) AAHUs. The proposed wing dikes on the opposite bank would result in an increase of 3.56 AAHUs, mainly as a result of gains in lake sturgeon forage (2.39) and channel catfish (0.70) AAHUs. The placement of the upstream guardwall results in a small loss of 0.05 AAHUs.

Downstream, the acreage does not change, but decreased velocity from the guardwall causes a loss of 0.08 AAHUs. This change is made up of an increase for walleye winter (8.37) and loss for paddlefish spawning (-8.31), with other species registering changes of <1.0 AAHU.

c. Conclusions. Due to the extensive channel changes proposed, both construction alternatives at this site include extensive impacts to bottomland forest and non-forested wetlands. Location 2 has slightly fewer impacts to bottomland forest. The increases seen to AAHUs of main channel border species are largely driven by the losses of other habitat types. It should be noted that this is the only location where suitable water conditions for Western chorus frog were located during sampling. Habitat was located in the non-forested wetland.

Mooring facilities would be beneficial downstream to alleviate damage on the right descending bank where the bank is presently eroding; some sites are also under consideration upstream. Opportunities for remote re-make facilities are limited. The large channel excavation area upstream would remain as a small-scale measure, along with the series of dikes on the opposite shoreline. The SHEP evaluation showed large habitat impacts to bottomland forest. No channel changes are proposed downstream.

B. Estimated Habitat Replacement Costs. Though no mitigation is being planned at this time, potential measures to replace the impacts and costs of those measures have been estimated. While not mitigation planning, the process of replacing habitat impacts followed both U.S. Army Corps of Engineers guidance for mitigation planning (ER 1105-2-100, pp. 7-35) and U.S. Fish and Wildlife Service Mitigation Policy. The amount of effort expended to protect habitats is proportional to their value and scarcity. As with any project, measures that avoid and minimize impacts should be sought prior to attempting to replace the habitat impacted. Mitigation planning may also result in the recommendation to acquire and preserve existing habitat.

The U.S. Fish and Wildlife Service Mitigation Policy identifies four resource categories. Within this project, habitats were considered to fall within Categories 2, 3, or 4. Resource Category 2 is defined as high value habitat that is scarce or becoming scarce, Resource Category 3 is habitat with high to medium value and abundant, and Resource Category 4 is medium to low habitat value and abundant.

Habitats identified as Resource Category 2 are bottomland hardwood forest, non-forested wetland, and side channels. The goal is to have no net loss of in-kind habitat value for those identified as Resource Category 2. However, to determine the habitat replacement cost it is assumed that those habitats will be replaced in-kind (same kind of habitat value and functions). Replacement for habitats considered Resource Category 2 will be calculated at a 3:1 ratio. By providing three AAHUs for every one lost, this ratio provides compensation for the time that it takes the replacement habitat to become fully functional and assumes that some portions of the measures may not be fully successful. Main channel border and main channel habitat may be considered within Category 3, high to medium habitat value and abundant, with the goal of no net loss in habitat value while minimizing the loss of in-kind habitat value. It may also be within Category 4, medium to low habitat value and abundant, with the goal of minimizing loss of habitat value. Trade-off between main channel habitat and other habitat types may be considered during detailed mitigation planning. For replacement cost estimation, a 1:3 ratio was assumed. This ratio accounts for the trade-off in replacement of an abundant habitat (main channel border) with one that is high value and becoming scarce (side channel).

Traditional HEP requires that a habitat replacement location be chosen and evaluated for mitigation planning. Due to the magnitude of this project and uncertainty of exact site-specific habitat impacts, it was cost and time prohibitive to choose habitat replacement sites at this time. Instead, for each habitat type impacted by the project, replacement measures were considered and the resulting habitat changes projected through use of the HEP spreadsheet program. Trends used to project future habitat changes reflect those used in evaluation of project impacts and known effects of certain measures. The required acreage and restoration measures to achieve habitat replacement were used to estimate a dollar cost to compensate for each habitat type impacted.

Measures required to replace AAHUs lost due to proposed navigation improvements were developed using known habitat restoration measures such as those within EMP-Habitat Restoration and Enhancement projects, UMRS Section 1135 projects, and other environmental restoration projects. Habitat improvements resulting from those measures were determined and projected using the HEP spreadsheet. Acreage required to adequately replace AAHUs lost due to project impacts was determined from the equation of $(HSI * Acre = HUs)$. With the known factors being the quality of habitat (HSI) over the life of the project and the replacement goal (HU or AAHUs), the acreage of compensation area was increased until the replacement goal (AAHUs) was met. HUs were annualized over the 50-year project life.

Costs reflect estimates to compensate for the HU value and are based on the best available information with a 25% contingency (fall 1997 dollars). Planning, engineering and design (PED), supervisory and administrative (SA), and plans and specifications (P&S) costs are all included and calculated at 25% for projects over \$1 million and 40% for projects under \$1 million. This is based upon guidance for Section 1135 Environmental Restoration projects and discussion with Rock Island District Environmental Engineering staff. Site-specific planning may change the cost or the measure required for habitat replacement, which could increase or decrease costs significantly.

1. Bottomland Hardwood Forest Habitat Replacement. Habitat Replacement for bottomland forest impacts will ensure that the biological productivity of bottomland forests is replaced in-kind (ER 1105-2-100, P.L. 98-662). In order to ensure replacement of bottomland forested wetland functions and values, this replacement area should be within the floodplain and accessible to flooding.

It was assumed that a non-forested or previously cleared area would be utilized to carry out the needed habitat creation. In order to estimate the replacement cost of AAHUs lost in any one impact area, forest replacement was estimated using the same bottomland forest species models as were used in performing HEP. Projection of the succession of the area was estimated using assumptions of what would be planted or constructed and those applicable assumptions made during the HEP analysis.

Bottomland hardwood forest habitat creation would include the following:

- Creation of potholes or other low areas within area to be planted to forest. Assume that wetland plant species will occupy the area when the necessary hydrology is returned.
- Establishment of high areas to be planted with mast-producing trees such as swamp white oak, northern pecan, pin oak, burr oak, and walnut.
- Soft mast will include natural generation of silver maple. However, to diversify the presence of soft mast trees, sycamore, hackberry, persimmon, and mulberry should also be planted. Cottonwood should be included to provide large nesting or roost trees for bald eagle.
- All trees should be balled and burlapped and approximately 3 to 6 feet in height. This will increase the survival of the trees and improve chances of success.
- Seed with acorns throughout the area.
- A ground cover such as red top should be planted to reduce erosion and the amount of encroachment by weedy species.
- Shrubs and other ground cover will generate naturally.
- Wood duck nest boxes will be placed on the site.

Though not included in this estimate, an alternative for planting would include a combination of balled and burlapped trees, 12- to 18-inch seedlings, and acorns throughout the area.

The following costs were located in the Cottonwood Island HREP Project and Mast Tree Section 1135 Project and estimated as follows:

Hard mast trees (B&B) - \$140/tree at 75 trees/acre = \$10,500
Acorn seeding dispersed throughout - \$100/acre
Soft mast trees (B&B) - \$100/tree at 50 trees/acre = \$5,000
Ground cover (red top) - \$240/acre

Potholes - \$14,000/acre with one pothole for every 10 acres

Land Acquisition - \$3,000/acre

Total \$18,840/acre plus \$14,000 for every 10 acres (potholes) = ~\$20,240

With 25% Contingency = **\$25,300**

Levee Work - \$425/linear foot

Construction/Setback - \$425/linear foot

Ranges are included at some sites. Those ranges reflect that land may be available between levees (low cost) or that there may not be land available and it would need to be connected to the river (high cost). Levee cost depends on replacement site and amount of area needed for replacement. To estimate costs, sample areas adjacent to the river that may provide suitable land for compensation were used.

2. Side Channel Habitat Replacement. Replacement of AAHUs representing the biological productivity of side channel habitat was estimated from the cost to restore and maintain a side channel. Since side channels on the Upper Mississippi River System are being filled due to sedimentation, replacement of the habitat will be in-kind with no loss of habitat value (AAHUs).

Restoration of a side channel may include the following measures: tree clearing, grading and shaping, and dredging. This depends on the side channel selected to restore. Maintenance of a side channel may include wing dikes or other structures to reduce sediment input and direct flow to the side channel. Deep holes and rock structures within the channel are also measures that would add to the habitat value.

Side channel restoration at the Cottonwood HREP was estimated to cost \$40,000/acre of side channel restored. This included clearing, grading and shaping, dredging, and deep hole creation.

Total \$40,000/acre

25% Contingency **\$50,000/acre**

3. Non-Forested Wetland Habitat Replacement. Wetlands are of high value and are becoming scarce. In order to accomplish the goal of no net loss of wetland habitat values and functions, they will be replaced in kind. It was assumed that a non-wetland or previously converted wetland would be utilized in habitat creation.

Wetland restoration costs are extremely variable and difficult to estimate. Costs for wetland restoration/mitigation were taken from the literature for estimation.

Fischenich et al. (1995) discussed costs ranging from \$30,000-\$50,000 per acre to restore emergent wetlands. King and Bohlen (1994) described a study of wetland restoration projects where the average cost of wetland mitigation was \$49,000/acre; however, that included pre-project planning and post-project monitoring. For estimation purposes, the

average cost of \$40,000 dollars per acre will be required to replace non-forested wetland habitat. With 25% Contingency **\$50,000/acre.**

4. Main Channel Border/Main Channel Habitat Replacement. Due to its abundance, main channel and main channel border habitat has been classified as Resource Category 3 or Category 4. Since it is relatively abundant throughout the system, measures will be sought to minimize the loss in habitat value but not necessarily seek replacement. If habitat replacement is deemed necessary during detailed site-specific evaluations and mitigation planning, habitat losses may be replaced out of kind. This will be accomplished by replacing habitat that is currently scarce or becoming scarce such as side channel or backwaters.

Measures that will minimize habitat impacts may include wing dam notching, off-bank revetment, chevron dikes, or other innovative techniques. Potential measures to replace main channel/main channel border habitat include enhancement of existing habitat through wing dam notching, off-shore revetment, creation of deep holes, or additional rock placement. Out-of-kind habitat replacement may include side channels, backwaters or other habitats that are scarce or becoming scarce within the system.

Replacement costs have been estimated assuming out-of-kind replacement with the available replacement plan and costs for side channels. Since habitats being replaced or enhanced are more scarce, and thus more valuable biologically, than main channel border, this was calculated at a 1:3 ratio. This estimation is considered a most costly scenario and does not preclude measures that minimize impacts to the habitat.

5. Estimated Site-Specific Habitat Replacement Costs.

These estimates are not to be considered as actual value of these habitats. They are merely a best available estimate of cost to compensate for the habitat impacted. In no way can all habitat functions or values be replaced. Compensation measures and costs are also subject to change after further review.

Where a 0 is given for main channel border habitat, it reflects a gain in habitat and no replacement required. That gain resulted from a loss in other habitats and therefore does not accurately reflect habitat impacts.

Lock and Dam 20 Habitat Replacement Costs

Habitat Type	Location 2	Location 3	Location 4	Wicket Gate
Bottomland Forest	\$1,062,600 - \$2,223,750	\$495,880 - \$1,717,750	No Impacts	\$779,240 - \$1,970,750
Main Channel Border	0	0	\$450,000	0
Side Channel	0	0	0	\$2,750,000
Mussels	No known concentrations	No known concentrations	No known concentrations	No known concentrations
Endangered Species	bald eagle, Indiana bat (minimized without wicket)			

* The 0 in side channel reflects a slight increase in habitat value resulting from the project and no habitat replacement is required.

Lock and Dam 21 Habitat Replacement Costs

Habitat Type	Location 2	Location 3	Location 4
Bottomland Forest	\$2,593,250 - \$5,398,250	\$2,593,250 - \$5,398,250	\$1,328,250 - \$2,730,750
Main Channel Border	\$70,000	0	\$210,000
Mussels	Potential beds right bank upstream and downstream	Potential beds right bank upstream and downstream	Potential beds right bank upstream and downstream
Endangered Species	bald eagle, Indiana bat, 2 mussels potential	bald eagle, Indiana bat, 2 mussels potential	bald eagle, Indiana bat, 2 mussels potential

Lock and Dam 22 Habitat Replacement Costs

Habitat Type	Location 2	Location 3	Location 4
Bottomland Forest	\$2,087,250 - \$4,079,438	\$2,087,250 - \$4,079,438	\$2,087,250 - \$4,079,438
Main Channel Border	\$2,250,000	\$2,250,000	\$2,370,000
Mussels	Bed upstream in proposed wing dam field	Bed upstream in proposed wing dam field	Bed upstream in proposed wing dam field
Endangered Species	Indiana bat, bald eagle, mussels	Indiana bat, bald eagle, mussels	Indiana bat, bald eagle, mussels

Lock and Dam 24 Habitat Replacement Costs

Habitat Type	Location 2	Location 3	Location 4	
Bottomland Forest	\$247,940	\$247,940	\$247,940	
Main Channel Border	\$280,000	\$350,000	<u>Without Gate</u> \$560,000	<u>With Gate</u> \$350,000
Mussels	Potential mussel bed downstream	Potential mussel bed downstream	Potential mussel bed downstream	
Endangered Species	Indiana bat, bald eagle, decurrent false aster, fat pocketbook; avoid bald eagle perch trees during staging	Indiana bat, bald eagle, decurrent false aster, fat pocketbook; avoid bald eagle perch trees during staging	Indiana bat, bald eagle, decurrent false aster, fat pocketbook; avoid bald eagle perch trees during staging	

Lock and Dam 25 Habitat Replacement Costs

Habitat Type	Location 1	Location 2	Location 3	Location 4	
Bottomland Forest	\$2,213,750	\$283,360 Minimizable	\$708,400 Minimizable	\$708,400 Minimizable	
Side Channel	\$910,000	Side channel impacts avoidable	Side channel impacts avoidable	Side channel impacts avoidable	
Non-Forested Wetland	No gate replacement	No gate replacement	No gate replacement	\$70,000 Gate replacement impact	
Mussels	Mussel bed upstream	Mussel bed is avoidable	Mussel bed is avoidable	Potential mussel bed upstream	
Main Channel Border	0	\$350,000	\$350,000	Without Gate \$280,000	With Gate \$140,000
Endangered Species	bald eagle perch trees, Indiana bat	Potentially avoid impacts	Potentially avoid impacts	Potentially avoid impacts	

La Grange Lock Habitat Replacement Costs

Habitat Type	Location 1	Location 2
Bottomland Forest	\$2,624,875 - \$5,485,656	\$2,213,750 - \$5,074,531
Main Channel Border	0	0
Non-Forested Wetland	\$1,190,000	\$1,190,000
Mussels	No known concentrations	No known concentrations
Endangered Species	Indiana bat, decurrent false aster, bald eagle	Indiana bat, decurrent false aster, bald eagle

Peoria Lock Habitat Replacement Costs

Habitat Type	Location 1	Location 2
Bottomland Forest	\$506,000	\$506,000
Main Channel Border	\$70,000	\$140,000
Mussels	No known concentrations	No known concentrations
Endangered Species	Indiana bat, decurrent false aster	Indiana bat, decurrent false aster