Introduction

The Middle Mississippi River Regional Corridor (MMRRC) study is one of five federally funded watershed studies being conducted in response to the Fiscal Year 2006 Energy and Water Development Appropriations Act (PL 109-103). That legislation directs the Secretary to conduct, "at full federal expense, comprehensive analyses that examine multi-jurisdictional use and management of water resources on a watershed or regional scale." As prerequisites, selected studies were to include collaboration among a broad range of stakeholders, apply systems-level approaches, cover a large geographic area, and strive to achieve multiple goals. The focus for the MMRRC study is on improving regional collaboration and providing the tools and products necessary for better interagency planning within the Middle Mississippi River (MMR). The framework for the MMRRC study focuses on ecosystem restoration, natural resources management, and the interaction between the natural resource community and other communities of practice which impact or is impacted by natural resource planning and decision-making.

A central part in this study has been played by the Middle Mississippi River Partnership (MMRP). The MMRP is a group of twenty-one stakeholders in the region who come from federal agencies, state agencies, and non-governmental organizations. The vision statement of the MMRP is:

"*To develop a network of diverse and sustainable natural resources on public and private lands in the Middle Mississippi River corridor that adequately supports fish and wildlife habitat and provides conservation benefits consistent with a variety of other uses.*"

This document is part of a larger effort in the region driven by the MMRP and is complemented by two other documents produced for the region during this same time period. The first of the documents is the MMRP Regional Coordination Plan. This plan strives to give the stakeholders goals, objectives, and strategies/actions in order to achieve the aforementioned vision as well as the individual partners' missions.

The second document that was produced was "An Evaluation of Ecosystem Restoration Options for the Middle Mississippi River Regional Corridor." This document uses a hydrogeomorphic approach to determine historic vegetation communities and allow the user to plan for restoring these communities to their historical locations where chances for successful restoration are greatest. The hydrogeomorphic technique takes a variety of data such as geology, topography, and flood frequency as well as the use of historic documents to determine historic vegetation communities and their locations. The results of this report will be described further and is heavily referenced throughout this document.

The MMRRC study relies heavily upon the previously mentioned documents as well all of the stakeholders efforts. While this document is the core of the MMRRC study, it would not be nearly as powerful without the other efforts, and it is the combination of all of these efforts that truly make up the study.

The Middle Mississippi River Corridor Study

The MMR is an approximately 200 hundred mile stretch of river that lies between the confluence of the Missouri River near St. Louis, Missouri and the confluence of the Ohio River at Cairo, Illinois (Figure I-1). The associated floodplain includes approximately 550,000 acres. It is also the most northern section of the Mississippi River where water levels are not regulated by dams.

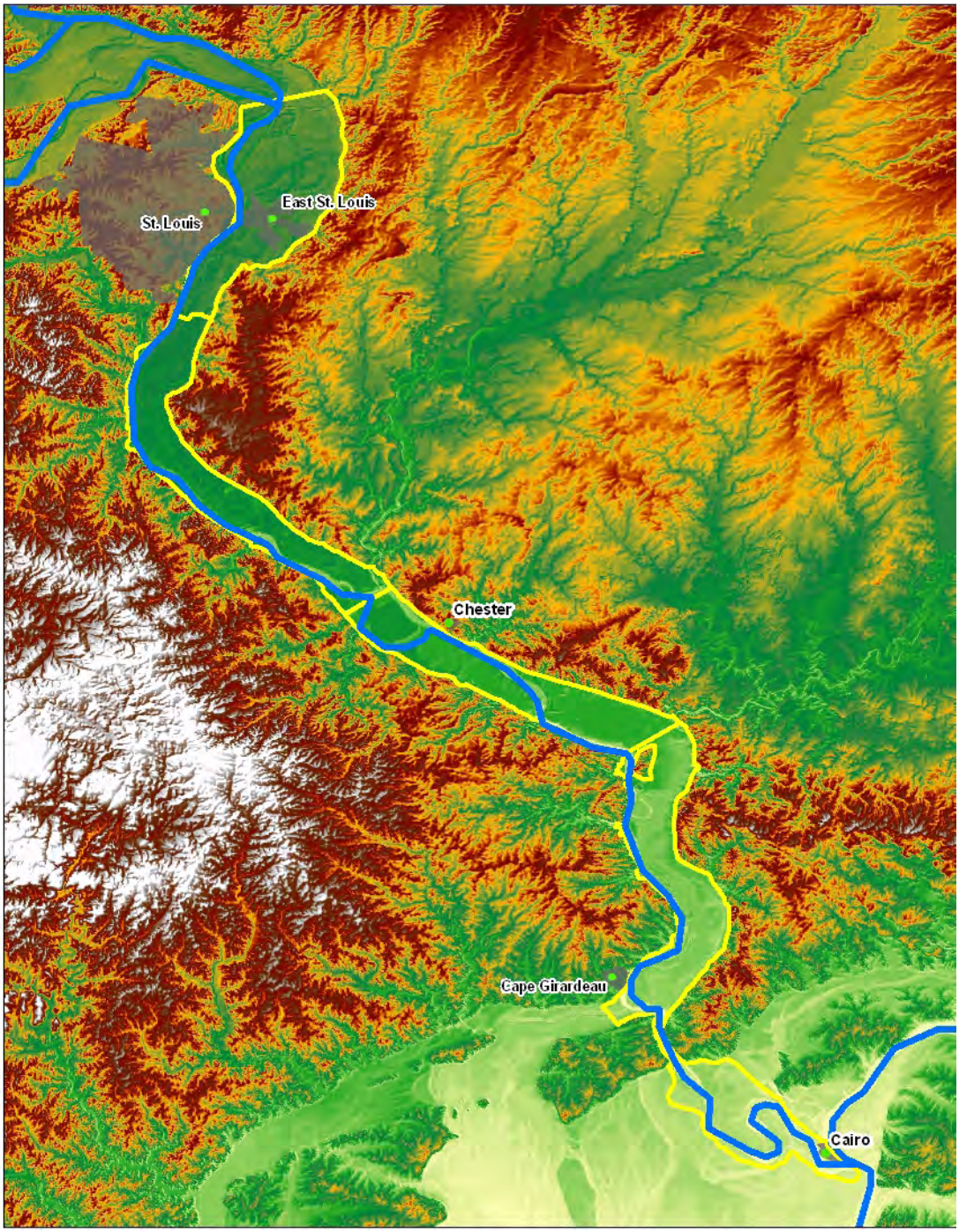

Figure I-1: The MMR Study Area

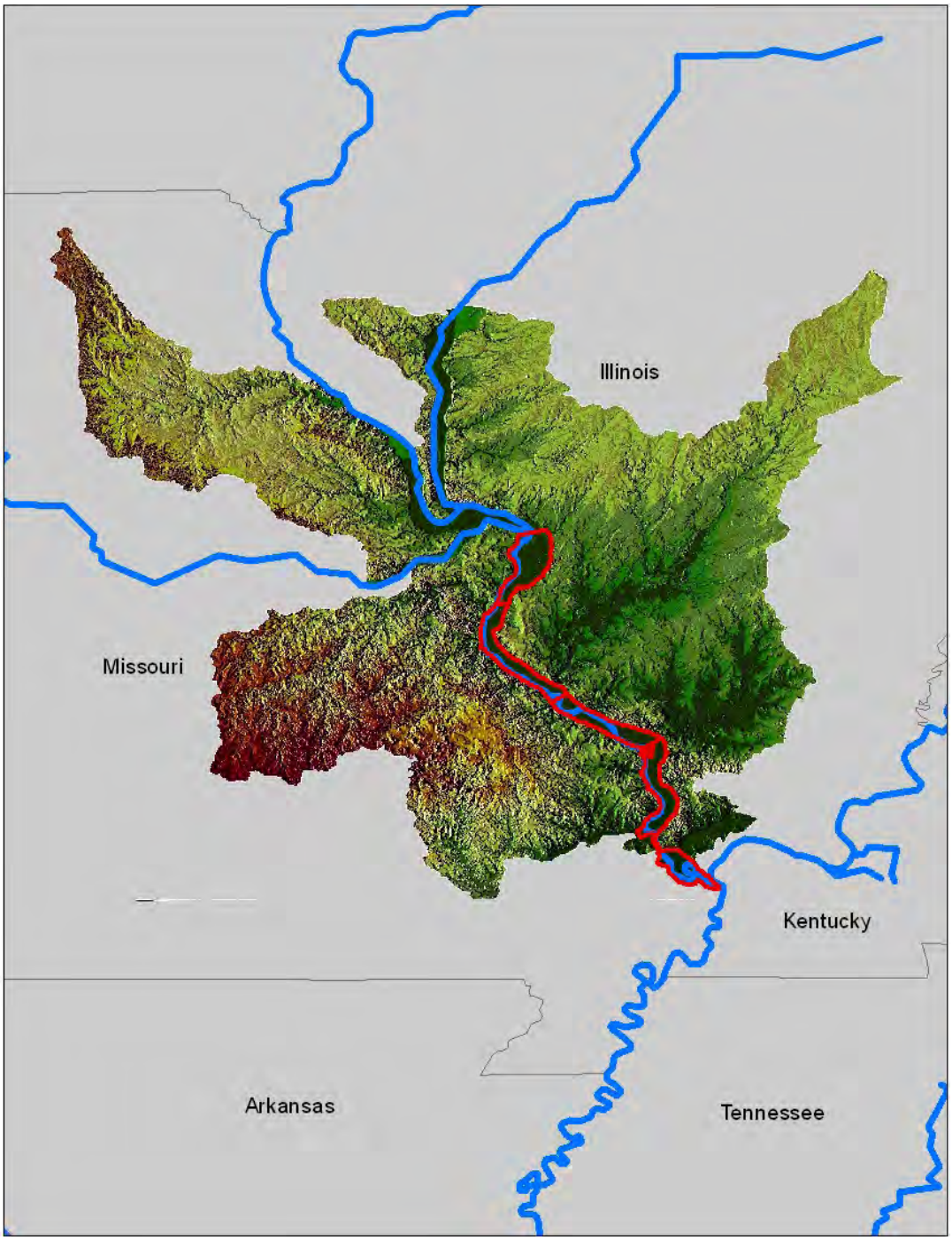

Figure I-2: Location of the MMR

When the Middle Mississippi River is examined from an ecological perspective it can be divided into three regions (Heitmeyer, 2008). These regions, as described in Heitmeyer (2008), are referred to as the American Bottom region, Kaskaskia to Thebes region and below Thebes region (Figure I-4). The American Bottom region is historically dominated by prairie as well as some forest types. Kaskaskia to Thebes is a "transitional" area that historically had some prairie, but

contained more forest. The area below Thebes was a more southern ecosystem in nature that was dominated by the presence of bottomland hardwood forests.

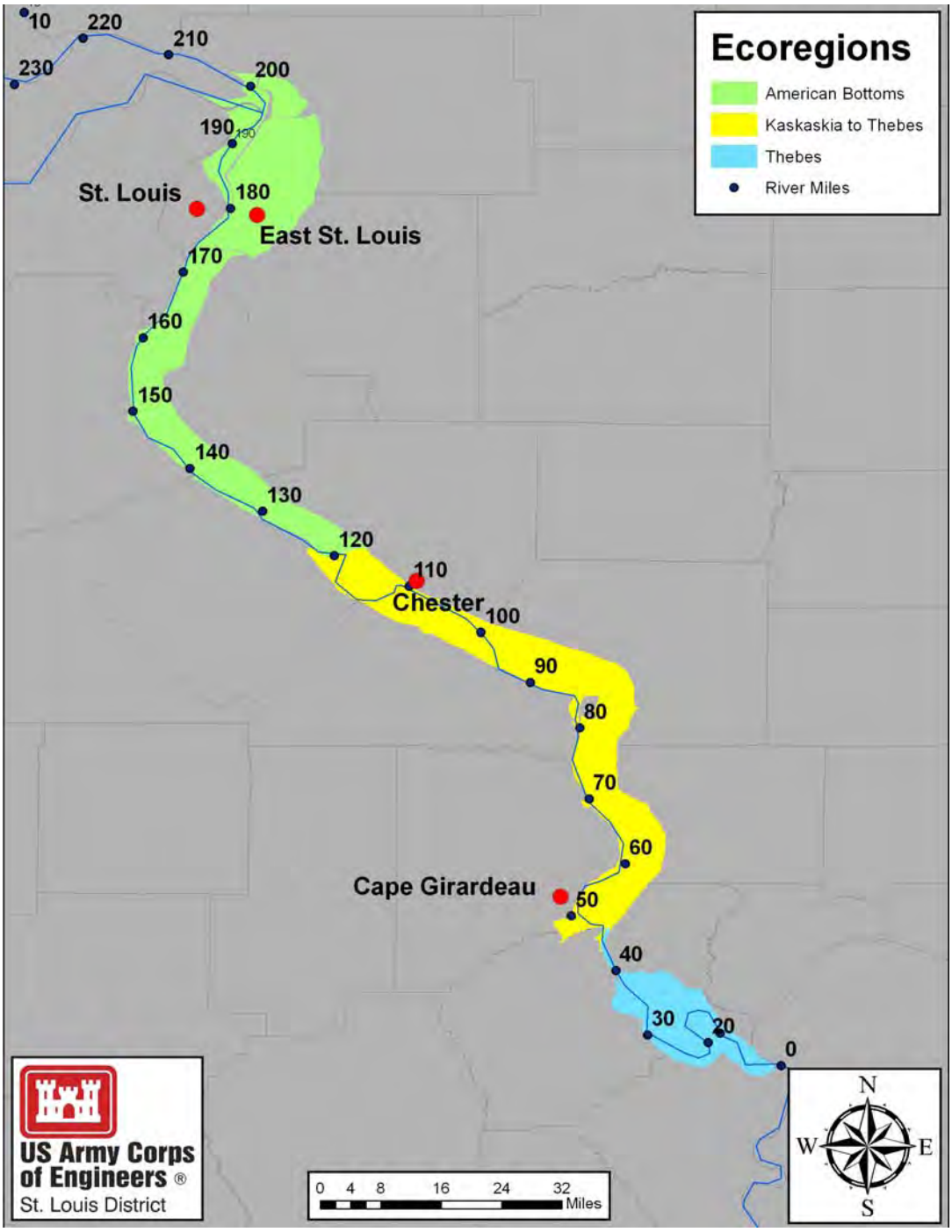

Figure I-3: Location of MMR Ecoregions

In an attempt to divide this reach into manageable units for the study, the river was further subdivided into five, approximately forty mile sections (Figure I-5). The responsibilities for consolidating data and information for each reach were given to a different partnering agency

that has been participating in this study. Each agency has used this data to contribute to assessments of their forty mile stretch of river and its associated floodplain. These participating agencies and their reach responsibilities can be seen in Table I-1.

Table I-1: Reach Responsibilities by Agency

Reach	River Mile	Agency
1	156 - 200	Southwestern Illinois Resource Conservation & Development
2	117 - 156	U.S. Army Corp of Engineers
3	80-117	American Land Conservancy
4	40 - 80	U.S. Forest Service
5	0 - 40	Illinois Department of Natural Resources

Each reach was then subdivided even further into subareas in order to help drive regional focus towards narrower bounds. This further subdivision allowed for greater accuracy in targeting opportunities, problems, needs, and abilities within the MMR. The boundaries for each subarea were primarily driven by ownership of the lands. Subareas were then grouped based on whether they were unprotected floodplain, floodplain protected by levees, or part of the main channel and its border. The number of subareas varied within each reach and is discussed in greater detail in later chapters.

A large part of this study consisted of gathering existing information on the reaches. This effort looked to several different types of sources. One of the most influential sources of data came from Geographic Information Systems (GIS) data. GIS is a computer program that takes information and data and gives it a spatial location. It is a very powerful tool that allows for data and spatial relationships between the data to be visually seen and analyzed. GIS data was gathered from numerous sources. Two of the largest contributors were the U.S. Geological Survey's (USGS) Long Term Resource Monitoring Program (LTRMP) and the Middle Mississippi River Decision Support System (MMRDSS). In addition to GIS data all previous reports and studies involving the MMR that could be identified and located were gathered. The prime data sources for the description of existing ecosystem conditions were:

- MMR Partnership Coordination Plan (MMRPCP, 2005)
- Southwest Illinois Regional Commerce and Development (SWIRC & D, 2005)
- UMR-IWW System Navigation Feasibility Study Report and Appendices (USACE, 2004b)
- MMR Decision Support System (USACE, 2005c)
- Long-Term Resource Monitoring Plan (LTRMP) Data (USGS, 1999)
- Habitat Needs Assessment [HNA (USACE, 2000a)]
- MMR Side Channels Rehabilitation and Conservation Project Report (USACE, 1999)
- MMR Side Channels Current Conditions Report (2004c)
- Stone Dike Alterations Project Report (USACE, 2002)
- Hydrogeomorphology Study and Evaluation (USACE 2008)
- Geomorphology Study of the MMR (USACE, 2005a).

All of this compiled data was put together into data forms. A data form (Appendix A of each Reach section) was constructed to help tabulate available data regarding each site location. The

completion of this form is an interactive process with periodic improvements being made as team reviews and new information enters the picture. These forms are also meant to help augment the ecosystem objectives refinement matrices included in the data forms. Information gathered on the sub-areas is available upon request.

The site characterization work benefited greatly from recent reach data summaries developed for the MMR, including:

- Geomorphic data parameters (average river width, average channel width, channel length, sinuosity, number of islands, total island area, average island area, wetted bank, wetted surface area, off channel wetted area, cumulative side channel length, and percent of wetted area that is back channel)

- Regulatory works structures (channel configuration, river slope, total dikes, dikes/mile, percent notched dikes, number of dike fields, number of dikes per field, location and number of weirs, miles of chute/river mile, location and size of chutes)

- Historic dredging data (including number of dredge cuts, quantity of materials dredged)

- Side channels current conditions (degree of connectivity, water volume, water depth, surface area, and monthly stage)

- Other side channel characteristics (dimensions, structures, bathymetry, and substrate)

Future modeling needs should consider the use of analytical tools such as hydraulics micro-models, HEC-EFM, WHAG, AHAG, and CE/ICA. A description of these and other useful models can be found in Environmental Chapter 9 of the UMRCP report.

The collection of GIS data as well as a host of information on the MMR gathered from a variety of sources was presented at a series of meetings held for each of the five reaches. Present at these meetings were a variety of stakeholders from throughout the region. These included federal agencies, state agencies, departments of transportation, planning agencies, NGOs, and private individuals. During these meetings the various stakeholders were asked to examine the gathered information and discuss its accuracy as well as add to it. Stakeholders were given the opportunity to voice their concerns, desires, and needs for the region and each of the subareas. At the end, the stakeholders were asked to prioritize the subareas based on where they most wanted to direct their efforts. They ranked the sub areas into the following categories: low, medium, and high.

Important to mention, is the fact that most stakeholders participating in the corridor study are also members of the Middle Mississippi River (MMR) partnership group. The goals and objectives of the MMRP and those of the corridor study are very similar, and the work of one is often consistent with the interests of the other. The MMRP had developed a living document known as the MMRP Coordination Plan that complements this MMR Corridor Study. This plan outlines goals towards natural resource conservation consistent with economic sustainability in

the MMR and the various strategies for obtaining these goals. The members of the MMRP can be seen in the table below.

Table I-2: MMRP Member Groups

Federal Partners	State Partners	Additional Partners
Upper Mississippi & Great Lakes Region Joint Venture	Illinois Department of Natural Resources	American Land Conservancy
U.S. Army Corps of Engineers, St. Louis District	Illinois Forestry Development Council	The Conservation Fund
U.S. Environmental Protection Agency	Illinois Society of American Foresters	Ducks Unlimited
U.S. Fish & Wildlife Service	Missouri Department of Conservation	The Nature Conservancy
U.S. Forest Service	Missouri Department of Natural Resources	SIUC Cooperative Wildlife Research Lab
U.S. Geological Survey		Southern Illinois Community Foundation
USDA Natural Resources Conservation Service (IL & MO)		Southwestern Illinois RC&D, Inc.
		Wildlife Forever
		National Wild Turkey Federation

The third part of this effort was the commissioning of a hydrogeomorphic (HGM) study (Heitmeyer, 2008) for the region. This study incorporated knowledge of the topography, geology, soils, flooding frequency, and historical maps to determine what and where vegetative communities existed in the MMR before European settlement. It also allows us to determine where these communities can exist today and what it will take to return them. The results were packaged into a separate report as well as into ArcGIS shapefiles that can be used by anyone to conduct their own analyses of the region. This is a very valuable study that is heavily referenced throughout this report.

The Middle Mississippi River

Physical Characteristics

The climate of the MMR tends to experience wet springs and early summers. The fall and early winters tend to be drier. The National Weather Service describes weather trends in St. Louis: "Since 1870, records indicate that temperatures of 90 degrees or higher occur on about 35-40 days per year. Extremely hot days (100 degrees or more) are expected on no more than five days per year," and "Records show that temperatures drop to zero or below on average of 2 or 3 days per year, and temperatures as cold as 32 degrees or lower occur less than 25 days in most years." The average annual precipitation near St. Louis is about 37 inches. At Cairo, Illinois near the southern extent of the MMR, annual temperatures are slightly warmer. The average annual

precipitation is 46 inches. Elevation of the river at the confluence with the Missouri is about 419 feet above mean sea level (amsl) and at 314 feet (amsl) near Cairo.

The Historic MMR

The first inhabitants of the Middle Mississippi Region probably arrived sometime around 9,000 B.C. At this time use of the river and its floodplain consisted entirely of subsistence. After the Wisconsin Ice Age, humans became more settled and agriculture developed. Eventually people settled into larger groups and the Cahokian culture developed in the northern area of the Middle Mississippi River near present day East St. Louis. Hernando De Soto and his party were the first Europeans to discover the Mississippi River. They made their discovery near present day Memphis in 1541. European settlement of the area began with the French in the late seventeenth and early eighteenth centuries.

Changes

Changes to these systems by humans began even before European settlement. Native Americans settled the area thousands of years ago and eventually converted small portions of the landscape to agriculture. They also helped maintain the prairie through periodic fires set to maintain an open landscape conducive to hunting. With the arrival of European settlers, more land was cleared and drained for agriculture and development. These changes brought relatively minor effects especially when compared with later alterations.

Three types of modifications have been particularly influential in the alteration of the physical processes related to the MMR: channelization to maintain the 9-foot deep navigation channel, levee construction for flood protection, and watershed development. The following is a brief description of the historic conditions based on the USGS Ecological Status and Trends Report (USGS, 1999), and the UMRBC Upper Mississippi River Comprehensive Master Plan (UMRBC, 1982). For a more detailed discussion of this topic, the reader should refer to the Status and Trends Report.

1. Navigation Development. The MMR is different from the pooled reaches of the UMRS, in that (1) the Missouri River contributes significant quantities of water and sediments, and (2) it has no locks and dams to maintain the navigation channel. Rather than using impoundments to create a navigable channel, this reach has been stabilized via extensive dredging, construction of wing dams, and bank protection.

In 1881, Congress approved a comprehensive plan for the regulation of the MMR, calling for a reduction in channel width to 2,500 feet. Early on, construction started with the placement of revetments and permeable timber pile wing dams. Then in 1927, the Corps was authorized to construct and maintain a 9-foot deep, 300-feet wide navigation channel, by installing regulatory works and bank stabilization to constrict the river to 2,250 feet. Today, there are over 800 wing dams along the MMR, or about 4 wing dams per river mile. The river width is currently about 1,800 feet. Construction still continues along the MMR, and areas prone to sedimentation have been maintained by dredging. In the process of contracting the river, many side channels no longer contribute significantly as biologically functional components of the river's ecosystem.

2. Agricultural Development. Between 1821 and 1888, the riparian forest was cleared for steamboat fuel wood, lumber, and agriculture. Levee development was initiated to protect the crops in an uncoordinated fashion by the late 1800s. Disastrous flooding in 1927 in the Lower Mississippi River Valley resulted in a large and coordinated flood control plan for the lower valley. By 1973, nearly the entire river along the MMR was lined with Corps mainline levees. Conversion to farming was responsible for the loss of more than 80 percent of the natural floodplain habitat in the MMR reach. Levees have also changed sediment and river stage characteristics.

3. Watershed Development. The MMR exhibits a surprisingly natural hydrograph on average. However, the amplitude and rate of hydrologic change is greater than in the past. The frequency of hydrologic change is also greater. Additionally, flood flow distribution is significantly reduced by levees.

Basin land use and land management practices have changed over time, affecting the rates of upland erosion and sediment delivery to the river. Improvements in land management have increased in recent decades, but sediment storage in the tributaries remains a significant problem.

4. Ecological Impacts of Prior Systemic Developments. Based on the Trends Report (USGS, 1999) and the Comprehensive Master Plan (UMRBC, 1982) the river modifications described above include the following physical conditions, which contribute to degradation of the river ecosystem:

- The presence of regulating works (i.e., wingdams and closing dams) causes sedimentation in main channel border areas. Subsequent vegetation growth tends to stabilize these deposits, and encourages additional deposition when these areas are flooded. Sediment behind these structures can also prevent water movement to backwaters and side channels.

- Levees construction stops the flow of water into the large non-channel areas—thus causing secondary channel and contiguous floodplain sedimentation processes and the deterioration of water quality.

- Prior to these river modifications, there was adequate room in the floodplain for water and sediment to meander back and forth, alternately creating and filling side channels, backwaters and islands. This process thus maintained a diversity of habitat conditions.

- Sedimentation with subsequent conversion of water to land area has resulted in a 40% conversion of water surface area to land.

- These modifications have also resulted in a significant loss in aquatic habitat quantity and quality, and in floodplain storage capacity.

- Dredging operation problems tend to be site-specific and related to increased turbidity and sedimentation, reduced dissolved oxygen, and the release of contaminants from the sediments.

The ecological responses to these physical conditions include:

- A direct loss of aquatic habitat from sedimentation effects.
- A reduced interchange of nutrients and organisms between the main river and its former floodplain.
- A conversion of native habitat types to crop land use in both levee protected and unprotected floodplain areas.
- Water quality changes affecting plant production, the smothering of bottom dwelling organisms, destruction of spawning areas for fish, reduced habitat diversity, physiological stress from low DO levels, and the release of contaminants into the environment.

The MMR has seen its most dramatic ecological changes due to human influence over the last 200 years. A comparison of the estimated presettlement land cover and the land cover from 2006 (Heitmeyer, 2008) can be seen in Table I-3 and Figure I-4. These changes are numerous and products of several influences. An important milestone in the changing of the MMR landscape was marked by the arrival of the first steamboat into the Upper Mississippi in 1823. From this point forward steamboat presence on the Upper Mississippi began to increase rapidly. As a result, the riparian forests lining the banks of the MMR were often cleared to help power ships (Norris, 1997). The removal of these trees led to destabilized banks and severe erosion. This also caused the river to widen considerably and in some cases this widening actually engulfed some villages (Norris, 1997). One of the results of the increased navigation by steamboats and the dramatic widening of the river was an attempt to control the river itself.

The MMR did not need many alterations at first in order to allow reliable navigation. While improvements were authorized earlier for other portions of the Upper Mississippi, it was not until 1866 that Congress authorized a 4 foot channel and snag clearing that would affect the MMR. Progressively greater channel depths were authorized in subsequent years and over time the banks of the river were lined with dikes and revetment to keep the river in place. These structures scoured the main channel deeper and at the same time contributed to the side channels and backwaters filling in with sediment. There were additional alterations to the floodplains that also helped contribute to the sedimentation of MMR backwaters.

The fertile lands of the floodplains were cleared and drained in order to be converted to agriculture. To prevent flooding, these lands were subsequently leveed. This prevented any lands that were still left in original habitat from receiving periodic flooding and drying that helped maintain the diversity of species. The farming practices of the late 1800s and early 1900s also gave no thought to soil loss. Significant amounts of topsoil from the cleared lands eroded and ended up in the river. While sediment has always been present and has been a necessary part of the MMR system; these practices introduced vastly greater amounts of soil to the system and

accelerated the filling of side channels and backwaters. Soil was not the only pollutant entering the river and reducing water quality.

In 1900, the MMR saw another important and devastating milestone in its ecological history when the Chicago Sanitary and Ship Canal was completed. This waterway connected the Illinois River with Lake Michigan and was intended to improve the water quality of Lake Michigan. At the time Chicago discharged all of its wastes into the lake. This canal allowed all of the waste to be sent down the Illinois River instead. This heavily polluted water then flowed straight into the MMR. This was in addition to wastes being directed into the MMR already by communities along and upstream of this portion of the river. Until the 1950's, both industrial and agricultural waste was dumped directly into the river, severely impacting the water quality. At about this time, laws regulating point source pollution began to be enacted, and since this time water quality has improved in the MMR. However, non point source pollution such as chemicals from storm water and agriculture still remain a problem.

Table I-3: Area (acres) of Hydrogeomorphic (HGM) habitats in the three ecoregions of the Middle Mississippi River Regional Corridor during the Presettlement Period and remnant patches remaining in 2006.

	Ecoregion									Combined Presettlement	2006	% Loss
	American Bottoms			Kaskaskia to Thebes			Thebes-Ohio River					
Habitat type	Presettlement	2006	% Loss	Presettlement	2006	% Loss	Presettlement	2006	% Loss			
Bottomland Hardwood				15,045	10,630	29.3%	33,540	9,304	72.3%	48,585	19,934	59.0%
BLH High				2,370	331	86.0%				2,370	331	86.0%
Bottomland Lake	16,959	7,450	56.1%	16,288	3,504	78.5%	4,986	3,066	38.5%	38,233	14,020	63.3%
Bottomland Prairie Ridge	4,777	357	92.5%	3,936	67	98.3%				8,713	424	95.1%
Bottomland Prairie Swale	34,493	3,948	88.6%	516	79	84.7%				35,009	4,027	88.5%
Bottomland Prairie Urban	16,071	446	97.2%							16,071	446	97.2%
Terrace Mesic Prairie	18,924	655	96.5%							18,924	655	96.5%
Slope Savanna	10,365	137	98.7%							10,365	137	98.7%
Floodplain Forest Ridge	8,618	755	91.2%	31,818	8,375	73.7%				40,436	9,130	77.4%
Floodplain Forest Swale	32,721	2,764	91.6%	73,489	16,467	77.6%	5,700	1,273	77.7%	111,910	20,504	81.7%
Floodplain Forest Urban	9,323	345	96.3%							9,323	345	96.3%
Loessal Upland				3,387	3,387	0.0%				3,387	3,387	0.0%
Riverfront Forest	65,125	24,104	63.0%	46,094	24,632	46.6%	9,080	8,794	3.1%	120,299	57,530	52.2%
Slope Forest	16,934	1,207	92.9%	6,861	1,913	72.1%	1,695	1,080	36.3%	25,490	4,200	83.5%
Total	234,310	42,168	82.0%	199,804	69,385	65.3%	55,001	23,517	57.2%	489,115	135,070	72.4%

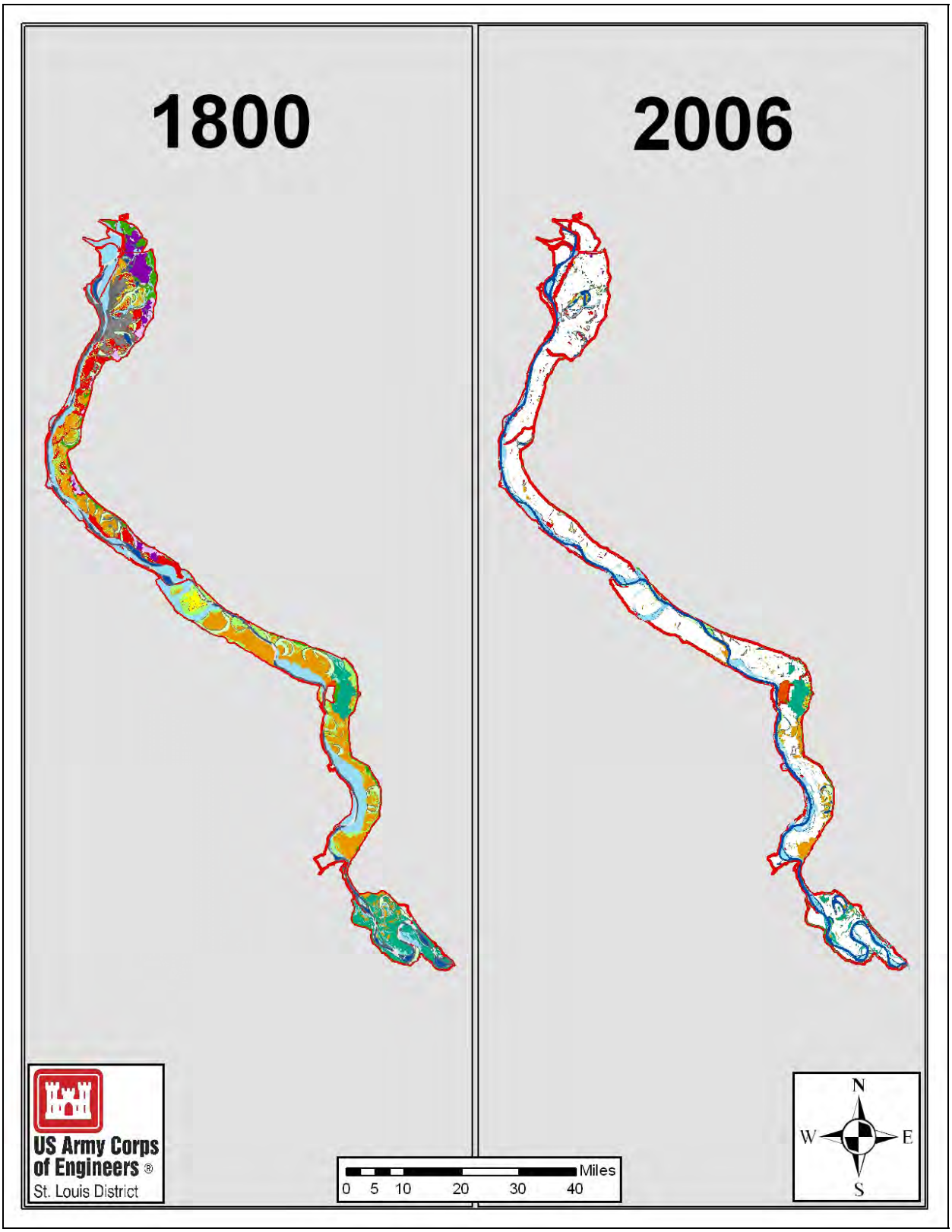

Figure I-4: Comparison of land cover between 1800 and 2006. Areas in color represent natural habitats. Areas of white in 2006 show locations of natural habitat losses.

Current State of the MMR:

Land Cover

Today the landscape of the MMR is dominated by agriculture throughout and by development in the upper portion of the American Bottom Ecoregion. What little natural habitat is left lies primarily between the levees and the river itself (Figure I-5). While this is a rather large number of acres, the natural habitat types are not very diverse and are primarily forests of silver maple, cottonwood, and willow. A large portion of the floodplain in the MMR, 354,947 acres, is behind levees. This number is roughly 64% of the total acres in the MMR. These levees block the ability of the river to spread across the flood plains in times of high water. The lack of this connection between the river and its floodplain has severe ecological consequences. This prevents the flooding and drying cycles that help maintain habitats such as prairie and wetlands by preventing succession of woody species and the invasion of exotic species. It also limits areas of spawning and rearing for fish which would normally use the flooded areas to accomplish this.

Table I-4: Current Land Cover in the MMR from USGS LTRMP year 2000 data.

Class	Acres	Percent
Agriculture	293,100	53.14%
Developed	55,675	10.09%
Forest	88,975	16.13%
Grass/Forbs	16,684	3.02%
Sand/Mud	6,656	1.21%
Unknown	4,895	0.89%
Water	64,846	11.76%
Wetland	20,723	3.76%

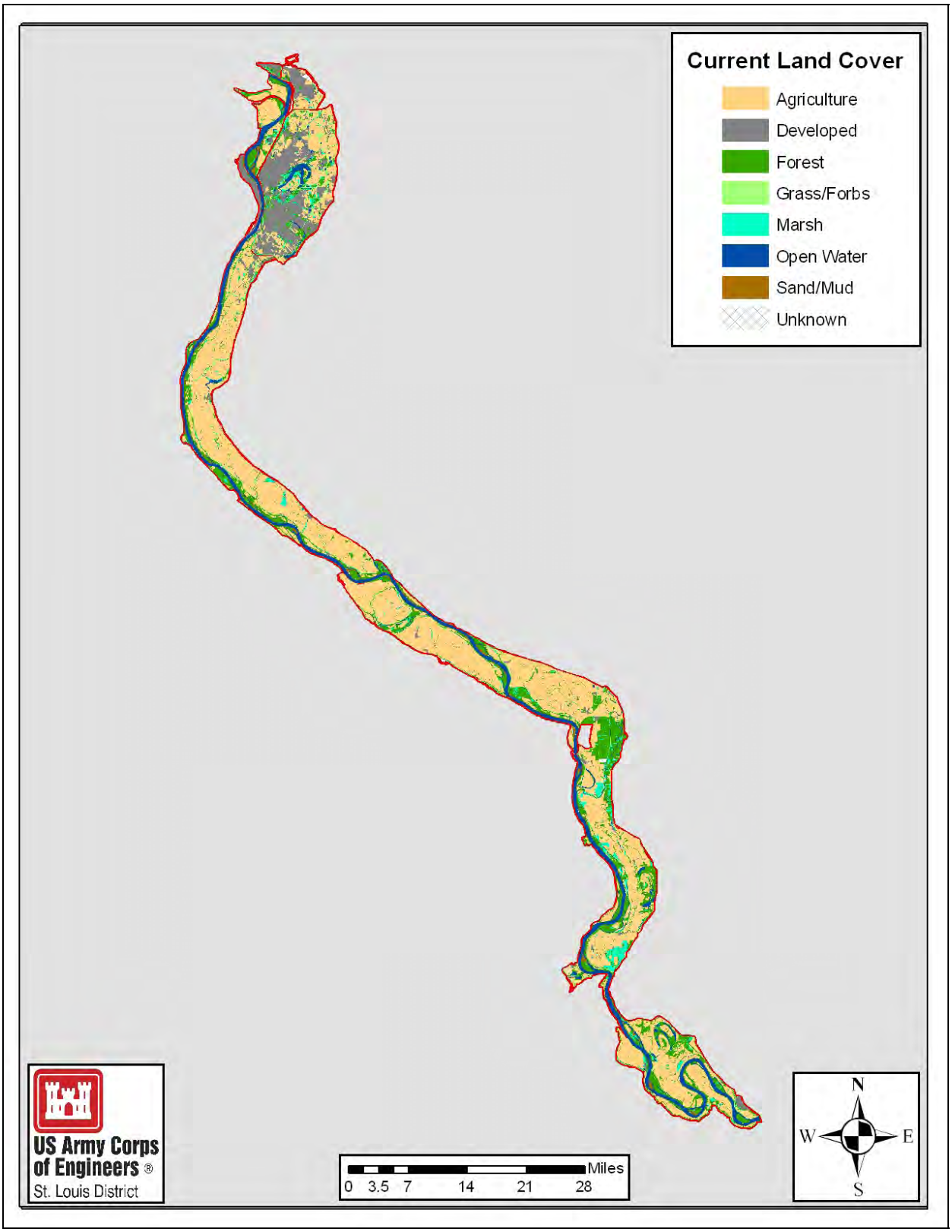

Figure I-5: Current land cover present in the MMR

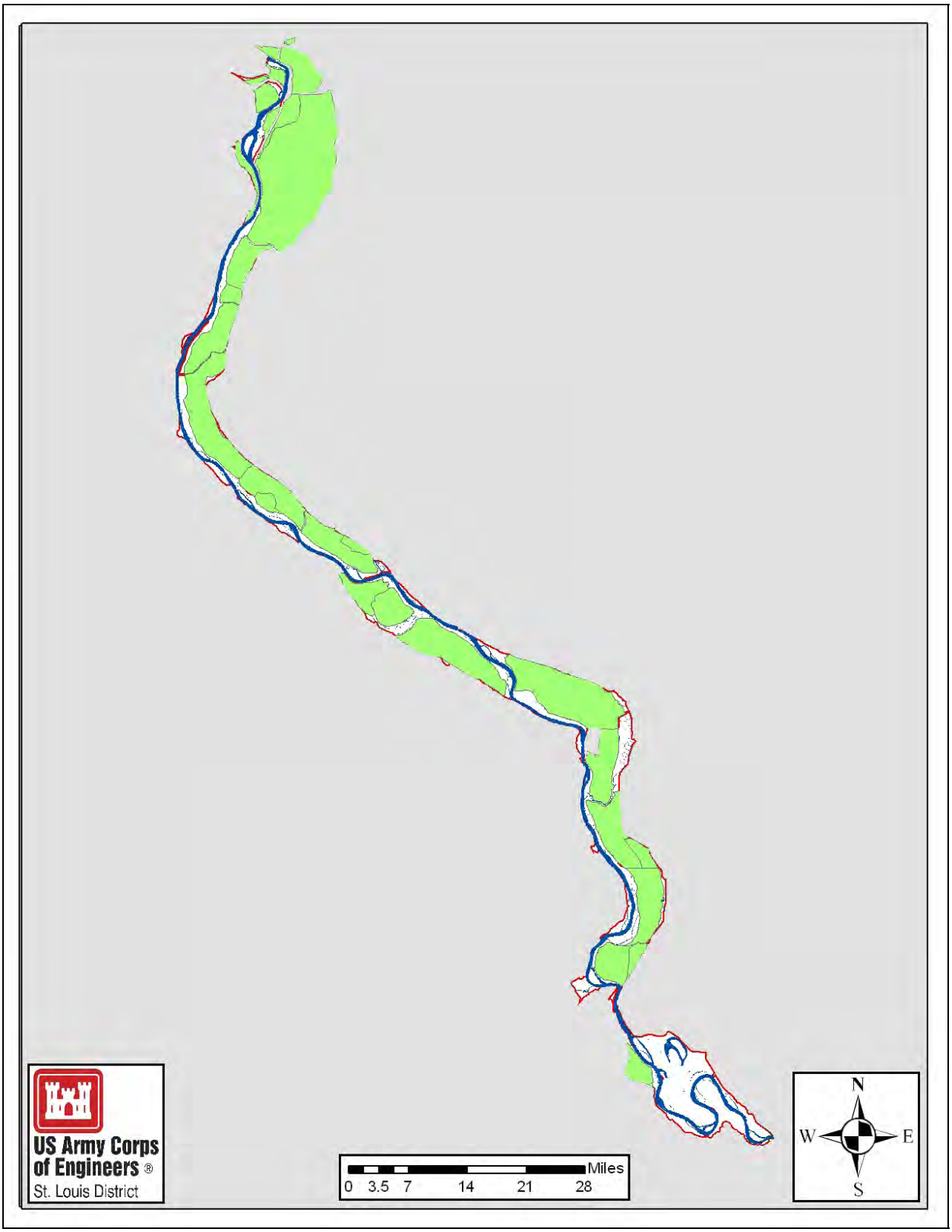

Figure I-6: Leveed areas in the MMR represented in green.

Agriculture in the MMR:

Probably one of the largest and most influential presences in the MMR is agriculture (Figure I-7). Primary crops within the MMR are corn and soybeans. Agriculture makes up a large portion of the economy for persons living along the MMR and its floodplains. Over 58% of the lands within the MMR are considered some type of prime farmland. According to NRCS, prime farmland is, "Land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses." Some of this land is currently only marginally suited for agriculture because of the frequency that it receives flooding (Figure I-8). Over 52,500 acres, 9.53% of land in the MMR, is farmed land that is frequently flooded. A particularly striking number is that over 26,000 acres of the MMR are non prime farmland that is frequently flooded.

Table I-5: Farmland types in the MMR from NRCS 2007 data.

Type	Acres	Percent
All areas are prime farmland	124,245	22.51%
Farmland of statewide importance	28,006	5.07%
Not prime farmland	203,018	36.77%
Prime farmland if drained	96,513	17.48%
Prime farmland if protected	30,398	5.51%
Water	69,879	12.66%

Table I-6: Land use and flooding frequency from NRCS 2007 data.

Land Use and Flooding Frequency	Acres	Percent
Agriculture, Frequent	52,581	9.53%
Agriculture, Not Frequent	240,155	43.51%
Non-Agriculture, Frequent	69,292	12.55%
Non-Agriculture, Not Frequent	111,758	20.25%
Unknown, Frequent	1,035	0.19%
Unknown, Not Frequent	3,715	0.67%
Water	73,426	13.30%

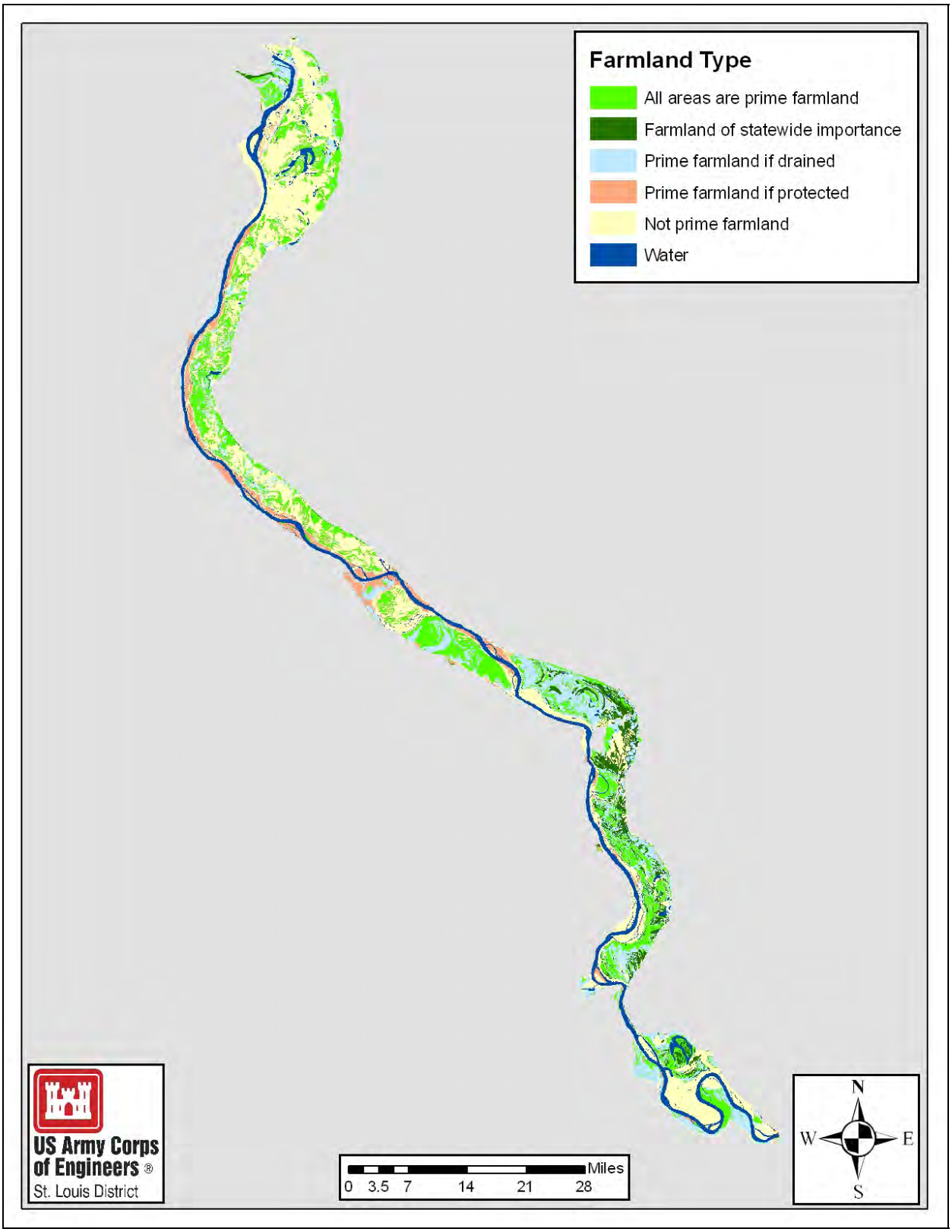

Figure I-7: Farmland types present in the MMR

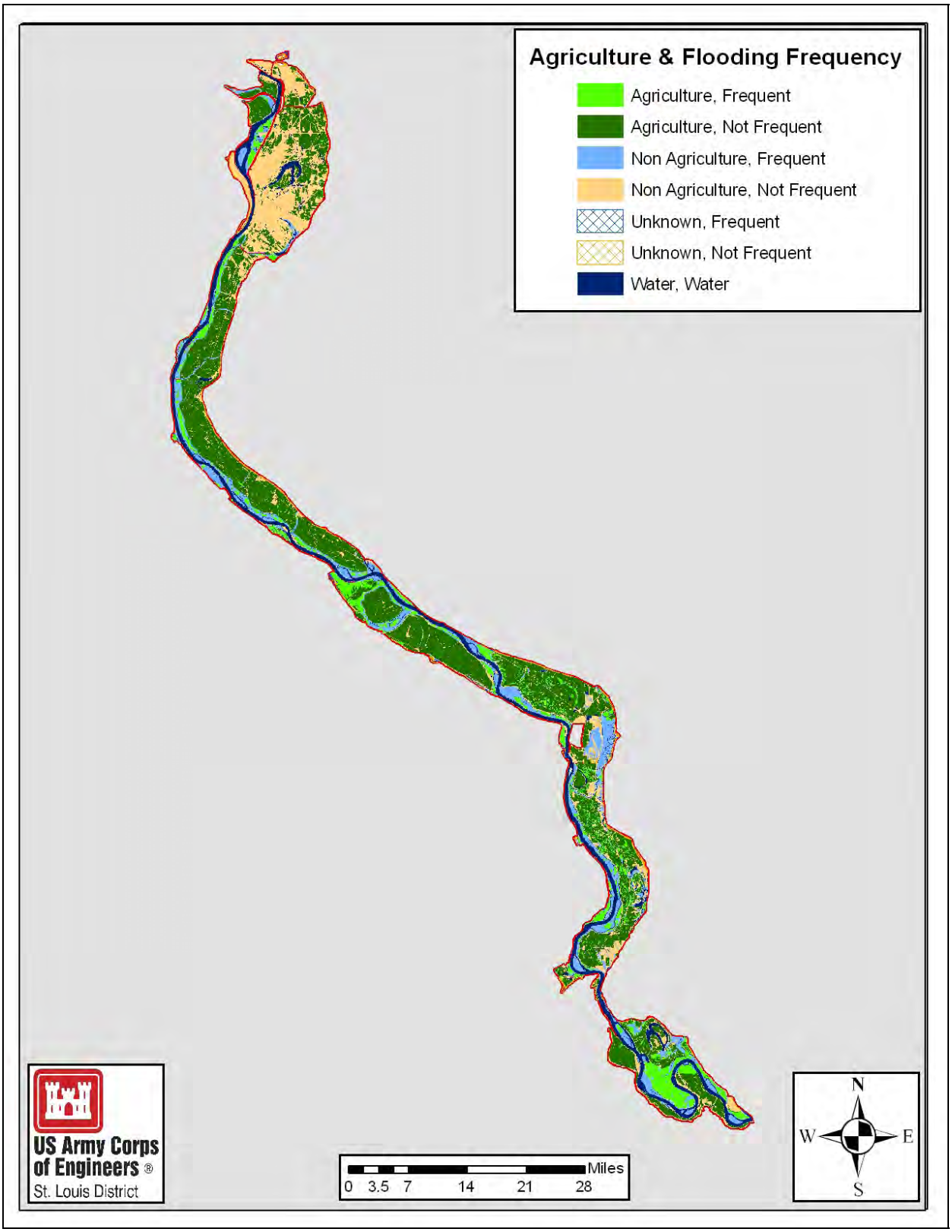

Figure I-8: Agriculture and flooding frequency in the MMR

Public Lands & Wetland Reserve Program

The MMR contains approximately 65,895 acres of public land, or 12% of the total MMR acreage (Figure I-9). Public land in the MMR contains the majority of what little natural habitat remains within the floodplain. The amount of public land increased dramatically after the flood of 1993. This increase was the result of buyouts of flood prone areas along the river. Many other areas that remained in the ownership of private individuals were enrolled in the Wetland Reserve Program (WRP) administered by the Natural Resource and Conservation Service (NRCS). This is a conservation easement program that keeps enrolled lands as wetlands in perpetuity. The majority of the public lands in the MMRC can be found in Reach 1 and Reach 4.

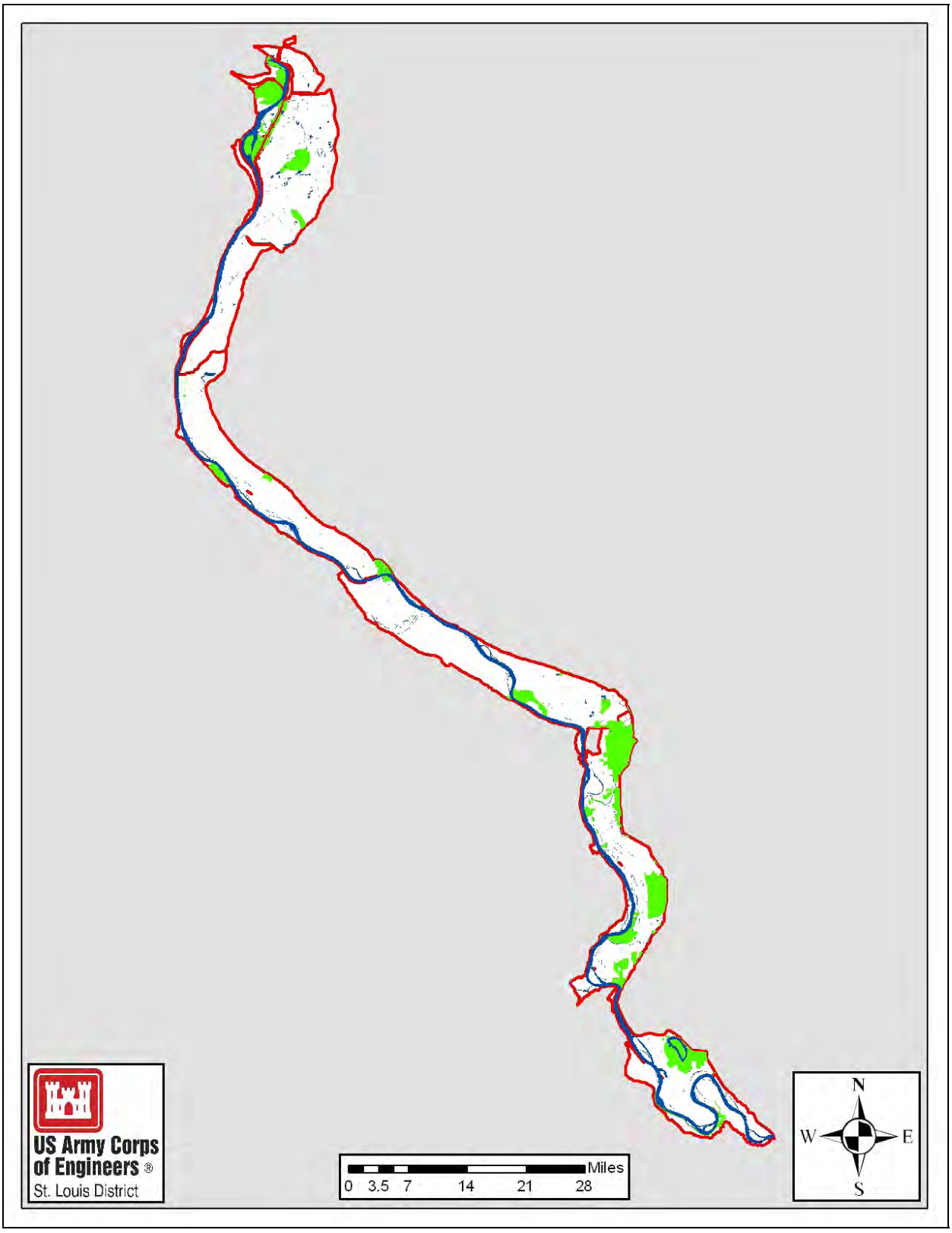

Figure I-9: Public land in the MMR

Restoration Efforts and Plans to Date:

There has been a considerable increase in information available about the MMR over the past 10 to 15 years. Historic data and new tools have been combined to better understand historic, current, and future conditions. The information used for ecosystem restoration planning was compiled from one or more of the following studies and programs:

Avoid and Minimize (A&M) Program

The Avoid and Minimize Program was established to reduce possible environmental impacts from increased navigation traffic due to the construction of a second lock at Melvin Price Locks and Dam. Full scale implementation of the Avoid and Minimize Program began in 1996. The direction of the program is coordinated through an Avoid and Minimize Program study team, which consists of state, federal and private partners in both natural resource management and industry. Each year a progress report detailing Avoid and Minimize Program activities during the past year is released. Activities funded under the Avoid and Minimize Program have included such things as the MMR Pallid Sturgeon Habitat Use Project, and the placement of woody habitat structures on the MMR (USACE, 2004a).

UMR—Environmental Management Program

In 1986, PL 99-662, Section 1103 provided a comprehensive program for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement. Key types of restoration projects within the realm of the Corps' Environmental Management Program implementation authority, and applicable to the MMR are: backwater dredging, side channel openings/closures, wing dam and closing dam modifications, and local watershed sediment control structures (http://www.mvr.usace.army.mil/emp/).

MMR Side Channels Report

In 2000, the St. Louis District completed a vision document for MMR side channels restoration (USACE, 1999). The document was prepared by the Avoid and Minimize Program team members. Long-term goals established by the team included providing over-wintering habitat every 5-7 miles, providing off channel habitat every 5-7 miles, maintaining connectivity and small craft access to the side channel areas, and providing improved public access to river resources. The condition and physical attributes of all 31 side channels in the MMR are outlined in that document, as are the initial proposed actions required for rehabilitation and enhancement.

O&M Stone Dike Alterations Report

The Stone Dike Alterations Project was initiated under the Environmental Management Program, and a draft report was published in 2002 (USACE, 2002). The project investigates the potential for selected existing MMR dikes to be notched to allow flow through channel borders at higher river stages to produce a more diverse scour and depositional pattern. The sites selected for alteration would be in areas where the habitat improvement need is the greatest and where the notching of existing dikes offers the greatest opportunity for success. It is anticipated that the beneficial effects of this project could enhance as much as ten percent of the total aquatic habitat of the affected river reaches. The continuing project may eventually produce a comprehensive master plan to include environmental alterations or features to existing dike fields throughout the MMR. However, this initial report focuses on an inventory of MMR parameters and data.

Applied River Engineering Center Hydraulic Sediment Response Work

The USACE St. Louis District Applied River Engineering Center (AREC) has conducted hydraulic sediment response studies of side channel (e.g. Salt Lake Chute, RM 141-133; USACE, In press a) and stone dike alteration (e.g. Herculaneum Stone Dikes, RM 150-156; USACE, 2004c) sites within the MMR. These model studies represent the next step in restoration project development beyond that of the general concepts laid out in the Side Channels and Stone Dike Alterations Reports. Hydraulic sediment response models are tabletop moveable bed hydraulic models used to speculate on restoration alternatives. The models are flexible enough to be used by novice stakeholders conducting "what if" exercises and watching the river bed response, or by engineers using laser survey techniques for precision design work.

Upper Mississippi River Comprehensive Plan

The authority for the Upper Mississippi River Comprehensive Plan is contained in Section 459 of WRDA 1999. The legislation calls for the development of a plan to address water resources and related land resource problems and opportunities in the Upper Mississippi and Illinois River basins, from Cairo, Illinois, to the headwaters of the Mississippi River, in the interest of systemic flood damage reduction by means of structural and non-structural flood control and floodplain management strategies; continued maintenance of the navigation project; management of bank caving and erosion; watershed nutrient and sediment management; habitat management; recreation needs; and other related purposes. A pre-draft study report was circulated for an independent technical review in October 2005. That report (USACE, In Press b) provides useful information for each Drainage and Levee District regarding: GIS habitat acres, levee over-topping elevations, start of damages, average annual damages, design flood elevation, critical infra-structure, tributary feeders, number of landowners, percent floodplain below the 2-year flood elevation, the cross-sectional area of floodplain below the 2-yr flood elevation, and a measure of topographical variation. The Upper Mississippi River Comprehensive Plan study also assesses the environmental restoration opportunities afforded by various Flood Damage Reduction plans ranging from the purely structural to the purely non-structural.

Middle Mississippi River Partnership Coordination Plan

The *Middle Mississippi River Partnership Regional Coordination Plan* was revised in 2008. The plan was generated by a collaboration of 21 federal/state agencies and NGOs that have a common goal of restoring and enhancing the natural resources of the MMR corridor. The plan highlights the historical natural resource trends, identifies priority resource issues along the corridor, and outlines goals and strategies for addressing those resource needs. The coordination plan has been undergoing updating in conjunction with the creation of the reach reports. Information from each is being exchanged to add to their values.

Refuge Comprehensive Conservation Plan

The Comprehensive Conservation Plan (CCP) for the Mark Twain National Wildlife Refuge (MTNWR) complex identified the MMR (including Harlow Reach) as a strategic area for flood storage. The existing refuge proposal delineates an approach to address USFWS habitat and floodplain concerns, with willing sellers during a 15-year planning horizon. In response to the Great Flood of 1993, the Service prepared a Big Rivers Ascertainment Initiative (http://www.fws.gov/midwest/Planning/marktwain/index.html) that proposed strategies for evaluating lands to be acquired for the protection and restoration of sustainable representative

habitats along the Illinois, Missouri and Mississippi Rivers. Approval was granted in 1997 to study the potential addition of 60,000 acres to the MTNWR Complex. The first tier of lands to be acquired includes 14,100 acres within the MMR NWR. The selection and prioritization of parcels by the USFWS include a consideration of: refuge purposes; CCP goals/objectives; interagency input, site wetlands and forest restoration potential, levee District flood histories; habitat needs; opportunity to remove erosion/flood prone agricultural lands; and recreational access areas. The parcels within the project boundary also contribute to policy matters addressed by other agencies as well. The potential for nutrients reduction, increased flood storage benefits, and reduced disaster relief payments by the government on such lands were also considerations.

Geomorphology Study of the Middle Mississippi River

A geomorphology study of the Middle Mississippi River, from St. Louis, Missouri to Cairo, Illinois, was conducted between 2000 and 2005 by the St. Louis Corps District's Applied River Engineering Center (USACE, 2005b). The study was originally initiated as an investigative study for the Mississippi River Channel Improvement Project and later supported by the Biological Opinion. The primary goals of the report were to qualitatively and quantitatively chronologize the historical planform changes of the MMR and to develop conclusions and formulate ideas for future environmental initiatives (USACE, 2005b).

Master Plan for Channel Improvements, and Environmental Restoration

This plan consists of a series of plates depicting existing and planned river regulatory works structures (i.e. dikes, revetment, chevrons, and bendway weirs). It also shows the location of dredge cuts and disposal locations of dredging operations during the past decade. Woody habitat structures, and recapture locations for radio-tagged sturgeon are also depicted in these plates (USACE, 2005a).

WRP

Wetlands Reserve Program (WRP), Emergency Wetlands Reserve Program (EWRP), and Emergency Watershed Protection (EWP) Floodplain Easements– The Wetlands Reserve Program is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program (NRCS 2008). Within the MMR, there are 18,769 acres of WRP. The WRP easements can be found on both private and public lands.

Shawnee National Forest Land and Resource Management Plan (2006)

The Forest Plan identified a special management prescription for the Mississippi and Ohio River floodplain lands on the Forest in 2006 emphasizing restoration and protection and management of valuable floodplain and bottomland hardwood forest and wetland resources. This management area includes a new (i.e., Fall, 2005) 60,000 acre purchase unit on the forest targeted for acquisition of available floodplain lands for restoration and protection purposes.

Evaluation Report of Ecosystem Restoration Options for the Middle Mississippi River Regional Corridor

A Hydro-geomorphology Study/Report of the Middle Mississippi River and its Floodplain (Heitmeyer, 2008). This report uses the HGM process to evaluate ecosystem restoration options for the MMR. The report includes the following:

1. Identification of the pre-European settlement ecosystem condition and ecological processes in the MMR.
2. Evaluation of differences between pre-European settlement and current conditions in the MMR, with specific reference to alterations in hydrology, vegetation community structure and distribution, and resource availability to key wildlife species.
3. Identification of restoration and management approaches and ecological attributes needed to successfully restore specific habitats and conditions within the MMR.