

Assessment of 404 Wetland Mitigation Sites in Missouri

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Table of Contents

Acknowledgements.....2

Introduction.....4

Methods

 Permit Records Compilation.....6

 Geographic Location Information.....6

 Selecting Mitigation Sites7

 Assessing Mitigation Sites8

 Wetland Indicators.....10

Results and Discussion

 Geographic Locations.....11

 Mitigation Site Selections.....12

 Mitigation Site Assessments.....15

 Wetland Indicators Observed.....17

Description of Table 2. Assessment Sites Summarized.....19

Conclusion.....22

References.....23

Tables

Table 1. Number of Wetland Mitigation Projects Selected for Assessment.....13

Table 2. Assessment Summary Table of Selected Wetland Mitigation Sites
in Missouri21

Figures

Figure 1. Locations of activities in Missouri receiving Corps ‘404’ approval.....6

Figure 2. USACE 404-CWA Wetland Mitigation Locations for Individual and
Nationwide Permits, 1992 through 2004.....9

Appendices

Appendix A

Table A1. Wetland Mitigation sites for Individual and Nationwide permits
approved between approved between 1992 and 2005 in the

Appendix A (continued)

St. Louis District of the U.S. Army Corps of Engineers.....	A1
Table A2. Wetland Mitigation sites for Individual and Nationwide permits approved between approved between 1992 and 2005 in the Kansas City District of the U.S. Army Corps of Engineers.....	A5
Table A3. Wetland Mitigation sites for Individual and Nationwide permits approved between approved between 1992 and 2002 in the Little Rock District of the U.S. Army Corps of Engineers.....	A9
Table A4. Wetland Mitigation sites for Individual and Nationwide permits approved between approved between 1992 and 2004 in the Rock Island District of the U.S. Army Corps of Engineers.....	A9
Table A5. Wetland Mitigation sites for Individual and Nationwide permits approved between approved between 1992 and 2004 in the Memphis District of the U.S. Army Corps of Engineers.....	A10

Appendix B - Descriptions of Observations made at each Mitigation Site Assessed.

Appendix C – Images of Wetland Mitigation Sites Assessed.

Introduction

“Wetlands play many critical environmental roles, including providing habitat for rare, threatened and endangered species; serving as rest stops for migratory birds; helping to prevent floods; controlling erosion; and filtering water.” (U.S. Army Corps of Engineers, 2005) Recognized as an important water resource, maintaining wetland resources has become an integral component of activities and actions carried out by natural resource government agencies and non-governmental organizations. “Wetlands are now recognized as one of the most productive ecosystems in the world, deserving of protection for their multiple benefits. Missouri Governor John Ashcroft called for ‘the enhancement of Missouri’s wetlands and the implementation of a common sense no net loss policy’ as one of his natural resource goals for the 1990’s.” (Missouri Department of Natural Resources, 1992)

Wetlands that are waters of the U.S. and within the jurisdiction of the U.S. Army Corps of Engineers and the Missouri Department of Natural Resources as authorized by Sections 404 and 401 of the Federal Clean Water Act (404-CWA), are sometimes subjected to unavoidable adverse impacts. Losses of the wetland resource due to anthropogenic activities are commonly required to be mitigated. For the past several years states and federal agencies throughout the U.S. have been examining the successfulness of mitigating impacts to wetlands, that are waters of the U.S., as authorized by 404-CWA. Also, the 401 Water Quality Certification Unit within the Missouri Department of Natural Resources, watershed planners and others have expressed a need for awareness of the distribution of wetland mitigation sites within Missouri required by 404-CWA and their successfulness.

In response to these needs as well as continued implementation of the Missouri Wetland Conservation Plan, the Surface Water Section of the Water Resources Center, Missouri Department of Natural Resources conducted this assessment in cooperation with the Watershed Planning and Implementation Branch of the Environmental Protection Agency, Region VII. Funding for this project was provided by the Missouri Department of Natural Resources and through a Wetland Program Development Grant from Region VII of the Environmental Protection Agency.

Goals of the project were to present the geographic distribution of wetland mitigation sites in Missouri and gain insight into the successfulness of wetland mitigation efforts in the state. Objectives included creating a compilation of wetland mitigation site locations in the state, converting the location information into a geographic format, and conducting onsite examinations of a representative subset of those sites.

Each U.S. Army Corps of Engineers (Corps) district in Missouri has maintained a database of known activities occurring in that district subject to 404-CWA requirements. Information describing wetland mitigation sites in the state was obtained from the five Corps districts that include portions of Missouri. Project staff communicated with each of the five Corps regulatory districts and acquired copies of computerized data files containing information pertaining to specific 404-CWA authorized projects. Assessment

was conducted on a sample set of wetland mitigation projects required by 404-CWA. Assessment was intended to be based on success criteria included in wetland mitigation plans assumed submitted by applicants and approved by Corps regulatory offices.

In recent years much discussion has ensued among wetland scientists and regulatory agencies regarding the effectiveness of 404-CWA to mitigate losses of wetlands that are waters of the U.S. This project assessed one component of examining the effectiveness of 404-CWA; implementation of success criteria required by the Corps. This assessment will contribute to understanding the extent to which 404-CWA is mitigating authorized impacts to wetlands that are waters of the U.S. The National Academy of Sciences (2001), Corps (1993), and others have indicated a component to ensuring no net loss of wetlands is the retention of wetland functions. This project did not attempt to assess mitigation of wetland functions lost.

Methods

Permit Records Compilation

District regulatory offices of the Corps each maintain a database listing activities and action items of permit applications and subsequent project implementation subject to requirements of Section 404 of the CWA (404-CWA). Missouri is within five regulatory districts among three divisions of the Corps; Rock Island, St. Louis and Memphis districts in the Mississippi Valley Division, Little Rock District in the Southwestern Division and Kansas City District in the Northwestern Division. Electronic records from Corps district databases were procured from the five district offices. Each district maintains a database somewhat unique to the district. Compilation of district records was kept separate among the five districts. For this project, the two main uses of these records were 1) a list from which to randomly choose projects that were required to conduct wetland mitigation and 2) a source for geospatial information describing geographic locations of wetland mitigation projects in Missouri authorized and subject to 404-CWA requirements.

Beginning in approximately 1992, Corps district 404-CWA databases began including a data record field indicating the number of acres of wetlands for which mitigation was performed if wetland mitigation was required for the specific permit. Corps regulatory staff indicated that would be the only electronic source for determining which 404-CWA permits required wetland mitigation as part of the specific permit approval. Initial requests for records from the Corps districts were for electronic files of permitting activities for 1992 through 2002. Based on electronic records obtained from the Corps, more than 15,000 404-CWA authorizations are estimated to have been issued for specific activities intended to be carried out by 404-CWA applicants in the state between 1992 and 2002. After becoming familiar with Corps district databases, later requests were for wetland mitigation permitting activities from 1992 to the most recent available, i.e., 2004 or 2005 depending on the district.

Geographic Location Information

Geospatial information describing locations of specific permitted projects authorized through 404-CWA from 1992 to 2002 was included in the computer files obtained from the five Corps Districts. Some permit records from the Corps districts included geographic coordinate system data in the form of longitude (x) and latitude (y) numeric values in units of decimal degrees, North American Datum 1983, with an origin at the intersection of the equator and the geographic Prime (Greenwich) Meridian. Other records included projected coordinate system data in the form of Universal Transverse Mercator, North American Datum 1983, Zone 15 North.

Location information for some records from the Corps Kansas City and Rock Island Districts were only available in the form of legal descriptions of the Public Land Survey System (PLSS) presented as township, range and section. While the Districts are in the process of converting PLSS coordinates to the geographic coordinate system of longitude and latitude coordinates, the large number of permit records to be converted has prolonged conversion of geospatial location information for permitted projects. The geographic location information is determined from documents in the permit files often in the form of paper copy illustrations or aerial photographs. Those documents are interpreted to determine and record the location of permitted activities in terms of coordinate systems that use longitude and latitude or Universal Transverse Mercator. For some projects, the most accurate information describing the location of the permitted activity has been a sketched map drawn by the 404-CWA applicant depicting the activity site.

Kansas City and Rock Island Districts' computerized file records for which geospatial location data was represented with PLSS township, range and section were converted to longitude and latitude coordinates in decimal degrees, North American Datum 1983. Longitude and latitude coordinates were assigned to the respective 404-CWA permitted activity point locations corresponding to the centroid of the PLSS section designated in the 404-CWA permit record computer files that we obtained from the Corps. Assuming a PLSS section encompasses one square mile, as most do in Missouri, it can be assumed the accuracy of resultant longitude and latitude is within approximately 0.7 miles of the 404-CWA permitted site. However some PLSS sections in Missouri that are a part of the Land Grant system, are as much as 10 square miles in size and therefore would require the accuracy to be stated as being within approximately 7 miles of the 404-CWA permitted site. Some electronic records of each of the Corps districts did not include geospatial information other than the state and county that the permitted activity was within. A few of the wetland mitigation electronic records we obtained did not include at least township, range and section. Conversion to longitude and latitude was not accomplished for records lacking PLSS information to the level of section.

Selecting Mitigation Sites

Wetland mitigation sites to be assessed were randomly chosen from Corps district lists of permitting records. Types of permits that were assessed included those termed by the Corps as Individual Permits and Nationwide Permits. For the purpose of conserving travel and reducing file searches and communication with multiple Corps districts, not all five Corps districts were included in site assessments. The three districts with the largest geographic extents in the state were included in site selection, i.e., the Corps Kansas City, St. Louis, and Little Rock Districts. Approximately ninety percent of Missouri is within those three Corps regulatory districts. Including sites to assess within the three districts represented the highest concentrations of 404-CWA wetland mitigation occurring in the state. Included were the metropolitan areas of Kansas City and St. Louis, the Black River basin in southeast Missouri near the state boundary shared with Arkansas, the lower South Grand River and the area known as the four rivers in west central Missouri encompassing the confluences of the Marias des Cygnes, Marmaton, Little Osage and Osage rivers (Figure 2). Sampling among the three Corps districts also included much of the physiographic variation in the state, i.e., dissected glacial till plains of northern Missouri, non-glaciated plains of western Missouri, Ozark Plateaus of southern Missouri (Fenneman, 1938) and the western portion of the alluvial plains in the southeast corner of the state.

Within the three Corps districts, permits initiated during the years 1997 through 2000 were included in the selection process. The year 2000 was chosen as the most recent year of permit initiation to be assessed so as to approximate choosing only projects that would be at least nearly completed at the time site assessments would be conducted. The year 1997 was chosen as the earliest year of permit initiation to coincide with permitting requirements published in the Federal Register on December 13, 1996, "Final Notice of Issuance, Reissuance, and Modification of Nationwide Permits". On March 9, 2000, the Corps did publish new rules for issuance of 404-CWA Nationwide Permits. A few mitigation projects that were assessed were given Corps authorization under the March 9, 2000 rules. However, permit requirements issued for those projects appeared essentially equivalent to requirements issued for the mitigation projects assessed that were subject to the December 1996 rules.

Stratified random sampling (McGrew, 2000) was applied to compilations of 404-CWA permitting records of wetland mitigation activities in Missouri. Stratification of sampling was applied to improve representation of 404-CWA wetland mitigation throughout much of the state. Stratification included Corps district and type of permit. Random selection within the stratification categories was conducted by assigning random numbers to mitigation projects in the compilation lists. Records in the compilation lists were sorted numerically in ascending order. Number of selections in each category of stratification was approximately equal to category proportions of the number of 404-CWA records included in the random selection (Table 1). With the intent to assess at least thirty wetland mitigation projects, thirty-three were randomly selected in anticipation of the need to eliminate a few selected projects for unforeseen reasons. In the end, thirty-one sites were assessed.

Assessing Mitigation Sites

In preparation for visiting and assessing wetland mitigation sites, detailed information was sought regarding descriptions of each proposed mitigation site and requirements stipulated in 404-CWA project approvals issued by the Corps. Much of the information did not exist in electronic form; thus we had to search extensively through paper files.

Our search for wetland mitigation information pertaining to specific permitted projects included documents with descriptions of topics such as:

- Section 404-CWA permitted activity
- Site description of permitted activity
- Permit approval
- Permit special conditions
- Location description (map) of wetland mitigation site
- Final wetland mitigation plan
- Declaration of covenants and restrictions recorded with county Register of Deeds
- Changes in mitigation site ownership
- Changes to permit requirements and status
- Certificate of completion
- Wetland mitigation monitoring reports

Initially this project was intended to examine whether or not specific wetland mitigation projects had fulfilled success criteria as stipulated in wetland mitigation plans required by the Corps. However, examination of specific 404-CWA wetland mitigation project files of Corps districts and discussions with Corps regulatory staff revealed that many projects were not required to submit specific wetland mitigation plans and did not include requirements referred to as success criteria. Of the fourteen sites for which specific mitigation plans had been developed, three of them included requirements referred to as “success criteria”. None of the other permitted activities assessed by this project included requirements referred to as success criteria. The three wetland mitigation projects that were given specific success criteria were required to establish minimum percentages of hydrophitic vegetation among overall vegetation at the site and were required to establish “adequate” hydrology.

These vegetation and hydrologic requirements were similar to those recommended by various sources who have commented on 404-CWA permit conditions that should be issued to specific projects by Corps districts. The National Academy of Sciences (2001) as well as some Corps districts (U.S. Army Corps of Engineers, 2005) in Missouri have, in the past few years, indicated the most important factor of successfully completing a wetland mitigation project is the establishment of the presence of water at the site in sufficient quantities and durations to create hydric soil conditions and support a population of hydrophitic vegetation. For the purpose of assessing wetland mitigation sites that lacked specified success criteria in the mitigation plans, appropriate hydrology

was considered a success criterion especially for projects that also were not specifically required to establish hydrophytic species comprising a percentage of vegetation population greater than a specified minimum.

Hydrology of sites was estimated through observation of inundation and qualitative estimates of inundation duration. Abundance of water at sites visited was referenced to what would normally be present as indicated by vegetative species existing among the range of elevations encompassing the mitigation site. The Palmer Drought Severity Index (PDSI) and number of days since the last significant rainfall were used in considering soil moisture at the sites and duration of soil saturation and inundation observed. The PDSI is known as a meteorological drought index based upon precipitation, temperature and local available water content of the soil (Hayes, 2006). Monthly PDSI values have been determined for National Oceanic and Atmospheric Administration climate divisions in the United States. PDSI values provided a qualitative reference for the water observed at each site relative to the abundance of water that might exist at the site when not experiencing drought conditions. Number of days since the last significant rainfall was compared to the minimum number of days assumed necessary to initiate development of anaerobic activity in the soil and induce the establishment of hydrophytic vegetation.

Wetland Indicators

In addition to evaluation of whether or not success criteria of each mitigation project was achieved, each site visited was assessed for existing indicators of the three wetland parameters described in the 1987 publication titled, "Corps of Engineers Wetlands Delineation Manual". The three parameters are commonly referred to as hydrophytic vegetation, hydric soils, and wetland hydrology. A soil core was extracted at the approximate center of each site and examined for visible indications of prolonged anaerobic conditions. Hydrophytic plant species percentage greater or less than fifty percent of total vegetation was estimated. Hydrologic character of each mitigation site was considered as to whether there was an abundance of water. Due to the relatively dry conditions that had persisted throughout much of the state during the months leading up to site visits, presence of surface water was evidence of an abundance of water at each site. Dryness of sites relative to recent months was estimated as described in the preceding paragraph of this report. For sites lacking surface water, indicators such as drift lines, water marks, drainage patterns and saturated soil were considered.

Results and Discussion

Geographic Locations

Geographic locations of projects regulated by 404-CWA and receiving specific approval from the Corps between 1992 and 2002 are presented in Figure 1. For illustrative purposes at a statewide level, those records whose location descriptions consisted of only

a county name were included in Figure 1 in the form of a dot density distribution representing the number of records per county. Approximately 600 of the more than 15,000 404-CWA permitting records included only county name.



Figure 1. Locations of activities in Missouri receiving Corps 404-CWA permitting approval for Individual and Nationwide permits, 1992 - 2002.

Mitigation Site Selections

Based on the query criteria that a 404-CWA record should include a value representing the number of mitigation acres that were required as part of the 404-CWA approval from the Corps, we compiled the following number of wetland mitigation sites from each of the five Corps regulatory districts in Missouri.

St. Louis District	316
Memphis District	63
Little Rock District	41
Kansas City District	391
Rock Island District	20

During the time information was being gathered for this project, the Corps were converting the various district RAMS databases to a new format throughout the U.S. Conversion was anticipated to be implemented during the autumn of 2006. Due to this database transition some Corps districts in Missouri were temporarily unable to produce an electronic file of recent wetland mitigation projects. We were able to acquire records of wetland mitigation projects from the Kansas City and St. Louis districts being initiated into the 404-CWA permitting process as recently as 2005. Wetland mitigation projects listings from Rock Island, Memphis and Little Rock districts include records of activities

as recently as 2004. Figure 2 illustrates the geographic locations of the compilation of wetland mitigation sites.

Tables A1 through A5 in Appendix A list the wetland mitigation sites with their respective Corps district file record number, county, longitude and latitude, impacted acres and mitigation acres. The tables are primarily intended to list locations of wetland mitigation. In each of the tables, the name of the data field representing the file record identification (1st column) is not consistent between individual Corps districts' databases. Due to variation in the Corps electronic records, total mitigation acres found in the tables should not be summed as representing the total number of acres that were mitigated during the time periods designated. Corps electronic records often list multiple records for a single approved impact activity when multiple sites are involved. Records for each site, when multiple sites are involved, often duplicate the total number of mitigation acres for the project. However in a few instances multiple records and sites for a project did appear to list mitigation acres for the specific site.

Table 1. **Number of Wetland Mitigation Projects Selected for Assessment**

Corps District	Individual Permits	Nationwide Permits	Total
St. Louis	7 (49)	10 (77)	17 (126)
Kansas City	4 (24)	8 (56)	12 (80)
Little Rock	2 (11)	2 (9)	4 (20)
Total	13 (84)	20 (142)	33 (226)

Note: numbers in parentheses indicate number of permitted activities that included wetland mitigation and were initiated during the years 1997 through 2000.

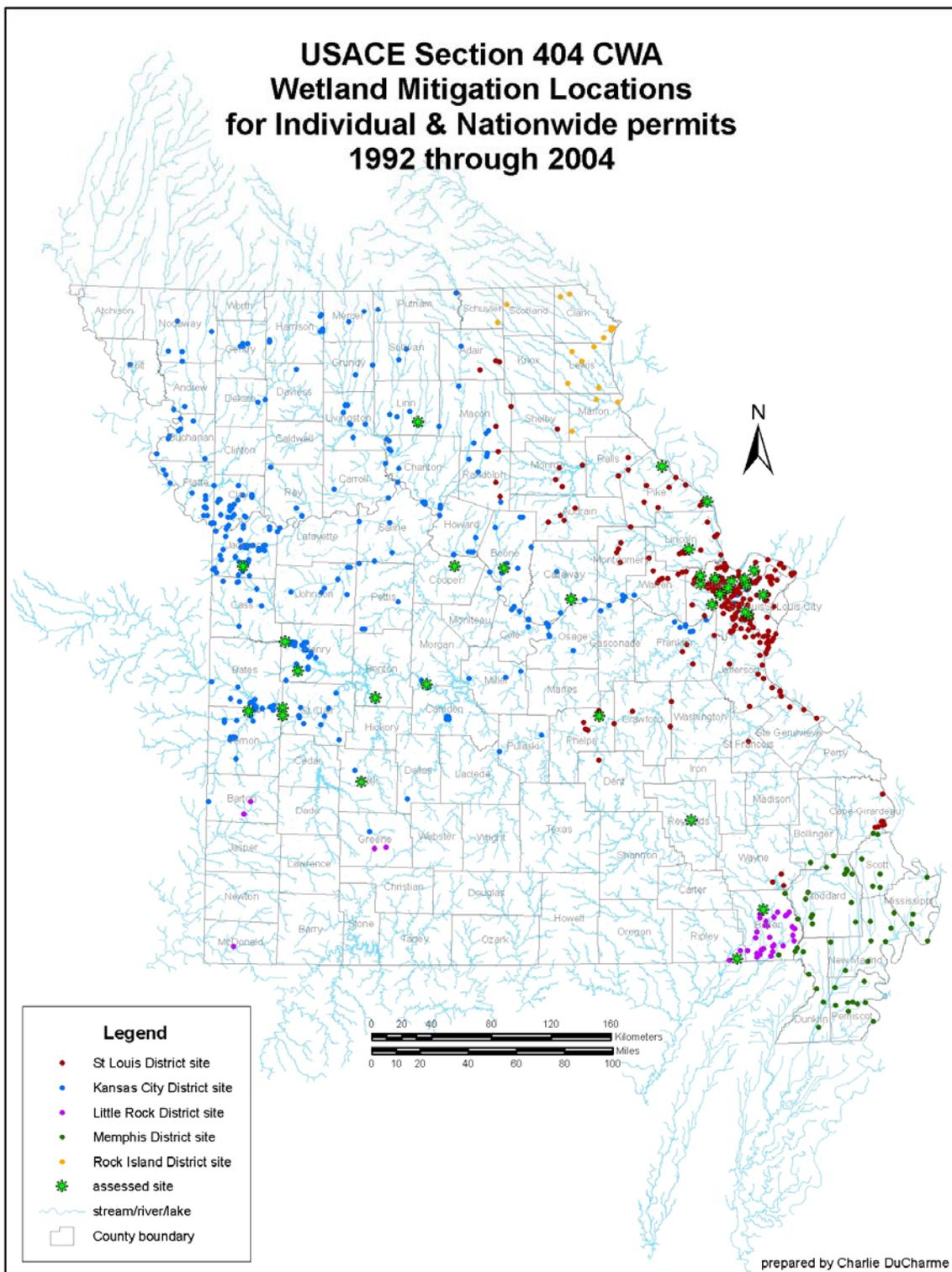


Figure 2. Wetland mitigation sites in Missouri required for Corps approval of specific projects as part of Individual and Nationwide permits, 1992 through 2004.

Mitigation Site Assessments

Several mitigation projects appeared to be a few years behind schedule from the required dates indicated in the permit documentation and had either not completed construction, vegetation plantings or were still in the monitoring phase of the established mitigation site. It was not the intent of this assessment to document the extent to which projects were behind schedule. Assessment of those sites was warranted for the purpose of observing whether or not delayed projects were prone to never being completed. Seven mitigation projects appeared to be in progress even though permittees had been given specific approval and requirements several years prior to site visits. It appeared that all seven projects were actively being pursued for completion.

Overall, this assessment found most of the wetland mitigation sites that were visited had accomplished the success criteria identified in the permit documentation. All sites assessed had experienced at least a significant attempt to create, restore or enhance wetlands. At least some wetland indicators were observed at all visited sites (see Table 2). Review of documentation of the thirty-three 404-CWA projects randomly selected for assessment as well as communication with Corps regulatory staff and permittees revealed that two of the projects had not carried out the impacts, i.e., the work (impacts) for which permittees had been given Corps approval was not conducted. One wetland mitigation project that was reviewed had not yet carried out the required wetland mitigation. Thus at these three sites there was no wetland mitigation to assess. The third site mentioned here was included in Table 2 as the unusual situation of that project warranted description later in this report. Table 2 includes information pertaining to each mitigation project relevant to findings of the individual site assessments.

Although most projects were not given requirements specifically referred to as “success criteria” in permit documentation, permit conditions issued by Corps districts did require eleven of those projects to establish vegetation populations with proportions of hydrophitic species being greater than specified minimum percentages. Five projects were required to establish an abundance of water referred to as “adequate hydrology”, “expected hydrology”, or “wetland hydrology”. Another four projects were required to create a water pool anticipated to have permanent inundation. Two of those four projects were required to construct stormwater detention basins in residential neighborhoods. One project (ID # 199901681) was required to create a small lake intended to serve as an aesthetic feature in a suburban residential neighborhood. No storage for stormwater detention was included in that lake. One project (ID # 199901069) was required to create a depressional area adjacent to a permanent flowing stream that would maintain a water depth ranging from twelve inches to 3 feet.

Of all thirty mitigation sites assessed, twelve of them were issued requirements of establishing a vegetation population with a percentage of hydrophitic species greater than a specified minimum. Four of the sample sites were required to create a vegetation population described as consisting of a “dominance” of hydrophitic vegetation.

Three wetland mitigation sites had been given requirements specifically termed by the Corps as “success criteria”. Site assessments determined all three sites had accomplished their success criteria. Wetlands were identified at all three sites. For the twenty-eight wetland mitigation projects that were not given specific success criteria by the Corps, implied success criteria were determined based on Corps documentation of specific requirements issued to each project as explained earlier in this report. Three of those projects had experienced prolonged delays of a few years by the permittees and had not yet completed construction of the mitigation sites. One project was delayed due to the original mitigation site (ID # 13531) no longer being available. The proposed wetland mitigation site was located on land owned by someone other than the 404-CWA permittee. The landowner had deceased and present owners were not interested in providing the land for the 404-CWA permittees required mitigation. The Corps was working with the permittee to establish another site acceptable for wetland mitigation. With the application initially submitted in 1998, it was an example of periodic unusual circumstances that sometimes require additional attention by 404-CWA regulatory staff and extended schedules to attain project completion. Worth noting is that the original planned mitigation would have been a good example of the concept of compensatory mitigation. It involved converting pastureland to forested wetland in floodplain of the waterway immediately downstream of the impacted site. A visit to that site concluded hydrology there would probably have been adequate and abundant seed sources in a bottomland forest exist adjacent to the site. Another project involved a permittee who had been injured and thus far has been unable to carry out the construction work (ID # 199801396).

Of the remaining twenty-five projects that had completed construction activities and vegetation plantings and were not given specific success criteria, two were determined to have not met all of the implied success criteria. One appeared to be slightly lacking of adequate hydrology on a portion of the site (ID # 200006670). With the site still being monitored, permittee personnel were aware of the minimal hydrology there and were considering modification to direct additional water to it. The site had been relying upon overbank flow from the Missouri River which has been experiencing lower than normal runoff from its drainage area for the last several years. During years of river flow at normal levels and greater, the river may provide overbank flows frequent enough to create and maintain wetland. The other site that had not met the implied success criteria had been required to create a 3.8 acre lake (ID # 199901681). Although the constructed impoundment did maintain a full pool, its surface area appeared to be approximately only 50 percent as large as had been required. The areal approximation was verified with measurement in a geographic information system and National Agricultural Imagery Program aerial imagery. For these twenty-five projects, it can be said that 92% of the assessed projects that had conducted wetland mitigation had also fulfilled the implied success criteria interpreted from requirements included with the Corps regulatory approval.

Wetland Indicators Observed

The thirty mitigation sites that were visited were assessed for indicators of the presence of the three wetland parameters hydrophytic vegetation, hydric soils, and wetland hydrology as described in the 1987 publication, "Corps of Engineers Wetlands Delineation Manual". Sites with indicators of the three wetland parameters were designated in Table 2 as wetlands. Plant species with a greater affinity for wet conditions, i.e., obligate and facultative wet, were found at sites with obvious prolonged pooling of water as well as soils with signs of longer periods of water saturation and inundation. Indications of hydric soils were more evident at sites that showed more obvious signs of prolonged pooling of water. Hydrology indicators at many sites showed signs of an abundance of water present for extended periods of time during the growing season. Based on PDSI values from the National Oceanic and Atmospheric Administration for climate divisions of Missouri within which site assessments were conducted, moderate to severe drought conditions existed during the months site assessments were conducted. During non-drought periods, wetter conditions than was observed would be expected at the sites. Abrupt changes in vegetation at the perimeter of sites appeared to reflect the affect of a water surface elevation that would exist due to prolonged pooling of surface water. Prolonged pooling would be duration of inundation well beyond the approximate minimum of 9 to 12 days normally assumed necessary in Missouri for formation of wetlands depending on the county the mitigation site would be located within. Aerial imagery from the National Agricultural Imagery Program collected during the growing season of previous years was also interpreted for the historic presence of surface water at the assessed sites. Appendix B. presents descriptions of wetland parameter observations made at each site.

At most mitigation sites that were assessed, indicators were identified for at least one of the three wetland parameters. At only one site were no wetland indicators observed (ID # 199907820). That site appeared to be incomplete as the required tree plantings were not observed at the site. Construction described in the mitigation documentation appeared to be complete as well as initial seeding of ground cover vegetation that had been mowed. Whether or not the permittee intended to conduct tree planting in the near future was undetermined. Although wetland parameters were not observed at the location identified in the permit documentation, wetland indicators did exist adjacent to the designated mitigation site in the form of shoreline hydrophytic vegetation at the edge of a stormwater detention basin that appeared to maintain a permanent pool of water. An undocumented modification to the wetland design may have been implemented. The stormwater detention basin did appear to contain at least adequate water and hydrophytic vegetation and probably would have displayed anaerobic conditions in the soil had it been examined. Assessment assumed the storm water detention basin was not a part of the mitigation site.

At twenty-five sites, all three wetland parameters were observed. At six sites not all three of the wetland parameters were observed. Two of those six mitigation sites, still in five-year monitoring periods and would not necessarily be expected to display the three

parameters yet. One (ID # 199901991) of the two sites was recently constructed and was lacking hydric soil indicators. Although wetlands were not identified, conditions there displayed good potential for the development of anaerobic soil and an increased population of the existing hydrophitic vegetation during the next couple of years. Especially with a couple of years of at least normal rainfall, wetlands are likely to develop there. A portion of the other site (ID # 12332) also had not been receiving enough water to create inundation or soil saturation for sufficient durations over the previous couple of years. Project personnel were considering modification to direct additional water into the mitigation site. Project ID # 19993840 consisted of a sloping site in which the upper portion may be on too great of a slope to detain runoff from above and at an elevation too great to receive overbank flow from the adjacent stream below. One project had experienced unanticipated delays and was simply considered incomplete in the permitting and mitigation process. This was the project described in the previous section involving the heirs of the deceased third party landowner. Project ID # 199900690 involved a local governmental permittee. The mitigation site was in a residential area in a small backyard of a home adjacent to a concrete-lined storm water channel. With limited space for a backyard, the homeowner kept the grass mowed and the dominant vegetation could not be identified. However the permit requirement that hydrophitic tree species be planted had been carried out. Project ID # 200006670, described in the previous section as thus far lacking adequate water did have a dominance of hydrophitic vegetation that had been planted and seeded. The lowest portion of that site displayed anaerobic conditions in the soil.

Twenty-four projects from the random selection of wetland mitigation sites to assess appeared to have completed construction, plantings and monitoring. Wetlands were identified on twenty-two of those projects. Thus 92% of the assessed wetland mitigation projects that had been carried out to the point of completing their required monitoring periods contained wetlands. At two of the twenty-four projects, wetlands were not identified. The two projects had included mitigation for impacts to narrow riparian corridors due to necessary stream bank stabilization activities in urban and residential settings. Both projects impacted waters of the U.S. While this assessment did not identify wetlands at the two sites, hydrologic wetland indicators were observed at one site as an active stream channel that would often have flowing water (ID # 199809570) over a cobble sized rock stream bed. The stream channel at the other site (ID # 199900690) was completely lined with concrete and appeared as though it may only have flowing water during and immediately following storm runoff events. The impacted stream corridor resources at both sites were well established with the presence of vegetation (although not determined predominantly hydrophitic) at the edge of the stream channel stabilization structures, i.e., gabions and concrete walls. The riparian zones that existed previously were described in the 404-CWA documentation as degraded stream corridors. At both sites the stabilization structures appeared to be functioning properly preventing bank failure and keeping the adjacent soil columns intact.

Photography was recorded at most of the wetland mitigation sites that were assessed. Appendix C presents imagery of several of the sites. The images provide a visual perspective of samples of wetland mitigation sites occurring in Missouri. Some of the

images in Appendix C are panoramic, created by combining multiple images displaying a wide field-of-view to portray the entire mitigation site within one image.

Description of Table 2. Assessment Sites Summarized

- First column, “USACE dist. ID #”, is the identifying number assigned to the permit record issued by the USACE district within which the wetland impact site was located.
- Second column, “Impacted acres”, is the number of acres of wetland anticipated to be impacted by the approved permit activity determined by the respective USACE district.
- Third column, “mitigation acres”, is the number of acres of wetland to be created, restored or enhanced as required by the respective USACE district.
- Fourth column, “USACE district”, is the name of the USACE district within which the wetland impact site is located.
- Fifth column, “permit type”, is the category of 404-CWA permit type that pertains to the wetland impact activity. The two major categories included in this project are individual permit (IP) and nationwide permit (NW). There are many subcategories of NW permits issued by the USACE. Each subcategory attempts to address special concerns regarding a unique situation of either the impacted site or the type of impact activity being permitted. As subcategories of NW permits are revised they published in the federal register.
- Sixth column, “mitigation type”, indicates whether the approved mitigation activity involves creation of wetland, restoration of wetland that previously existed at the mitigation site, enhancement of wetland at the mitigation or a combination of creation, restoration or enhancement. Documentation of some of the permits indicated which of the three types of mitigation was intended.
- Seventh column, “purpose of impacts”, indicates what type of activity necessitated impacting wetlands.
- Eighth column, “Mitigation Plan required”, indicates whether or not USACE approval required a mitigation plan be submitted by the permittee.
- Ninth column, “Mitigation Plan in file”, indicates whether or not a mitigation plan was found in the documentation reviewed by this project.
- Tenth column, “success criteria”, describes the success criteria that were stipulated or eluded to in the permit documentation. Additional explanation is in the “Methods” Section, “Mitigation Site Assessment” subsection.
- Eleventh column, “success criteria specified”, is an indication as to whether or not mitigation approval by the Corps included the requirement that a wetland mitigation plan be submitted for Corps approval.
- Twelfth column, “criteria met”, indicates whether or not the mitigation efforts were successful in fulfilling the criteria described in column ten of Table 2.
- Thirteenth column, “wetland ID”, indicates whether or not wetland was identified at the mitigation site. Existence of wetland was based upon the three wetland parameters described in the Corps 1987 Wetlands Identification Manual. In the table,

the letters V (hydrophitic vegetation), S (hydric soil), and H (wetland hydrology) were used to symbolize the parameter for which wetland indicators were not observed.

Table 2. Summary of Selected Wetland Mitigation Sites in Missouri Permitted by the U.S. Army Corps of Engineers from 1997 to 2000.

USACE dist. ID #	impacted acres	mitigation acres	USACE district	permit type	purpose of impacts	mitigation type	Mitigation Plan required	Mitigation Plan in file	success criteria	success criteria specified	criteria met	wetland identified*
199801396	0	0.01	Kansas City	IP	core dredging	E	no	no	results in hydrologic enhancement	no	incomplete	yes
200002181	0.07	0.07	St. Louis	IP	roadway	R/E	yes	yes	≥80% planted vegetation survival & 75% hph sp implied as success criteria, adequate hydrology	no	yes	yes
199901991	0.13	0.13	Kansas City	NW 14	road bridge	C/E	no	yes	"create an 0.11 acre wetland area" ... "connected to the existing 0.15 acre wetland"	no	yes	S, V
199907820	0.13	0.13	St. Louis	NW 26	residential construction	E	yes	yes	≥95% survival of planted trees; 30x30 foot spacing on 0.13 acres	no	incomplete	yes
199809570	0.2	0.2	St. Louis	NW 13	stream bank stabilization (tees)	E	no	no	not specified	no	yes	S, V
200001776	0.21	0.21	Kansas City	NW 14	highway	C	yes	yes	≥50% hph emergent sp; ≥80% planted tree survival	yes	yes	yes
199901470	0.23	0.23	St. Louis	IP	stream channel modification	E	yes	no	≥75% planted tree survival implied to be success criteria	no	yes	yes
199706470	0.33	0.33	St. Louis	NW 14 & 26	highway	R	no	no	claim 0.66 acres credit at the Page Ave. Extension mitigation area	no	yes	yes
200000892	0.4	0.4	Kansas City	IP	highway	C	yes	yes	nonspecific; eludes to a required dominance of hph, "expected hydrology"	no	yes	yes
200006670	0.45	0.45	St. Louis	NW 14	highway	C	yes	yes	wetland hydrology	no	partial	H
200007810	0.3	0.45	St. Louis	IP	interpretive walking path	C, R/E	no	no	or-going reforestation efforts at the wildlife refuge	no	yes	yes
199800866	0.3	0.5	Kansas City	NW 26	mine land reclamation	C	no	no	create wetlands at toe slope of high walls being backfilled	no	yes	yes
199902145	0.3	0.5	Kansas City	IP	road bridge	C	yes	yes	predominance hph sp; ≥ 80% planted tree survival; wetland indicators	yes	yes	yes
199900690	0.73	0.5	St. Louis	IP	storm channel improvement	C	no	no	70% survival of trees and shrubs; 15 foot spacing	no	yes	V
199700336	0.55	0.55	Kansas City	NW 26	agriculture	R	no	no	not specified; minimal impacts expected	no	yes	yes
199902891	0.43	0.65	St. Louis	NW 26	residential construction	C	yes	no	create 0.66 acres of wetland onsite with ≥75% hph & inundation/saturation > 15 days	no	yes	yes
200005240	0.48	0.72	St. Louis	NW 39	retailer distribution construction	C	yes	yes	≥ 50% hph sp; 75% hph sp cover; adequate hydrology	yes	yes	yes
199900342	0	0.84	Kansas City	NW 14 & 26	highway	C, R	yes	yes	nonspecific; eludes to a required dominance of hph sp	no	yes	yes
18661	0.8	1.2	Little Rock	NW 26	agriculture	R	no	no	maintain buffer strip	no	yes	yes
199903940	0.43	2.28	St. Louis	NW 14	highway	C	no	yes	>85% planted tree survival after first two years	no	yes	yes
199905090	0.75	3	St. Louis	NW 26	residential construction	C	no	no	create a 3.0 acre lake	no	yes	H
200004200	1.66	3.5	St. Louis	IP	retail auto sales	C, R/E	yes	yes	≥90% pldd tree survival & "adequate hydrology"	no	yes	yes
199901681	0.49	3.8	St. Louis	NW 26	residential construction	C	yes	no	create a 3.8 acre lake	no	partial	yes
12332	1.7	3.9	Little Rock	IP	highway	C, R	yes	no	≥ 75% survival of planted sp	no	yes	**
13531	1.44	4.32	Little Rock	IP	recreation	C, R	yes	not yet	project not complete yet	no	incomplete	not yet
199805780	4.3	5.3	St. Louis	IP	retail store construction	C	yes	yes	100% survival of all planted vegetation, lake depth ≥ 8 feet over 70% of surface area	no	yes	yes
199901069	3.2	5.5	Kansas City	IP	agriculture	R	no	yes	construct 3 acre borrow pit - 12" to 3' water; plant 0.5 ac of trees; 2 acre wooded buffer	no	yes	yes
199903010	2	6	St. Louis	IP	boat ramp	R	no	no	≥80% planted tree survival implied to be success criteria	no	yes	yes
200001902	1	20	Kansas City	NW 27	waterfowl habitat	E	no	no	results in hydrologic enhancement	no	yes	yes
199901462	2	58	Kansas City	NW 27	waterfowl habitat	E	no	yes	results in hydrologic enhancement	no	yes	yes
200001072	16	1425	Kansas City	NW 27 & 42	waterfowl habitat	C, R	no	no	not specified	no	yes	yes

hph = hydrophobic; sp = species

* Identification was based upon the wetland parameters described in the 1987 publication, "Corps of Engineers Wetlands Delineation Manual" S=lacking hydric soils; V=inadequate hydrophobic plants; H=lacking wetland hydrology

** Site consisted of multiple cells. One cell contained an identified wetland. The other cell displayed non of the three wetland parameters.

Conclusion

The wetland mitigation projects examined in this assessment did generally complete what was considered as success criteria. All of the mitigation sites that were assessed reflected the results of 404-CWA permittees making significant efforts to carry out wetland mitigation as required by the Corps. Assuming the mitigation sites selected for assessment were representative of wetland mitigation in Missouri, results of this assessment indicate the regulatory government agencies have the cooperation of those who are known to conduct activities requiring mitigation of adversely impacted wetlands that are subject to 404-CWA.

Definitive determination of whether or not success criteria were fulfilled by individual mitigation projects was hindered by a lack of success criteria being specified. A lack of documentation of monitoring reports and certification of project completion created uncertainty as to whether mitigation projects were determined complete by regulatory agencies. More consistently requiring specific success criteria would make verification of successful mitigation projects more definite.

A few projects were lacking in at least one of the three parameters used to determine the existence of a wetland. Findings of this assessment did not necessarily indicate a wetland was not evolving at a site. Soils not displaying hydric characteristics may eventually develop them. At sites where vegetative planting was not required or were not found to be dominant, hydrophytic species existing at the site may increase in percent of the total vegetation and hydrophytic vegetation in close proximity may eventually migrate to the site. However this would create a time lag in the vegetation component of habitat available and may be a detriment to desired animal species.

Conversely, a mitigation site with soil that displayed hydric characteristics that would be representative of anaerobic conditions did not necessarily indicate anaerobic conditions existed at the site that would encourage the establishment of hydrophytic vegetation. The hydric soil indicators observed may have been remnant of a previous site from which the soil was transferred to the mitigation site. Permit documentation available from the Corps did not specify whether or not soil had been transferred to mitigation sites. For mitigation sites involving restoration, display of hydric characteristics in the soil could have been an indication of anaerobic conditions existing at the site prior to historic destruction of the previous wetland.

Several mitigation projects appeared to be delayed from their original schedules although lack of documentation reduced certainty in determining project status and completeness. Lack of documentation made it necessary to rely on features observed at each mitigation site in determining whether or not projects were completed. Improved recordkeeping of documents submitted by permittees as well as better permit tracking by regulatory agencies would improve the ability to determine successfulness of wetland mitigation projects.

Regulatory tracking of mitigation site monitoring and response to inadequacies reported can contribute to assuring the type of wetland that was impacted would be mitigated and provide the benefits intended. Uncertainties of which species of vegetation will do best at a site can be reduced if there is opportunity to modify the site based on its observed response to meteorologic and climatic conditions that occur there. Modification to sites can be made based upon observations of wetland characteristics as they develop. A more specific type of wetland may be established based upon response of the site to environmental conditions as opposed to being based solely upon conditions predicted to exist following construction, landscape modification and establishment of vegetation.

This assessment did not determine to what extent regulatory agencies have made improvements to their programs in implementing 404-CWA between the year 2000 and now. It is well known that improvements have been made to the implementation of 404-CWA during the past several years. From what was experienced in conducting this assessment, improvements in recordkeeping, tracking and verification of successful completion of wetland mitigation projects will add credibility to implementation of 404-CWA and may result in establishing higher quality wetlands within shorter time periods. This would reduce temporary wetland losses that would be anticipated with mitigation of wetlands requiring many years of ecological development such as with forested wetlands.

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Appendix A

Table A1. Wetland Mitigation sites for Individual and Nationwide permits approved between 1992 and 2005 in the St. Louis District of the U.S. Army Corps of Engineers.

Action ID	County	Long	Lat	Impacted Acres	Mitigated Acres	Action ID	County	Long	Lat	Impacted Acres	Mitigated Acres
199281600	St. Charles	-90.23	38.90	2.500	5.000	199408980	St. Louis	-90.69	38.65	16.720	20.250
199281743	Pike	-91.02	39.43	8.000	8.000	199409040	St. Louis	-90.35	38.42	4.860	7.040
199281790	St. Francois	-90.51	37.83	21.190	24.100	199410171	Lincoln	-90.96	38.98	0.100	0.100
199281830	Cape Girardeau	-89.58	37.28	0.800	0.900	199410270	St. Charles	-90.66	38.73	0.190	0.900
199282470	St. Charles	0.00	0.00	8.300	16.760	199410430	Pike	-91.25	39.39	2.120	3.000
199284171	Phelps	-91.53	37.96	0.100	0.500	199410760	St. Louis	-90.45	38.52	0.670	0.250
199284750	Ste. Genevieve	-89.99	37.96	5.500	10.200	199411520	Scott	0.00	0.00	3.200	8.600
199285930	St. Charles	-90.68	38.75	1.500	2.500	199411720	Lincoln	-90.99	38.98	0.070	0.070
199286750	Monroe	-91.74	39.52	0.100	4.000	199411810	Warren	-91.16	38.82	0.940	0.830
199300170	Macon	-92.40	39.61	0.100	0.075	199412480	St. Charles	-90.57	38.75	0.250	1.000
199300490	Jefferson	0.00	0.00	1.000	1.000	199413000	St. Charles	-90.67	38.79	0.230	0.230
199300800	St. Charles	-90.64	38.80	3.930	7.940	199413320	St. Louis	-90.34	38.43	2.000	2.000
199301640	Cape Girardeau	-89.55	37.29	10.000	23.000	199413340	St. Louis	-90.47	38.54	0.200	0.970
199302421	St. Charles	-90.65	38.78	2.500	2.500	199413440	St. Charles	-90.64	38.74	0.700	4.750
199303030	St. Charles	-90.60	38.81	1.000	7.000	199501450	Monroe	-91.90	39.39	0.011	0.006
199303110	Jefferson	-90.32	38.15	0.550	1.100	199501740	St. Louis	-90.36	38.72	1.970	3.000
199303530	St. Louis	-90.55	38.51	0.060	0.060	199502090	St. Charles	-90.65	38.77	0.130	0.250
199304131	St. Louis	-90.34	38.58	1.000	1.000	199502110	Pike	-90.82	39.28	2.000	15.000
199304730	St. Charles	-90.70	38.79	1.100	1.000	199502340	St. Louis	-90.33	38.82	4.190	15.700
199305590	St. Charles	-90.66	38.91	20.000	110.000	199502520	St. Charles	-90.76	38.80	1.300	1.300
199306120	Lincoln	-90.78	39.16	0.320	4.000	199502690	Wayne	0.00	0.00	9.110	98.900
199306270	Jefferson	-90.36	38.36	10.710	85.000	199503520	St. Charles	-90.60	38.72	0.080	1.000
199307330	Washington	-91.10	37.93	0.150	1.030	199504780	St. Charles	0.00	0.00	2.100	2.000
199308670	St. Louis	-90.52	38.56	0.170	0.170	199505040	St. Charles	-90.72	38.74	0.240	2.460
199308930	St. Charles	-90.64	38.77	43.400	24.400	199505220	St. Charles	-90.41	38.85	1.200	2.000
199309012	Ste. Genevieve	0.00	0.00	0.040	0.040	199505420	St. Charles	-90.42	38.91	4.000	6.000
199309270	Perry	0.00	0.00	110.000	110.000	199505450	St. Charles	-90.62	38.81	0.780	1.500
199309481	St. Louis	-90.49	38.75	4.800	13.990	199505500	Shelby	-91.94	39.74	1.170	2.700
199400120	Phelps	-91.64	38.03	0.140	0.900	199506020	Montgomery	-91.38	39.14	0.120	3.000
199400360	St. Charles	-90.64	38.75	0.092	0.600	199506800	Jefferson	-90.32	38.15	0.550	1.100
199400821	Crawford	-91.39	38.03	1.660	3.000	199507070	Cape Girardeau	-89.51	37.30	3.700	11.390
199400850	St. Charles	-90.65	38.76	0.890	1.000	199507380	St. Louis	-90.65	38.64	0.470	1.750
199401930	St. Charles	-90.69	38.72	0.980	2.500	199508120	Macon	-92.29	39.88	0.300	0.200
199402530	St. Louis	-90.33	38.71	1.550	1.550	199508280	Lincoln	-90.71	39.09	0.100	3.200
199402631	St. Charles	-90.32	38.92	0.230	0.230	199508320	Lincoln	-90.73	39.07	0.300	0.180
199403371	St. Louis	-90.36	38.46	0.570	1.700	199509230	St. Charles	-90.15	38.83	0.100	1.500
199403500	Wayne	-90.29	37.02	1.200	2.500	199509910	St. Louis	-90.44	38.78	2.750	2.750
199403501	Wayne	-90.29	37.02	0.040	8.000	199509940	St. Louis	-90.41	38.47	48.000	48.500
199404061	Jefferson	-90.39	38.29	4.140	4.140	199510000	St. Charles	-90.59	38.73	1.130	1.020
199404190	St. Charles	-90.65	38.78	0.500	28.000	199510620	St. Louis	-90.49	38.59	1.330	1.790
199404400	St. Louis	-90.31	38.43	1.800	1.800	199511710	St. Louis	-90.61	38.57	2.650	0.400
199405570	Ralls	-91.39	39.56	2.160	3.000	199512270	St. Charles	-90.71	38.76	1.070	1.130
199405790	Jefferson	-90.35	38.42	5.300	31.200	199512290	St. Charles	-90.72	38.77	0.760	0.780
199406880	Jefferson	-90.41	38.35	1.430	2.370	199512410	St. Charles	-90.70	38.76	1.380	30.260
199407980	Ste. Genevieve	-90.19	38.03	0.110	0.110	199513310	St. Charles	-90.75	38.81	0.300	1.200
199408971	St. Louis	-90.48	38.56	6.900	12.610	199513710	St. Charles	-90.47	38.80	3.690	18.000
						199513841	St. Charles	-90.75	38.74	2.200	5.000
						199514720	Monroe	-91.92	39.50	0.300	3.000
						199514940	Warren	-91.02	38.85	0.100	60.000
						199515120	St. Charles	-90.71	38.73	1.230	1.320

Appendix A

Action ID	County	Long	Lat	Impacted Acres	Mitigated Acres	Action ID	County	Long	Lat	Impacted Acres	Mitigated Acres
199600420	Warren	-91.24	38.95	0.030	0.030	199708010	St. Charles	-90.61	38.70	0.200	0.340
199600440	St. Charles	-90.61	38.81	0.030	0.030	199708270	Pike	-90.84	39.26	0.010	0.010
199601910	St. Charles	-90.69	38.72	0.300	6.500	199708470	St. Louis	-90.51	38.61	0.330	0.330
199602270	St. Charles	-90.89	38.82	3.220	6.620	199708484	Cape Girardeau	-89.52	37.29	0.100	0.100
199602540	St. Louis	-90.54	38.66	0.100	0.900	199708900	St. Charles	-90.51	38.81	0.420	0.420
199603140	St. Louis	-90.49	38.51	0.600	0.350	199709310	Jefferson	-90.45	38.46	0.400	0.400
199603160	St. Louis	-90.61	38.64	0.410	0.300	199709601	Wayne	-90.28	36.95	3.500	3.500
199603220	St. Louis	-90.67	38.66	71.000	218.000	199709760	St. Charles	-90.73	38.73	3.190	2.480
199605010	St. Louis	-90.52	38.58	0.900	0.900	199710790	St. Louis	-90.54	38.66	0.650	4.350
199606010	St. Charles	-90.66	38.89	0.020	8.200	199710860	St. Charles	-90.79	38.78	0.128	5.600
199607060	St. Louis	-90.60	38.52	0.120	0.100	199711861	Lincoln	-90.84	38.99	0.190	0.190
199607063	St. Louis	-90.59	38.53	0.250	0.500	199800220	St. Louis	-90.63	38.49	0.000	0.650
199607411	St. Louis	0.00	0.00	0.900	1.500	199800300	Ralls	-91.47	39.45	0.830	0.830
199607760	St. Charles	-90.96	38.87	3.200	4.100	199801080	Jefferson	-90.43	38.23	2.430	4.900
199608010	St. Louis	-90.42	38.71	0.350	0.700	199801130	Jefferson	-90.52	38.46	0.150	0.150
199609081	Warren	-91.10	38.82	0.050	0.050	199801470	St. Charles	-90.49	38.78	0.230	0.230
199610801	St. Louis	-90.34	38.46	1.000	1.500	199801910	St. Charles	-90.90	38.79	1.300	3.000
199611320	St. Charles	-90.73	38.78	0.700	0.350	199801911	St. Charles	-90.90	38.79	0.200	0.200
199611570	St. Louis	-90.35	38.68	6.500	6.000	199802650	St. Charles	-90.67	38.71	0.580	0.580
199612150	St. Louis	-90.29	38.64	4.310	10.000	199803010	Pike	-91.13	39.50	2.000	6.000
199612420	St. Louis	-90.48	38.60	1.300	1.300	199803140	St. Charles	-90.72	38.75	0.200	2.800
199612570	St. Louis	-89.51	37.49	9.100	14.500	199803660	Randolph	-92.39	39.33	0.300	0.300
199612870	St. Louis	-90.64	38.68	72.300	119.600	199804160	Cape Girardeau	0.00	0.00	2.830	2.830
199613111	St. Charles	-90.52	38.82	1.800	2.300	199804870	St. Louis	-90.30	38.45	2.830	5.790
199613590	St. Charles	-90.69	38.89	1.400	3.000	199804880	St. Louis	-90.37	38.46	0.300	0.500
199700180	St. Charles	-90.73	38.72	4.780	4.800	199805150	St. Louis	-90.48	38.59	0.080	0.080
199700270	St. Charles	-90.82	38.60	1.880	38.500	199805261	St. Charles	-90.68	38.82	0.420	1.800
199700540	St. Charles	-90.68	38.80	1.400	1.300	199805380	St. Louis	-90.58	38.65	0.980	2.000
199700760	St. Louis	-90.57	38.66	0.230	0.230	199805780	St. Charles	-90.61	38.80	4.300	5.300
199700850	St. Louis	-90.58	38.58	0.630	0.630	199806030	St. Charles	-90.70	38.79	0.480	17.260
199700862	St. Charles	-90.71	38.74	0.300	4.000	199806460	St. Louis	-90.31	38.79	0.400	0.660
199701150	St. Louis	-90.45	38.52	0.340	0.340	199807390	Pike	-90.94	39.39	1.500	1.500
199701160	St. Louis	-90.59	38.59	0.700	0.900	199807401	Jefferson	-90.38	38.21	7.370	22.110
199701780	St. Louis	-90.59	38.66	0.360	8.730	199807402	Jefferson	-90.38	38.21	0.400	0.400
199701790	St. Louis	-90.63	38.63	0.460	2.300	199807530	Adair	-92.38	40.14	0.050	0.050
199702360	St. Charles	-90.92	38.66	0.110	57.000	199807710	Lincoln	-90.69	38.96	1.300	1.300
199702682	St. Charles	-90.98	38.98	0.050	0.050	199808030	St. Charles	-90.81	38.78	0.035	0.030
199703540	St. Louis	-90.59	38.58	1.200	1.700	199808370	St. Charles	-90.58	38.76	0.740	1.200
199703680	Audrain	-91.80	39.26	0.010	0.020	199808780	Warren	-91.21	38.87	0.020	0.020
199703960	Pike	-91.08	39.37	0.240	0.240	199809501	Lincoln	-90.93	39.00	0.008	0.008
199703970	Pike	-91.16	39.25	0.400	0.400	199809560	St. Charles	-90.60	38.74	0.006	0.006
199704720	St. Louis	-90.47	38.59	0.830	1.250	199809570	St. Charles	-90.51	38.81	0.200	0.200
199705980	St. Charles	-90.67	38.71	0.860	1.200	199810040	St. Louis	-90.61	38.66	0.200	0.200
199706640	St. Charles	-90.75	38.76	4.390	61.000	199810410	St. Charles	-90.87	38.81	0.010	0.010
199706642	St. Charles	-90.75	38.76	0.020	0.020	199900510	St. Charles	-90.89	38.81	0.080	6.000
199706921	St. Charles	-90.63	38.77	0.100	0.100	199900690	St. Louis	-90.36	38.71	0.730	0.500
199706980	Warren	-91.18	38.80	0.010	0.010	199900840	St. Louis	-90.52	38.69	2.900	3.900
199707200	Randolph	-92.42	39.42	0.180	0.180	199900860	Montgomery	-91.49	38.99	0.300	0.300
199707520	Pike	-91.39	39.48	0.010	0.010	199900960	Audrain	-91.92	39.22	0.010	0.010
199707620	St. Charles	-90.66	38.87	15.000	15.000	199901070	Adair	-92.41	40.15	0.010	0.010

Appendix A

Action ID	County	Long	Lat	Impacted Acres	Mitigated Acres	Action ID	County	Long	Lat	Impacted Acres	Mitigated Acres
199901110	St. Charles	-90.23	38.89	1.400	2.800	200009040	Phelps	-91.73	37.92	0.430	0.500
199901610	St. Louis	-90.42	38.79	29.400	164.330	200009220	Franklin	-90.75	38.48	0.250	0.750
199901681	St. Charles	-90.70	38.72	0.490	3.800	200009620	Ste. Genevieve	-90.09	38.01	9.300	9.300
199902190	St. Charles	-90.65	38.75	0.500	11.900	200009790	St. Charles	-90.77	38.78	0.330	0.495
199902570	Macon	-92.41	39.75	0.240	0.240	200010310	St. Charles	-90.72	38.88	1.800	0.300
199902691	St. Charles	-90.84	38.83	0.430	0.650	200101220	St. Charles	-90.55	38.86	0.180	0.180
199903840	St. Charles	-90.76	38.66	0.430	2.280	200101690	St. Charles	-90.60	38.82	0.500	0.500
199904010	St. Charles	-90.66	38.80	1.010	1.010	200102280	Montgomery	-91.46	38.93	12.300	14.000
199904530	St. Louis	-90.30	38.81	0.980	2.830	200102410	St. Louis	-90.14	38.83	4.070	4.100
199904620	St. Charles	-90.69	38.75	2.250	6.420	200103000	Montgomery	-91.45	39.04	0.200	1.030
199904681	Phelps	-91.75	37.93	0.290	0.290	200103010	Montgomery	-91.48	39.01	0.100	0.570
199904750	St. Louis	-90.48	38.57	0.590	1.090	200103500	Audrain	-92.01	39.18	0.040	0.040
199905080	St. Charles	-90.84	38.78	0.750	3.000	200103970	Audrain	-91.89	39.19	0.790	1.310
199905600	St. Charles	-90.55	38.83	0.400	12.000	200105890	St. Louis	-90.48	38.58	3.540	3.540
199905611	St. Charles	-90.53	38.79	0.200	0.200	200106361	Warren	-91.14	38.82	0.190	0.190
199905710	St. Louis	-90.42	38.80	0.300	0.300	200106450	Washington	-91.09	38.08	0.120	0.120
199907110	St. Louis	-90.56	38.64	0.310	0.310	200106760	St. Louis	-90.34	38.68	0.310	0.310
199907190	St. Charles	-90.74	38.67	0.720	3.000	200106780	Warren	-90.99	38.86	0.340	0.590
199907820	St. Charles	-90.73	38.82	0.130	0.130	200107810	Franklin	-90.97	38.43	0.500	1.000
199907860	St. Louis	-90.62	38.50	10.200	13.050	200107940	Phelps	-91.73	37.92	0.870	0.870
199907870	St. Charles	-90.66	38.80	1.200	2.750	200108550	St. Louis	-90.26	38.80	0.960	1.920
199908300	Phelps	-91.76	37.97	0.550	0.830	200108640	St. Louis	-90.30	38.78	3.670	3.670
199908580	St. Charles	-90.47	38.80	0.280	0.500	200108750	Monroe	-91.95	39.43	0.300	0.300
199908730	St. Charles	-90.72	38.75	0.250	0.500	200200380	Jefferson	-90.41	38.42	0.500	0.750
199908850	St. Louis	-90.28	38.48	0.190	0.190	200201050	St. Louis	-90.54	38.57	0.210	0.420
200000670	St. Louis	-90.34	38.40	0.920	0.920	200201280	St. Charles	-91.01	38.97	0.690	0.770
200000990	St. Louis	-90.39	38.82	3.000	3.000	200201290	St. Louis	-90.33	38.49	1.450	1.450
200001011	St. Louis	-90.27	38.86	3.400	7.600	200201680	St. Louis	-90.68	38.61	0.220	0.220
200001560	St. Louis	-90.33	38.43	0.070	0.070	200201960	St. Louis	-90.47	38.57	0.130	0.130
200001991	St. Louis	-90.58	38.60	0.150	0.300	200202160	Jefferson	-90.26	38.13	6.150	12.300
200002180	St. Charles	-90.64	38.76	1.090	2.450	200202570	St. Charles	-90.68	38.73	0.550	1.100
200002181	St. Charles	-90.64	38.76	0.070	0.070	200203380	Jefferson	-90.50	38.04	0.480	5.000
200002321	St. Louis	-90.49	38.65	0.400	0.400	200203920	St. Louis	-90.61	38.50	0.480	0.720
200002330	St. Louis	-90.47	38.69	0.150	0.150	200203940	St. Charles	-90.21	38.87	0.140	0.400
200002690	Jefferson	-90.35	38.39	0.750	1.150	200203990	St. Charles	-90.55	38.73	7.500	11.300
200003960	Franklin	-90.92	38.31	0.307	0.307	200204540	Pike	-91.27	39.29	0.140	0.280
200004200	St. Louis	-90.49	38.59	1.660	3.500	200204630	St. Charles	-90.87	38.83	0.090	0.140
200004480	Jefferson	-90.26	38.13	0.001	0.001	200204760	St. Louis	-90.30	38.82	0.200	4.670
200004490	Cape Girardeau	-89.53	37.32	0.200	0.200	200204780	St. Louis	-90.47	38.57	0.040	0.040
200005240	Phelps	-91.64	38.00	0.480	0.720	200206050	St. Charles	-90.54	38.78	0.080	0.150
200005380	St. Charles	-90.79	38.76	0.500	0.500	200206250	St. Charles	-90.13	38.84	7.700	10.000
200005390	St. Charles	-90.63	38.78	0.460	0.690	200207712	Franklin	-91.00	38.38	0.100	0.100
200005950	St. Charles	-90.74	38.74	0.450	0.800	200300060	Adair	-92.53	40.10	0.530	0.980
200006140	Phelps	0.00	0.00	0.170	0.250	200300690	St. Charles	-90.65	38.90	0.100	0.100
200006670	St. Charles	-90.43	38.86	0.450	0.450	200300870	Wayne	-90.36	36.97	0.100	0.100
200007160	St. Louis	-90.35	38.42	31.000	31.900	200302580	St. Charles	-90.71	38.83	0.120	0.140
200007710	St. Charles	-90.84	38.80	2.200	5.180	200302600	Lincoln	-90.93	38.93	1.750	2.600
200007810	Pike	-90.78	39.28	0.300	0.450	200305660	St. Charles	-90.64	38.75	0.320	0.400
200008100	St. Charles	-90.64	38.88	0.400	0.400	200307270	St. Louis	-90.64	38.68	0.250	0.250
200008920	Ste. Genevieve	-90.25	38.10	14.000	61.000	200307670	St. Charles	-90.50	38.75	0.730	0.730

Appendix A

Action ID	County	Long	Lat	Impacted Acres	Mitigated Acres
200308490	Warren	0.00	0.00	0.500	2.410
200308780	Dent	-91.65	37.74	0.100	0.100
200309510	St. Charles	-90.55	38.76	0.720	3.300
200400080	St. Charles	-90.73	38.73	18.080	42.230
200400640	St. Louis	-90.57	38.62	1.270	4.590
200401290	St. Louis	-90.62	38.49	0.350	0.690
200401600	Jefferson	-90.64	38.30	0.820	0.320
200402800	Jefferson	-90.36	38.36	0.090	0.450
200406310	St. Louis	-90.61	38.58	0.130	0.130
200406400	St. Louis	-90.31	38.82	0.500	0.500
200408001	St. Charles	-90.91	38.82	0.100	0.300
200409160	Jefferson	-90.63	38.27	4.000	13.200
200500220	Jefferson	-90.40	38.19	0.010	0.010
200502460	St. Charles	-90.53	38.77	0.100	0.100
200502830	Franklin	-90.98	38.40	0.010	0.010
200503330	Wayne	-90.27	36.93	0.010	0.010
200503420	St. Charles	-90.35	38.94	0.100	0.100
200504410	St. Louis City	-90.19	38.66	0.200	0.200
580350851	Cape Girardeau	-89.51	37.32	0.010	0.010
850316519	St. Louis City	-90.19	38.67	0.500	0.500

Appendix A

Table A2. Wetland Mitigation sites for Individual and Nationwide permits approved between 1992 and 2005 in the Kansas City District of the U.S. Army Corps of Engineers.

Base Number	County	Long	Lat	Impacted Acres	Mitigated Acres
2151	St. Louis	-90.48	38.76	8.000	10.000
2797	Callaway	-92.18	38.59	0.310	0.610
3491	Platte	-94.61	39.16	1.200	4.010
3550	Franklin	-90.81	38.57	1.000	1.000
3588	Miller	-92.63	38.24	0.430	0.360
199201046	Buchanan	-94.89	39.72	5.000	10.000
199201309	Howard	-92.75	38.98	0.700	0.700
199201699	Clay	-94.31	39.33	4.540	4.700
199201889	Bates	-94.15	38.06	1.230	1.000
199201935	Chariton	-93.25	39.67	4.700	10.000
199202326	St. Charles	-90.48	38.77	5.100	7.650
199202720	Jackson	-94.52	39.00	9.760	13.340
199300184	Callaway	-92.17	38.59	0.360	0.360
199300265	St. Louis	-90.40	38.80	0.400	0.450
199300287	Vernon	-94.26	38.04	100.000	450.000
199300540	Randolph	-92.63	39.56	3.300	12.000
199300581	Henry	-93.97	38.43	0.580	0.580
199300828	St. Louis	-90.59	38.67	13.000	13.000
199300884	Moniteau	-92.40	38.78	0.300	0.300
199301009	Vernon	-94.45	37.86	1.400	1.400
199301081	Vernon	-94.41	37.87	0.300	0.300
199301081	Vernon	-94.43	37.87	0.300	0.300
199301148	Henry	-93.80	38.36	1.000	1.450
199301165	Vernon	-94.43	37.87	0.007	0.007
199301317	St. Clair	-93.65	38.15	0.870	0.870
199301499	Saline	-93.24	39.18		0.250
199301528	St. Louis	-90.48	38.75	2.840	9.990
199301624	St. Clair	-93.92	38.00	1.100	1.100
199400204	Platte	-94.95	39.40	0.450	0.450
199400315	DeKalb	-94.21	39.91	1.800	1.800
199400563	Livingston	-93.61	39.84	0.300	0.300
199400573	Platte			8.000	12.000
199400590	Buchanan			1.250	1.250
199400758	Carroll			6.430	6.430
199400810	Franklin			0.096	0.320
199400846	Ray	-93.92	39.21	11.000	11.000
199400858	Platte	-94.62	39.16	1.250	16.900
199400858	Platte	-94.62	39.16	0.100	0.100
199400860	Clay	-94.49	39.15	1.700	3.500
199400930	DeKalb	-94.27	39.90	1.200	1.200
199401072	St. Charles	-90.57	38.72	0.300	1.100
199401140	Livingston	-93.43	39.77	0.840	0.840
199401389	Bates	-94.30	38.08	16.900	16.900
199401469	St. Louis	-90.50	38.75	0.900	0.900
199401743	Henry	-93.88	38.41	0.200	0.200
199401860	St. Clair	-93.73	38.01	0.620	0.620
199500231	Osage	-92.02	38.56	0.000	4.200
199500231	Osage	-92.02	38.55	0.000	4.200
199500268	Vernon	-94.41	37.88	0.400	0.400
199500295	Linn	-93.24	39.83	2.800	2.800
199500344	Jackson	-94.37	39.15	4.430	6.200
199500344	Jackson	-94.37	39.14	4.430	6.200
199500649	Henry	-93.88	38.41	2.000	2.000
199500771	Morgan	-93.00	38.23	0.020	0.020
199501209	Vernon	-94.49	37.98	0.100	0.100
199501209	Vernon	-94.40	37.98	0.100	0.100
199501209	Vernon	-94.49	37.96	0.100	0.100
199501536	Ray	-94.09	39.14	1.100	1.100
199502291	Jackson	-94.17	39.14	0.690	0.690
199502291	Jackson	-94.17	39.13	0.690	0.690
199502433	Gasconade	-91.62	38.64	10.000	10.000
199502591	Cole	-92.24	38.64	46.200	46.200
199600122	Camden	-92.80	38.01	0.910	0.910
199600164	Jackson	-94.55	38.97	1.100	4.000
199600379	Jackson	-94.25	39.02	4.600	5.000
199600379	Jackson	-94.23	39.01	4.600	5.000
199600481	Platte	-94.98	39.45		130.900
199600660	Livingston	-93.59	39.88	0.100	0.400
199600660	Livingston	-93.57	39.88	0.100	0.400
199600813	Boone	-92.21	39.21	0.200	0.200
199600813	Boone	-92.23	39.21	0.200	0.200
199600901	Cole	-92.28	38.67	26.600	26.600
199600912	Callaway	-92.17	38.59	0.080	0.150
199601076	Henry	-93.96	38.45	1.100	1.100
199601202	Callaway	-92.04	38.57	0.880	2.000
199601225	Macon	-92.49	39.72	0.001	0.001
199601470	Boone	-92.30	38.65	9.500	9.500
199601483	Bates	-94.45	38.11		8.600
199601689	Platte	-94.67	39.30	0.380	0.380
199601742	Nodaway			0.600	0.600
199602009	Macon	-92.86	39.76	12.840	12.840
199602017	Henry	-93.89	38.42	0.500	0.500
199602023	Jackson			0.050	0.050
199602353	Dallas	-93.10	37.51	0.280	0.280
199700056	Buchanan	-94.96	39.68	4.000	4.000
199700335	Benton	-93.35	38.12	0.550	0.550
199701012	Bates	-94.45	38.11		8.800
199701021	Vernon	-94.41	37.87		0.190
199701033	Putnam	-92.72	40.57	0.500	20.000
199701453	Buchanan	-94.96	39.67	0.047	0.047
199701957	Platte	-94.67	39.26	1.200	1.800
199702013	Atchison			0.300	0.500
199702049	St. Charles			5.700	5.700
199702141	Franklin	-90.91	38.50	0.600	0.600
199702141	Franklin	-90.93	38.50	0.600	0.600
199702437	Jackson	-94.36	39.02	0.638	1.270

Appendix A

Base Number	County	Long	Lat	Impacted Acres	Mitigated Acres	Base Number	County	Long	Lat	Impacted Acres	Mitigated Acres
199702569	Livingston	-93.55	39.77	0.800	3.440	199902112	Saline	-92.99	39.30	0.100	0.100
199702589	Osage	-91.83	38.40	0.000	0.100	199902112	Saline	-92.97	39.30	0.100	0.100
199702692	Clay	-94.42	39.39	0.290	0.290	199902112	Saline	-92.97	39.29	0.100	0.100
199800010	Camden	-92.80	38.00	0.100	0.100	199902155	Henry	-93.84	38.38	0.010	50.000
199800089	Linn	-93.09	39.85	0.350	0.800	199902178	Sullivan	-93.11	40.22	0.100	0.100
199800110	Chariton	-92.85	39.28	3.580	3.850	199902189	Grundy	-93.38	40.13	0.250	0.250
199800110	Chariton	-92.85	39.27	3.580	3.850	199902202	Chariton	-93.26	39.68	1.000	1.000
199800260	Howard	-92.74	38.98	1.200	2.000	199902288	Ray	-93.96	39.26	0.990	1.500
199800485	Livingston	-93.56	39.77	59.050	78.740	199902309	Chariton	-93.24	39.62	3.700	3.700
199800603	St. Clair	-93.93	38.01	0.320	0.320	199902333	Chariton	-93.28	39.53	0.100	0.100
199800856	Henry	-93.93	38.28	0.300	0.500	199902352	Pulaski	-92.08	37.89	0.010	0.020
199800856	Henry	-93.93	38.29	0.300	0.500	200000030	Callaway	-91.95	38.88	0.210	0.210
199800922	Camden	-92.78	38.00	0.240	0.120	200000162	Nodaway	-94.87	40.14	1.550	2.440
199800922	Camden	-92.80	37.99	0.240	0.120	200000772	Vernon			1.000	8.000
199800922	Camden	-92.78	37.99	0.240	0.120	200000795	Jackson	-94.34	39.03	0.320	0.320
199801232	Cole	-92.02	38.50	1.700	1.700	200000795	Jackson	-94.36	39.03	0.320	0.320
199801396	Morgan	-92.95	38.20	0.000	0.010	200000795	Jackson	-94.34	39.02	0.320	0.320
199801627	Andrew			0.900	0.900	200000875	Henry	-93.99	38.44	8.000	8.000
199801634	Jackson	-94.25	39.00	0.373	0.230	200000883	Henry	-93.89	38.45	5.800	58.000
199801686	Montgomery	-91.44	38.71	0.800	0.800	200000883	Henry	-93.87	38.45	5.800	58.000
199801687	Clay	-94.60	39.39	0.020	0.020	200000892	Polk	-93.45	37.61	0.400	0.400
199801856	Boone	-92.33	38.93	0.060	0.060	200000904	Gentry	-94.40	40.25	2.330	3.500
199801883	Ray	-94.16	39.51	0.010	0.010	200000904	Gentry	-94.40	40.23	2.330	3.500
199802016	Texas	-92.40	37.79	0.100	0.100	200000904	Gentry	-94.42	40.23	2.330	3.500
199802026	Jackson	-94.36	39.03	0.320	0.320	200001048	Henry	-93.91	38.44	1.800	25.000
199802145	Callaway	-91.84	38.71	0.300	0.500	200001062	Mercer	-93.57	40.39	0.180	0.180
199802184	Randolph	-92.38	39.30	0.080	0.080	200001072	Vernon	-94.31	38.03	16.000	1425.000
199900001	Harrison	-93.78	40.43	0.420	0.420	200001072	Vernon	-94.29	38.03	16.000	1425.000
199900135	Cass	-94.26	38.77	0.470	0.470	200001102	Henry	-93.87	38.41	0.180	20.000
199900336	Jackson	-94.37	38.87	0.080	0.080	200001102	Henry	-93.89	38.41	0.180	20.000
199900342	Jackson	-94.37	38.90	0.000	0.840	200001195	Bates	-94.07	38.05	0.730	18.000
199900346	Cooper	-92.63	39.00	17.000	510.000	200001342	Clay	-94.60	39.39	1.920	1.920
199900346	Cooper	-92.61	39.00	17.000	510.000	200001354	Johnson	-93.56	38.91	115.000	115.000
199900346	Cooper	-92.60	39.00	17.000	510.000	200001354	Johnson	-93.55	38.91	115.000	115.000
199900599	Saline	-93.47	39.18	0.060	8.810	200001428	Jackson	-94.50	39.14	1.500	3.000
199900615	Grundy	-93.51	40.07	0.100	0.100	200001525	Jackson	-94.60	38.88	0.030	0.500
199900855	Camden	-92.94	38.18	0.006	0.006	200001543	Jackson	-94.50	39.13	0.800	1.600
199900859	Harrison	-94.19	40.27	0.500	0.500	200001591	Boone	-92.15	39.03	0.040	2.600
199900933	Saline	-92.86	39.22	0.570	0.570	200001764	Jackson	-94.54	38.94	2.130	3.200
199900975	Clay	-94.38	39.33	1.100	2.200	200001776	Linn	-93.02	39.78	0.210	0.210
199901069	Cooper	-92.73	38.91	3.200	5.500	200001776	Linn	-93.02	39.77	0.210	0.210
199901432	Harrison	-93.77	40.34	0.270	0.270	200001852	Clay	-94.49	39.20	0.470	0.940
199901432	Harrison	-93.77	40.33	0.270	0.270	200001902	St. Clair	-94.05	38.01	1.000	20.000
199901462	Henry	-94.04	38.45	2.000	58.000	200002119	Macon	-92.71	40.00	0.070	0.070
199901587	St. Clair	-94.05	38.05	0.500	3.500	200002125	Montgomery	-91.45	38.73	0.100	0.300
199901651	Bates	-94.21	38.05	1.200	60.000	200100023	Jackson	-94.39	39.06	0.110	0.170
199901814	Henry	-94.03	38.22	0.700	60.000	200100104	Cass	-94.40	38.81	0.160	0.160
199901906	Jackson	-94.40	38.93	0.150	1.200	200100123	Bates	-94.26	38.11	6.000	6.000
199901991	Boone	-92.35	38.90	0.130	0.130	200100253	Gasconade	-91.55	38.67	2.220	2.220
199902077	Jackson	-94.57	38.87	0.420	0.420	200100273	Barton	-94.60	37.49	0.100	7.600

Appendix A

Base Number	County	Long	Lat	Impacted Acres	Mitigated Acres	Base Number	County	Long	Lat	Impacted Acres	Mitigated Acres
200100385	Johnson	-94.00	38.75	0.030	0.045	200201043	Franklin	-90.97	38.54	0.040	0.040
200100387	Boone	-92.47	38.88	0.090	0.090	200201087	Jackson	-94.43	38.96	0.344	0.344
200100493	Clay	-94.45	39.28	0.076	0.076	200201175	Miller	-92.23	38.28	0.140	0.140
200100714	Linn	-93.18	39.82	0.340	0.340	200201252	Miller	-92.35	38.24	0.350	0.350
200100975	Gentry	-94.36	40.25	0.960	1.200	200201256	Bates	-94.12	38.07	0.220	0.220
200101005	Adair	-92.68	40.24	1.000	5.000	200201257	Henry	-93.86	38.36	3.890	3.890
200101008	Montgomery	-91.43	38.72	4.000	4.000	200201259	Henry	-93.86	38.29	0.080	0.080
200101008	Montgomery	-91.45	38.70	4.000	4.000	200201438	Jackson	-94.39	39.02	0.000	0.670
200101165	Henry	-94.00	38.45	6.000	6.000	200201601	Cole	-92.01	38.49	0.350	0.350
200101165	Henry	-93.98	38.45	6.000	6.000	200201678	Platte	-94.68	39.21	0.010	0.010
200101224	Franklin	-91.01	38.53	0.080	0.080	200201794	St. Clair	-93.91	38.06	0.740	0.740
200101368	Bates	-94.25	38.06	10.500	10.500	200201928	Pettis	-93.17	38.70	0.350	0.700
200101531	Harrison	-93.79	40.33	0.020	0.020	200201930	Platte	-94.77	39.35	0.400	0.400
200101617	Jackson	-94.59	38.89	0.370	0.370	200202020	Platte	-94.67	39.33	0.010	0.010
200101653	Clay	-94.42	39.30	1.600	1.600	200202029	Buchanan	-94.68	39.55	1.430	2.150
200101941	St. Clair	-93.76	37.96	0.300	0.300	200202060	Jackson	-94.34	38.93	0.020	0.020
200101956	Chariton	-93.23	39.61	1.250	5.500	200202093	Bates	-94.60	38.21	0.100	0.100
200101969	Henry	-93.86	38.29	0.100	0.100	200202112	Randolph	-92.55	39.48	0.010	0.010
200102016	Jackson	-94.21	39.04	0.020	0.020	200202130	Saline	-93.25	39.33	0.750	0.750
200102043	Clay	-94.47	39.20	0.260	0.400	200202162	Cass	-94.39	38.55	0.060	0.060
200200001	Johnson	-93.57	38.74	0.180	0.180	200202177	Jackson	-94.23	39.01	0.300	0.300
200200067	Harrison	-94.19	40.26	0.060	0.060	200202257	Ray	-93.92	39.22	1.100	1.100
200200128	Jackson	-94.11	39.12	0.030	0.030	200300053	Chariton	-93.17	39.50	0.270	0.270
200200168	Macon	-92.47	39.73	0.030	0.030	200300055	Pettis	-93.48	38.93	2.600	68.000
200200182	Franklin	-90.97	38.54	0.040	0.040	200300088	Putnam	-93.34	40.47	0.560	0.560
200200193	Jackson	-94.20	39.04	0.005	0.005	200300293	Clay	-94.60	39.16	7.600	17.940
200200248	Buchanan	-94.88	39.79	0.090	1.500	200300399	Platte	-95.00	39.48	1.000	1.000
200200318	Polk	-93.50	37.68	0.250	0.250	200300469	St. Clair	-93.70	38.06	0.010	0.010
200200342	Jackson	-94.43	38.96	0.002	0.002	200300535	Vernon	-94.27	38.07	0.100	0.100
200200344	Mercer	-93.45	40.46	0.140	0.140	200300554	Platte	-94.65	39.21	0.030	0.030
200200379	Boone	-92.37	38.87	0.050	0.050	200300711	Boone	-92.42	39.15	0.030	4.600
200200439	Clay	-94.31	39.34	1.920	3.000	200300724	Jackson	-94.31	39.03	0.020	0.020
200200501	Carroll	-93.18	39.42	0.120	0.120	200300807	Jackson	-94.33	38.93	0.040	0.040
200200508	Buchanan	-94.77	39.78	0.002	0.002	200300886	Bates	-94.29	38.09	0.625	0.625
200200565	Johnson	-93.76	38.75	0.030	0.030	200300887	Bates	-94.38	38.09	0.650	0.650
200200625	Cole	-92.01	38.49	0.350	0.350	200300887	Bates	-94.29	38.09	0.650	0.650
200200635	Randolph	-92.48	39.60	0.060	0.060	200300945	Clay	-94.58	39.29	0.358	0.510
200200635	Randolph	-92.48	39.58	0.060	0.060	200301124	Livingston	-93.53	39.69	0.090	0.090
200200637	Saline	-93.22	39.00	3.200	3.200	200301256	Clay	-94.37	39.21	0.750	0.750
200200640	Buchanan	-95.05	39.57	0.070	15.000	200301358	Clay	-94.46	39.26	0.480	0.480
200200641	Holt	-95.28	40.11	2.100	2.100	200301361	Warren	-91.36	38.73	0.700	0.700
200200722	Platte	-94.66	39.25	1.940	1.980	200301378	Jackson	-94.20	39.00	1.350	2.025
200200747	Pettis	-93.43	38.53	0.020	0.020	200301528	Cass	-94.52	38.82	0.390	2.200
200200747	Pettis	-93.45	38.53	0.020	0.020	200301587	Platte	-94.67	39.26	0.290	0.500
200200764	Carroll	-93.18	39.42	0.120	0.120	200301646	Franklin	-90.97	38.54	0.100	0.100
200200771	Harrison	-94.19	40.26	0.060	0.060	200301649	Harrison	-93.79	40.42	0.030	0.030
200200780	Macon	-92.47	39.73	0.030	0.030	200301660	Boone	-92.25	38.90	0.050	0.050
200200905	Jackson	-94.11	39.12	0.030	0.030	200301688	Johnson	-93.64	38.83	2.100	2.100
200200945	Clay	-94.55	39.21	0.008	0.008	200301714	Henry	-93.84	38.39	1.200	1.200
200201038	Jackson	-94.58	39.12	0.300	0.300	200301766	Polk	-93.62	37.87	0.660	1.270

Appendix A

Base Number	County	Long	Lat	Impacted Acres	Mitigated Acres	Base Number	County	Long	Lat	Impacted Acres	Mitigated Acres
200301794	Henry	-93.84	38.39	1.710	1.710	200402354	Carroll	-93.67	39.38	0.070	36.600
200301795	Vernon	-94.29	38.00	1.280	1.280	200500077	Jackson	-94.37	39.04	0.040	2.800
200301815	St. Clair	-93.92	38.01	4.500	4.500	200500192	Cooper	-92.74	38.95	0.070	0.070
200301934	Henry	-93.89	38.45	1.000	1.000	200500238	Clay	-94.60	39.19	0.240	0.240
200301934	Henry	-93.87	38.45	1.000	1.000	200500312	Platte	-94.64	39.17	0.320	0.320
200302128	Howard	-92.58	39.09	0.070	0.070	200500370	Macon	-92.83	39.98	0.900	15.500
200302142	Nodaway	-94.87	40.19	0.010	0.010	200500417	Sullivan	-93.18	40.18	6.000	6.000
200302143	Nodaway	-94.64	40.32	0.010	0.010	200500427	Lafayette	-94.10	39.01	0.250	0.250
200302145	Nodaway	-94.92	40.38	0.010	0.010	200500454	Chariton	-93.15	39.43	4.100	10.400
200302172	Nodaway	-94.98	40.19	0.010	0.010	200500706	Clay	-94.60	39.17	0.480	0.480
200302187	Cole	-92.18	38.55	0.220	0.220	200500775	Clay	-94.54	39.29	0.040	0.040
200302193	Clay	-94.31	39.33	2.570	2.570	200500876	Bates	-94.29	38.13	0.220	0.220
200302241	Jackson	-94.30	39.03	0.130	0.700	200500888	Jackson	-94.23	39.22	0.280	0.280
200302246	Macon	-92.59	39.66	1.400	1.400	200500971	Chariton	-93.22	39.59	0.600	15.000
200302289	Clay	-94.44	39.22	0.100	0.100	200501050	Linn	-93.29	39.68	25.500	25.500
200302291	Jackson	-94.32	38.95	0.003	0.003	200501124	Henry	-93.83	38.30	4.900	4.900
200302414	Andrew	-94.84	39.86	0.010	0.010	200501129	Platte	-94.62	39.16	0.490	4.000
200400098	Cass	-94.22	38.67	0.060	0.090	200501235	Jackson	-94.34	38.99	0.350	0.350
200400153	Callaway	-91.74	38.71	0.350	0.500	200501245	Benton	-93.36	38.28	0.050	0.050
200400342	Johnson	-93.74	38.78	0.700	1.200	200501252	Clay	-94.40	39.26	0.080	0.080
200400365	Jackson	-94.41	38.85	5.400	6.900	200501289	Livingston	-93.55	39.76	0.040	0.080
200400414	Sullivan	-93.17	40.16	0.600	0.600	200501313	Clay	-94.42	39.33	0.187	0.200
200400445	Clay	-94.35	39.20	0.200	0.200	200501371	Johnson	-93.64	38.83	2.100	2.100
200400455	Franklin	-91.05	38.56	0.070	0.070	200501372	Jackson	-94.49	39.13	0.600	0.600
200400468	Callaway	-91.74	38.70	0.060	0.060	200501498	Clay	-94.47	39.25	0.014	0.014
200400606	St. Clair	-93.89	37.96	5.560	5.560	200501546	Henry			23.000	23.000
200400695	Clay	-94.48	39.27	0.200	0.200	200501599	Bates	-94.25	38.07	7.700	7.700
200400707	Clay	-94.48	39.24	0.213	0.413	200501603	Henry	-93.84	38.39	0.500	0.500
200400739	Cass	-94.41	38.81	3.630	7.260	200501623	Johnson	-93.99	38.57	0.050	0.050
200400746	Jackson	-94.51	39.08	0.200	0.200	200501701	Vernon	-94.39	37.99	0.010	0.010
200400792	Henry	-93.86	38.30	9.300	9.300	200501768	Buchanan	-94.78	39.75	0.010	0.010
200400840	Clay	-94.57	39.31	0.500	0.500	200501829	Henry	-94.05	38.45	0.010	0.010
200400889	Clay	-94.55	39.31	0.100	0.240	200501878	Platte	-94.66	39.48	0.200	20.000
200400916	Andrew	-94.93	39.85	1.000	1.000	200502096	Vernon	-94.29	37.82	0.010	0.010
200401034	Vernon	-94.44	37.87	2.850	2.850	200502101	Vernon	-94.28	37.82	0.020	0.020
200401035	Bates	-94.39	38.18	0.570	0.570	200502178	Saline	-93.44	38.98	0.340	0.340
200401075	Macon	-92.49	39.72	0.010	0.010	200502191	Franklin	-91.25	38.56	1.500	15.000
200401187	Jackson	-94.32	38.85	0.080	0.120	200502243	Livingston	-93.41	39.73	11.000	11.000
200401305	Bates	-94.12	38.04	1.600	1.600	200502435	Clay	-94.52	39.25	0.200	0.400
200401371	Cass	-94.31	38.70	0.020	0.020	200502501	Howard	-92.68	39.04	0.900	4.000
200401421	Henry	-93.95	38.32	0.720	0.720	200502590	Platte	-94.87	39.47	0.040	0.040
200401437	Miller	-92.23	38.28	0.350	0.350	200502639	Jackson	-94.31	39.03	0.020	0.020
200401581	Saline	-93.36	38.95	0.690	0.700	200502664	Saline	-93.26	39.18	0.010	2.000
200401660	Osage	-91.93	38.63	0.500	0.500	200600050	Boone	-92.27	39.17	0.100	0.200
200401678	Buchanan	-94.87	39.73	0.300	0.900						
200401726	Vernon	-94.27	37.97	1.000	1.000						
200401845	Platte	-94.62	39.16	0.040	0.750						
200401951	Daviess	-93.97	40.10	0.120	0.640						
200401954	Vernon	-94.40	37.74	1.300	4.000						
200402296	Greene	-93.38	37.31	0.124	0.124						

Appendix A

Table A3. Wetland Mitigation sites for Individual and Nationwide permits approved between 1992 and 2002 in the Little Rock District of the U.S. Army Corps of Engineers.

Permit	County	Long	Lat	Impacted Acres	Mitigation Acres
2807		0.00	0.00	4.7	20.00
5978	Butler	-90.41	36.71	4	12.00
10872	Butler	-90.49	36.54	3.8	5.90
11494	Butler	-90.37	36.55	86	100.40
12053	Butler	-90.36	36.59	9.5	9.50
12054	Butler	-90.37	36.59	2.2	2.20
12055	Butler	-90.39	36.52	0	0.60
12056	Butler	-90.50	36.64	0	5.30
12057	Butler	-90.27	36.76	2.4	2.40
12058	Butler	-90.29	36.59	2.8	2.80
12332	Reynolds	-90.96	37.36	1.7	3.90
12651	Butler	-90.24	36.79	3.06	3.06
13531	Butler	-90.43	36.81	1.44	4.32
13536	Butler	-90.21	36.62	0.5	1.50
13784	Butler	-90.42	36.71	4.3	10.75
14169	Greene	-93.26	37.21	0	0.80
14323	Greene	-93.35	37.21	0.11	0.11
14368	Butler	-90.20	36.69	1.9	1.90
14369	Butler	-90.47	36.54	4.8	7.50
14551	Butler	-90.56	36.56	0.6	0.90
14902	Ripley	-90.70	36.51	0.3	0.30
15333	Butler	-90.22	36.65	0.9	2.40
15555	Butler	-90.49	36.52	0	3.50
15587	Butler	-90.46	36.76	0.8	0.80
15669	Butler	-90.46	36.78	0.68	0.68
15851	Ripley	-90.64	36.51	0.8	1.20
16396	Butler	-90.36	36.76	11.2	11.40
16397	Butler	-90.46	36.56	3.6	5.10
16627	Butler	-90.42	36.74	0.48	0.60
16650	Butler	90.24	36.70	0.6	1.80
16659	Butler	-90.22	36.70	0.4	0.60
16716	Butler	-90.44	36.57	5.1	5.10
16827	Butler	-90.26	36.77	0.4	0.40
16997	Butler	-90.39	36.64	0.9	1.30
17026	Ripley	-90.61	36.56	2	6.80
17027	Butler	-90.49	36.68	0.7	1.00
17255	Barton	-94.28	37.49	5.24	15.00
17531	Barton	-94.33	37.41	0.04	0.50
17596	Butler	-90.33	36.79	1.4	3.10
17757	McDonald	-94.40	36.60	0.35	0.40

Table A4. Wetland Mitigation sites for Individual and Nationwide permits approved between 1992 and 2005 in the Rock Island District of the U.S. Army Corps of Engineers.

Permit No.	Count	Long	Lat	Impacted Acres	Mitigated Acres
270800	Clark	-91.50	40.34	0.188	0.36
270800	Clark	-91.50	40.33	0.188	0.36
275680	Lewis	-91.81	40.20	0.10	9.00
277590	Lewis	-91.85	40.01	47.20	47.20
283630	Lewis	-91.81	40.20	0.12	30.00
306800	Marion	-91.82	39.72	12.00	18.30
306830	Scotland	-92.32	40.50	0.2	5.5
324490	Lewis	-91.74	40.14	0.07	12.00
331700	Clark	-91.90	40.54	0.00	200.00
334980	Clark	-91.50	40.34	0.21	0.36
334980	Clark	-91.50	40.33	0.21	0.36
352670	Marion	-91.46	39.89	0.12	2.10
359400	Clark	-91.56	40.29	0.04	0.04
388830	Clark	-91.50	40.34	0.62	0.62
394470	Clark	-91.48	40.34	0.00	3.70
409310	Marion	-91.63	39.91	0.20	0.20
411720	Lewis	-91.61	39.98	0.43	0.65
424150	Clark	-91.82	40.55	0.25	0.75
435720	Lewis	-91.64	40.23	0.48	10.00
457000	Clark	-92.40	40.38	0.03	25.00

Appendix A

Table A5. Wetland Mitigation sites for Individual and Nationwide permits approved between 1992 and 2003 in the Memphis District of the U.S. Army Corps of Engineers.

File Number	County	Long	Lat	Permitted Acres	Mitigated Acres	File Number	County	Long	Lat	Permitted Acres	Mitigated Acres
199300007	Pemiscot	-89.69	36.22	84.000	160.000	200176003	Scott	-89.55	37.00	0.200	0.200
940260000	New Madrid	-89.66	36.48	57.600	86.400	200200051	Stoddard	-90.07	36.71	2.500	3.000
950130010	Stoddard	-89.77	36.83	12.760	12.760	200200122	Mississippi	-89.20	36.97	1.100	3.300
950260050	New Madrid	-89.64	36.60	0.640	0.640	200200159	New Madrid	-89.94	36.60	0.100	0.100
950260110	Dunklin	-90.00	36.24	0.400	0.400	200200163	Cape Girardeau	-89.59	37.25	8.100	15.400
950260280	Stoddard	-89.75	36.72	1.400	1.400	200200272	New Madrid	-89.46	36.76	0.100	0.100
950430300	Stoddard	-90.10	36.90	0.940	2.000	200200273	Pemiscot	-89.92	36.32	0.100	0.100
950430740	Stoddard	-90.08	36.75	1.200	1.200	200200354	Bollinger	-90.07	37.08	0.000	220.000
950560050	Cape Girardeau	-89.56	37.24	4.800	15.000	200200375	Scott	-89.69	37.10	0.200	0.200
960030010	Pemiscot	-89.82	36.18	0.100	0.100	200200487	Stoddard	-89.80	37.03	1.800	4.000
960760000	New Madrid	-89.53	36.59	0.900	0.900	200200679	Pemiscot	-89.75	36.22	0.100	0.100
970130140	Stoddard	-89.82	37.01	1.600	2.700	200200835	New Madrid	-89.48	36.67	0.100	0.200
970320090	Mississippi	-89.33	36.69	0.000	70.000	200300001	Pemiscot	-89.76	36.38	0.200	0.200
970320110	Mississippi	-89.21	36.59	0.000	200.000	200300423	Stoddard	-89.99	36.80	0.120	2.500
970320130	Mississippi	-89.32	36.75	0.100	0.100	200300622	New Madrid	-89.94	36.58	0.100	0.100
970760040	Scott	-89.56	36.92	0.330	0.330	200300738	New Madrid	-89.54	36.79	0.100	0.100
970760050	Scott	-89.56	36.92	0.300	0.300						
980090020	Butler	-90.20	36.55	0.200	0.500						
980260030	Dunklin	-90.05	36.09	0.900	2.200						
980430130	Dunklin	-90.18	36.75	1.200	1.200						
980430200	Dunklin	-90.14	36.55	5.100	5.500						
980431100	Butler	-90.27	36.90	0.000	32.000						
990130010	Stoddard	-89.82	37.01	1.600	2.700						
990260120	Pemiscot	-89.83	36.23	0.200	0.200						
990260130	New Madrid	-89.70	36.36	0.800	2.400						
990260140	Stoddard	-89.80	37.04	1.600	3.000						
990260140	Stoddard	-89.80	37.02	1.600	3.000						
990320120	Mississippi	-89.20	36.97	1.100	3.300						
990320140	Pemiscot	-89.64	36.11	4.100	4.100						
990760020	Scott	-89.61	36.93	0.700	2.000						
990890030	Stoddard	-90.07	36.77	0.300	0.800						
2000130020	Stoddard	-89.95	37.05	0.400	0.400						
2000130050	Stoddard	-89.90	37.12	2.000	5.700						
2000260060	Pemiscot	-89.79	36.23	0.400	0.400						
2000260170	Pemiscot	-89.92	36.22	2.100	3.900						
2000430200	Stoddard	-90.11	36.86	1.400	3.700						
2000430470	Dunklin	-90.06	36.32	4.000	4.000						
2000430470	Dunklin	-90.11	36.41	4.000	4.000						
2000760030	New Madrid	-89.48	36.67	0.140	0.420						
2000760040	New Madrid	-89.48	36.67	0.140	0.420						
2000760050	New Madrid	-89.48	36.67	0.210	0.630						
200109057	Butler	-90.33	36.53	1.200	1.200						
200126037	Stoddard	-89.76	37.01	5.000	5.000						
200126041	New Madrid	-89.84	36.42	5.200	13.500						
200126056	New Madrid	-89.64	36.72	0.100	0.100						
200143114	Dunklin	-90.19	36.57	0.900	0.900						

Appendix B.

Summaries of wetland soil, vegetative and hydrologic indicators observed at each assessed wetland mitigation site. Each summary identification number corresponds to the "USACE district ID #" in Table 2 of the main text.

Soil sample information is based upon characteristics described for measurement in the 1987 USACE Wetlands Delineation Manual and includes depth to the soil ped that was examined, soil color for the matrix and mottles (if present), and soil texture. Vegetation is the dominant species observed at the site. Hydrology is that which was observed at the site as well as consideration of drought conditions at the time of the site visit.

12332, 3/3/06

Soil sample: depth 2 inches, 7.5YR 4/4, clayey

Vegetation: *Typha angustifolia*, *Polygonum pennsylvanica*

Hydrology: west cell was dry. Elevation of water control structure probably too high to allow flow from adjacent creek frequent enough. East cell had some standing water and recent extensive inundation.

13531, 3/3/06

Mitigation site not yet determined. Original location of mitigation was a suitable site.

15851, 3/2/06

Soil sample: depth 5 inches, Matrix 7.5YR 4/1, Mottle 7.5YR 4/6 - many/medium/distinct, clayey

Vegetation: *Polygonum pennsylvanica*.

Hydrology: standing water over part of site, low area at edge of ag field adjacent to drainage ditch has a moist regime.

199700335, 2/15/06

Soil sample: depth 6 inches, matrix 10YR 3/2, mottle 10YR 3/1, many/coarse/faint, clayey.

Vegetation: *Platanus occidentalis*, *Quercus bicolor*, *Gleditsia triacanthos*, *Aster* spp., old growth trees dead potentially due to frequent flooding from Truman Reservoir.

Hydrology: periodic flooding from Truman Reservoir as well as immediate flood plain of Prairie Creek.

199800856, 6/22/06

Soil sample: depth 6 inches, matrix 10YR 4/1, mottle 10YR 4/6 - many/large/distinct, clay.

Vegetation: *Rumex crispus*, *Xanthium strumarium*, *Carex crus-corvi*, *Juncus interior*, *Ambrosia artemisiifolia*. Site is grazed by cattle.

Hydrology: minimally adequate, lower portion of area does appear adequate.

199801396, 2/15/06

Soil sample: depth 6 inches, matrix 10YR 4/1, coarse loamy.

Vegetation: partially a mud flat, *Eleocharis obtusa*.

Hydrology: long duration inundation during warm season pool levels of Lake of the Ozarks.

199802145, 1/25/06

Soil sample: depth 4 inches, matrix 7.5YR 5/2, mottle 5YR 4/4 - many/medium/distinct, clay.

Vegetation: *Quercus palustris*, *Quercus bicolor*, *Carex* spp., *Juncus* spp.

Hydrology: small pools of standing water indicate prolonged inundation in small depressions.

199900342, 12/13/05

Soil sample: depth 4 inches, matrix 10YR 4/1, mottle 10YR 4/4 - many/fine/distinct, clayey.

Vegetation: *Ludwigia peploides*, *Eleocharis obtusa*, *Scirpus validus*, many hydrophitic spp.

Hydrology: permanent inundation over much of area.

Appendix B. (continued)

199901069, 1/27/06

Soil sample: depth 6 inches, matrix 5/5GY, mottle 7.5YR 4/4.

Vegetation: *Polygonum pennsylvanica*, *Ludwigia peploides*, *Juglans Nigra*, *Platanus occidentalis*.

Hydrology: permanent shallow inundation on much of site, immediate floodplain of Petite Saline Creek.

199901462, 2/28/06

Soil sample: depth 7 inches, matrix .5YR 3/1, mottle 2.5YR 4/6.

Vegetation: *Eleocharis obtusa*, *Polygonum pennsylvanica*.

Hydrology: prolonged inundation, several cells with water control structures maintaining water depths pooled seasonally for waterfowl habitat.

199901991, 11/9/05

Soil sample: depth 4 inches, matrix 7.5YR 4/2, silty.

Vegetation: in portion of mitigation site adjacent to existing wetland the vegetation was mowed. In the existing wetland there was *Sagittaria*, *Salix nigra*, *Typha angustifolia*.

Hydrology: water control structure creating prolonged inundation over pre-mitigation portion of site and at least periodic inundation over entire mitigation site. Berm elevation along creek may be too high to allow adequate frequency of flooding. Site is early in the monitoring stage.

200000892, 12/23/05

Soil sample: depth 7 inches, 10YR 3/1, mottle 2.5YR 3/6.

Vegetation: *Typha angustifolia*, *Carex* spp., *Polygonum* spp., *Scirpus atrovirens*.

Hydrology: appears to act as a vernal pool; bare soil at lowest elevation portion of wetland appears to be due to prolonged inundation. Much of site has been inundated since its construction.

200001072, 6/22/06

A specific mitigation site was not designated. Mitigation was said to be accomplished through construction of the levee restoring of 1,400 acres of wetlands within the Missouri Dept of Conservation August Busch Memorial Wetlands at Four Rivers Conservation Area; a managed wetlands complex with water control structures to maintain a variety of seasonal inundations especially for waterfowl habitat marshes.

Vegetation: (near the permitted parking lot) *Sagittaria* spp., *Polygonum* spp., *Salix nigra*.

Hydrology: prolonged inundation contained with levees

200001776, 12/15/05

Mitigation site was not specified. It was a part of a MODOT wetland mitigation complex consisting of a variety of restored or created wetlands mitigated for multiple highway projects.

Soil sample: depth 7 inches, matrix 5YR 4/1, mottle 10YR 4/6 - many/medium/distinct, clayey

Vegetation: *Echinochloa crusgalli*, *Bidens* spp., *Acer saccharinum*

Hydrology: site is at least periodically inundated as part of a wetland complex of a range of inundation durations.

200001902, 2/28/06

Soil sample: depth 4 inches, matrix 2.5Y 2.5/1, mottle 2.5YR 4/3 - many/small/faint, clayey.

Vegetation: *Polygonum*, *Hibiscus moscheutos*, *Ludwigia peploides*.

Hydrology: long duration inundation in some portions of site; seasonal inundation in other portions of site for waterfowl habitat.

199708470, 12/6/05

No specified mitigation site; a part of a wetland mitigation complex (Page Avenue Mitigation Complex) with expansive restored wetlands.

Appendix B. (continued)

199801470, 2/17/06

Soil sample: depth 7 inches, 2.5YR 4/1, mottle 7.5YR 4/4 - many/coarse/distinct, silty clay.

Vegetation: *Typha latifolia*, *Salix exigua*, *Populus deltoides*, *Polygonum hydropiper*.

Hydrology: floodplain of stream channel in stormwater detention basin; probably inundated several times during growing season; usually water table within 12 inches of ground surface.

199803010, 12/16/05

Soil sample: depth 6 inches, matrix 10YR 4/1, mottle 2YR 4/4 – common/medium/distinct, silty clay.

Vegetation: *Populus deltoides*, *Quercus palustris*, *Desmodium paniculatum*, *Phalaris arundinaceae*.

Hydrology: depressional landscape maintains an aquic moisture regime and wet soil, probably also receives periodic flooding from the adjacent Salt River.

199805780, 6/23/06

Soil sample: depth 7 inches, matrix 10YR 5/2, mottle 7.5YR 5/6 – many/medium/distinct, very clayey.

Vegetation: *Typha angustifolia*, *Salix exigua*, *Lotus corniculatus*, *Eleocharis obtusa*, *Eleocharis acicularis*.

Hydrology: a landscaped underwater bench inward of shoreline on small lake in community park creates long duration inundation of a shallow wetland area.

199809570, 2/17/06

Soil sample: stream embankment rock content too high from which to extract soil; consists of rip-rap with organic matter accumulating on surface

Vegetation: *Lonicera* spp.

Hydrology: along active stream bank of permanent flow unnamed tributary of Cole Creek, probably receives brief inundation a few times per year during annual growing season

199900690, 2/3/06

Soil sample: depth 3 inches, matrix 5YR 4/1, mottle 4/10B - many/coarse/faint, clayey.

Vegetation: ground cover is mowed lawn, nearby planted trees were *Quercus palustris*, *Acer rubrum*, *Fraxinus pennsylvanica*.

Hydrology: although adjacent to a waterway channel, due to the concrete embankment, water movement through the channel bank to the adjacent riparian area will be minimal. Riparian mitigation site may not maintain high water table as the concrete channel bank includes drainage pipes to allow subsurface water to flow from the riparian zone into the waterway.

199901681, 2/22/06

Soil sample: depth 4 inches, 3/5GY, clayey.

Vegetation: approximately 50% of the mitigation site lake perimeter consists of rock riprap, 20% is mowed grass, 30% is forested with *Acer nigrum* or *succharum*. Approximately 500 square of a *Typha* population exists at the dam.

Hydrology: an impounded water body with a high water level maintained. Water surface area appears to be less than half of the required 3.8 acres.

199902691, 2/22/06

Soil sample: depth 4 inches, matrix 3/10B, clayey.

Vegetation: only tree species were discernable – *Acer succharum*, *Populus deltoides*, *Salix exigua*.

Hydrology: three stormwater detention basins with shallow prolonged duration pools maintained.

Appendix B. (continued)

199903840, 6/23/06

Soil sample: depth 6 inches, matrix 2.5YR 6/1, mottle 2.5YR 4/6 – many/large/distinct, silty clay loam.

Vegetation: *Quercus palustris*, *Quercus bicolor*, *Panicum rigidulum*.

Hydrology: site is partially a low lying area along creek that will be frequently inundated. The mitigation site extends uphill from creek to practically an upland landscape. The upper end of the site will probably rarely be inundated by overbank flow from creek.

199905080, 2/17/06

Soil sample: depth 4 inches, matrix 4/10Y, very clayey.

Vegetation: *Typha latifolia*, *Salix exigua*.

Hydrology: mitigation site is a lake with a fairly constant water level.

199907820, 6/23/06

Soil sample: depth 4 inches, matrix 5YR 4/6.

Vegetation: mowed grasses.

Hydrology: might be inadequate for generating reduced conditions in the soil as downslopes exist on two sides of the mitigation site.

200002181, 2/3/06

Soil sample: depth 4 inches, matrix 3.5/N, mottle 2.5YR 4/6 – few/fine/distinct, silty clay

Vegetation: *Quercus palustris*, *Quercus bicolor*, *Cephalanthus occidentalis*, *Cornus florida*, *Platanus occidentalis*, *Polygonum lapathifolium*

Hydrology: low lying in floodplain of adjacent creek, portion of mitigation site has prolonged inundation. Remainder of site seems low enough to receive frequent inundation

200004200, 2/22/06

Soil sample: depth 4 inches, matrix 10YR 4/2, mottle 10YR 5/1 – common/large/faint, silty clay.

Vegetation: *Scirpus atrovirens*, *Elymus virginicus*, *Quercus bicolor*, *Acer saccharinum*, *Quercus palustris*, *Polygonum pennsylvanicum*, *Quercus macrocarpa*.

Hydrology: portion of mitigation site receives prolonged inundation. Remainder of site is an aquatic moisture regime in active floodplain with overbank flows from Grand Glaize Creek as well as upland runoff.

200005240, 3/2/06

Soil sample: depth 5 inches, matrix 7.5YR 4/1, mottle 7.5YR 3/4 - many/medium/distinct, silty clay.

Vegetation: *Salix nigra*, *Polygonum pennsylvanicum*, *Cyperus esculentus*, *Eleocharis palustris*, *Carex vulpinoidea*.

Hydrology: mitigation site is in a low lying area that receives significant runoff from a very large parking lot via a stormwater detention basin.

200006670, 2/22/06

Soil sample: depth 4 inches, matrix 7.5YR 4.1, mottle 7.5YR 4/4 – common/medium/distinct, sandy clay.

Vegetation: *Quercus palustris*, *Quercus shumardii*, *Carya illinoensis*, *Acer saccharinum*.

Hydrology: site is in floodplain of Missouri River. Site has experienced less than normal flows on the river in recent years providing less than adequate quantities of water to produce wetland on the entire site. With normal frequency of overbank flows on the river the site will receive more water, possibly enough to at least create an ephemeral wetland.

Appendix B. (continued)

200007810, 12/16/05

A specific mitigation site was not designated. The permit indicated “ The current and on-going reforestation efforts occurring within the Mark Twain National Wildlife Refuge, Annada District, are sufficient to meet the required mitigation”. The wildlife refuge is essentially a large wetland complex of emergent wetlands and bottomland forests.

Appendix C.



Wetland mitigation site within waterfowl habitat established by a private hunting club near the Osage River in St. Clair County. February 28, 2006. ID # 200001902



Wetland mitigation site in a low-lying portion of a rural landscape in Callaway County. January 25, 2006. ID # 199802145



Wetland mitigation site as part of a stormwater detention pond in a recently constructed residential neighborhood in St. Charles County. February 22, 2006. ID # 199902691

Appendix C.



Wetland mitigation site enhancing an existing wetland adjacent to Grand Glaize Creek in St. Louis County. February 22, 2006. ID # 200004200



Wetland intended for enhancement as a mitigation site at the upper end of a cove on Lake of the Ozarks. February 15, 2006. ID # 199801396

Appendix C.



Wetland mitigation site enhancing an existing wetland adjacent to a stream in Boone County mitigating impacts to wetlands due to construction of the roadway in the photograph. November 9, 2005. ID # 199901991



Wetland mitigation site adjacent to an urban stormwater channel of Coldwater Creek in St. Louis County. February 3, 2006. ID # 199900690

Appendix C.



This expansive wetland restoration project in Vernon County included mitigating wetlands impacted by earthen levees constructed to maintain the shallow water habitat shown in the center of this image. June 22, 2006. ID # 200001072



A wetland mitigation complex in Livingston County that included mitigating impacts to an emergent wetland in Linn County. December 15, 2005. ID # 200001776

Appendix C.



Wetland mitigation site (center of photograph) in an excavated area mitigating impacts to an adjacent wetland for the purpose of constructing a parking lot (left side of photograph) and boat ramp to access the Salt River in Pike County. December 16, 2005. ID # 199803010

Appendix C.



Wetland mitigation site adjacent to the impacted wetland due to construction of the bridge in the photograph over Femme Osage Creek in St. Charles County. June 23, 2006. ID # 199903840

Appendix C.



Created and enhanced wetlands for mitigation adjacent to Dardenne Creek in St. Charles County, February 3, 2006. ID # 200002181



Created wetland for mitigation in Polk County, December 23, 2005. ID # 200000892

Appendix C.



Wetland mitigation site (left) adjacent to Prairie Creek and periodically inundated by high water levels on Truman Lake at the edge of an agricultural field (right). Dying trees are reportedly due to increased frequency of inundation from Truman Lake during the 1990's. February 15, 2006. ID # 199700335

Appendix C.



Wetland mitigation site (right) and adjacent storm water detention basin in St. Louis County. June 23, 2006.
ID # 199907820



Left side of lake has a landscaped underwater bench for mitigation of a shallow emergent wetland in St. Charles County.
February 17, 2006. ID # 19980578

Appendix C.



Wetland mitigation site adjacent to East Fork Little Blue River in Jackson County between divided lanes of highway along which wetlands were impacted due to road construction. December 13, 2005. ID # 199900342



Constructed mitigation wetland expanding a riparian corridor along Petite Saline Creek in Cooper County riverward of an agricultural levee. Wetland had been impacted in the adjacent agricultural field. January 27, 2006. ID # 199901069

Appendix C.



Waterfowl habitat complex adjacent to South Grand River in Henry County that included wetland mitigation for impacts to wetland due to construction of levee to maintain the shallow water habitat shown in the photograph. February 28, 2006. ID # 199901462



Recently excavated wetland mitigation site adjacent to Carter Creek (left side of photograph) for impacts to wetlands due to highway construction in Carter County. Embankment of the highway is shown at right side of photograph. March 3, 2006. ID # 12332

Appendix C.



Residential neighborhood lake in St. Louis County. Creation of the lake was considered as mitigation for impacts to an emergent wetland due to residential construction in St. Charles County. February 22, 2006. ID # 199901681



Wetland mitigation site for impacts to nearby emergent wetlands due to construction of a regional retail distribution facility in Phelps County. Creation of curvilinear wetland area receives outflow from adjacent stormwater detention basin (right side of photograph). March 2, 2006. ID # 200005240

Appendix C.



Residential neighborhood lake in St. Charles County. Creation of the lake was considered as mitigation for impacts to an emergent wetland due to the residential construction. February 17, 2006. ID # 199905080 (This panoramic view created significant distortion to the dam along the bottom of the composite image. The dam is actually straight, not curved as shown)