# A WATERFOWL TECHNICAL APPENDIX

**for the**

# YAZOO BACKWATER AREA PROJECT

**Prepared by**
**Larry E. Marcy**
**Fish and Wildlife Biologist**

**U.S. Fish and Wildlife Service**
**Mississippi Field Office**
**Jackson, Mississippi**

## EXECUTIVE SUMMARY

## YAZOO BACKWATER AREA PROJECT
## WATERFOWL APPENDIX

This document summarizes the findings contained in the U.S. Fish and Wildlife Service's (Service) Waterfowl Technical Appendix (appendix) associated with the Vicksburg District, U.S. Army Corps of Engineers (Corps) Yazoo Backwater Area Project. It is the Service's understanding that this appendix is to become an integral part of the Corp's environmental report.

Because of the loss of migratory waterfowl breeding and wintering habitat, continental waterfowl breeding populations are below long term averages. Since the loss and degradation of habitat have been identified as the major waterfowl management problem in North America, quantifying the impacts of the proposed alternatives for the Yazoo Backwater Area Project in terms of alteration to wintering waterfowl carrying capacity and foraging habitat is the primary purpose of this appendix.

For purposes of feasibility evaluations of the Yazoo Backwater Area Project alternatives, the Corps has forecasted that existing conditions will not change over the future without-project (FWOP). In contrast, the Service believes that those conditions will change significantly over the 50-year period of evaluation. Because there is a high degree of uncertainty associated with the Corps' projection, there is a substantial risk that project impacts will be underestimated. Thus, in cases where a great deal of uncertainty or disagreement exists, the use of alternative future forecasts may be the only method by which decision-makers can clearly be shown the degree of risk and uncertainty associated with the feasibility (i.e., completeness, effectiveness, efficiency, and acceptability) of each project alternative. Accordingly, the Service's planning team developed an alternative future without-project forecast, and it is incorporated by reference as a co-equal scenario in evaluating the impacts of all project alternatives on wintering waterfowl habitat. A comparison was made of impacts associated with each plan under the Corps' and the Service's future without project forecasts.

Using with and without hydrology modifications and land use data supplied by the Corps, the impact methodology used in this appendix was based on food as an index of wintering waterfowl carrying capacity expressed in terms of the number of duck-use-days (DUD). This methodology also accounts for the effects of seed consumption and decomposition. Project impacts in terms of increases and decreases of average seasonal acres flooded, during the 120 day wintering period from November 15 to March 15, were also identified. Project impacts were determined by comparing existing conditions to the impacts associated with initial array of 35 project alternatives and the final array of 7 alternatives.

Implementation of purely structural flood control features would result in adverse impacts to migratory waterfowl wintering habitat (maximum loss of 463,113 DUD, Plan 29, Levee). Structural plans with reforestation also result in losses (947,514 DUD, Plan 18). Losses would occur both on private and public lands and would be evident in the four hydrologic reaches. From the final array of seven alternatives, Plan 3 (NED) would reduce wintering waterfowl foraging habitat carrying capacity by 188,624 DUD due to the effects of the reduction in hydrology from pump operation. The purely nonstructural alternative (Plan 2) would result in a loss of 824,505 DUD. Plan 2, as well as other plans that have a reforestation feature, result in a loss of DUD compared to existing conditions. Reforestation provides fewer foraging benefits than cropland.

Quantifying food availability and consumption by waterfowl represents one facet of waterfowl biology. It also represents only 50 percent of waterfowl habitat requirements. The availability of winter water for other uses, i.e., loafing and pair bonding, are equally important and should be considered equally when a proposed alternative would reduce winter water. The reduction in wintering waterfowl habitat that has occurred due to the completion of flood control projects in the Lower Mississippi Alluvial Valley is of concern to the Service not just because of adverse impacts to migratory waterfowl, but cumulative impacts to the floodplain ecosystem.

Due to the planning efforts of the Corps, the Service, and other interested parties, decision makers now have the opportunity to reforest a significant portion of the Yazoo Backwater Area, benefitting all fish and wildlife species dependent on forested wetland habitat. The planning effort that produced the final array of alternatives for the Yazoo Backwater Area Project, could chart “new directions” in water resource planning, not just for Yazoo Basin, but the Lower Mississippi Valley.

**TABLE OF CONTENTS**

## LIST OF TABLES

# INTRODUCTION

This revised draft Waterfowl Technical Appendix (appendix) is submitted in partial fulfillment of the Fiscal Year 2000 scope of work for U.S. Fish and Wildlife Service (Service) activities pertaining to the U.S. Army, Corps of Engineers (Corps), Vicksburg District activities associated with the Yazoo Backwater Area Project. The purpose of this appendix is threefold: first, to identify the relative importance of the general project area in terms of historic trends in wetlands and wintering waterfowl, primarily mallards (*Anas platyrhynchos*); secondly, to document existing wintering waterfowl carrying capacity in the project area, and thirdly, to document project induced impacts compared to future without-project conditions using food as an index of carrying capacity expressed in terms of duck-use-days (DUD). Quantifying food availability and consumption by waterfowl represents one facet of waterfowl biology and it is represents only 50 percent of waterfowl habitat requirements. The availability of winter water for other uses, i.e., loafing and pair bonding, are equally important, but difficult to quantify. Flood control projects that reduce the extent, duration, and frequency of winter water are of concern to the Service.

Water resource planning in the Mississippi Delta has historically been project specific. There has been a chronic tendency to inadequately consider very real hydrological, social, and environmental relationships (ecosystem relationships) between flood control projects planned in one area and their impacts on adjacent areas. All of the projects completed and planned within the Mississippi Delta (Big Sunflower River Maintenance Project, Upper Yazoo Project, Steele Bayou Project) exemplify this tendency. These projects may be easily separable on paper, but all are hydrologically interconnected; high water events within the major rivers and tributary streams of the Mississippi Delta are dependent on the Big Sunflower River to provide an outlet, which in turn are dependent on the Yazoo River, and ultimately the Mississippi River.

Flood control projects should be approached on an ecosystem basis with the goal of creating economically and ecologically sustainable land uses. The planning effort, both Corps' and Service's, that produced the final array of alternatives for the Yazoo Backwater Area Project, could chart a new direction in water resource planning, not just for Yazoo Basin, but the Lower Mississippi Valley. Several features of the plans in the final array would provide environmentally significant wetland restoration as well as reduce flood damages. This waterfowl technical appendix represents one of four technical appendices (the others being terrestrial, aquatic, and wetlands) that analyze the adverse impacts associated with project implementation.

The information contained in this appendix is submitted in accordance with the referenced scope of work and with provisions of the Fish and Wildlife Coordination Act, but does not constitute the final report of the Department of Interior, U.S. Fish and Wildlife Service, as required by Section 2(b) of the Act.

## PROJECT DESCRIPTION

The reformulation of the Yazoo Backwater Area Project constitutes the third of four phases in the Yazoo Basin Reformulation Study. The purpose of the reformulation study is to determine the best plan to address the remaining flood control needs in the area as well as restoration of the area's historical environmental resources. Phases one and two (Upper Yazoo Project and Steele Bayou Project, respectively) have been completed. Phase four, the Tributaries Project, was initiated in 1995.

The Purpose of the Yazoo Backwater Area project is to reduce flood damages that occur to approximately 625,000 acres which could be inundated by the 100-year interior flood. When gravity evacuation of the interior runoff through existing drainage structures (Steele Bayou and Little Sunflower River structures) is prevented due to high water stages on the Mississippi and Yazoo Rivers, the pumping plant would be operated to reduce the frequency and duration of internal flood waters. The pumping plant would be located near the existing Steele Bayou gravity structure and as an integral feature of the 27.7 mile long Yazoo Backwater Area Levee (completed in 1978). An inlet channel from the Steele Bayou structure and an outlet channel to the Yazoo River were completed in 1986.

## PROJECT ALTERNATIVES

The development of the initial array of alternatives was accomplished through the use of facilitated meetings between interested parties (Federal, State, and local interests) and further refined by a Consensus Building Committee. The Corps divided the Yazoo Backwater Area into four reaches based on drainage: (1) Steele Bayou, 255,735 acres (2) Big and Little Sunflower Rivers, 121,368 acres, (3) Delta National Forest, 106,733 acres, and (4) Whittington Canal area, 145,965 acres. Land use was determined within each reach. Thirty-five alternatives were evaluated in four reaches to determine which alternative(s) would best achieve the project purpose and have the least impact on fish and wildlife resources.

The 35 plans represent different combinations of project features. Plans 1 and 2 are non-structural alternatives, with and without a reforestation component. Plan 29 involves the construction of levees along both sides of the Sunflower River system. The levees would restore the historical separation between the Sunflower and Steele Bayou drainages that was breached in 1978 with the construction of the connecting channel. This alternative would decrease flood stages in the Steele Bayou sump area, but increase stages in Reach 4.

All other plans involve the installation and maintenance of a pumps to evacuate flood water over the main levee at the Steele Bayou drainage structure. The plans differ in pump capacity (i.e., 14,000 or 17,500 cubic feet per second (cfs)), target water elevation for pump operation (i.e., 80, 85, 87, 88.5, 91 feet NGVD), and environmental design features (i.e., preservation of existing woodlands and/or reforestation of existing cleared lands below a specified elevation) (Table 1).

In addition, most plans involve water management that will retain water in forested areas during specified periods of the year. For example, water management options include (1) maintenance of water levels below 80 feet NGVD from 1 December to 1 March (eight plans), (2) maintenance of water levels below 85 feet from 1 January to 15 February, and 80 feet from 1 December to 1 January and 15 February to 1 March (eight plans), and (3) maintenance of water levels below 75 feet year-round (one plan). The Corp's economic analysis showed that the majority of these alternatives were not economically feasible and the initial array was reduced to seven alternatives (Plan 1 no action, Plan 2 nonstructural, Plan 3 NED, Plan 4 85' pump elevation, Plan 5 87' pump elevation, Plan 6 88.5' pump elevation, and Plan 7 91' pump elevation).

## HISTORICAL PERSPECTIVE OF WETLANDS AND WATERFOWL IN THE MISSISSIPPI ALLUVIAL VALLEY

### Wetlands

Before settlement by European and Africans, the Mississippi Alluvial Valley (MAV) was an intricate maze of bottomland hardwood forests, swamps, and bayous, and historically, the largest forested wetland in North America (25 million acres) extending approximately from southeastern Missouri to southern Louisiana. The transformation of this vast forest into agriculture use was gradual, yet deliberate, with over 80 percent of the forest in this region cleared. Most of the MAV was subject to periodic flooding by the Mississippi River and its tributaries. Following the Flood Control Act of 1941, hydrologic relationships in the MAV were altered by federally funded water resource developments for flood control and agriculture (Reinecke et al. 1988). Despite these changes to the landscape and hydrology in the MAV, it remains a critical ecoregion for North American waterfowl and other wildlife (Kaminski 1999).

Congress enacted a series of Swamplands Acts in the mid-1800's that deeded more than 20 million acres of swamplands to the states. With the proceeds from the sale of these lands being used for reclamation, wetlands were cleared, drained, and converted to agriculture use. Extensive settlement of the MAV occurred by 1900. As the result of devastating floods (1912, 1913, 1916, and 1927), Congress enacted the comprehensive flood protection program called the Mississippi River and Tributaries Project (MR&T). As a direct result of the construction of 1,500 miles of mainline levees along both banks of the Mississippi River under the MR&T Project, thousands of acres of bottomland hardwood forests were cleared for agricultural production. These lands were generally high in elevation for the Delta, well drained, and the

**TABLE 1. INITIAL ARRAY OF PROJECT PLANS, YAZOO BACKWATER PROJECT.**

| Plans | Pump Component | Existing Woodland Easement | Existing Cleared Land Easement | Water Management |
|---|---|---|---|---|
| Plan 1 | NA | Preserve below 100.3' NGVD | Use retained | NA |
| Plan 2 | NA | Preserve below 100.3' NGVD | Reforest below 90' NGVD | NA |
| Plan 3 | 14,000 cfs [A] | Preserve below 85' NGVD | Use retained below 85' NGVD | NA |
| Plan 4 | 14,000 cfs [A] | Preserve below 85' NGVD | Use retained below 85' NGVD | Below 80' NGVD [B] |
| Plan 5 | 14,000 cfs [A] | Preserve below 85' NGVD | Use retained below 85' NGVD | Below 85' NGVD [C] |
| Plan 6 | 14,000 cfs [A] | Preserve below 85' NGVD | Reforest below 85' NGVD | NA |
| Plan 7 | 14,000 cfs [A] | Preserve below 85' NGVD | Reforest below 85' NGVD | Below 80' NGVD [B] |
| Plan 8 | 14,000 cfs [A] | Preserve below 85' NGVD | Reforest below 85' NGVD | Below 85' NGVD [C] |
| Plan 9 | 14,000 cfs [A] | Preserve below 90' NGVD | Use retained below 90' NGVD | NA |
| Plan 10 | 14,000 cfs [A] | Preserve below 90' NGVD | Use retained below 90' NGVD | Below 80' NGVD [B] |
| Plan 11 | 14,000 cfs [A] | Preserve below 90' NGVD | Use retained below 90' NGVD | Below 85' NGVD [C] |
| Plan 12 | 14,000 cfs [A] | Preserve below 90' NGVD | Reforest below 90' NGVD | NA |
| Plan 13 | 14,000 cfs [A] | Preserve below 90' NGVD | Reforest below 90' NGVD | Below 80' NGVD [B] |
| Plan 14 | 14,000 cfs [A] | Preserve below 90' NGVD | Reforest below 90' NGVD | Below 85' NGVD [C] |

**TABLE 1. INITIAL ARRAY OF PROJECT PLANS, YAZOO BACKWATER PROJECT.**

| Plans | Pump Component | Existing Woodland Easement | Existing Cleared Land Easement | Water Management |
|---|---|---|---|---|
| Plan 15 | 17,500 cfs [A] | Preserve below 85' NGVD | Use retained below 85' NGVD | NA |
| Plan 16 | 17,500 cfs [A] | Preserve below 85' NGVD | Use retained below 85' NGVD | Below 80' NGVD [B] |
| Plan 17 | 17,500 cfs [A] | Preserve below 85' NGVD | Use retained below 85' NGVD | Below 85' NGVD [C] |
| Plan 18 | 17,500 cfs [A] | Preserve below 85' NGVD | Reforest below 85' NGVD | NA |
| Plan 19 | 17,500 cfs [A] | Preserve below 85' NGVD | Reforest below 85' NGVD | Below 80' NGVD [B] |
| Plan 20 | 17,500 cfs [A] | Preserve below 85' NGVD | Reforest below 85' NGVD | Below 85' NGVD [C] |
| Plan 21 | 17,500 cfs [A] | Preserve below 90' NGVD | Use retained below 90' NGVD | NA |
| Plan 22 | 17,500 cfs [A] | Preserve below 90' NGVD | Use retained below 90' NGVD | Below 80' NGVD [B] |
| Plan 23 | 17,500 cfs [A] | Preserve below 90' NGVD | Use retained below 90' NGVD | Below 85' NGVD [C] |
| Plan 24 | 17,500 cfs [A] | Preserve below 90' NGVD | Reforest below 90' NGVD | NA |
| Plan 25 | 17,500 cfs [A] | Preserve below 90' NGVD | Reforest below 90' NGVD | Below 80' NGVD [B] |
| Plan 26 | 17,500 cfs [A] | Preserve below 90' NGVD | Reforest below 90' NGVD | Below 85' NGVD [C] |
| Plan 27 | 14,000 cfs [D] | NA | NA | NA |
| Plan 28 | 17,500 cfs [D] | NA | NA | NA |

## TABLE 1. INITIAL ARRAY OF PROJECT PLANS, YAZOO BACKWATER PROJECT.

| Plans | Pump Component | Existing Woodland Easement | Existing Cleared Land Easement | Water Management |
|---|---|---|---|---|
| Plan 29 | Levee | NA | NA | NA |
| Plan 30 NED | 14,000 cfs | Preserve below 100.3' NGVD | NA | NA |
| Plan 31 | 14,000 cfs | NA | Reforest below 87' NGVD south of Highway 14 | Below 75' NGVD [E] |
| Plan 32 | 14,000 cfs | NA | Reforest below 87' NGVD | Below 87' NGVD |
| Plan 33 | 14,000 cfs | NA | Reforest below 91' NGVD | Below 91' NGVD |
| Plan 34 | 14,000 cfs | NA | Reforest below 91' NGVD | Below 91' NGVD [F] |
| Plan 35 | 14,000 cfs | NA | Reforest below 88.5' NGVD | Below 88.5' NGVD[F] |

[A] Pump would operate to provide flood damage reduction for cleared lands above the easement elevation.

[B] 1 December to 1 March.

[C] 80', 1 December to 1 January and 15 February to 1 March; 85' 1 January to 15 February.

[D] Pump would operate to provide flood damage reduction for cleared lands above elevation 80' NGVD, except during 1 December to 1 March when pump would be operated at 85' NGVD.

[E] Year round.

[F] Operation of the Steele Bayou drainage structure would be modified to maintain a 70 to 73-ft elevation at Steele Bayou during low-water periods and to reintroduce Mississippi River flows up to 87 ft NGVD.

most productive in the MAV. Today, these lands are primarily used for the production of cotton, with soybeans, rice, and wheat also important crops.

Following the completion of interior flood control projects, the period from 1950 through the 1970's saw the expansion of agriculture into the lower, wetter, flood prone land. During this time period, approximately 3.5 million acres of wooded wetlands were converted to agriculture production in the MAV (MacDonald et al. 1979). In western Mississippi, construction of the Mississippi River mainstem levee system and additional interior drainage improvements have reduced the acres flooded by the 2 year event by approximately 88 percent (Galloway 1980). The Yazoo Backwater Area Project is designed to provide additional flood damage reduction for these marginal agricultural lands.

The futility of farming marginal, floodprone land was made evident during the devastating floods that occurred from 1973 through 1993, despite the occasional periods of drought. As the result of this extended period of flooding, Congress enacted legislation to protect and restore wetlands (marginal, flood prone agricultural land brought into production during the period from 1950-1970): the 1985 Farm Bill, the Emergency Wetlands Protection Act of 1986, the Water Resources Development Act of 1986, the Agriculture Credit Act of 1987, the Conservation Reserve Program, the 1990 Farm Bill, the Food Security Act of 1992, the Wetlands Reserve Program (WRP), and the Federal Agriculture Improvement and Reform Act of 1996. For example, under the provisions of WRP, the federal government pays land owners fair market value for marginal cropland (farmed wetlands) and assists in replanting these areas in bottomland hardwood species. Today, the trend of Federal policy is decidedly toward (1) wetland restoration that will benefit waterfowl and other wildlife dependent on wetland habitat, and (2) sound floodplain management.

## Waterfowl

Historically, the MAV served as a major wintering area for waterfowl. Waterfowl population numbers began to decline in the 1960's as the direct result of extensive droughts and loss of nesting habitat in the prairie pothole region of the North America and the conversion of wintering areas in the MAV (bottomland hardwoods) to agricultural production. Waste grain, rice, and soybeans are now the dominate food sources of waterfowl in the MAV. These crops are typically grown on frequently flooded cropland. Federal flood control and drainage programs have reduced the extent of these flooded areas, the result being that naturally flooded or ponded habitat is limited for a significant portion of the wintering period and areas that do flood are less extensive and more ephemeral.

The net effect of wetland conversion and drainage has been that natural habitat is no longer sufficient to meet the needs of wintering waterfowl and other migratory birds. Clearing for grazing, timber harvesting, agriculture, and reservoir projects have all contributed to the decline of bottomland hardwoods in the region.

Within North America, several species of waterfowl, including mallards, are showing signs of recovery approaching or exceeding the population levels recorded in the 1950's (Annual Breeding Duck Survey, Table 2). Total duck abundance was 44.4 million birds, and increase of 14 percent over that of 1998, and 35 percent higher than the 1955-98 average. Mallard (*Anas platyrhynchos*) abundance was 11.3 million, an increase of 17 percent over 1998 and 53 percent greater than the long term average. Blue-winged teal (*Anas discors*) abundance was 7.2 million, similar to 1998, but 66 percent greater than the long term average. Northern pintail (*Anas acuta*; 3.1 million, +22 percent), green-winged teal (*Anas crecca*; 2.8 million, +36 percent), northern shoveler (*Anas clypeata*; 3.9 million, +22 percent), and American widgeon (*Anas americana*; 2.9 million, +4 percent) increased from 1998 estimates. American widgeon (+13 percent), green-winged teal (+60 percent), and northern shoveler (+95 percent), and gadwall (*Anas strepera*; 3.2 million, +110 percent) were above their respective long term averages. However, the northern pintail (-30 percent) was below its long term average.

While the annual breeding duck surveys are the most reliable estimates of waterfowl populations, population estimates are also available from extensive surveys of wintering ducks as well as waterfowl harvest data. The midwinter waterfowl survey for the Mississippi Flyway, conducted by the Service and the states, is an attempt to count the total number of ducks of each species (Table 3). Total duck abundance was 5.4 million birds, a decrease of 2 percent over that of 1998, but equal to the 1989-98 average. Mallard abundance was 2.4 million, an increase of 3 percent over 1998 and equal to the 1989-1998 average. Blue-winged teal abundance was 186,000 birds, an 8 percent decrease from 1998, but a 79 percent increase over the 1989-1998 average. Northern pintail (317,000, -16 percent), green-winged teal (618,000, +5 percent), northern shoveler (164,000, -45 percent), and American widgeon (244,000, +21 percent) compared to the 1998 estimates. American widgeon (-3 percent), green-winged teal (-14 percent), northern shoveler (-24 percent), and northern pintail (-37 percent) were below the 1989-1998 average, whereas gadwall (+27 percent) was above the long term average. These population estimates are not considered of sufficient reliability to measure trends in abundance of most duck species because of the large area which must be surveyed and the difficulty of counting birds, especially in wooded habitats, and the lack of a valid statistical sampling scheme.

**TABLE 2. BREEDING DUCK POPULATION ESTIMATES (in thousands) [1].**

| Years | Mallard | Gadwall | American Widgeon | Green-winged Teal | Northern Shoveler | Northern Pintail | Blue-winged Teal |
|---|---|---|---|---|---|---|---|
| 1955-60 | 9,386 | 651 | 3,195 | 1,584 | 1,556 | 8,543 | 4,909 |
| 1961-65 | 6,062 | 928 | 2,310 | 1,228 | 1,368 | 3,514 | 3,601 |
| 1966-70 | 7,805 | 1,641 | 2,702 | 1,652 | 2,105 | 5,177 | 4,138 |
| 1971-75 | 8,284 | 1,544 | 2,973 | 1,873 | 2,026 | 5,968 | 4,617 |
| 1976-80 | 7,800 | 1,457 | 3,012 | 1,851 | 1,910 | 4,891 | 4,695 |
| 1981-85 | 5,915 | 1,483 | 2,616 | 1,612 | 1,934 | 3,240 | 3,645 |
| 1986-90 | 5,932 | 1,443 | 2,002 | 1,860 | 1,789 | 2,334 | 3,584 |
| 1991 | 5,444 | 1,584 | 2,254 | 1,558 | 1,716 | 1,803 | 3,764 |
| 1992 | 5,976 | 2,033 | 2,208 | 1,773 | 1,954 | 2,098 | 4,333 |
| 1993 | 5,708 | 1,755 | 2,053 | 1,694 | 2,046 | 2,053 | 3,193 |
| 1994 | 6,980 | 2,318 | 2,382 | 2,108 | 2,912 | 2,972 | 4,616 |
| 1995 | 8,269 | 2,836 | 2,614 | 2,301 | 2,855 | 2,758 | 5,140 |
| 1996 | 7,941 | 2,984 | 2,272 | 2,500 | 3,449 | 2,736 | 6,407 |
| 1997 | 9,940 | 3,897 | 3,118 | 2,507 | 4,120 | 3,558 | 6,124 |
| 1998 | 9,640 | 3,742 | 2,857 | 2,087 | 3,183 | 2,520 | 6,398 |
| 1999 | 11,257 | 3,235 | 2,983 | 2,834 | 3,892 | 3,060 | 7,212 |

[1] U.S. Fish and Wildlife Service 1999a

**TABLE 3. MIDWINTER WATERFOWL SURVEYS, MISSISSIPPI (in thousands) [1].**

| Years | Mallard | Gadwall | American Widgeon | Green-winged Teal | Northern Shoveler | Northern Pintail |
|---|---|---|---|---|---|---|
| 1971-1975 | 343 | 4 | 11 | 5 | 2 | 22 |
| 1976-1980 | 272 | 8 | 11 | 11 | 2 | 14 |
| 1981-1985 | 184 | 15 | 12 | 4 | 10 | 8 |
| 1986-1990 | 133 | 11 | 8 | 6 | 23 | 7 |
| 1991 | 144 | 22 | 6 | 12 | 6 | 25 |
| 1992 | 126 | 14 | 7 | 16 | 4 | 15 |
| 1993 | 191 | 27 | 9 | 18 | 10 | 8 |
| 1994 | 174 | 43 | 15 | 27 | 9 | 23 |
| 1995 | 146 | 21 | 9 | 33 | 6 | 7 |
| 1996 | 127 | 11 | 7 | 36 | 6 | 10 |
| 1997 | 126 | 22 | 5 | 17 | 8 | 5 |
| 1998 | 98 | 39 | 4 | 30 | 4 | 3 |
| 1999 | 107 | 16 | 1 | 12 | 1 | 4 |

[1] Gamble 1999

Mid-winter waterfowl surveys provide useful, general information on wintering waterfowl population levels. Further, comparing the statewide numbers from year to year does not account for extremes of temperature or above or below normal rainfall; factors known to influence the arrival and departure of wintering waterfowl. Therefore, these surveys tend to count fewer ducks than are actually present, but the amount of undercount is unknown and is likely variable from year-to-year.

Waterfowl harvests have fluctuated since records have been kept, being lowest during the early 1960's when waterfowl populations, potential hunters, and days afield were low. In most years, harvests have tracked the fluctuation of these factors, especially waterfowl populations. In recent years, nationwide harvests of the heavily hunted mallard and of total ducks remained relatively constant, while hunter numbers declined and hunter success increased. It appears that fewer hunters have been increasingly successful at harvesting ducks. In the Mississippi Flyway, 2.75 million mallards were harvested in 1998, or 52.6 percent of the total mallard harvest in the United States, followed by 1 million gadwall (56.5 percent of the total harvest), 1 million green-winged teal (43.4 percent of the total harvest), and 838,000 wood ducks (58.6 percent of the total harvest). Within Mississippi, mallards also comprised the majority of the ducks harvested (55.1 percent), followed by gadwall (15.8 percent), green-winged teal (8.3 percent), and wood duck (5.6 percent) (U.S. Fish and Wildlife Service 1999b). Hunters afield in Mississippi totaled 23,041 in 1998 (10 percent more than 1997) and total hunter days equaled 257,530 days (9 percent less than 1997). Total duck harvest in Mississippi in 1998 was 414,300 ducks or 15.7 ducks per adult hunter.

## WINTERING WATERFOWL BIOLOGICAL CHARACTERISTICS

The loss and degradation of waterfowl habitat has been identified as the major waterfowl management problem in North America (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1986). Wintering waterfowl habitat requirements can be broken down into three components: habitat availability, utilization, and suitability in meeting social behavioral requirements. Waterfowl populations and recruitment in the MAV are a direct function of these three components.

### Habitat Availability

Relationships exist among availability of wetland habitat and food during winter and waterfowl physiological, behavioral, and population responses (Kaminski 1999). Hydrology and resulting wetland habitat and intrinsic resources are critical proximate factors related to waterfowl use of alluvial environments like the Lower Mississippi Delta (Fredrickson and Heitmeyer 1988). Additionally, current and cross-seasonal physiological status, survival, and reproductive performance of waterfowl have been linked to winter habitat and food resources (Table 4).

**TABLE 4. POTENTIAL GENERIC BENEFITS TO MALLARDS AND WOOD DUCKS FROM FAVORABLE WINTER WATER (HABITAT) AND FEEDING CONDITIONS IN THE MISSISSIPPI ALLUVIAL VALLEY OR UNDER CAPTIVE CONDITIONS (adapted from Reinecke et al. 1988).**

| POTENTIAL BENEFIT | REFERENCE |
|---|---|
| **Improved foraging** | |
| Natural foods (e.g., seeds, invertebrates) | Wright (1961), Wehrle et al. (1995) |
| Agricultural seeds (rice) | Reinecke et al. (1988) |
| **Improved physiological condition** | |
| Increased body weight | Delnicki and Reinecke (1986), Demarest et al. (1997) |
| Earlier prebasic molt in females | Heitmeyer (1987), Richardson and Kaminski (1992), Barras (1993) |
| Increased pair formation | Demarest et al. (1997), Vrtiska (1995) |
| **Changes in distribution and habitat use** | |
| Response to local/regional flooding | Reinecke (unpubl. data), Hepp and Hines (1991) |
| Regional increase in winter population | Nichols et al (1983) |
| **Increased survival and reproductive performance** | |
| Survival | Reinecke et al. (1987), Demarest et al. (1997), Vrtiska (1995) |
| Reproductive performance | Heitmeyer and Fredrickson (1981), Kaminski and Gluesing (1987), Dubovsky and Kaminski (1994) and Vrtiska (1995) |

Studies of wild mallards and wood ducks have revealed that landscape-scale flooding and dry conditions during winter influence distribution and abundance of these and likely other species of waterfowl and wetland birds (Kaminski 1999). Widespread winter flooding in the MAV resulted in regional increases in mallards (Nichols et al. 1983), and below-average precipitation during spring and summer in southeastern United States caused wood ducks to disperse to more southerly latitudes during fall and winter where wetland availability apparently was greater (Hepp and Hines 1991). Additionally, increased wetland availability during winter presumably enhances foraging opportunities and food availability for mallards and other waterfowl (Wright 1961, Delnicki and Reinecke 1986, Reinecke et al 1988, Wehrle et al 1995), which in turn have been related to increased body weights in mallards (Delnicke and Reinecke 1986), earlier prebasic molt and acquisition of basic (breeding) plumage in female mallards (Heitmeyer 1987, Richardson and Kaminski 1992), and increased mallard survival (Reinecke et al. 1987) and reproductive rates (Heitmeyer and Fredrickson 1981, Kaminski and Gluesing 1987). The results of recent research on mallards and wood ducks showed that winter wetland availability is linked to current and cross-seasonal life-cycle events of mallards and wood ducks, and possibly other waterfowl using alluvial environments like the Delta (Kaminski 1999).

Managed and unmanaged wintering waterfowl habitats are present in the MAV. Managed habitats, using structural measures and vegetation manipulation, are primarily found on federal and state lands, and represent the core wintering habitat during dry (below normal rainfall) years.

Since 1988, Ducks Unlimited, the U.S. Fish and Wildlife Service's Private Lands Program, and the Mississippi Partners Program (comprised of the U.S. Fish and Wildlife Service, Delta Wildlife Foundation, and Mississippi Department of Wildlife, Fisheries and Parks) have provided assistance to hundreds of private land owners to manage 59,677 acres as winter waterfowl habitat (30,767 acres under the Private Lands Program, 16,676 by Ducks Unlimited, and 12,234 acres by the Mississippi Partners Program).

Unmanaged winter habitat provides important foraging habitat to wintering waterfowl during years of normal or above normal rainfall. These periods of above normal rainfall show increases in available foraging habitat from 900 percent in Mississippi to 1,200 percent in Arkansas (Reinecke et al. 1988). The increased availability of wintering habitat also effects the distribution of wintering waterfowl in the MAV. Proportionately more waterfowl have been found to winter in the MAV during periods of above normal rainfall and cold winters (Nichols et al. 1983, Reinecke et al. 1987). This unmanaged and flood susceptible habitat, which is so important to wintering waterfowl, has long been subject to federal flood control drainage projects in the MAV.

**Habitat Utilization**

Waterfowl are mobile and opportunistic, and their feeding habits have changed over time, presumedly in response to the large scale conversion of native wooded wetlands to small grain agricultural crops. The principal foods of mallards generally include agricultural grains; seeds and tubers of native plants; acorns; and invertebrates such as isopods, snails, and fingernail clams (Reinecke et al. 1987). Heitmeyer (1985) and Combs (1987) found that pin oak (*Quercus palustris*) and cherrybark oak (*Quercus falcata* var. *pagodaefolia*) acorns dominate the mallard diet during years of good mast production and favorable water conditions in southeastern Missouri. Nuttall oak (*Quercus nuttalli*) fills the same ecological niche in the southern Mississippi Delta as pin oak in Missouri.

In the early fall, mallards concentrate on shallowly flooded openings in bottomland forests. Shortly after arrival, mallards complete prealternate (breeding plumage) molt and consume aquatic insects and moist soil seeds. Following molt, mallards begin courtship and by early January, 90 percent of the birds are paired (Bellrose 1980). During pairing, mallards forage intensively in flooded forests or agricultural fields, where they consume acorns and cereal grains. After pairing, mallards readily use shallowly flooded forests and continue to consume acorns, but increase consumption of macroinvertebrates (Fredrickson and Batema 1992).

Wood ducks and hooded mergansers (*Lophodytes cucculatus*) use overcup oak, cypress/tupelo forest types and scrub/shrub habitats during fall courtship and pairing (Bellrose 1980). Both species breed in Mississippi and nest in natural tree cavities or artificial nest boxes. After pairing, wintering habitat includes the deeper areas of lowland hardwoods, cypress/tupelo, overcup oak, and scrub/shrub habitats.

Wright (1961) and Delnicki and Reinecke (1986) demonstrated the importance to waterfowl of large areas of flooded rice and soybean fields. Seeds and tubers of grasses, sedges, and other moist soil plants are also important components of the diet (Wright 1961, Wills 1970, Heitmeyer 1985, Delnicki and Reinecke 1986, Combs 1987). Invertebrates generally provide less than 10 percent of the diet in agricultural (Delnicki and Reinecke 1986) and moist soil (McKenzie 1987) habitats, but may be more important in forested wetlands (Heitmeyer 1985).

Although the nutrition of wintering waterfowl is not well understood, it is, however, increasingly clear that nutrition affects dietary energy and protein intake, and that meeting these dietary requirements is positively related to winters with normal or above normal rainfall. Studies conducted in Mississippi during the wet winter of 1982-83 show increased mallard body weights while the dry winter of 1980-1981 show decreased mallard body weights (Delnicke and Reinecke 1986). Similar results in Missouri indicated that mallard body weights increased when water conditions and mast production were favorable, or when rainfall was sufficient to flood low lying cropland (Heitmeyer 1985, Combs 1987). The condition in which waterfowl return to the breeding grounds has been shown to have a major impact on their breeding success and survival (Bellrose 1980, Reinecke et al. 1989).

In recent years, research has focused on relative waterfowl utilization and associated food availability in natural and agricultural foraging habitat. Utilization of agricultural fields differs among crops (Nelms and Twedt 1996). Herbaceous native vegetation is used to a greater extent than any agricultural crops. Bottomland hardwoods are utilized for foraging to a certain extent and roosting, loafing, and pair formation to a large extent (Reinecke et al. 1989). (Caloric values, seed consumption, and seed decomposition rates of available waterfowl foraging habitat form the basis for determining project impacts and are discussed in detail in the Impact Assessment Methodology section of this appendix.)

### Social Behavior

During winter, courtship and pair formation dominate the social behavior of dabbling ducks. Most of the project area is agricultural land, replacing forested wetlands as the primary foraging habitat. The forested wetlands and normally associated shrub swamps, beaver ponds, riparian habitat, and other deep water habitat are used as resting or roosting areas and provide isolation from human disturbance, protection from predators, and a location for courtship and other social activities where pairs are visually isolated. Whereas much of the foraging and nutritional requirements can be met by flooded agricultural lands, a variety of habitats is needed to satisfy the total biological requirements of wintering waterfowl, because members of the population may differ in their habitat needs at any particular time (Reinecke et al. 1987). Examples include the likelihood of juvenile or unpaired mallards feeding in agricultural lands and adults and pairs seeking the isolation of shrub swamps to avoid harassment from courting parties (Heitmeyer 1985).

## PROJECT IMPACTS

Project adverse impacts include the direct loss of wooded wetlands due to construction of the levee alternative ( Plan 29) and indirect loss of wintering waterfowl habitat from the flood protection provided by the levee alternative. Loss of flooded wintering waterfowl habitat could also occur by the operation of the pumps alone alternatives and combined alternatives.

### Impact Assessment Methodology

In this section, the term wintering waterfowl includes primarily puddle ducks consisting of the mallard, northern pintail, American wigeon, gadwall, green-winged teal, northern shoveler, and blue-winged teal.

Prior waterfowl appendices incorporated a methodology that used available food (energy) as an index of the carrying capacity of winter foraging habitat for dabbling ducks in the MAV. This methodology was developed in 1992 by Mr. Robert Barkley (U.S. Fish and Wildlife Service, Vicksburg Field Office) and Dr. Kenneth J. Reinecke (United States Geological Survey, Mississippi Valley Research Field Station). This method was used on several Corps flood control projects to quantify the impact of altering hydrology on traditional waterfowl wintering areas and for designing appropriate mitigation measures (U.S. Army Corps of Engineers 1991, 1993). This method has also been used in setting habitat management goals for wintering waterfowl habitat in the MAV (Loesch et al. 1994).

The Corps prepared a GIS data base tailored to identify the acres of available foraging habitat under existing conditions, future conditions with and without the project. For a determination of existing and future carrying capacities (based on the implementation of an alternative), land use was broken down into available foraging habitats having food value to wintering waterfowl: soybeans, rice, moist soil, bottomland hardwood forested wetlands, and other (includes pasture, open water, etc.).

To determine carrying capacity in terms of numbers of duck-use-days (DUD), data requirements include land use, hydrology, and available food during the 120 day (November 1 to March 1) waterfowl wintering period. The data were specific to those habitats and food resources that were available and used by foraging waterfowl.

The amount of food available on a unit area was determined by Reinecke et al. (1989) and McAbee (1994). Small grain crop residues, moist soil native weed seeds, acorns, and invertebrates in forest stands with more than 25 percent red oaks represent the available winter waterfowl food.

For this waterfowl appendix the previously described methodology was further refined to include information on seed deterioration rates and seed abundance, invertebrate abundance, as well as depth and duration of flooding (Nelms 1996). Waterfowl foraging habitat, regardless of food value, is only of use to wintering waterfowl if available. Food availability is dependent on flooding. Waterfowl use relatively shallow water areas, eighteen inches or less, for feeding. Through the use of extensive hydrological data (1943-1999), the Corps provided seasonal acres flooded eighteen inches or less for the wintering season. The land use data provided for the study area were specific to those acres inundated and represent only potential available foraging habitat. By including the factors described above, the present methodology is more representative of winter waterfowl foraging habitat.

The index of carrying capacity for wintering waterfowl foraging habitat is expressed in duck-use-days (DUD) per acre which represents the capacity of the available forage per acre that meets the energy requirements of one duck for one day. The information requirements to estimate DUD are: (1) current land use, including crop type, (2) extent, duration, and depth of flooding, (3) amount of winter food present by land use, (4) energy of food items, (5) deterioration rates of food items, (6) energy requirements of waterfowl, and (7) estimated density of waterfowl. The equation for this is as follows:

$$DUD / Acre = \frac{Food \times Energy}{Duck\ Energy\ Needs}$$

The equation used to estimate DUD was further refined by factoring in the amount of seed deterioration that occurs over time because seed deterioration has a significant impact on DUD. Deterioration rates were estimated from experimental data using the best fitting regression model (Nelms and Twedt 1996). Daily seed consumption estimates were also incorporated into the equation to preclude overestimating the influence of seed deterioration because foods consumed by ducks are not subject to deterioration. Since DUD are a function of the weight of the food available and food is easily converted to calories, calculations are in terms of the weight of food. The equation for food available to ducks on a given day when seed consumption and deterioration are taken into account is:

$$Food_j = Food_0 - \sum_{i=0}^{j}(Food_{consumed_i} + Food_{deteriorated_i})$$

where:

$$Food_{consumed} = \frac{Mean\ duck\ density \times Kcal\ consumed / duck / day}{Kcal / kg\ of\ \ food}$$

and

$$Food_{deteriorated} = Food \times Deterioration\ rate \times days_i$$

where i and j are days.

Duck-use-days per acre, adjusted for deterioration, is calculated by multiplying the number of days times the projected density of ducks. By converting to DUD, units are comparable across habitats which facilitates both wetland mitigation efforts and management decisions. This is particularly useful when the loss of one habitat must be mitigated with another habitat type due to practical constraints or the need to meet multiple ecosystem management goals. DUD provide an objective index of the relative value of different habitats for dabbling ducks as winter foraging habitats.

To facilitate calculation, food item densities, deterioration rates, and energy values were aggregated within a given habitat type. Weighted averages based on weights of food items were used to calculate the aggregate values. Aggregate values are representative of any generic unit of food in the habitat of interest (Table 5).

Once aggregate values were calculated, the density of ducks feeding in the habitats of interest is projected so that daily consumption can be estimated. An overall average of systematic observations of waterfowl in flooded moist soil, rice, and soybean fields in the MAV was used to estimate duck density. The estimated diurnal density of ducks in flooded rice, soybean, and moist soil fields in the MAV from data collected by McAbee (1994) and Dr. Dan Twedt (U.S. Geological Survey) and Mr. Curtis Nelms (U.S. Fish and Wildlife Service, Vicksburg) (unpublished data) is 10.1 ducks/ha. No empirical estimates of waterfowl density in flooded bottomland hardwoods (BLH) in the MAV are known to exist, so estimates from croplands and moist soil are also used for BLH. Little information is available on nocturnal feeding densities of waterfowl, although this has been shown to be an important phenomenon (Paulus 1980, Reinecke unpublished data). To adjust for nocturnal foraging, the estimate of diurnal density is doubled to 20.2 ducks/ha. The role of the projected density and subsequent consumption estimates is to dampen the effects of seed deterioration on food availability. If the average daily consumption estimates were not included in the model then the influence of seed deterioration would be overestimated because foods consumed by ducks are no longer subject to deterioration. From these calculations, DUD/ha and Days to Exhaustion (DTE) were generated (Table 6).

Reasonable estimates were generated for the number of days of flooding until exhaustion of food resources occurred at an average duck density. This density is assumed to be the point where declining foraging efficiency causes ducks to abandon a field. Reinecke et al. (1989) found this threshold foraging efficiency to be 50 kg/ha. The estimated Days To Exhaustion (DTE) of food resources is useful for determining the impact of the length of flooding on habitat values. DTE allows the inclusion of data on flood duration and is useful in determining the impacts of flood control projects on wintering waterfowl foraging habitat. For example, if under existing conditions a moist soil area floods for 126 days during the waterfowl season, it can support 1,037 ducks per acre per day, and this food resource will be exhausted in 126 days. If a flood control project reduces the duration of flooding, then food availability will also be reduced (i.e., loss of DUD).

**TABLE 5. FOOD DENSITIES AND METABOLIZABLE ENERGY CONTENT OF FOODS IN THE MISSISSIPPI ALLUVIAL VALLEY [1].**

| Foraging Habitat | Acorns kg/ha (Kcal/kg) | Grain kg/ha (Kcal/kg) | Weeds kg/ha (Kcal/kg) | Invertebrates kg/ha (Kcal/kg) |
|---|---|---|---|---|
| Moist Soil | | | 450 (2,500) | 0.69 (2,500) |
| Corn | | 250 (3,670) | | |
| Milo | | 200 (3,500) | 25 (2,500) | |
| Rice | | 166 [1, 2] (2,933) | 32 [1, 2] (2,500) | 3.96 [2] (2,500) |
| Soybean | | 86 [1, 2] (1,871) | 54 [2] (2,500) | 0.44 [2] (2,500) |
| 30% Red Oaks | 27 (3,500) | | 22.5 (2,500) | 13.7 (2,500) |
| 50% Red Oaks | 44 (3,500) | | 22.5 (2,500) | 13.7 (2,500) |
| 70% Red Oaks | 62 (3,500) | | 22.5 (2,500) | 13.7 (2,500) |
| 90% Red Oaks | 80 (3,500) | | 22.5 (2,500) | 13.7 (2,500) |

[1] All information from Reinecke et al. (1989) unless indicated otherwise
[2] McAbee (1994)

**TABLE 6. DUCK-USE-DAYS (PER HECTARE AND ACRE) AND DAYS TO EXHAUSTION OF WINTER FOOD RESOURCES FOR FLOODED MOIST SOIL, RICE, SOYBEAN, AND BOTTOMLAND HARDWOOD FORESTS [1].**

| Habitat | Duck-use-days/ha | Duck-use-days/ac | Days to Exhaustion |
|---|---|---|---|
| Moist Soil | 2,563 | 1,037 | 126 |
| Rice | 1,434 | 580 | 71 |
| Soybean | 626 | 253 | 31 |
| 30% Red Oaks | 141 | 57[2] | 7 |
| 50% Red Oaks | 303 | 123 | 15 |
| 70% Red Oaks | 485 | 196 (237[3]) | 24 |
| 90% Red Oaks | 667 | 270 | 33 |

[1] Nelms and Twedt 1996

[2] 30% red oaks (57 DUD/acre) is used in this appendix to represent carrying capacity of existing BLH, and in the calculation of existing conditions.

[3] 70% red oaks is used in this appendix as an average seedling survival rate. Forty-one DUD were added due to the presence of moist soil (fallow field) habitat during the first five years after planting. The 237 DUD/acre is used as the carrying capacity of reforested cleared land in the calculation of future with and without-project conditions, and to determine mitigation acres.

## CONSTRUCTION IMPACTS

Construction impacts are those impacts that would be associated with the construction of the pumps, maintenance of rights-of-way, or placement of dredged/fill material for the construction of a levee (Plan 29). These impacts are "direct" in that an acre-for-acre change in land use occurs. The majority of clearing for the inlet and outlet channels for the pumps was completed in 1986 and resulted the loss of 296 acres of wooded wetlands. An additional 38 acres of wooded wetlands will be cleared for a disposal area, and 110.5 acres of cleared land and 5.2 acres of open water will be filled. Remaining pump construction impacts will be minimal on wintering waterfowl habitat. Plan 29 (the levee alternative) consists of clearing existing woodlands (400 acres in Reach 2 and 370 acres in Reach 4) and would directly impact wintering waterfowl habitat.

## OPERATIONAL IMPACTS (CHANGES IN SEASONAL FLOODING)

For purposes of feasibility evaluations of the Yazoo Backwater Area Project alternative plans, the Corps forecast that existing conditions will not change over the future without-project (FWOP). In other words, the waterfowl foraging habitat currently available will not increase in the absence of a project. In contrast, the Service believes that those conditions will change significantly over the 50-year period of evaluation (i.e., more reforestation will occur in the absence of a project). Because there is a high degree of uncertainty associated with the Corps' projection, there is a substantial risk that project impacts could be underestimated. Thus, in cases where a great deal of uncertainty or disagreement exists, the use of alternative future forecasts may be the only method by which decision-makers can clearly be shown the degree of risk and uncertainty associated with the feasibility (i.e., completeness, effectiveness, efficiency, and acceptability) of each project alternative. Accordingly, the Service's planning team developed an alternative future without-project forecast, and it is incorporated by reference as a co-equal scenario in evaluating the impacts of all project alternatives, including the tentatively selected plan (Plan 32) (U.S. Fish and Wildlife Service 1999c).

### Corps Future With and Without-Project Analysis

For existing habitats with value as waterfowl foraging areas and that would be impacted by the hydrology alteration resulting from the operation of a pump, foraging value could be reduced to zero. Areas that are hydrologically modified (reduced flooding) would reduce the extent of existing foraging habitat. However, for those alternatives with water management features being considered, wintering waterfowl foraging habitat would increase. Water management consists of intentionally flooding areas by holding the water elevation at higher than normal levels to increase the extent of waterfowl foraging habitat.

Total DUD for baseline conditions and each alternative plan are presented in Tables 7 and 8, respectively. Based on Corps' data analysis, seasonal acres flooded by land use categories, for all hydrological reaches flooded 18 inches deep or less total 11,907 acres for baseline conditions. This value included a land use category "other" that does not provide waterfowl foraging habitat (i.e., roads). Baseline seasonal acres flooded were adjusted based on the percent of actual foraging habitat by reach and was determined to be 9,138 acres. Using these acres of habitat, average seasonal duck-use-days for all hydrological reaches total 2,074,371 duck-use-days (baseline conditions). As mentioned above, the Corps forecast that baseline conditions will not change significantly over the 50-year period of evaluation. Since the Corps projects no change in future without-project conditions, the future with-project impacts of a particular plan, changes in DUD associated with a particular alternative (gains or losses), were compared to baseline conditions (Table 9).

Implementation of purely structural flood control features would result in adverse impacts to migratory waterfowl wintering habitat (Plans 3, 9, 15, 21, 27, 28, 29, and 30). Losses would occur both on private and public lands and would be evident in all hydrological reaches. For example, wintering waterfowl foraging habitat carrying capacity would be reduced annually by 188,624 duck-use-days (Plan 30, NED) (Table 9). Combinations of structural and nonstructural methods (with water management and/or reforestation features) were also evaluated, and depending on the alternative selected, could have positive benefits to waterfowl (maximum increase of 733,279 DUD, Plan 11) or negative impacts (maximum loss of 947,514 DUD, Plan 18). Losses of DUD occur when flooded, cleared agricultural land (foraging value of 253 DUD/acre) is reforested (foraging value of 237 DUD/acre).

## TABLE 7. DUCK USE DAYS AVAILABLE FOR BASELINE CONDITIONS

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 186 | 109 | 51 | 203 | 549 | 1,037 | 569,313 |
| **Rice** | 11 | 17 | 1 | 4 | 510 | 370 | 26 | 101 | 1,007 | 580 | 584,060 |
| **Soybeans** | 13 | 46 | 10 | 25 | 603 | 1,002 | 256 | 633 | 2,494 | 253 | 630,982 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,299 | 1,481 | 333 | 937 | 4,050 | | *1,784,355* |
| **BLH** | 45 | 16 | 71 | 33 | 2,088 | 349 | 1,815 | 836 | 5,088 | 57 | *290,016* |
| **Acres Subtotal** | | | | | 3,387 | 1,830 | 2,148 | 1,773 | 9,138 | | *2,074,371* |
| **Other** | 27 | 16 | 16 | 30 | 1,253 | 349 | 408 | 759 | 2,769 | 0 | 0 |
| **Total Acres** | | | | | 4,640 | 2,179 | 2,556 | 2,532 | 11,907 | | **2,074,371** |

## TABLE 8. PLAN 1, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 186 | 109 | 51 | 203 | 549 | 1,037 | 569,313 |
| **Rice** | 11 | 17 | 1 | 4 | 510 | 370 | 26 | 101 | 1,007 | 580 | 584,060 |
| **Soybeans** | 13 | 46 | 10 | 25 | 603 | 1,002 | 256 | 633 | 2,494 | 253 | 630,982 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,299 | 1,481 | 333 | 937 | 4,050 | | *1,784,355* |
| **BLH** | 45 | 16 | 71 | 33 | 2,088 | 349 | 1,815 | 836 | 5,088 | 57 | *290,016* |
| **Acres Subtotal** | | | | | 3,387 | 1,830 | 2,148 | 1,773 | 9,138 | | *2,074,371* |
| **Other** | 27 | 16 | 16 | 30 | 1,253 | 349 | 408 | 759 | 2,769 | 0 | 0 |
| **Total Acres** | | | | | 4,640 | 2,179 | 2,556 | 2,532 | 11,907 | | **2,074,371** |

**TABLE 8. PLAN 2, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 186 | 109 | 51 | 203 | 549 | 1,037 | 569,313 |
| **Rice** | 11 | 17 | 1 | 4 | 510 | 370 | 26 | 101 | 1,007 | 580 | 584,060 |
| **Soybeans** | 13 | 46 | 10 | 25 | 603 | 1,002 | 256 | 633 | 2,494 | 253 | 630,982 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,299 | 1,481 | 333 | 937 | 4,050 | | *1,784,355* |
| **BLH** | 45 | 16 | 71 | 33 | 2,088 | 349 | 1,815 | 836 | 5,088 | 57 | *290,016* |
| **Acres Subtotal** | | | | | 3,387 | 1,830 | 2,148 | 1,773 | 9,138 | | *2,074,371* |
| **Other** | 27 | 16 | 16 | 30 | 1,253 | 349 | 408 | 759 | 2,769 | 0 | 0 |
| **Total acres** | | | | | 4,640 | 2,179 | 2,556 | 2,532 | 11,907 | | **2,074,371** |

**TABLE 8. PLAN 3, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 166 | 101 | 47 | 186 | 500 | 1,037 | 518,500 |
| **Rice** | 11 | 17 | 1 | 4 | 456 | 342 | 24 | 93 | 915 | 580 | 530,700 |
| **Soybeans** | 13 | 46 | 10 | 25 | 540 | 925 | 235 | 582 | 2,282 | 253 | 577,346 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,162 | 1,368 | 306 | 861 | 3,697 | | *1,626,546* |
| **BLH** | 45 | 16 | 71 | 33 | 1,866 | 322 | 1,671 | 768 | 4,627 | 57 | *263,739* |
| **Acres Subtotal** | | | | | 3,028 | 1,690 | 1,977 | 1,629 | 8,324 | | *1,890,285* |
| **Other** | 27 | 16 | 16 | 30 | 1,118 | 321 | 376 | 699 | 2,514 | 0 | 0 |
| **Total acres** | | | | | 4,146 | 2,011 | 2,353 | 2,328 | 10,838 | | **1,890,285** |

**TABLE 8. PLAN 4, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 176 | 118 | 46 | 205 | 545 | 1,037 | 565,165 |
| **Rice** | 11 | 17 | 1 | 4 | 485 | 401 | 23 | 103 | 1,012 | 580 | 586,960 |
| **Soybeans** | 13 | 46 | 10 | 25 | 573 | 1,084 | 232 | 641 | 2,530 | 253 | 640,090 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,234 | 1,603 | 301 | 949 | 4,087 | | *1,792,215* |
| **BLH** | 45 | 16 | 71 | 33 | 1,983 | 377 | 1,649 | 846 | 4,855 | 57 | *276,735* |
| **Acres Subtotal** | | | | | 3,217 | 1,980 | 1,950 | 1,795 | 8,942 | | *2,068,950* |
| **Other** | 27 | 16 | 16 | 30 | 1,189 | 377 | 371 | 769 | 2,706 | | |
| **Total acres** | | | | | 4,406 | 2,357 | 2,322 | 2,564 | 11,649 | | **2,068,950** |

**TABLE 8. PLAN 5, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 | Reach 2 | Reach 3 | Reach 4 | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 230 | 166 | 60 | 265 | 721 | 1,037 | 747,677 |
| **Rice** | 11 | 17 | 1 | 4 | 632 | 566 | 30 | 132 | 1,360 | 580 | 788,800 |
| **Soybeans** | 13 | 46 | 10 | 25 | 746 | 1,530 | 298 | 828 | 3,402 | 253 | 860,706 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,608 | 2,262 | 388 | 1,225 | 5,483 | | *2,397,183* |
| **BLH** | 45 | 16 | 71 | 33 | 2,584 | 532 | 2118 | 1,093 | 6,327 | 57 | *360,639* |
| **Acres Subtotal** | | | | | 4,192 | 2,794 | 2,506 | 2,318 | 11,810 | | *2,757,822* |
| **Other** | 27 | 16 | 16 | 30 | 1,549 | 533 | 477 | 993 | 3,552 | 0 | 0 |
| **Total acres** | | | | | 5,741 | 3,327 | 2,983 | 3,311 | 15,362 | | **2,757,822** |

## TABLE 8. PLAN 6, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 166 | 101 | 47 | 186 | 500 | 1,037 | 518,500 |
| **Rice** | 11 | 17 | 1 | 4 | 456 | 342 | 24 | 93 | 915 | 580 | 530,700 |
| **Soybeans** | 13 | 46 | 10 | 25 | 540 | 925 | 235 | 582 | 2,282 | 253 | 577,346 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,162 | 1,368 | 306 | 861 | 3,697 | | *1,626,546* |
| **BLH** | 45 | 16 | 71 | 33 | 1,866 | 322 | 1,671 | 768 | 4,627 | 57 | *263,739* |
| **Acres Subtotal** | | | | | 3,028 | 1,690 | 1,977 | 1,629 | 8,324 | | *1,890,285* |
| **Other** | 27 | 16 | 16 | 30 | 1,118 | 321 | 376 | 699 | 2,514 | 0 | 0 |
| **Total acres** | | | | | 4,146 | 2,011 | 2,353 | 2,328 | 10,838 | | **1,890,285** |

**TABLE 8. PLAN 7, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 176 | 118 | 46 | 205 | 545 | 1,037 | 565,165 |
| **Rice** | 11 | 17 | 1 | 4 | 485 | 401 | 23 | 103 | 1,012 | 580 | 586,960 |
| **Soybeans** | 13 | 46 | 10 | 25 | 573 | 1,084 | 232 | 641 | 2,530 | 253 | 640,090 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,234 | 1,603 | 301 | 949 | 4,087 | | *1,792,215* |
| **BLH** | 45 | 16 | 71 | 33 | 1,983 | 377 | 1,649 | 846 | 4,855 | 57 | *276,735* |
| **Acres Subtotal** | | | | | 3,217 | 1,980 | 1,950 | 1,795 | 8,942 | | *2,068,950* |
| **Other** | 27 | 16 | 16 | 30 | 1,189 | 377 | 371 | 769 | 2,706 | | |
| **Total acres** | | | | | 4,406 | 2,357 | 2,322 | 2,564 | 11,649 | | **2,068,950** |

## TABLE 8. PLAN 8, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 | Reach 2 | Reach 3 | Reach 4 | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 230 | 166 | 60 | 265 | 721 | 1,037 | 747,677 |
| **Rice** | 11 | 17 | 1 | 4 | 632 | 566 | 30 | 132 | 1,360 | 580 | 788,800 |
| **Soybeans** | 13 | 46 | 10 | 25 | 746 | 1,530 | 298 | 828 | 3,402 | 253 | 860,706 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,608 | 2,262 | 388 | 1,225 | 5,483 | | *2,397,183* |
| **BLH** | 45 | 16 | 71 | 33 | 2,584 | 532 | 2118 | 1,093 | 6,327 | 57 | *360,639* |
| **Acres Subtotal** | | | | | 4,192 | 2,794 | 2,506 | 2,318 | 11,810 | | *2,757,822* |
| **Other** | 27 | 16 | 16 | 30 | 1,549 | 533 | 477 | 993 | 3,552 | 0 | 0 |
| **Total acres** | | | | | 5,741 | 3,327 | 2,983 | 3,311 | 15,362 | | **2,757,822** |

**TABLE 8. PLAN 9, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| **Land Use** | **Percent Land Use** | | | | **Reach 1 Acres** | **Reach 2 Acres** | **Reach 3 Acres** | **Reach 4 Acres** | **Total Acres** | **DUD/acre** | **Total DUD (Acres X DUD/acre)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 170 | 102 | 48 | 192 | 512 | 1,037 | 520,944 |
| **Rice** | 11 | 17 | 1 | 4 | 469 | 347 | 24 | 96 | 936 | 580 | 542,880 |
| **Soybeans** | 13 | 46 | 10 | 25 | 554 | 939 | 240 | 599 | 2,332 | 253 | 589,996 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,193 | 1,388 | 312 | 887 | 3,780 | | *1,653,820* |
| **BLH** | 45 | 16 | 71 | 33 | 1,917 | 327 | 1,703 | 791 | 4,738 | 57 | *270,066* |
| **Acre Subtotal** | | | | | 3,110 | 1,715 | 2,015 | 1,678 | 8,518 | | *1,923,886* |
| **Other** | 27 | 16 | 16 | 30 | 1,159 | 326 | 384 | 718 | 2,587 | 0 | 0 |
| **Total Acres** | | | | | 4,259 | 2,041 | 2,399 | 2,396 | 11,095 | | **1,923,886** |

**TABLE 8. PLAN 10, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 181 | 120 | 48 | 211 | 560 | 1,037 | 580,720 |
| **Rice** | 11 | 17 | 1 | 4 | 498 | 407 | 24 | 106 | 1,035 | 580 | 600,300 |
| **Soybeans** | 13 | 46 | 10 | 25 | 589 | 1,101 | 237 | 660 | 2,587 | 253 | 654,511 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,268 | 1,628 | 309 | 977 | 4,182 | | *1,835,531* |
| **BLH** | 45 | 16 | 71 | 33 | 2,039 | 383 | 1,686 | 871 | 4,979 | 57 | *283,803* |
| **Acre Subtotal** | | | | | 3,307 | 2,011 | 1,995 | 1,848 | 9,161 | | *2,119,334* |
| **Other** | 27 | 16 | 16 | 30 | 1,224 | 383 | 379 | 790 | 2,776 | 0 | 0 |
| **Total acres** | | | | | 4,531 | 2,394 | 2,374 | 2,638 | 11,937 | | **2,119,334** |

## TABLE 8. PLAN 11, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 235 | 168 | 61 | 271 | 735 | 1,037 | 762,195 |
| **Rice** | 11 | 17 | 1 | 4 | 646 | 572 | 30 | 135 | 1,383 | 580 | 802,140 |
| **Soybeans** | 13 | 46 | 10 | 25 | 763 | 1,547 | 304 | 846 | 3,460 | 253 | 875,380 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,644 | 2,287 | 395 | 1,252 | 5,578 | | *2,439,715* |
| **BLH** | 45 | 16 | 71 | 33 | 2,642 | 538 | 2,158 | 1,117 | 6,455 | 57 | *367,935* |
| **Acres Subtotal** | | | | | 4,286 | 2,825 | 2,553 | 2,369 | 12,033 | | *2,087,650* |
| **Other** | 27 | 16 | 16 | 30 | 1,584 | 539 | 487 | 1,015 | 3,625 | 0 | 0 |
| **Total acres** | | | | | 5,870 | 3,364 | 3,040 | 3,384 | 15,658 | | **2,807,650** |

**TABLE 8. PLAN 12, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 170 | 102 | 48 | 192 | 512 | 1,037 | 520,944 |
| **Rice** | 11 | 17 | 1 | 4 | 469 | 347 | 24 | 96 | 936 | 580 | 542,880 |
| **Soybeans** | 13 | 46 | 10 | 25 | 554 | 939 | 240 | 599 | 2,332 | 253 | 589,996 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,193 | 1,388 | 312 | 887 | 3,780 | | *1,653,820* |
| **BLH** | 45 | 16 | 71 | 33 | 1,917 | 327 | 1,703 | 791 | 4,738 | 57 | *270,066* |
| **Acre Subtotal** | | | | | 3,110 | 1,715 | 2,015 | 1,678 | 8,518 | | *1,923,886* |
| **Other** | 27 | 16 | 16 | 30 | 1,159 | 326 | 384 | 718 | 2,587 | 0 | 0 |
| **Total Acres** | | | | | 4,259 | 2,041 | 2,399 | 2,396 | 11,095 | | **1,923,886** |

**TABLE 8. PLAN 13, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 181 | 120 | 48 | 211 | 560 | 1,037 | 580,720 |
| **Rice** | 11 | 17 | 1 | 4 | 498 | 407 | 24 | 106 | 1,035 | 580 | 600,300 |
| **Soybeans** | 13 | 46 | 10 | 25 | 589 | 1,101 | 237 | 660 | 2,587 | 253 | 654,511 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,268 | 1,628 | 309 | 977 | 4,182 | | *1,835,531* |
| **BLH** | 45 | 16 | 71 | 33 | 2,039 | 383 | 1,686 | 871 | 4,979 | 57 | *283,803* |
| **Acre Subtotal** | | | | | 3,307 | 2,011 | 1,995 | 1,848 | 9,161 | | *2,119,334* |
| **Other** | 27 | 16 | 16 | 30 | 1,224 | 383 | 379 | 790 | 2,776 | 0 | 0 |
| **Total acres** | | | | | 4,531 | 2,394 | 2,374 | 2,638 | 11,937 | | **2,119,334** |

## TABLE 8. PLAN 14, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 235 | 168 | 61 | 271 | 735 | 1,037 | 762,195 |
| **Rice** | 11 | 17 | 1 | 4 | 646 | 572 | 30 | 135 | 1,383 | 580 | 802,140 |
| **Soybeans** | 13 | 46 | 10 | 25 | 763 | 1,547 | 304 | 846 | 3,460 | 253 | 875,380 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,644 | 2,287 | 395 | 1,252 | 5,578 | | *2,439,715* |
| **BLH** | 45 | 16 | 71 | 33 | 2,642 | 538 | 2,158 | 1,117 | 6,455 | 57 | *367,935* |
| **Acres Subtotal** | | | | | 4,286 | 2,825 | 2,553 | 2,369 | 12,033 | | *2,087,650* |
| **Other** | 27 | 16 | 16 | 30 | 1,584 | 539 | 487 | 1,015 | 3,625 | 0 | 0 |
| **Total acres** | | | | | 5,870 | 3,364 | 3,040 | 3,384 | 15,658 | | **2,807,650** |

## TABLE 8. PLAN 15, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 | Reach 2 | Reach 3 | Reach 4 | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 163 | 100 | 47 | 184 | 494 | 1,037 | 512,278 |
| **Rice** | 11 | 17 | 1 | 4 | 448 | 341 | 23 | 92 | 904 | 580 | 524,320 |
| **Soybeans** | 13 | 46 | 10 | 25 | 530 | 921 | 232 | 576 | 2,259 | 253 | 571,527 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,141 | 1,362 | 302 | 852 | 3,657 | | *1,608,125* |
| **BLH** | 45 | 16 | 71 | 33 | 1,834 | 321 | 1,649 | 760 | 4,564 | 57 | *260,148* |
| **Acre Subtotal** | | | | | 2,975 | 1,683 | 1,951 | 1,612 | 8,221 | | *1,868,273* |
| **Other** | 27 | 16 | 16 | 30 | 1,101 | 320 | 372 | 691 | 2,484 | 0 | 0 |
| **Total acres** | | | | | 4,076 | 2,003 | 2,323 | 2,303 | 10,705 | | **1,868,273** |

**TABLE 8. PLAN 16, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 173 | 118 | 46 | 203 | 540 | 1,037 | 559,980 |
| **Rice** | 11 | 17 | 1 | 4 | 476 | 400 | 23 | 102 | 1,001 | 580 | 580,580 |
| **Soybeans** | 13 | 46 | 10 | 25 | 563 | 1,082 | 229 | 635 | 2,509 | 253 | 634,777 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,212 | 1,600 | 298 | 940 | 4,050 | | *1,775,337* |
| **BLH** | 45 | 16 | 71 | 33 | 1,948 | 376 | 1,627 | 838 | 4,789 | 57 | *272,973* |
| **Acre Subtotal** | | | | | 3,160 | 1,976 | 1,925 | 1,778 | 8,839 | | *2,048,310* |
| **Other** | 27 | 16 | 16 | 30 | 1,169 | 375 | 367 | 762 | 2,673 | 0 | 0 |
| **Total acres** | | | | | 4,329 | 2,351 | 2,292 | 2,540 | 11,512 | | **2,048,310** |

## TABLE 8. PLAN 17, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 226 | 166 | 59 | 263 | 714 | 1,037 | 740,418 |
| **Rice** | 11 | 17 | 1 | 4 | 621 | 564 | 29 | 131 | 1,345 | 580 | 780,100 |
| **Soybeans** | 13 | 46 | 10 | 25 | 734 | 1,526 | 294 | 820 | 3,374 | 253 | 853,622 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,581 | 2,256 | 382 | 1,214 | 5,433 | | *2,374,140* |
| **BLH** | 45 | 16 | 71 | 33 | 2,542 | 531 | 2,088 | 1,083 | 6,244 | 57 | *355,908* |
| **Acre Subtotal** | | | | | 4,123 | 2,787 | 2,470 | 2,297 | 11,677 | | *2,730,048* |
| **Other** | 27 | 16 | 16 | 30 | 1,525 | 530 | 471 | 984 | 3,510 | 0 | 0 |
| **Total acres** | | | | | 5,648 | 3,317 | 2,941 | 3,281 | 15,187 | | **2,730,048** |

**TABLE 8. PLAN 18, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 163 | 100 | 47 | 184 | 494 | 1,037 | 512,278 |
| **Rice** | 11 | 17 | 1 | 4 | 448 | 341 | 23 | 92 | 904 | 580 | 524,320 |
| **Soybeans** | 13 | 46 | 10 | 25 | 530 | 921 | 232 | 576 | 2,259 | 253 | 571,527 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,141 | 1,362 | 302 | 852 | 3,657 | | *1,608,125* |
| **BLH** | 45 | 16 | 71 | 33 | 1,834 | 321 | 1,649 | 760 | 4,564 | 57 | *260,148* |
| **Acre Subtotal** | | | | | 2,975 | 1,683 | 1,951 | 1,612 | 8,221 | | *1,868,273* |
| **Other** | 27 | 16 | 16 | 30 | 1,101 | 320 | 372 | 691 | 2,484 | 0 | 0 |
| **Total acres** | | | | | 4,076 | 2,003 | 2,323 | 2,303 | 10,705 | | **1,868,273** |

## TABLE 8. PLAN 19, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 173 | 118 | 46 | 203 | 540 | 1,037 | 559,980 |
| **Rice** | 11 | 17 | 1 | 4 | 476 | 400 | 23 | 102 | 1,001 | 580 | 580,580 |
| **Soybeans** | 13 | 46 | 10 | 25 | 563 | 1,082 | 229 | 635 | 2,509 | 253 | 634,777 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,212 | 1,600 | 298 | 940 | 4,050 | | *1,775,337* |
| **BLH** | 45 | 16 | 71 | 33 | 1,948 | 376 | 1,627 | 838 | 4,789 | 57 | *272,973* |
| **Acre Subtotal** | | | | | 3,160 | 1,976 | 1,925 | 1,778 | 8,839 | | *2,048,310* |
| **Other** | 27 | 16 | 16 | 30 | 1,169 | 375 | 367 | 762 | 2,673 | 0 | 0 |
| **Total acres** | | | | | 4,329 | 2,351 | 2,292 | 2,540 | 11,512 | | **2,048,310** |

**TABLE 8. PLAN 20, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 226 | 166 | 59 | 263 | 714 | 1,037 | 740,418 |
| **Rice** | 11 | 17 | 1 | 4 | 621 | 564 | 29 | 131 | 1,345 | 580 | 780,100 |
| **Soybeans** | 13 | 46 | 10 | 25 | 734 | 1,526 | 294 | 820 | 3,374 | 253 | 853,622 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,581 | 2,256 | 382 | 1,214 | 5,433 | | *2,374,140* |
| **BLH** | 45 | 16 | 71 | 33 | 2,542 | 531 | 2,088 | 1,083 | 6,244 | 57 | *355,908* |
| **Acre Subtotal** | | | | | 4,123 | 2,787 | 2,470 | 2,297 | 11,677 | | *2,730,048* |
| **Other** | 27 | 16 | 16 | 30 | 1,525 | 530 | 471 | 984 | 3,510 | 0 | 0 |
| **Total acres** | | | | | 5,648 | 3,317 | 2,941 | 3,281 | 15,187 | | **2,730,048** |

## TABLE 8. PLAN 21, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 169 | 102 | 48 | 191 | 510 | 1,037 | 528,870 |
| **Rice** | 11 | 17 | 1 | 4 | 464 | 346 | 24 | 96 | 930 | 580 | 539,400 |
| **Soybeans** | 13 | 46 | 10 | 25 | 548 | 937 | 240 | 598 | 2,323 | 253 | 587,719 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,181 | 1,385 | 312 | 885 | 3,763 | | *1,655,989* |
| **BLH** | 45 | 16 | 71 | 33 | 1,897 | 326 | 1,701 | 789 | 4,713 | 57 | *268,641* |
| **Acre Subtotal** | | | | | 3,078 | 1,711 | 2,013 | 1,674 | 8,476 | | *1,924,630* |
| **Other** | 27 | 16 | 16 | 30 | 1,137 | 326 | 382 | 716 | 2,561 | 0 | 0 |
| **Total acres** | | | | | 4,215 | 2,037 | 2,395 | 2,390 | 11,037 | | **1,924,630** |

**TABLE 8. PLAN 22, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 180 | 120 | 47 | 211 | 558 | 1,037 | 578,646 |
| **Rice** | 11 | 17 | 1 | 4 | 494 | 407 | 24 | 105 | 1,030 | 580 | 597,400 |
| **Soybeans** | 13 | 46 | 10 | 25 | 584 | 1,100 | 237 | 658 | 2,579 | 253 | 652,487 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,258 | 1,627 | 308 | 974 | 4,167 | | *1,828,533* |
| **BLH** | 45 | 16 | 71 | 33 | 2,021 | 383 | 1,684 | 868 | 4,956 | 57 | *282,492* |
| **Acre Subtotal** | | | | | 3,279 | 2,010 | 1,992 | 1,842 | 9,123 | | *2,111,025* |
| **Other** | 27 | 16 | 16 | 30 | 1,213 | 381 | 380 | 789 | 2,763 | 0 | 0 |
| **Total acres** | | | | | 4,492 | 2,391 | 2,372 | 2,631 | 11,886 | | **2,111,025** |

## TABLE 8. PLAN 23, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 233 | 168 | 61 | 270 | 732 | 1,037 | 759,084 |
| **Rice** | 11 | 17 | 1 | 4 | 641 | 571 | 30 | 135 | 1,377 | 580 | 798,660 |
| **Soybeans** | 13 | 46 | 10 | 25 | 758 | 1,545 | 304 | 844 | 3,451 | 253 | 873,103 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,632 | 2,284 | 395 | 1,249 | 5,560 | | *2,430,847* |
| **BLH** | 45 | 16 | 71 | 33 | 2,623 | 537 | 2,155 | 1,114 | 6,429 | 57 | *366,453* |
| **Acre Subtotal** | | | | | 4,255 | 2,821 | 2,550 | 2,363 | 11,989 | | 2,797,300 |
| **Other** | 27 | 16 | 16 | 30 | 1,574 | 538 | 485 | 1,013 | 3,610 | 0 | 0 |
| **Total acres** | | | | | 5,829 | 3,359 | 3,035 | 3,376 | 15,599 | | **2,797,300** |

**TABLE 8. PLAN 24, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 169 | 102 | 48 | 191 | 510 | 1,037 | 528,870 |
| **Rice** | 11 | 17 | 1 | 4 | 464 | 346 | 24 | 96 | 930 | 580 | 539,400 |
| **Soybeans** | 13 | 46 | 10 | 25 | 548 | 937 | 240 | 598 | 2,323 | 253 | 587,719 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,181 | 1,385 | 312 | 885 | 3,763 | | *1,655,989* |
| **BLH** | 45 | 16 | 71 | 33 | 1,897 | 326 | 1,701 | 789 | 4,713 | 57 | *268,641* |
| **Acre Subtotal** | | | | | 3,078 | 1,711 | 2,013 | 1,674 | 8,476 | | *1,924,630* |
| **Other** | 27 | 16 | 16 | 30 | 1,137 | 326 | 382 | 716 | 2,561 | 0 | 0 |
| **Total acres** | | | | | 4,215 | 2,037 | 2,395 | 2,390 | 11,037 | | **1,924,630** |

**TABLE 8. PLAN 25, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 180 | 120 | 47 | 211 | 558 | 1,037 | 578,646 |
| **Rice** | 11 | 17 | 1 | 4 | 494 | 407 | 24 | 105 | 1,030 | 580 | 597,400 |
| **Soybeans** | 13 | 46 | 10 | 25 | 584 | 1,100 | 237 | 658 | 2,579 | 253 | 652,487 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,258 | 1,627 | 308 | 974 | 4,167 | | *1,828,533* |
| **BLH** | 45 | 16 | 71 | 33 | 2,021 | 383 | 1,684 | 868 | 4,956 | 57 | *282,492* |
| **Acre Subtotal** | | | | | 3,279 | 2,010 | 1,992 | 1,842 | 9,123 | | *2,111,025* |
| **Other** | 27 | 16 | 16 | 30 | 1,213 | 381 | 380 | 789 | 2,763 | 0 | 0 |
| **Total acres** | | | | | 4,492 | 2,391 | 2,372 | 2,631 | 11,886 | | **2,111,025** |

## TABLE 8. PLAN 26, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 233 | 168 | 61 | 270 | 732 | 1,037 | 759,084 |
| **Rice** | 11 | 17 | 1 | 4 | 641 | 571 | 30 | 135 | 1,377 | 580 | 798,660 |
| **Soybeans** | 13 | 46 | 10 | 25 | 758 | 1,545 | 304 | 844 | 3,451 | 253 | 873,103 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,632 | 2,284 | 395 | 1,249 | 5,560 | | *2,430,847* |
| **BLH** | 45 | 16 | 71 | 33 | 2,623 | 537 | 2,155 | 1,114 | 6,429 | 57 | *366,453* |
| **Acre Subtotal** | | | | | 4,255 | 2,821 | 2,550 | 2,363 | 11,989 | | 2,797,300 |
| **Other** | 27 | 16 | 16 | 30 | 1,574 | 538 | 485 | 1,013 | 3,610 | 0 | 0 |
| **Total acres** | | | | | 5,829 | 3,359 | 3,035 | 3,376 | 15,599 | | **2,797,300** |

## TABLE 8. PLAN 27, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| **Land Use** | **Percent Land Use** | | | | **Reach 1 Acres** | **Reach 2 Acres** | **Reach 3 Acres** | **Reach 4 Acres** | **Total Acres** | **DUD/acre** | **Total DUD (Acres X DUD/acre)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 166 | 100 | 47 | 186 | 499 | 1,037 | 517,463 |
| **Rice** | 11 | 17 | 1 | 4 | 456 | 341 | 23 | 93 | 913 | 580 | 529,540 |
| **Soybeans** | 13 | 46 | 10 | 25 | 538 | 921 | 234 | 582 | 2,275 | 253 | 575,575 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,160 | 1,362 | 304 | 861 | 3,687 | | *1,622,578* |
| **BLH** | 45 | 16 | 71 | 33 | 1,864 | 321 | 1,664 | 768 | 4,617 | 57 | *263,169* |
| **Acre Subtotal** | | | | | 3,024 | 1,683 | 1,968 | 1,630 | 8,305 | | |
| **Other** | 27 | 16 | 16 | 30 | 1,117 | 320 | 375 | 698 | 2,510 | 0 | 0 |
| **Total acres** | | | | | 4,141 | 2,003 | 2,343 | 2,328 | 10,815 | | **1,885,747** |

**TABLE 8. PLAN 28, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 163 | 100 | 46 | 184 | 493 | 1,037 | 511,241 |
| **Rice** | 11 | 17 | 1 | 4 | 448 | 339 | 23 | 92 | 902 | 580 | 523,160 |
| **Soybeans** | 13 | 46 | 10 | 25 | 529 | 918 | 231 | 575 | 2,253 | 253 | 570,009 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,140 | 1,357 | 300 | 851 | 3,648 | | *1,604,410* |
| **BLH** | 45 | 16 | 71 | 33 | 1,832 | 319 | 1,642 | 759 | 4,552 | 57 | *259,464* |
| **Acre Subtotal** | | | | | 2,972 | 1,676 | 1,942 | 1,610 | 8,200 | | *1,863,874* |
| **Other** | 27 | 16 | 16 | 30 | 1,099 | 319 | 371 | 689 | 2,478 | 0 | 0 |
| **Total acres** | | | | | 4,071 | 1,995 | 2,313 | 2,299 | 10,678 | | **1,863,874** |

**TABLE 8. PLAN 29, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 116 | 93 | 42 | 182 | 433 | 1,037 | 449,021 |
| **Rice** | 11 | 17 | 1 | 4 | 320 | 316 | 21 | 91 | 748 | 580 | 433,840 |
| **Soybeans** | 13 | 46 | 10 | 25 | 378 | 856 | 209 | 570 | 2,013 | 253 | 509,289 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 814 | 1,265 | 272 | 843 | 3,194 | | *1,392,150* |
| **BLH** | 45 | 16 | 71 | 33 | 1,310 | 298 | 1,484 | 752 | 3,844 | 57 | *219,108* |
| **Acre Subtotal** | | | | | 2,124 | 1,563 | 1,756 | 1,595 | 7,038 | | *1,611,258* |
| **Other** | 27 | 16 | 16 | 30 | 786 | 297 | 334 | 685 | 2,102 | 0 | 0 |
| **Total acres** | | | | | 2,910 | 1,860 | 2,090 | 2,280 | 9,140 | | **1,611,258** |

**TABLE 8. PLAN 30, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 166 | 100 | 47 | 186 | 499 | 1,037 | 517,463 |
| **Rice** | 11 | 17 | 1 | 4 | 456 | 341 | 23 | 93 | 913 | 580 | 529,540 |
| **Soybeans** | 13 | 46 | 10 | 25 | 538 | 921 | 234 | 582 | 2,275 | 253 | 575,575 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,160 | 1,362 | 304 | 861 | 3,687 | | *1,622,578* |
| **BLH** | 45 | 16 | 71 | 33 | 1,864 | 321 | 1,664 | 768 | 4,617 | 57 | *263,169* |
| **Acre Subtotal** | | | | | 3,024 | 1,683 | 1,968 | 1,630 | 8,305 | | |
| **Other** | 27 | 16 | 16 | 30 | 1,117 | 320 | 375 | 698 | 2,510 | 0 | 0 |
| **Total acres** | | | | | 4,141 | 2,003 | 2,343 | 2,328 | 10,815 | | **1,885,747** |

**TABLE 8. PLAN 31, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 299 | 129 | 85 | 266 | 779 | 1,037 | 807,823 |
| **Rice** | 11 | 17 | 1 | 4 | 823 | 440 | 43 | 133 | 1,439 | 580 | 834,620 |
| **Soybeans** | 13 | 46 | 10 | 25 | 972 | 1,189 | 425 | 831 | 3,417 | 253 | 864,501 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 2,094 | 1,758 | 553 | 1,230 | 5,635 | | *2,506,944* |
| **BLH** | 45 | 16 | 71 | 33 | 3,365 | 414 | 3,015 | 1,097 | 7,891 | 57 | *449,787* |
| **Acre Subtotal** | | | | | 5,459 | 2,172 | 3,568 | 2,327 | 13,526 | | *2,956,731* |
| **Other** | 27 | 16 | 16 | 30 | 2,019 | 413 | 680 | 997 | 4,109 | 0 | 0 |
| **Total acres** | | | | | 7,478 | 2,585 | 4,248 | 3,324 | 17,635 | | **2,956,731** |

**TABLE 8. PLAN 32, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 174 | 107 | 50 | 196 | 527 | 1,037 | 546,499 |
| **Rice** | 11 | 17 | 1 | 4 | 478 | 363 | 25 | 98 | 964 | 580 | 559,120 |
| **Soybeans** | 13 | 46 | 10 | 25 | 565 | 983 | 251 | 612 | 2,411 | 253 | 609,983 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,217 | 1,453 | 326 | 906 | 3,902 | | *1,715,602* |
| **BLH** | 45 | 16 | 71 | 33 | 1,956 | 342 | 1,779 | 806 | 4,883 | 57 | *278,331* |
| **Acre Subtotal** | | | | | 3,173 | 1,795 | 2,105 | 1,712 | 8,785 | | *1,993,933* |
| **Other** | 27 | 16 | 16 | 30 | 1,174 | 342 | 400 | 735 | 2,651 | 0 | 0 |
| **Total acres** | | | | | 4,347 | 2,137 | 2,505 | 2,447 | 11,436 | | **1,993,933** |

## TABLE 8. PLAN 33, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 181 | 109 | 50 | 201 | 541 | 1,037 | 561,017 |
| **Rice** | 11 | 17 | 1 | 4 | 497 | 370 | 25 | 100 | 992 | 580 | 575,360 |
| **Soybeans** | 13 | 46 | 10 | 25 | 587 | 1,000 | 252 | 627 | 2,466 | 253 | 623,898 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,265 | 1,479 | 327 | 928 | 3,999 | | *1,760,275* |
| **BLH** | 45 | 16 | 71 | 33 | 2,031 | 348 | 1,791 | 827 | 4,997 | 57 | *284,829* |
| **Acre Subtotal** | | | | | 3,296 | 1,827 | 2,118 | 1,755 | 8,996 | | 2,045,104 |
| **Other** | 27 | 16 | 16 | 30 | 1,218 | 347 | 404 | 751 | 2,720 | 0 | 0 |
| **Total acres** | | | | | 4,514 | 2,174 | 2,522 | 2,506 | 11,716 | | **2,045,104** |

**TABLE 8. PLAN 34, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 220 | 130 | 54 | 241 | 645 | 1,037 | 668,865 |
| **Rice** | 11 | 17 | 1 | 4 | 605 | 443 | 27 | 121 | 1,196 | 580 | 693,680 |
| **Soybeans** | 13 | 46 | 10 | 25 | 714 | 1,198 | 271 | 754 | 2,937 | 253 | 743,061 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,539 | 1,771 | 352 | 1,116 | 4,778 | | *2,105,606* |
| **BLH** | 45 | 16 | 71 | 33 | 2,473 | 417 | 1,926 | 995 | 5,811 | 57 | *331,227* |
| **Acre Subtotal** | | | | | 4,012 | 2,188 | 2,278 | 2,111 | 10,589 | | *2,436,833* |
| **Other** | 27 | 16 | 16 | 30 | 1,483 | 417 | 435 | 904 | 3,239 | 0 | 0 |
| **Total acres** | | | | | 5,495 | 2,605 | 2,713 | 3,015 | 13,828 | | **2,436,833** |

**TABLE 8. PLAN 35, CALCULATION OF DUCK USE DAYS, WITHOUT REFORESTATION.**

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 215 | 129 | 54 | 238 | 636 | 1,037 | 659,532 |
| **Rice** | 11 | 17 | 1 | 4 | 591 | 438 | 27 | 119 | 1,175 | 580 | 681,500 |
| **Soybeans** | 13 | 46 | 10 | 25 | 699 | 1,185 | 270 | 743 | 2,897 | 253 | 732,941 |
| **Crop Subtotal** | 28 | 68 | 13 | 37 | 1,505 | 1,752 | 351 | 1,100 | 4,708 | | *2,073,973* |
| **BLH** | 45 | 16 | 71 | 33 | 2,418 | 412 | 1,922 | 980 | 5,732 | 57 | *326,724* |
| **Acre Subtotal** | | | | | 3,923 | 2,164 | 2,273 | 2,080 | 10,440 | | *2,400,697* |
| **Other** | 27 | 16 | 16 | 30 | 1,450 | 413 | 434 | 890 | 3,187 | 0 | 0 |
| **Total acres** | | | | | 5,373 | 2,577 | 2,707 | 2,970 | 13,627 | | **2,400,697** |

**TABLE 9. GAINS OR LOSSES IN DUCK-USE-DAYS FOR EACH PLAN COMPARED TO BASELINE CONDITIONS BASED ON THE CORPS FUTURE WITHOUT-PROJECT PROJECTION.**

| Plans | DUD w/o Reforest.[1] | Acres to Reforest [2] | DUD with Reforest.[3] | Plan Total DUD [4] | Baseline Conditions [5] | Change in DUD [6] |
|---|---|---|---|---|---|---|
| Plan 1 | 2,074,371 | 0 | NA | 2,074,371 | 2,074,371 | 0 |
| Plan 2 | 2,074,371 | 4,050 | 959,850 | 1,249,866 | 2,074,371 | - 824,505 |
| Plan 3 | 1,890,285 | 0 | NA | 1,890,285 | 2,074,371 | - 184,086 |
| Plan 4 | 2,068,950 | 0 | NA | 2,068,950 | 2,074,371 | - 5,421 |
| Plan 5 | 2,757,822 | 0 | NA | 2,757,822 | 2,074,371 | 683,451 |
| Plan 6 | 1,890,285 | 3,697 | 876,189 | 1,139,928 | 2,074,371 | - 934,443 |
| Plan 7 | 2,068,950 | 4,087 | 968,619 | 1,245,354 | 2,074,371 | - 839,682 |
| Plan 8 | 2,757,822 | 5,483 | 1,299,471 | 1,660,110 | 2,074,371 | -829,017 |
| Plan 9 | 1,923,886 | 0 | NA | 1,923,886 | 2,074,371 | - 150,485 |
| Plan 10 | 2,119,334 | 0 | NA | 2,119,334 | 2,074,371 | 44,963 |
| Plan 11 | 2,807,650 | 0 | NA | 2,807,650 | 2,074,371 | 733,279 |
| Plan 12 | 1,923,886 | 3,780 | 895,860 | 1,165,926 | 2,074,371 | - 908,445 |
| Plan 13 | 2,119,334 | 4,182 | 991,134 | 1,274,937 | 2,074,371 | - 799,434 |
| Plan 14 | 2,807,650 | 5,578 | 1,321,986 | 1,689,921 | 2,074,371 | - 384,450 |
| Plan 15 | 1,868,273 | 0 | NA | 1,868,273 | 2,074,371 | - 206,098 |
| Plan 16 | 2,048,310 | 0 | NA | 2,048,310 | 2,074,371 | - 26,061 |
| Plan 17 | 2,730,048 | 0 | NA | 2,730,048 | 2,074,371 | 655,677 |
| Plan 18 | 1,868,273 | 3,657 | 866,709 | 1,126,857 | 2,074,371 | - 947,514 |
| Plan 19 | 2,048,310 | 4,050 | 959,850 | 1,232,823 | 2,074,371 | -841,548 |
| Plan 20 | 2,730,048 | 5,433 | 1,287,621 | 1,643,529 | 2,074,371 | - 430,842 |

[1] DUD w/o reforestation = DUD for cleared land + DUD for existing BLH.
[2] Acres to reforest = all acres of available cropland.
[3] DUD with reforestation = determined using 70% red oaks at 237 DUD/acre.
[4] Plan Total DUD = DUD from acres of reforestation + DUD from acres of existing BLH.
[5] Baseline Conditions = Corps future without-project conditions.
[6] Change in DUD = Plan total DUD - Baseline DUD = plan's impact on waterfowl foraging habitat. These losses of DUD are due to reforestation. Reforestation provides fewer DUD than cropland (soybeans).

**TABLE 9. GAINS OR LOSSES IN DUCK-USE-DAYS FOR EACH PLAN COMPARED TO BASELINE CONDITIONS BASED ON THE CORPS FUTURE WITHOUT-PROJECT PROJECTION.**

| Plans | DUD w/o Reforest.[1] | Acres to Reforest.[2] | DUD with Reforest.[3] | Plan Total DUD [4] | Baseline Conditions [5] | Change in DUD [6] |
|---|---|---|---|---|---|---|
| Plan 21 | 1,924,630 | 0 | NA | 1,924,630 | 2,074,371 | - 149,741 |
| Plan 22 | 2,111,025 | 0 | NA | 2,111,025 | 2,074,371 | 36,654 |
| Plan 23 | 2,797,300 | 0 | NA | 2,797,300 | 2,074,371 | 722,929 |
| Plan 24 | 1,924,630 | 3,763 | 891,831 | 1,160,472 | 2,074,371 | - 913,899 |
| Plan 25 | 2,111,025 | 4,167 | 987,579 | 1,270,071 | 2,074,371 | - 804,300 |
| Plan 26 | 2,797,300 | 5,560 | 1,317,720 | 1,684,173 | 2,074,371 | - 390,198 |
| Plan 27 | 1,885,747 | 0 | NA | 1,885,747 | 2,074,371 | - 188,624 |
| Plan 28 | 1,863,874 | 0 | NA | 1,863,874 | 2,074,371 | - 210,497 |
| Plan 29 | 1,611,258 | 0 | NA | 1,611,258 | 2,074,371 | -463,113 |
| Plan 30 | 1,885,747 | 0 | NA | 1,885,747 | 2,074,371 | -188,624 |
| Plan 31 | 2,956,731 | 5,635 | 1,335,495 | 1,785,282 | 2,074,371 | - 289,089 |
| Plan 32 | 1,993,933 | 3,902 | 924,774 | 1,203,105 | 2,074,371 | - 871,266 |
| Plan 33 | 2,045,104 | 3,999 | 947,763 | 1,232,592 | 2,074,371 | - 841,779 |
| Plan 34 | 2,436,833 | 4,778 | 1,132,386 | 1,463,613 | 2,074,371 | - 610,758 |
| Plan 35 | 2,400,697 | 4,708 | 1,115,796 | 1,442,520 | 2,074,371 | - 631,851 |

[1] DUD w/o reforestation = DUD for cleared land + DUD for existing BLH.
[2] Acres to reforest = all acres of available cropland.
[3] DUD with reforestation = determined using 70% red oaks at 237 DUD/acre.
[4] Plan Total DUD = DUD from acres of reforestation + DUD from acres of existing BLH.
[5] Baseline Conditions = Corps future without-project conditions.
[6] Change in DUD = Plan total DUD - Baseline DUD = plan's impact on waterfowl foraging habitat. These losses of DUD are due to reforestation. Reforestation provides fewer DUD than cropland (soybeans).

**Service's Future Without-Project Analysis**

Because there is a high degree of risk and uncertainty associated with the Corps FWOP projection (no change over existing conditions for the 50-year project life), the Service's planning team developed an alternative future without-project forecast and it is incorporated by reference as a co-equal scenario in evaluating the impacts of all project alternatives, including the Corps' tentatively selected plan (Plan 32) (U.S. Fish and Wildlife Service 1999c).

The results of the Service's FWOP analysis showed that approximately 70 percent (30,293 acres) of the 43,432 acres of reforestation is projected to occur within Zone 1 (somewhat poorly to very poorly drained soils within the area inundated by backwater flooding at the 2-year frequency event) (U.S. Fish and Wildlife Service 1999c). Several assumptions were made to incorporate the Service's FWOP projection of 43,432 acres of cleared, frequently flooded agricultural lands being reforested over the next 50 years into this waterfowl impact analysis. The first assumption was that the acres of reforested wintering waterfowl foraging habitat would occur in Reaches 1 and 2 (primarily Sharkey and Issaquena Counties, within the frequently flooded areas of the lower and upper sump). Reach 3 is primarily Delta National Forest and has very few acres of cleared land available for reforestation and Reach 4 is comprised of cleared land, but at higher elevations than Reaches 1 or 2. The second assumption was that 3.8 percent (1,148 acres) of the cleared acres available with the Service's FWOP (30,293 acres) would be reforested with red oaks (70 percent survival) and provide 237 DUD/acre, or a total of 272,076 DUD (1,148 acres X 237 DUD/acre = 272,076 DUD). The percent of reforestation that would be flooded 18 inches deep or less during the waterfowl season was determined from the Corps hydrology analysis. This analysis showed that approximately 3.8 percent (4,066 acres) of the cleared land within the two-year flood event (107,000 acres) provides suitable wintering waterfowl foraging habitat. It was assumed that this same percentage would apply to the Service's FWOP.

Duck-use-days for the Service's FWOP projection are presented in (Table 10). The calculations show that under this FWOP, a total of 2,056,003 DUD would exist at the end of the 50-year period of analysis (1,493,911 DUD from cropland + 290,016 DUD from existing BLH + 272,076 DUD from reforesting 1,148 acres of cleared land). This represents a decrease of 18,368 DUD compared to the Corp's baseline condition, because reforesting bottomland hardwoods provide fewer DUD than would be available in agricultural fields. The Service's FWOP projection provides fewer DUD than the Corps' FWOP projection (existing conditions). Therefore, there will be no DUD foregone considering the Service's FWOP projection (i.e.., existing waterfowl foraging conditions are better under the Corps' FWOP than the Service's FWOP). It should be noted that quantifying food availability and consumption by waterfowl in shallow water (18 inches deep or less) represents one facet of waterfowl biology. It also represents approximately 50 percent of waterfowl habitat requirements. The availability of winter water at depths greater than 18 inches and for other uses, i.e., loafing and pair bonding, is equally important. The

## TABLE 10. DUCK-USE DAYS AVAILABLE UNDER THE FWS FUTURE WITHOUT-PROJECT CONDITION.

| Land Use | Percent Land Use | | | | Reach 1 Acres | Reach 2 Acres | Reach 3 Acres | Reach 4 Acres | Total Acres | DUD/acre | Total DUD (Acres X DUD/acre) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | | | | | | | |
| **Fallow Fields** | 4 | 5 | 2 | 8 | 186 | 109 | 51 | 203 | 549 | 1,037 | 569,313 |
| **Rice** | 11 | 17 | 1 | 4 | 510 | 370 | 26 | 101 | 1,007 | 580 | 584,060 |
| **Soybeans** | 0 | 21 | 10 | 25 | 0 | 457 | 256 | 633 | 1,346 | 253 | 340,538 |
| **Crop Subtotal** | 15 | 43 | 13 | 37 | 696 | 937 | 333 | 937 | 2,903 | | *1,493,911* |
| **Baseline BLH** | 45 | 16 | 71 | 33 | 2,088 | 349 | 1,815 | 836 | 5,088 | 57 | *(57 X 5088) = 290,016* |
| **FWOP BLH** | 13 | 25 | 0 | 0 | 603 | 545 | 0 | 0 | 1,148 | 237 | *(237 X 1,148) = 272,076* |
| **Acres Subtotal** | | | | | 3,387 | 1,830 | 2,148 | 1,773 | 9,138 | | *2,056,003* |
| **Other** | 27 | 17 | 16 | 30 | 1,253 | 349 | 408 | 759 | 2,769 | 0 | 0 |
| **Total Acres** | | | | | 4,640 | 2,179 | 2,556 | 2,532 | 11,907 | | **2,056,003** |

vertical structure provided by trees is also important for cover, notably absent from agricultural fields. Lastly, the benefits of reforestation meet the habitat requirements of many other species dependent on wooded wetlands.

### Final Array of Alternatives

The initial array of 35 alternatives was further reduced by the Corps' economic analysis, resulting in a final array of 7 alternatives (no action, nonstructural, NED, and 4 combination structural/nonstructural plans) (Table 11). The final array of alternatives were renumbered Plan 1 through Plan 7 and compared to the Corps' future with project conditions (Table 12). Comparing Plan 3 (NED, 1,885,747 DUD) to baseline conditions (Plan 1 No Action, 2,074,371 DUD) results in the loss of 188,624 DUD. The purely nonstructural alternative (Plan 2) resulted in a loss of 824,505 DUD. Plan 7, reforesting the same acreage as Plan 2 resulted in fewer losses of DUD (213,747 DUD) due to the effects of the hydrology restoration feature of this plan.

## CONCEPTUAL MITIGATION MEASURES

Depending on the alternative selected, wintering migratory waterfowl habitat losses could occur in all four reaches. The following discussion, which is conceptual, is intended to provide examples of how intensively managing wintering waterfowl habitat can both increase foraging habitat for wintering waterfowl and meet their broader ecological requirements.

### Reforestation

Reforestation is the Service's preferred mitigation technique for several reasons: 1) Reforestation constitutes an ecosystem approach to replacing the waterfowl values that would be lost through project construction. Instead of concentrating on implementing a mitigation feature aimed at primarily replacing the lost food values, reforestation would address all wintering waterfowl habitat requirements. In this appendix we have used food as an index of waterfowl habitat needs. Waterfowl are not able to divide their world and habitat needs into such specific compartments. A bottomland hardwood forest ecosystem provides food and other waterfowl habitat needs such as courtship sites, protection from predators and adverse weather, resting and roosting areas, and isolation from human disturbance. 2) Reforestation would provide a stable, low maintenance, high reliability mitigation feature. These mitigation features are supposed to last for the 50 year project life. Other mitigation techniques that would replace lost waterfowl food values, such as moist soil management areas, would require periodic maintenance and/or active operation in order to provide the predicted food supply.

**TABLE 11. FINAL ARRAY OF ALTERNATIVES.**

| Project Features | Plan 1[1] No Action | Plan 2 NS | Plan 3 NED | Plan 4 | Plan 5 TSP | Plan 6 | Plan 7 FWS |
|---|---|---|---|---|---|---|---|
| Non-structural Flood Damage Reduction Zone | NA | Below 91' | None | Below 85' | Below 87' | Below 88.5' | Below 91' |
| Pump Elevation | NA | NA | 80' | 85' | 87' | 88.5' | 91' |
| Pump Size | NA | NA | 14,000 cfs | 14,000 cfs | 14,000 cfs | 14,000 cfs | 14,000 cfs |
| Restoration Acreage | NA | >107,000 ac | None | 40,100 ac | 62,500 ac | 77,300 ac | 107,000 ac |
| Gate Closed Elevation | NA | NA | 75' | 75' | 75' | 87' | 87' |
| Hold Elevation | NA | NA | 70' | 70' | 70' | 73' | 73' |
| Mitigation Requirements | NA | None | Yes | Yes | None | None | None |
| Cleared Land Easements | NA | Yes | No | Yes | Yes | Yes | Yes |
| Woodland Easements | NA | Yes | No | No | No | No | Yes |

[1] Plans in the final array were re-numbered.
Plan 2 = Plan 33 (initial array)
Plan 3 = Plan 27 (initial array)
Plan 4 = Plan 6 (initial array)
Plan 5 = Plan 32 (initial array)
Plan 6 = Plan 35 (initial array)
Plan 7 = Plan 34 (initial array)

**TABLE 12. FUTURE WITH-PROJECT LOSS OR GAIN IN DUCK-USE-DAYS OF THE FINAL ARRAY OF ALTERNATIVES COMPARED TO THE CORPS FUTURE WITHOUT-PROJECT PROJECTION.**

| Plans | Baseline DUD [1] | Future with Plan DUD | Change in DUD with Plan compared to Baseline[2] |
|---|---|---|---|
| Plan 1 No Action | 2,074,371 | 2,074,371 | 0 |
| Plan 2 Non-Structural | 2,074,371 | 1,249,866 | -824,505 |
| Plan 3 NED | 2,074,371 | 1,885,747 | -188,624 |
| Plan 4 (85') | 2,074,371 | 1,139,928 | -934,443 |
| Plan 5 (87') | 2,074,371 | 1,203,105 | -871,266 |
| Plan 6 (88.5) | 2,074,371 | 1,442,520 | -631,851 |
| Plan 7 (91') | 2,074,371 | 1,463,613 | -610,758 |

[1] Baseline DUD = Corps FWOP.
[2] Losses of DUD are due to the effects of reforestation. Other benefits to wintering waterfowl would be realized from reforesting cleared land. Benefits would include isolation for pair bonding, better protection from disturbance and harassment than in more open areas, and protection from predation and extremes in weather conditions.

With constantly changing funding priorities a "no maintenance-no operation-self sustaining" mitigation feature is much more reliable and cost effective. 3) The chance of successful waterfowl habitat value replacement is highest with reforestation. Reforestation would create a system that would mimic the previously existing bottomland hardwood ecosystem, which historically had a proven record of providing high quality waterfowl habitat (Reinecke et al. 1989). 4) Application of the principles of landscape ecology dictate that we use reforestation as the primary mitigation technique. The project area contains large blocks of agricultural land and lacks large blocks of forested habitat. To establish ecosystem diversity, large blocks of forested habitat should be established. While meeting the goals of waterfowl, reforestation of large tracts of bottomland hardwood forests would also meet the needs of neotropical migratory birds many of which are declining (Hunter et al. 1993). Other management techniques would not benefit neotropical migratory birds. 5) Reforestation would also offset terrestrial and wetland losses. 6) Reforestation of marginal agricultural (farmed wetlands) or other cleared lands is easily accomplished. Actions required include direct seeding or planting seedlings and other activities ranging from extensive mowing and fertilization to only seed bed preparation.

Reforested mitigation areas should be subject to frequent and sustained winter flooding 18 inches deep or less. Forest stand composition should intentionally favor, but not be exclusively composed of, heavy seeded species dominated by red oaks for maximum benefits to wintering waterfowl. Table 13 shows the potential mitigation acres that would be required for the 28 plans that result in a loss of DUD. For example, using the Corps' FWOP (baseline conditions), if a mitigation site was reforested with red oak species with a seedling survival of 70 percent (237 DUD/acre), then the acres required to mitigate for impacts associated with the NED Alternative (Plan 3, final array) would be as follows: 188,624 DUD lost and 796 acres required to offset impacts. Through the use of water control structures, moist soil and rice fields could be used to offset impacts resulting from project construction, and further reduce the mitigation acres required. However, costly and intensive management would be required to achieve desired results with these two methods.

Based on costs recently developed by the Service and the Corps, seed bed preparation for either direct seeding or planting seedlings amounts to approximately $10 per acre using a bush-hog or $20 per acre using a disc (Mr. John Kaiser, Vicksburg District Corps, pers. comm.) Depending upon the availability of seeds or seedlings, planting costs are approximately $130 per acre. Bare root seedlings, purchased in lots of 100,000 or more, cost $135 per thousand; containerized seedlings cost $298 per thousand. Annual operation and maintenance costs vary from $1 to $20 per acre depending on the intensity of management efforts.

Benefits could be expected immediately due to the presence and availability of native moist soil plants in the newly planted "forest" and would gradually change to those benefits associated with forests dominated by red oaks and the associated invertebrate community.

**TABLE 13. PLANS THAT RESULT IN A LOSS OF DUCK-USE-DAYS AND THE POTENTIAL MITIGATION ACRES REQUIRED UNDER VARIOUS MANAGEMENT SCHEMES CONSIDERING THE CORPS FUTURE WITH AND WITHOUT-PROJECT PROJECTIONS.**

| | | Management Schemes | | | |
|---|---|---|---|---|---|
| Plans | Loss of DUD with Plan | Moist Soil @ 1,037 DUD/ac | Rice @ 580 DUD/ac | Soybean @ 253 DUD/ac | BLH @ 70% Red Oaks 237 DUD/ac |
| Plan 2 | - 824,505 | 795 | 1,422 | 3,259 | 3,379 |
| Plan 3 | - 184,086 | 178 | 317 | 728 | 777 |
| Plan 4 | - 5,421 | 5 | 9 | 21 | 23 |
| Plan 6 | -934,443 | 901 | 1,611 | 3,693 | 3,943 |
| Plan 7 | - 839,682 | 810 | 1,448 | 3,319 | 3,543 |
| Plan 8 | - 829,017 | 799 | 1,429 | 3,277 | 3,498 |
| Plan 9 | - 150,485 | 145 | 259 | 595 | 635 |
| Plan 12 | - 908,445 | 876 | 1,566 | 3,591 | 3,833 |
| Plan 13 | -799,434 | 771 | 1,378 | 3,160 | 3,373 |
| Plan 14 | -384,450 | 371 | 663 | 1,520 | 1,622 |
| Plan 15 | - 206,098 | 199 | 355 | 815 | 870 |
| Plan 16 | - 26,061 | 25 | 45 | 103 | 110 |
| Plan 18 | -947,514 | 914 | 1,634 | 3,745 | 3,998 |
| Plan 19 | -841,548 | 812 | 1,451 | 3,326 | 3,551 |
| Plan 20 | -430,842 | 415 | 743 | 1,703 | 1,818 |
| Plan 21 | - 149,741 | 144 | 258 | 592 | 632 |

**TABLE 13. PLANS THAT RESULT IN A LOSS OF DUCK-USE-DAYS AND THE POTENTIAL MITIGATION ACRES REQUIRED UNDER VARIOUS MANAGEMENT SCHEMES CONSIDERING THE CORPS FUTURE WITH AND WITHOUT-PROJECT PROJECTIONS.**

| | | Management Schemes | | | |
|---|---|---|---|---|---|
| Plans | Loss of DUD | Moist Soil @ 1,037 DUD/ac | Rice @ 580 DUD/ac | Soybean @ 253 DUD/ac | BLH @ 70% Red Oaks 237 DUD/ac |
| Plan 24 | -913,899 | 881 | 1,576 | 3,612 | 3,856 |
| Plan 25 | -804,300 | 776 | 1,387 | 3,179 | 3,394 |
| Plan 26 | - 390,198 | 376 | 673 | 1,542 | 1,646 |
| Plan 27 | - 188,624 | 182 | 325 | 746 | 796 |
| Plan 28 | - 214,645 | 207 | 370 | 848 | 906 |
| Plan 29 | - 463,113 | 447 | 798 | 1,830 | 1,954 |
| Plan 30 | - 188,624 | 182 | 325 | 746 | 796 |
| Plan 31 | - 289,089 | 279 | 498 | 1,143 | 1,220 |
| Plan 32 | - 871,266 | 840 | 1,502 | 3,444 | 3,676 |
| Plan 33 | -841,779 | 812 | 1,451 | 3,327 | 3,552 |
| Plan 34 | - 610,758 | 589 | 1,053 | 2,414 | 2,577 |
| Plan 35 | -631,851 | 609 | 1,089 | 2,497 | 2,666 |

## Average Annual Benefits

Mitigation values achieved would vary depending on the cover type established. Average annual duck-use-days/acre within the Project Area could be expected to range from 1,037 for a moist soil area exclusively devoted to wintering waterfowl, to 253 DUD/acre for a flooded harvested soybean field that has not been fall plowed or burned, to 237 DUD/acre for reforested bottomland hardwoods with mast bearing species (assuming a 70 percent seedling survival rate).

In addition to food values, other benefits to wintering waterfowl would also be realized from the establishment or enhancement of forested wetlands. Benefits would include isolation for pair bonding, better protection from disturbance and harassment than in more open areas, and protection from predation and extremes in weather conditions.

Unquantified benefits resulting from establishment of more dependable wintering waterfowl foraging habitat accrue to the whole range of resident and migratory species attracted to wetlands as well as overall wetland functional values. Not intended as all inclusive, the list of fauna benefitting would include resident aquatic furbearers, resident and migrant shore and water birds, insectivorous and granivorous neotropical migratory birds, native amphibians and reptiles, and the broad range of resident game and nongame birds and mammals known to inhabit forested wetlands and non-wooded wetlands (such as moist soil areas).

Other functional wetland values attributable to reforested areas include flood water storage, improved water quality, ground water recharge, esthetics, and scientific study opportunities. Additionally, economic benefits resulting from added outdoor recreation opportunities and the harvest of timber and other wood products could offset economic losses resulting from instances where existing agricultural practices/leases might have to be modified.

## CONCLUSIONS

Because there was a substantial risk that project impacts would be underestimated, it was necessary to analyze two future without-project scenarios so that decision makers would have the opportunity to evaluate the full range of alternatives and associated impacts. All plans, with the exception of the No Action Plan, decreased DUD with the Corps' FWOP projection. The No Action Plan under the Service's FWOP projection resulted in a loss of 18, 368 DUD due to the effects of reforestation. The Service's FWOP would provide fewer DUD than the Corps' FWOP, therefore, there would be no DUD foregone.

Implementation of purely structural flood control features (e.g., Plan 3 NED, final array) would result in adverse impacts to migratory waterfowl wintering habitat. Except for the no action plan, Plan 3 resulted in fewer losses of DUD than all plans with a reforestation feature. Losses would occur both on private and public lands and would be evident in all hydrological reaches. Project alternatives that reduce the extent, duration, and frequency of winter water are of concern to the Service. Other plans considered in the initial array of alternatives (maximum increase of 733,279 DUD, Plan 11) would provide higher DUD, but these increases were due to intentional water management (holding water at higher elevations with gates) during the waterfowl season. This type of water management feature was considered cost prohibitive and these plans were deleted from further analysis.

The purpose of this appendix was threefold: first, to identify the relative importance of the general project area in terms of historic trends in wetlands and wintering waterfowl; secondly, to document existing (baseline) wintering waterfowl carrying capacity in the project area, and thirdly, to document project induced impacts by comparing future with and without-project conditions using food as an index of carrying capacity expressed in terms of duck-use-days (DUD). However, quantifying food availability and consumption by waterfowl in shallow water (18 inches deep or less) represents one facet of waterfowl biology and only 50 percent of waterfowl habitat requirements. The availability of winter water at depths greater than 18 inches and for other uses, i.e., loafing and pair bonding, is equally important and should be considered when selecting a plan that could reduce the extent of wintering waterfowl habitat.

## LITERATURE CITED


Barras, S. C. 1993. Experiments on prebasic molt and acorn selection in captive female wood ducks. Thesis, Mississippi State Univ., Mississippi State. 70 pp.

Bellrose, F. C. 1980. Ducks, geese, and swans of North America. Stackpole Books, Harrisburg, PA. 540 pp.

Combs, D. L. 1987. Ecology of male mallards during winter in the upper Mississippi Alluvial Valley. Ph.D. Thesis, Univ. Missouri, Columbia. 223 pp.

Delnicki, D. and K. J. Reinecke. 1986. Mid-winter food use and body weights of mallards and wood ducks in Mississippi. J. Wildl. Manage. 50:43-51.

Demarest, D. W., R. M. Kaminski, L. A. Brennan, and C. R. Boyle. 1997. Body-mass, survival, and pairing consequences of winter-diet restriction in wood ducks. J. Wildl. Manage. 61:822-832.

Dubovsky, J. A., and R. M. Kaminski. 1994. Potential reproductive consequences of winter-diet restriction in mallards. J. Wildl. Manage. 58:780-786.

Fredrickson, L. H. and M. E. Heitmeyer. 1988. Waterfowl use of forested wetlands of the southern United States: an overview. Pages 307-323 *in* M. W. Weller, editor. Waterfowl in winter. Univ. Minn. Press, Minneapolis.

Fredrickson, L. H. and D. L. Batema. 1992. Greentree reservoir management handbook. Univ. Missouri, Columbia. 88 pp.

Galloway, G. E., Jr. 1980. Ex-post evaluation of regional water resources development: the case of the Yazoo-Mississippi Delta. U.S. Army Eng. Inst. Water Resour. Rep. IWR-80-DI. 304 pp.

Gamble, K. 1999. Waterfowl harvest and population survey data. U.S. Fish and Wildlife Service.

Heitmeyer, M. E. 1985. Wintering strategies of female mallards related to dynamics of lowland hardwood wetlands in the upper Mississippi Delta. Ph.D. Thesis, Univ. Missouri, Columbia. 378 pp.

Heitmeyer, M. E. 1987. The prebasic molt and basic plumage of female mallards (*Anas platyrhynchos*). Can. J. Zoo. 65:2248-2261.

Heitmeyer, M. E., and L. H. Fredrickson. 1981. Do wetland conditions in the Mississippi Delta hardwoods influence mallard recruitment? Trans. N. Am. Wildl. and Nat. Resour. Conf. 46:44-57.

Hepp, G. R., and J. E. Hines. 1991. Factors affecting winter distribution and migration distance of wood ducks from southern breeding populations. Condor 93:884-891.

Hunter, W.C., D. N. Pashley, and R. E. F. Escano. 1993. Neotropical migratory landbird species and their habitats of special concern within the southeast region. Pages 159-171, In D.M. Finch and P. W. Stangel eds. Status and Management of Neotropical Migratory Birds. U.S.D.A. For. Serv. Gen. Tech. Rep. RM-229. 422 pp.

Kaminski, R. M. 1999. Potential implications for waterfowl. Pages 41-53, in Implications of Providing Managed Wetlands/Flood Protection Options Using Two-Way Floodgates in Conjunction with the Yazoo Backwater Pumps. Mississippi Ag. and For. Exp. Sta., Mississippi State Univ. 102 pp.

Kaminski, R. M., and E. A. Gluesing. 1987. Density- and habitat-related recruitment in mallards. J. Wildl. Manage. 51:141-148.

Loesch, C. R., K. J. Reinecke, and C. K. Baxter. 1994. Lower Mississippi Valley Joint Venture Evaluation Plan. North American Waterfowl Management Plan, Vicksburg, MS. 34 pp.

MacDonald, P.O., W. E. Frayer, and J. K. Clauser. 1979. Documentation, chronology, and future projections of bottomland hardwood habitat loss in the lower Mississippi Alluvial Plain. Vol. 1, Basic Report, U.S. Fish and Wild. Serv., Vicksburg, MS. 133 pp.

McAbee, W.C. 1994. Waterfowl use and food availability on flooded croplands in northeast Louisiana. M.S. Thesis, La. Tech Univ., Ruston, La. 49 pp.

McKenzie, D.F. 1987. Utilization of rootstocks and browse by waterfowl on moist soil impoundments in Missouri. M.S. Thesis, Univ. Missouri, Columbia. 93 pp.

Nelms, C.O. In Prep. Quantification of winter foraging habitat requirements for dabbling ducks.

Nelms, C.O., and D. J. Twedt. 1996. Seed deterioration in flooded agricultural fields during winter. Wildl. Soc. Bull.

Nichols, J.D., K. J. Reinecke, and J. E. Hines. 1983. Factors affecting the distribution of mallards wintering in the Mississippi Alluvial Valley. Auk 100:932-946.

Paulus, S. L. 1980. The winter ecology of gadwall in Louisiana. M.S. Thesis, Univ. of N.D., Grand Forks, N.D. 357 pp.

Reinecke, K. J. 1989. Preliminary guidelines for evaluating foraging habitat. Monitoring and evaluation committee reports. Lower Mississippi Valley Joint Venture, Vicksburg, MS.

Reinecke, K. J., C. W. Shaiffer, and D. Delnicki. 1987. Winter survival of female mallards wintering in the lower Mississippi valley. Trans. North Am. Wildl. and Nat. Resour. Conf. 52:258-263.

Reinecke, K. J., R. C. Barkley, and C. K. Baxter. 1988. Potential effects of changing water conditions on mallards wintering in the Mississippi Alluvial. Pages 325-337 *in* M.W. Weller, ed., Waterfowl In Winter. Univ. Minn. Press, Minneapolis.

Reinecke, K. J., J.D. Moorhead, J.D. Hodges, and J. R. Nasser. 1989. Mississippi Alluvial Valley. Pages 203-247 in L. M. Smith, R. L. Pederson, and R. M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech Univ. Press, Lubbock. 560 pp.

Richardson, D. M., and R. M. Kaminski. 1992. Diet restriction, diet quality, and prebasic molt in female mallards. J. Wildl. Manage. 56:531-539.

U.S. Army Corps of Engineers. 1991. Upper Steele Bayou project reformulation study. Vicksburg, MS. 556 pp.

U.S. Army Corps of Engineers. 1993. Upper Yazoo projects reformulation study. Vicksburg, MS. 438 pp.

U.S. Fish and Wildlife Service and Canadian Wildlife Service. 1986. North American waterfowl management plan. Washington D.C. 31 pp. w/append.

U.S. Fish and Wildlife Service. 1999a. Midwinter waterfowl survey, January 4-8, 1999. Columbia, MO.

U.S. Fish and Wildlife Service. 1999b. Waterfowl harvest and hunter activity in the United States during the 1998 hunting season. Office of Migratory Bird Management. Laurel, MD. 34 pp.

U.S. Fish and Wildlife Service. 1999c. A Fish and Wildlife Coordination Act Planning-Aid Report on the Yazoo Backwater Area Project. U.S. Fish and Wildlife Service, Atlanta, GA. 28pp.

Vrtoska, M. P. 1995. Aspects of reproductive and remige molt biology in wood ducks. Dissertation, Mississippi State Univ., Mississippi State. 86pp.

Wehrle, B. W., R. M Kaminski, B. D. Leopold, and W. P. Smith. 1995. Aquatic invertebrate resources in Mississippi forested wetlands during winter. Wildl. Soc. Bull. 26:159-167.

Wills, D. 1970. Chufa tuber production and its relationship to waterfowl management on Catahoula Lake, Louisiana. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 24:146-153.

Wright, T. W. 1961. Winter foods of mallards in Arkansas. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 13:291-296.