Deconstructing the Mississippi River:
Restoring a Continental System Through the Integration of Flexible Infrastructure

by

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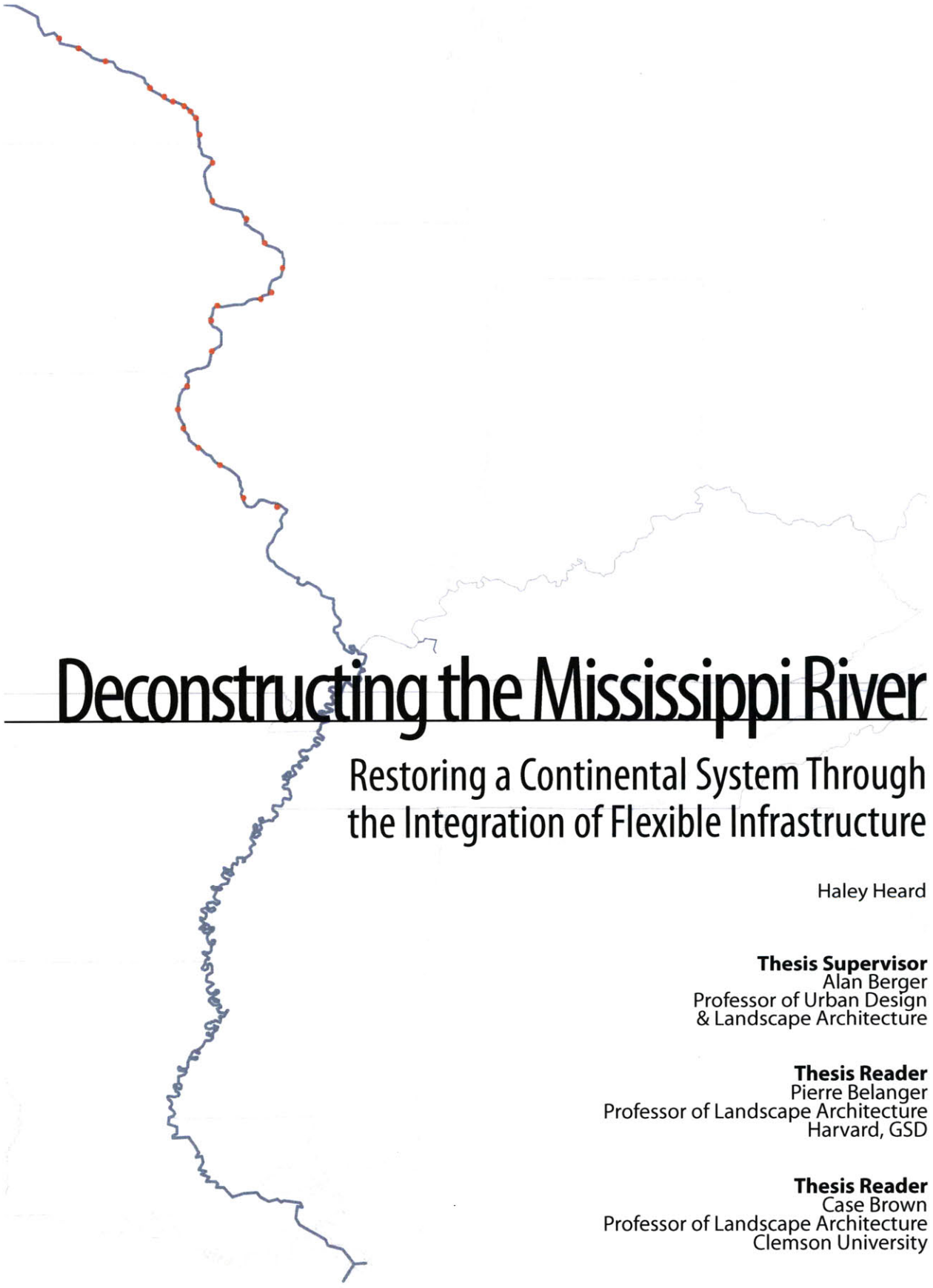

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DECONSTRUCTING THE MISSISSIPPI RIVER:
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Submitted to the Department of Urban Studies and Planning on May 20th 2010, in Partial Fulfillment of the Requirements for the Degree of Master of City Planning.

ABSTRACT

The most prevalent social and economic issues plaguing cities are symptomatic of much bigger underlying environmental problems. Cities are governed by legislation set within artificial political boundaries, however ecology systems surpass and are not restricted by these boundaries. The decisions urban designers and planners make on behalf of a city influences the natural environment, which in turn can affect other cities negatively. This thesis addresses the current disconnect between the way cities are planned, their artificial boundaries, and the larger, underlying ecological systems. The purpose of this research is to create new methods of design and planning from ecological scale thinking.

This thesis uses the Mississippi River as a case to illustrate how ecological scale thinking can reframe present urban design and planning paradigm. The research aims to answer the following questions: What are the principal causes of the Mississippi River's ecological degradation, and what measures can be taken to restore the River's quality? By regionalizing the organization of political jurisdictions, this will allow urban designers and planners to account for externalities and rebuild damaged ecological systems at the geographical scale.

Over the past century, man-made interventions have transformed the Mississippi River, altering it from its natural form and processes. These augmentations have been the result of planning decisions, which ignore the larger ecological system of the River. This thesis demonstrates that the existing political juggernaut consists of many actors only considering problems within their own jurisdiction, and therefore make decisions in a vacuum.

Instead of making a complete overhaul of the man-made system, this thesis proposes solutions utilizing the existing infrastructure and the waste it produces. It concludes by proposing a new management model: a Sediment Network that redistributes the waste sediment throughout the Mississippi River Basin in the form of new commodities. The Sediment Network illustrates at both the local scale and continental scale, how cities can utilize the sediment as a medium for urban revitalization, restore the River's health, and finally become an instrument for redistributing political power in order to achieve a more holistic form of planning.

ACKNOWLEDGEMENTS

This thesis would not have been possible without the guidance and support of many amazing people. Their constant and continuous encouragement allowed me to achieve things I never thought possible. Firstly, I would like to thank those who guided this journey over the last year. I would particularly like to extend my appreciation to Professor Alan Berger for his constant mentorship, patience and insight. He taught me to think critically, and break through conventional models in order to create better solutions. I would also like to thank Pierre Belanger, professor of Landscape Architecture at the Harvard Graduate School of Design, and Case Brown, associate professor of Landscape Architecture at Clemson University. They both shared a vast amount of knowledge on landscape, urbanism, and regional planning with me, and my thesis reached a higher level of intellect because of their feedback.

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Above all, I would like to extend a special thanks to my parents Larry and Ann Heard. Their constant and unconditional encouragement helped me believe that any goal I was willing to work for was within my reach. Most of all, I would like to thank my mother. Without her influence, none of my achievements would have been possible. She taught me one of the most priceless lessons that I have utilized while at MIT and will continue to utilize throughout my life. She taught how to create beauty and value out of the most mundane things, even something as mundane as dirt.

CONTENTS

INTRODUCTION

INTRODUCTION

The purpose of this thesis is to both conduct independent research to find out what areas of urban design and planning might be able to interact better with ecological systems and also to develop new methods of design from ecological scale thinking. The research aims to answer the following question: What are the principal causes of the Mississippi River's ecological degradation, and what measures can be taken to restore the river's quality?

In recent years, many issues concerning the Mississippi River have been brought to the public's consciousness through media coverage of catastrophic events. Experts are beginning to realize that these catastrophic events may not be merely coincidental, but are actually the culmination of the compounding effects caused by man-made interventions to the River system. The purpose of this thesis is to understand the cause of degradation to the ecological systems in the Mississippi River Basin and explore new types of interventions in which to minimize these effects.

The Mississippi River is a landscape of conflict. For centuries, people have attempted to tame the river for flood protection, while also exploiting its potential for hydrological-power and navigation. Through advances in engineering technology, and policies passed by Congress, this great River has become one of the most highly engineered hydrological systems in the world. These policies however, are not part of a grand vision; rather reactionary laws passed in order to convey a sense of security after flood events or to further prosperity. These policies include the 1890 Rivers and Harbors Act and the 1928 Flood Control Act.

Mark Twain once wrote, "The Mississippi River will always have its own way; no engineering skill can persuade it to do otherwise..." (Eruption)[1] Yet after two hundred years of engineering, the Mighty Mississippi is beginning to reveal the devastating effects caused by interrupting the processes of this complex ecological system. Experts

1 "Mark Twain quotations - Mississippi River."

believe that without intervention, many of the ecological systems in and around the River will soon collapse.

The conflict now lies between maintaining the structures that provide a navigation channel and flood protection or saving the remaining ecological system by opening the floodplain back up to restore the natural hydrologic processes. This begs the question, how can the Mississippi River be deconstructed in order to alleviate the conflict between natural fluvial processes and modern engineering?

DISCONNECT: ECOLOGY & POLICY

DISCONNECT: ECOLOGY & POLICY

The problem with urban design and planning today is that it is bounded by the very notion of the "city". The city is an area that is governed by legislation set within artificial political boundaries, however ecology and the natural environment are not confined to any such boundaries. This historical notion of the city has dominated the legislation, jurisdiction, and ideology of how cities are planned. The dilemma of the historical notion is that the source of many urban problems actually lies beyond the city's boundaries. Many cities are incapable of planning outside of their boundary, because they do not have the political authority or do not benefit economically from planning at a mega-region scale. Some critics claim that cities do not care about the region, because they don't account for the effects to the region or for the region's resources.[2]

The term "urban design" was formulated in the 1950s. Over the past sixty years, three generations of urban designers have approached complex problems without successfully integrating natural systems. Urban design and planning can be further criticized for not concentrating on these spatial and system problems more, but rather focusing on issues related more closely to sociology and economics. The next generation of practitioners in urban design and planning will have to address the challenge of thinking spatially outside of the jurisdictions that have been created, and that sociology and economics needs to be intertwined with the realities of the natural systems when decision-making and problem-solving. The large over-arching question is, how can urban designers and planners begin to address issues that deal with systems that extend beyond the scope of their political jurisdiction?

Ecology and Policy Disconnected

As discussed, currently, in the fields of urban design and planning there is a major disconnect between what designers and planners do in practice versus what they promote in academia. The problem in urban design and planning is that the silos only address their own

2 Belanger, 2010, April 28, "Deconstructing the Mississippi River- Thesis Defense."

specific problems. The only disciplines within the field that actually address the large-scale ecological issues are supposedly Planning and Landscape Architecture, and they do so inadequately, because they are constricted by the scope and client of each individual project. Within these inadequacies, however, lies an opportunity to rectify the situation and address very large-scale problems linked to natural systems in the real world. This problem provides planners the opportunity to create methods of problem solving that deals with large-scale ecological systems in the way different scales are addressed by the current discipline silos.[3]

In order to demonstrate how urban design and planning can successfully address large-scale ecological system, this thesis investigates the Mississippi River watershed. One of the reasons the Mississippi River has been chosen is because of the artificial political jurisdictions that intersect the natural functions of the river.

New Orleans, City of Susceptibility

The most prevalent social and economic issues plaguing cities are symptomatic of much bigger underlying environmental problems. Instead of identifying and treating the problems at the source, planners are trained to recommend solutions that treat the symptoms within their specific silo/jurisdiction and a within a defined set of parameters, i.e. block, district, city, region. However, the most basic unit of ecology is defined by geography, primarily the watershed. Urban design and planning's incapacity lies in the fact that forces external to the planner's scope and/or jurisdiction affect ecological systems. Thus, problem solving within the city boundary is important, but irrelevant without addressing the entire system.

The problems associated with non-systemic urban design and planning along the Mississippi River System are seen most prevalent in New Orleans, Louisiana. New Orleans is considered the "Inevitable City" due to the fact that it is located at the highest point of elevation

3 Berger, 2010, April 28, "Deconstructing the Mississippi River: Thesis Defense."

on the mouth of the Mississippi River and is the first and largest port on the largest North American waterway. It was discovered by Spanish explorers in the 1500s, but was first settled by the French in the 1700s. New Orleans is a hydrologic civilization and is accustomed to flooding and coastal storms, such as the infamous Hurricane Katrina. This research explores: why was Katrina so much more devastating than other storms in New Orleans' past? Was Hurricane Katrina a coincidence, a so-called "perfect storm", or was it actually a constructed catastrophe? This thesis aims to show that the catastrophes caused by Hurricane Katrina were signs of ecological system failure.

On August 29, 2005 Hurricane Katrina hit the Gulf Coast as a category 5 hurricane. In the course of two days, as it traveled across the Gulf of Mexico the hurricane gained enough energy to be elevated from a category 1 to a category 5. It was the most devastating storm in New Orleans history. Exports believe that the storm was more devastating than others for several reasons. First, Katrina became increasingly powerful as it approached the Gulf Coast because it had significantly more area and time over the warm waters of the Gulf of Mexico to absorb energy. Second, citizens had a false sense of security. Contrary to historic belief, they believed that the City had been engineered to be indestructible and that the Mississippi River wouldn't be able to penetrate the levee walls that had been built around them for protection. Finally, the last reason presented by experts explaining the storm's damage is that in the past 50 years, the Gulf Coast marshlands have lost over 2000 square miles. This not only allows a storm more time to absorb energy from the warm waters of the Gulf, but it also means there is significantly less protection. The storm hits land several hundred miles closer to New Orleans with much greater force. As the coastal marshlands are whittled away, so are the coastal city's protection against storms and surge, leaving them exposed and vulnerable.

The destruction that occurred during Hurricane Katrina, demonstrates how intimately connected cities are with their underlying ecological

systems. Engineering structures throughout the Mississippi River system are destroying the natural ecological processes and the effects are compounding downstream. Even modern engineering cannot remedy it's own problems. Unfortunately, New Orleans experienced the ramifications of the system failing.

Changing the Scope and Scale of Planning

The impairment along the Mississippi River is the culmination of many decisions being made at several points and scales throughout the entire river system. Effluents from municipal scale land uses to the harm caused by large-scale, federal engineering efforts have impacted the River. The case of New Orleans and the devastation caused by Hurricane Katrina is evidence that urban design and planning must stretch its scope beyond one site, one state, or one political system and shift the paradigm of urban design and planning to the scale of geography.

The reason to rethink this paradigm is because now urban designers and planners realize that the traditional way of thinking doesn't account for the externalities in other regions. Urban designers and planners should regionalize the organization of political jurisdictions and the planning process to the fullest possible extent, through a gradient that extends from the local scale all the way through to a continental scale. Once this happens, only then will planning and design begin to account for the externalities. Urban designers and planners can begin to understand through these new organizations that the current patterns of urbanization cannot persist. Why? There is a collapse happening in the ecological systems in every region that are now compounding into a continental scale. Urban design and planning must address the problems at all these scales and should take part in both the physical design of urbanization and the policy design to control the aspects of urbanization at a mega-region/ continental scale.

POLITICAL JUGGERNAUT

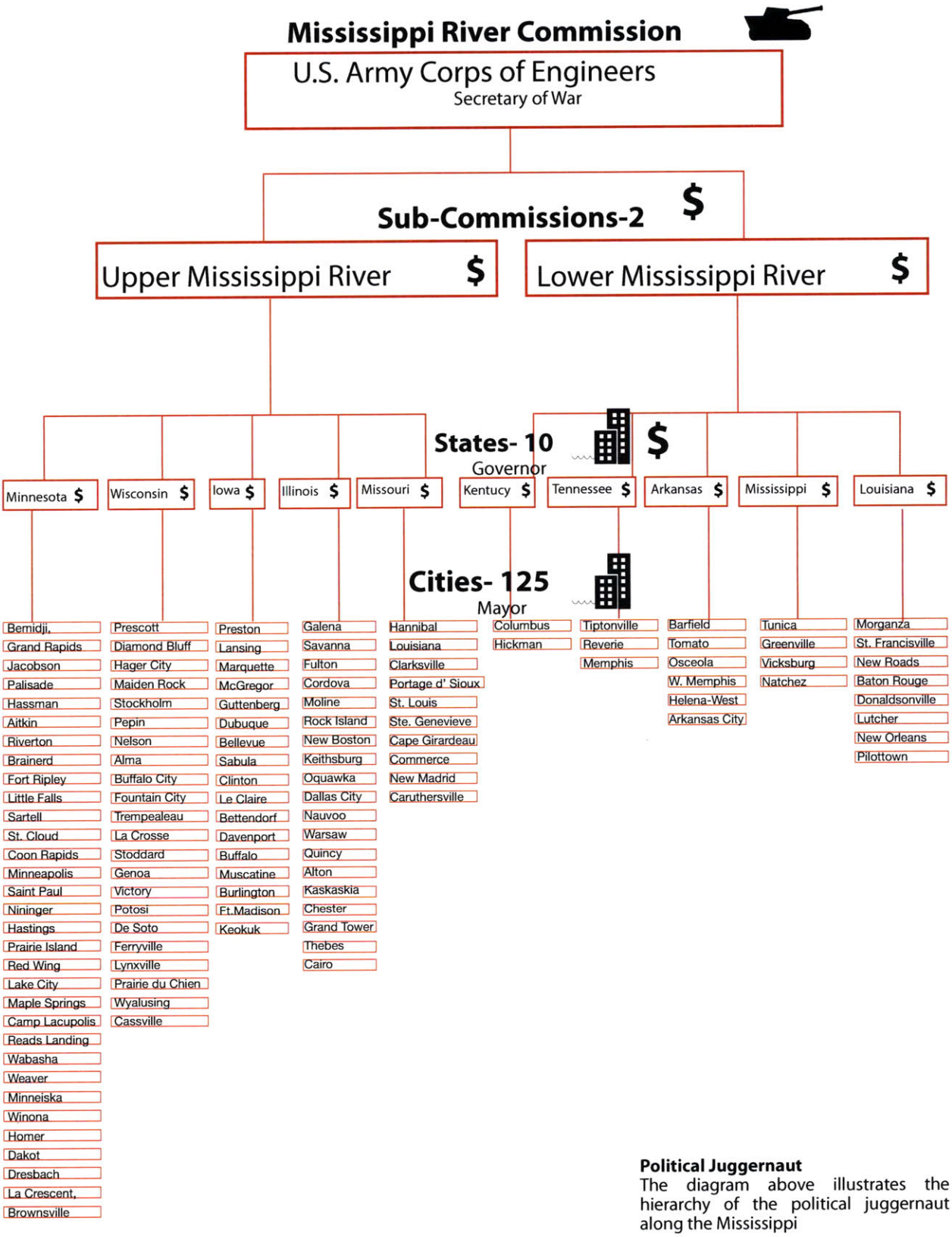
POLITICAL JUGGERNAUT

The problem with the United States, from a planning perspective, is that there is no concept of regional planning, much less continental planning. In the history of planning in the United States, regional planning has always failed, because there are too many actors and no regional authority.

Along the Mississippi River, there is a planning juggernaut consisting of several layers of actors; one at the federal scale, two sub-commissions at the mega-region, ten states, and one hundred-twenty five cities at the local scale. In the realm of design and planning, this tangled web of decision-making has been detrimental to the singular overarching ecosystem. The reason this organization of decision-making is so harmful is because the actors within the juggernaut are not considering problems outside their jurisdiction and are only concerned with their own municipalities and/or their own silos. This is ultimately creating the concept explored by philosopher Garrett Hardin in "Tragedy of the Commons". When multiple individuals act independently for their own self-interest, they will ultimately deplete a shared limited resource. Thus the tragedy of planning is that it does not acknowledge the implications a city's decisions have on the jurisdiction next door.

Federal- Mississippi River Commission

The Mississippi River is overseen by the Mississippi River Commission, and run by the Secretary of War. The Mississippi River Commission has created a unique situation in the United States, in that they have given one agency, US Army Corps of Engineers, complete control over the Mississippi River. The US Army Corps of Engineers is a planning body that oversees the entire system, which uses a top-down method of planning to effectively and efficiently achieve its goals for the Mississippi River. Although, the US Army Corps of Engineers has been highly successful in achieving their goals, they stand as an example of how detrimental top-down planning can be when the agency does not have a holistic set of priorities. The US Army Corps of Engineer's primary focus is maintaining the navigational channels



Political Juggernaut
The diagram above illustrates the hierarchy of the political juggernaut along the Mississippi

for economic and national security purposes. They have constructed several structures to modify and control the River in many ways including, the navigational lock and dam system, the levee system, cutoffs, channelization, etc. However, while they look at the River as a system, their priorities are wrong and thus the system fails. The problem with the US Army Corps of Engineer's thinking is that it only addresses the control and use of the River first, and ignores the effects their modifications have on the River environment. Their narrow and skewed priorities have augmented the Mississippi River's form and its processes throughout the entire system to achieve this control. This in turn has been the direct cause of the Mississippi River system's failures.

Regional- Upper and Lower Mississippi Commission

The Mississippi River is separated into two basins, the Upper and Lower Mississippi River Basin. Each of the basins is overseen by their own commission, however they each fall into the traditional planning trap. Each commission looks at problems within its own area, regardless of whether the problem originates outside their jurisdiction. The Upper Mississippi River Commission has been successful in working with all the states within the basin to oversee and control waste emissions into the River. This in turn has had a positive effect on the Lower Mississippi River, but the disconnect between the planning bodies still has not been able to solve the problems associated with the Gulf of Mexico hypoxia or sedimentation issues.

State- 10 Adjacent States, 35 in the Watershed

Congress passed the Clean Water Act in 1972, giving the Environmental Protection Agency jurisdiction over that which the river traverses. Currently, the Environmental Protection Agency (EPA) jointly monitors all states with the Army Corps of Engineers (USACE), to ensure water quality along the River remains at a healthy level.[4] However, individual states have the power to permit industrial land practices along the

4 Committee on the Mississippi River and the Clean Water Act, National Research Council, "Mississippi River Water Quality and the Clean Water Act: Progress, Challenges, and Opportunities."

River, such as manufacturing and agriculture, which depend on the federal navigation channels for importing and exporting goods. Some of the byproducts from these practices are harmful to the River, yet are not monitored by the EPA or USACE. By-products like sediment can disturb the geomorphology of the water, causing turbidity (cloudy water) and harming aquatic life.

Municipal- 125 Adjacent Cities

According to the US Constitution, the power to zone land belongs to local governments. Each of the 125 municipalities along the River has the right zone in a vacuum according to what is most beneficial to their city. However, because they only have the authority to make decisions within their own jurisdiction, cities disregard the external effects their decisions might have on other municipalities within the same ecological system. Viewing urbanization in aggregate throughout the entire Mississippi River system, one can see that local zoning is creating adjacent land uses that is damaging to the River.

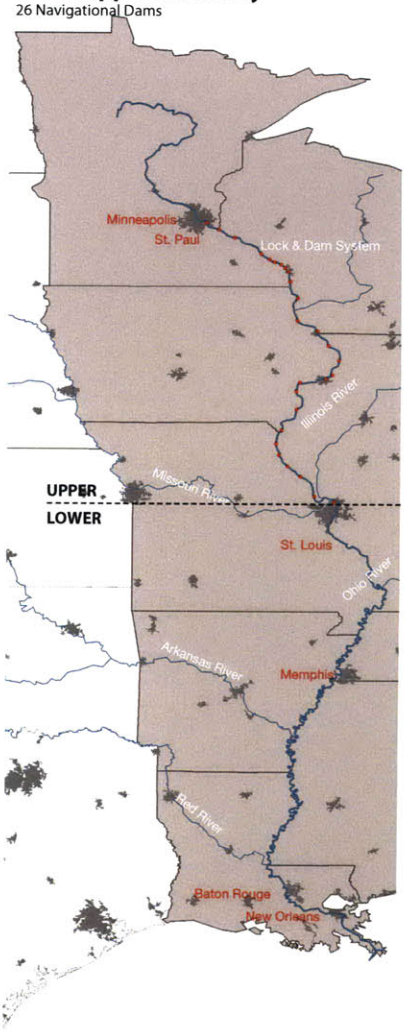
Americans have a romantic and idealized perception of the Mississippi

TALE OF TWO RIVERS

TALE OF TWO RIVERS

River. The River provides a nostalgic vision of a pristine landscape that is considered one of America's most important landmarks. Contrary to how many Americans envision the River, the actual picture reveals two very different streams of water. The Mississippi River has been altered to be an engineering marvel. At many points the River looks more like an industrialized machine rather than the iconic and bucolic vision of nature. The River has been stripped of its natural mystique in the name of economic progress.

Mississippi River Valley
26 Navigational Dams



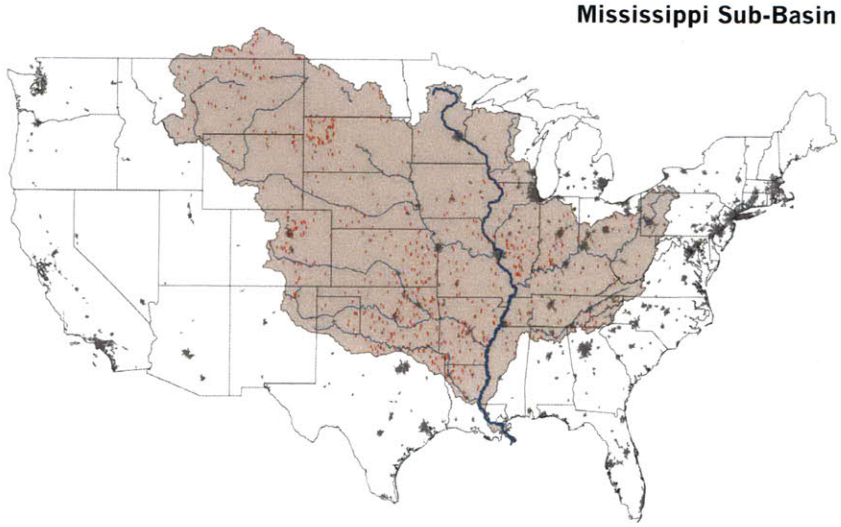
Natural

Geography of the Mississippi River System

The Mississippi River is one of America's most valuable resources. The River derives its name from the Chippewa Indians meaning "great river". It is approximately 2,300 miles long, from Lake Itasca in northern Minnesota to its delta in southern Louisiana, where it empties into the Gulf of Mexico. Over the entire course of the river, it falls 725 feet in elevation. [5] It touches 10 states, which are separated into two regions divided by the convergence of the Ohio River, the Upper Mississippi River, (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) and the Lower Mississippi (Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana). [6] The watershed is the third largest in the world, covering 1,837,000 square miles (41% of the continental United States).

5 Chambers, The Mississippi River and Its Wonderful Valley - Twenty-Seven Hundred And Seventy-Five Miles From Source To Sea.
6 "Mississippi River Anatomy."

Mississippi Sub-Basin



Mississippi River Valley
The diagram above illustrates the Mississippi River Basins, along with major cities and tributaries.

Mississippi River Sub-basin
The diagram to the left illustrates the Mississippi River watershed and the major dams that lie within.

Ecological Habitats and Wildlife Species

The river is important to the survival and livelihood of both people and animals. Approximately 50 million people rely on the Mississippi River and/or its tributaries as their primary source of drinking water. However, the true value is found in the richness of its habitats and the wildlife these habitats support. The river is an important resource for the survival of many of North America's wildlife species. [7]

The Mississippi River system is the largest and one of the most complex river systems in North America. Its habitats provide food and shelter for many of North America's wildlife including 50 species of mammals, 150 species of fish, over 125 species of mussels, and 270 species of birds, which reside in or travel through this corridor.[8]

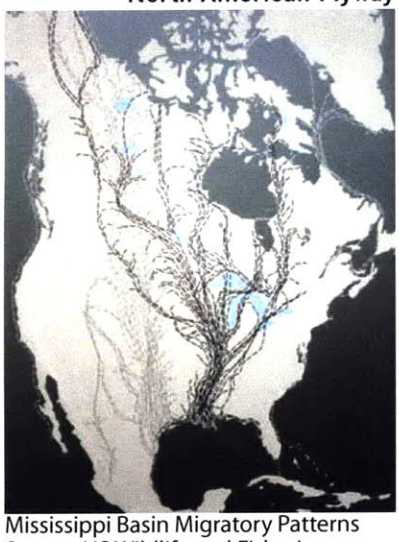
Mammals

Large numbers of mammals thrive near the river. Whitetail deer, bats and raccoons are found throughout the river corridor, while other species such as river otter, beaver, and fox are found in scattered pockets within the corridor.[9] Over the last century however, human encroachment has threatened these habitats and many of the mammals have had to adapt. The fragmentation of these habitats has lead to endangerment for many species, raising concern for several conservation agencies.[10]

Birds

This rich floodplain provides a home for 400 species of wildlife, containing 40 percent of North America's waterfowl. The Mississippi River creates an unobstructed valley that is conducive for migratory birds. In fact, the Mississippi River Valley is one of four major North

North American Flyway



Mississippi Basin Migratory Patterns
Source: US Wildlife and Fisheries

The diagram illustrates the North American Flyways, which are primary routes birds use annually to migrate.

7 "Mississippi National River and Recreation Area - Animals (U.S. National Park Service)."
8 "Mississippi National River and Recreation Area - Mississippi River Facts (U.S. National Park Service)."
9 "Mississippi National River and Recreation Area - Animals (U.S. National Park Service)."
10 Images found on left from top to bottom:
http://www.menaar.com/arkansas/arkansas_facts.htm;
http://www.worldwildlife.org/wildworld/profiles/g200/g146_lg.html
http://article.wn.com/view/2010/03/12/Climate_Change_Threatens_Migratory_Birds_Report_Says/
http://www.saraswatibhawan.org/ppmmississippi.html

American Flyways for migratory birds. It is the longest migratory route in the western hemisphere. Well timbered and watered, the entire region affords ideal conditions for the support of hosts of migrating birds. Another factor in determining the importance of this route is that it is used by large numbers of ducks, geese, shorebirds, blackbirds, sparrows, warbler and thrushes.[11]

Reptiles & Amphibians

At least 145 species of amphibians and reptiles inhabit the Upper Mississippi River environs. Several species of turtles, snakes, salamanders and frogs are found throughout the River. The reptile and amphibious populations are sensitive to changes in habitat quality, and chemical pollutants and atmospheric warming can significantly affect their populations.[12]

Fish

There are 260 species of fishes in the Mississippi River. This makes up 25% of all fish species in North America. [13] However, many factors including exploitation, dams (block migration routes), navigation activities (habitat loss), and contaminants, have lead to the decline in many of the fish populations.

Invertebrates

Mussels are important indicators in establishing water quality and a river's health. The health of the mussel populations is intimately tied with the health of the river. There are 38 documented species of mussel in the Upper Mississippi River and as many as 60 separate species of mussels in the Lower Mississippi River.[14] In recent years, the mussel population has begun to recover, but these populations are still vulnerable due to poor water quality.

11 "North American Migration Flyways."
12 "Mississippi National River and Recreation Area - Mississippi River Facts (U.S. National Park Service)."
13 Ibid.
14 Ibid.

Man-made

The Mississippi River's potential to become America's super highway was realized early on, due to its broad spans. However the Mississippi River in its natural state is not deep enough in the upper basin, so in order to connect the northern states and make the river viable for shipping and trade, the River had to be engineered with a lock and dam system.

Engineering Characteristics

The history of development along the Mississippi River has primarily been overseen by the US Army Corps of Engineers. In 1802, the Army Corps of Engineers was formed to maintain the navigational channel of the river. The first interventions started in 1829, when the Corps began removing snags, closing secondary channels, and excavating rocks and sandbars along rapids in the Upper Mississippi River Basin. The first major engineering project was the 1848 Illinois and Michigan Canal to connect the River to Lake Michigan. Through the 1930's twenty-nine lock and dams were built, altering the River's form and processes into what the River is today.[15]

There are several examples of engineering interventions that USACE uses as methods of river improvements.

Dams

Dam barriers are commonly constructed across a watercourse, to hold back water, often forming a reservoir or lake. Dams are also sometimes used to control or contain rockslides, mudflows, and the like in regions where these occurrences are common. Dams are made of timber, rock, earth, masonry, or concrete or of combinations of these materials.[16,17]

15 "Mississippi River Commission."

16 The Columbia Encyclopedia, Sixth Edition. 2008, "Encyclopedia.com articles about dam."

17 Images on left from top to bottom:
http://commons.wikimedia.org/wiki/File:Mississippi_River_Lock_and_Dam_number_22.jpg
http://www.johnweeks.com/bridges/pages/lockdam01.html
http://ian.umces.edu/imagelibrary/displayimage-toprated-39-1129.html
http://www.nola.com/hurricane/index.ssf/2009/11/corps_could_be_helping_rebuild.html

TALE OF TWO RIVERS

Lock

A lock is a stretch of water enclosed by gates, one at each end, built into a canal or river for the purpose of raising or lowering a vessel from one water level to another. A lock may also be built into the entrance of a dock for the same purpose. When the ship is to be raised to a higher level, it enters the lock and a gate is closed behind it. Water is let into the lock until its level equals that of the water ahead. The forward gate is then opened, and the ship progresses on the higher level. The procedure is reversed when the vessel is to pass from a higher to a lower level. As many locks as necessary are used in a given waterway. Most modern locks are made of concrete, although some have walls of steel-sheet piles or floors of natural rock or sand. [18]

Cutoffs

Cutoffs are a method of shifting the river laterally in order to channelize it. This method typically involves straightening a meandering channel and thus eliminating meander migration and shortening the river.[19]

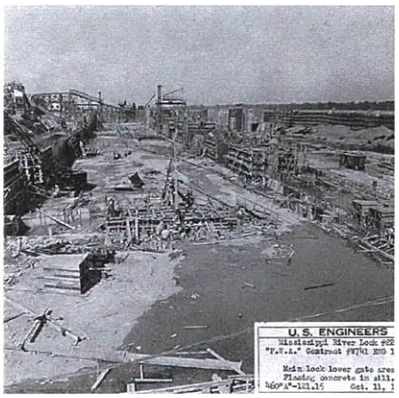
Levees

According to the Columbia Encyclopedia, a levee is an embankment built along a river to prevent flooding by high water. Levees are the oldest and the most extensively used method of flood control. They are constructed by piling earth on a surface that has been cleared of vegetation and leveled. From a broad base the levee narrows to a flat crown, on which sandbags or some other temporary protection may be placed to contain unusually high waters.[20]

Canals

A canal is an artificial waterway constructed for navigation or for the movement of water. Canals are also used to provide municipal and industrial water supplies. The drainage of wetlands may be accomplished by means of a canal. Canals can be used for flood

18 The Columbia Encyclopedia, Sixth Edition. 2008, "Encyclopedia.com articles about locks."
19 The Columbia Encyclopedia, Sixth Edition. 2008., "Encyclopedia.com articles about cutoffs"
20 The Columbia Encyclopedia, Sixth Edition. 2008., "Encyclopedia.com articles about levee."



Homes fronting the Forty Arpent Canal in Meraux

Canals dredged through marshlands

After dredging through the coastal marshlands

America's Economic Conduit
In reality the river has been augmented to promote economic progress. The governing bodies of the Mississippi River value the economy of the river over the river's ecological health and have altered it to run as efficiently as possible.

Images from top-left to bottom right:
http://www.nww.usace.army.mil/planning/er/millcrk/mctoc2_3.htm
http://www.nola.com/hurricane/index.ssf/2009/11/post_16.html
http://www.epa.gov/msbasin/photopops/gulf11_pop.html
http://chl.erdc.usace.army.mil/navnews-v3

control by diverting water from threatened areas into storage basins or to other outlets.[21,22]

Economic Importance

Due to the river's hydrology, the Mississippi River Basin area encompasses the nation's most productive agricultural and industrial regions. The Mississippi River is the nation's chief navigable water route that is kept open for shipping and national security purposes. Barges and towboats on the Mississippi River System carry sixty percent of the agricultural goods, industrial products, and raw materials transported on inland waterways.

The Mississippi River Valley brings in $7 billion from forest and agriculture products and $29 million from manufacturing each year. The river's navigational channel is an important contribution to the United States' economy as well, moving 470 million tons of cargo annually, mainly wheat from the Midwest and petro-chemicals from the Gulf of Mexico.[23]

Recreation is an important industry also. A recent study by the U.S. Geological Survey estimated over 12 million daily visits by recreationists take place each year in the Upper Mississippi River. These visits supported over $1.2 billion in national economic impacts (1990 price levels) and over 18,000 jobs nationwide. The Lower Mississippi Region generates $128 billion and 771,000 jobs through industries directly related to the River and its surrounding environs.[24]

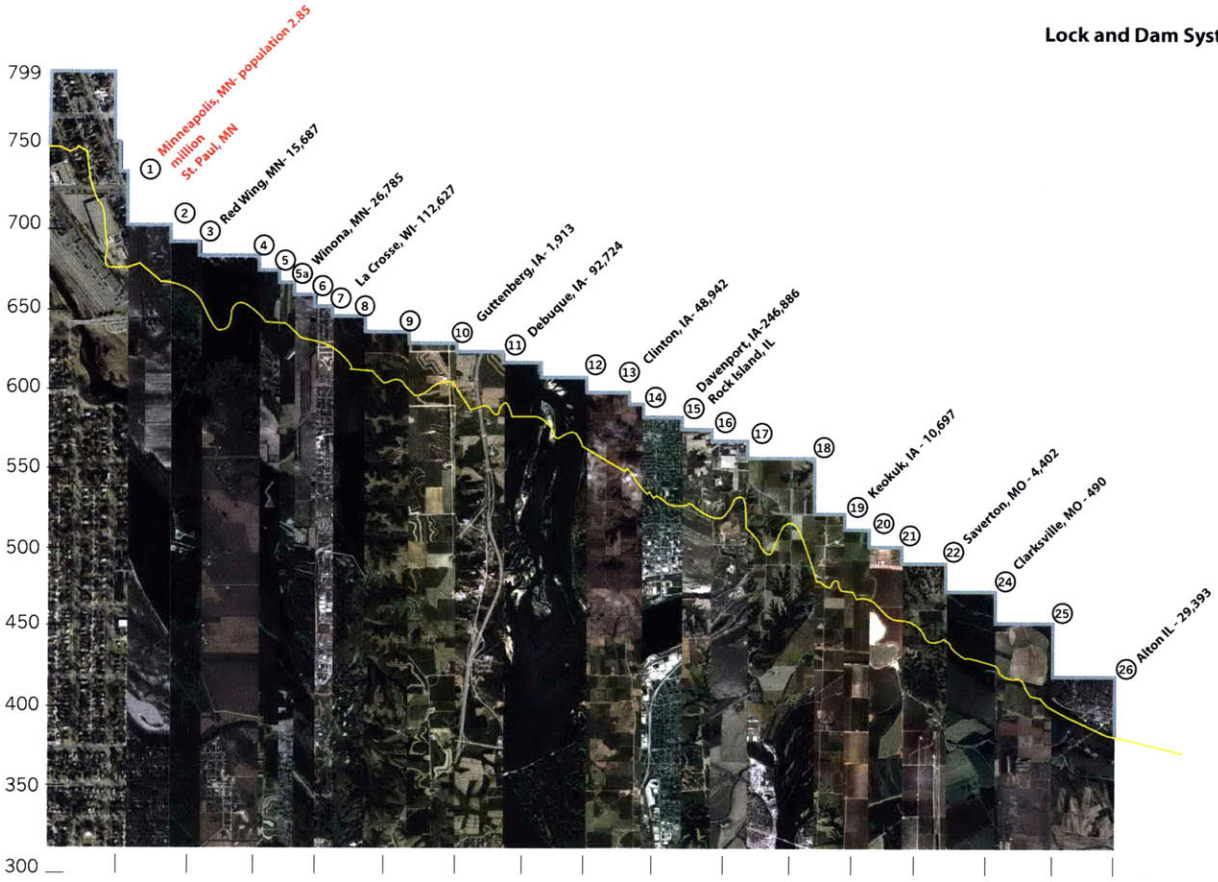
21 The Columbia Encyclopedia, Sixth Edition. 2008, "Encyclopedia.com articles about canal."
22 Images on the next page from right to left and top to bottom:
23 "Water transportation of freight, not elsewhere classified (SIC...: Information from Answers.com."
24 "Economic Impacts of Recreation on the Upper Mississippi River System."

Lock and Dam System
The graphic to the left shows the elevation of each dam along the first two reaches of the Upper Mississippi River, the corresponding cities and population, and the adjacent land uses.

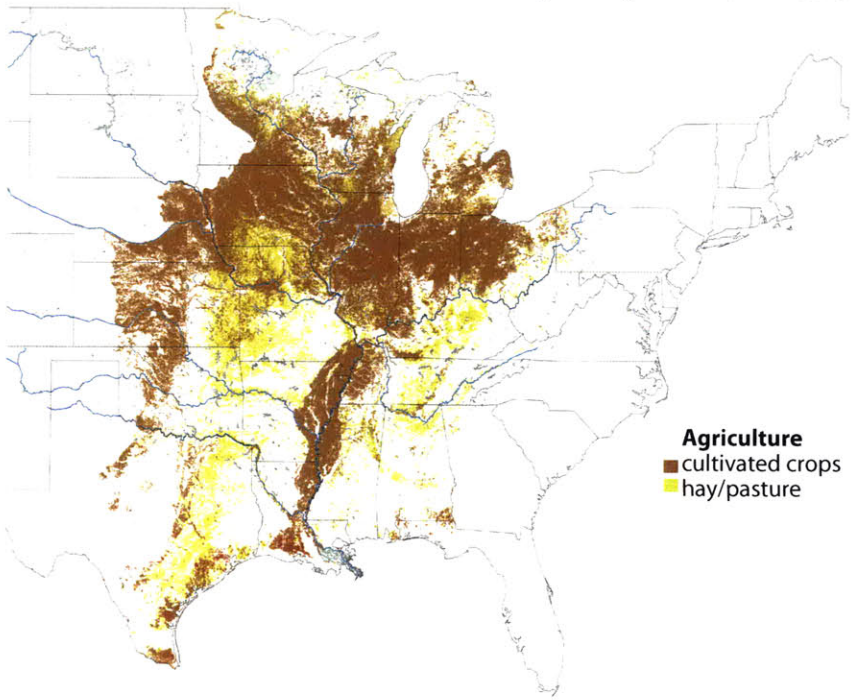
US Geologic Survey Land Use / Land Cover
This graphic illustrates the area of land in the zones that overlay the Mississippi River, according to the USGS that are currently being used for agriculture.

THREATS TO THE RIVER

Lock and Dam System



US Geologic Survey Land Use / Land Cover



Suspended sediment, total phosphorus, and nitrate yields in runoff by dominant land use in the United States for 1980–1989.

Land use	Runoff (kilograms per square kilometer per year) Suspended sediment	Total phosphorus	Nitrate
Wheat	3503	3.5	11.2
Urban	8056	41.7	192
Forest	10,858	22.1	89.3
Rangeland	11,559	6.0	10.9
Mixed crops	27,671	23.1	107
Corn and soybeans	35,026	57.1	326

Source:Smith et al. (1996).

TALE OF TWO RIVERS

Evidence of an Unhealthy River

The augmentation of the Mississippi River is severely compromising the River's health, to the point of entire system collapse. The species native to the Mississippi River Basin are showing signs of stress and are dying at a rapid rate. In every ecosystem the lowest invertebrates are the most sensitive species and act as the canary in the mine shaft. In the case of the Mississippi River, there are almost 300 species that are critically endangered and/or on the verge of extinction– a direct result of human threats to the river.[25]

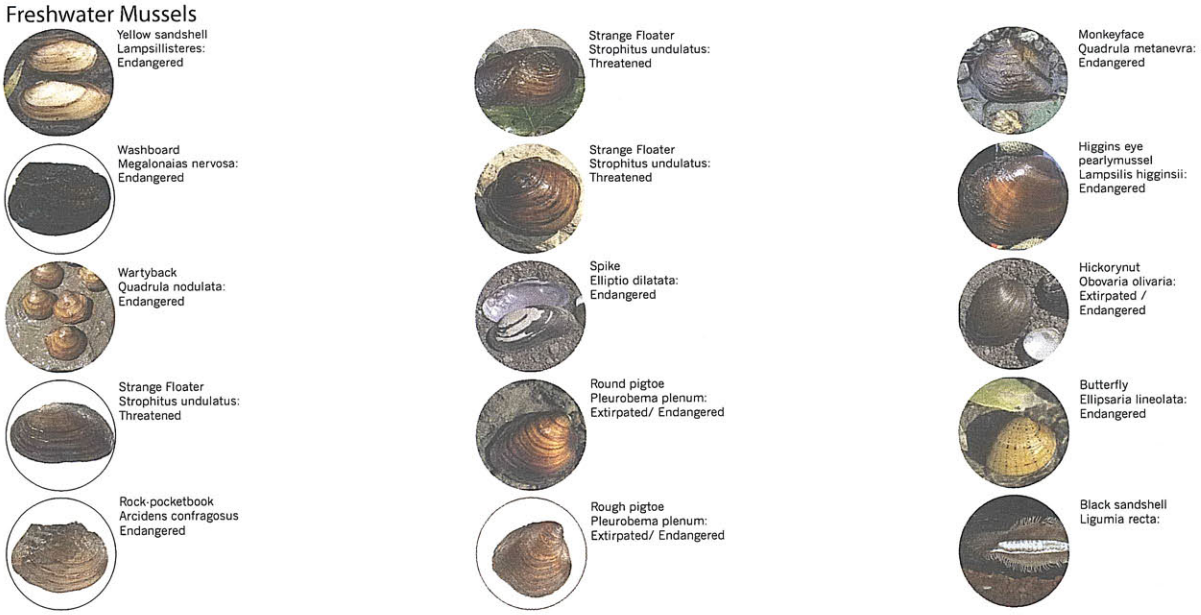
25 "USACE Threatened, Endangered, and Sensitive Species Protection and Management System."

USACE Threatened, Endangered, and Sensitive Species List

Invertebrates

Major causes of decline to mussel species is attributed to destruction of habitat (deforestation, riparian zone destruction) by siltation, dredging, channelization, impoundments, and pollution.

USACE Threatened, Endangered, and Sensitive Species List
This illustration shows examples of animals indigenous to the Mississippi River that are threatened or endangered due to man-made interventions.



Vertebrates

Major causes of decline to most of the vertebrates within the Mississippi River Valley have been directly related to man-made alterations to the river (i.e., dams, levees, channelization, etc.) This has caused loss and/or unsuitable habitat, as well as, loss of diversification and pollution.

Marine Mammal

West Indian Manatee
Trichechus manatus:
Endangered
The primary cause of death is watercraft collision (30%); other deaths may be attributed to water control structures and navigational locks. Threats also include coastal development, alteration of water flow to natural springs, loss of seagrass beds, and natural causes such as red tide and cold events.

Terrestrial Mammal

Louisiana Black Bear
Ursus americanus luteolus:
Threatened

Gray Bat
Myotis grisescens
Endangered
Many important caves were flooded and submerged by reservoirs. Other caves are in danger of natural flooding. Even if the bats escape the flood, they have difficulty finding a new cave that is suitable.

Birds

Interior least tern
Sterna antillarum athalassos:
Endangered
Man-made alterations (i.e., dams, channelization) affecting the natural processes of erosion and inundation of interior river systems have caused increased vegetation along shorelines thus, creating unsuitable habitat for the species.

Colonial Waterbirds
Various Species:
Specie of Concern

Brown pelican
Pelecanus occidentalis:
Endangered

Bald Eagle
Haliaeetus leucocephalus
Threatened
Present threats include loss of nesting habitat mainly to development in coastal areas and waterways, electrocution, and shooting.

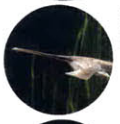
Piping plover
Charadrius melodus
Threatened

Fish

Walleye
Stizostedion vitreum:
Species of Concern

Smallmouth bass
Micropterus dolomieu:
Species of Concern

Gulf sturgeon
Acipenser oxyrinchus desotoi
Threatened



Paddlefish
Polyodon spathula:
Species of Concern

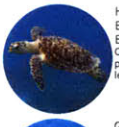
Bluegill
Lepomis macrochirus:
Species of Concern

Pallid sturgeon
Scaphirhynchus albus:
Endangered
Decline is due to degradation of habitat. Dams and channelization have altered the functions and have produced a less diverse ecosystem of which the pallid sturgeon is dependant on. Regular widths, constant velocities, and control of erosion produced by channelization have limited the assemblage of backwaters, sloughs, and sandbars required by the species. Dams have altered the natural river dynamics by modifying flows and reducing diversity to the system. Levee construction has eliminated natural flooding and reduced floodplains. Increased clarity from decreased sediment transport of once very turbid waters makes the pallid sturgeon more susceptible to predation. (USFWS 1993).

Marine Turtles

Loggerhead
Caretta caretta:
Endangered
The primary causes of decline in this species are shrimp trawling, coastal development, increased human use of nesting beaches, and pollution.

Kemp's Ridley
Lepidochelys kempii:
Endangered
Primary threat has been the increase of trawling in the Gulf which impacted a large portion of the reproducing population.



Hawksbill
Eretmochelys imbricata:
Endangered
Commercial exploitation which is primarily shells but also includes leather, oil, perfume, and cosmetics.

Green turtle
Chelonia mydas: Threatened
The major cause of the decline is the commercial harvest of food, eggs, and calipee. Other threats include commercial shrimp trawling and degradation of habitat.

Freshwater Turtles

Western Painted Turtle
Chrysemys picta bellii
Rare

Spiny Softshell Turtle
Apalone spinifera
Species of Concern

Smooth Softshell
Apalone mutica: Rare
Density indicates a sex ratio of males to females of 2.5:1. Some studies have indicated that 37 percent of the population is composed of immature individuals.

Ringed-sawback Turtle
Graptemys oculifera:
Threatened
Papermill effluents, sewage, industrial waste, habitat modification and water quality degradation are the most often cited reasons for declining numbers of ringed map (McCoy and Vogt 1980; Stewart 1988).

Ouachita Map Turtle
Graptemys ouachitensis:
Species of Concern
Some studies have shown a large female-biased sex ratio (3:1), which may be due to either the effects of temperature-dependent gender determination (Shively and Jackson 1985).

Common Map Turtle
Graptemys geographica:
Endangered
Populations may be substantial in waterways with abundant mollusks. Mature males outnumber mature females (Pluto and Bellis 1986).

Common Snapping Turtle
Chelydra serpentina:
Sensitive Species
Chemical pollution is linked to population decline (Ryan et al. 1986).

False Map Turtle
Graptemys pseudogeographica
Threatened
Declining populations are attributed to several factors, including water pollution, river channelization, reduction of suitable nesting sites, siltation, and unlawful shooting.

Blanding's Turtle
Emydoidea blandingi:
Species of Concern
Wetland alteration or destruction is believed to be an important factor in the decline of several populations of Blanding's turtles (Kofron and Schreiber 1985).

CHRONOLOGY OF THE RIVER

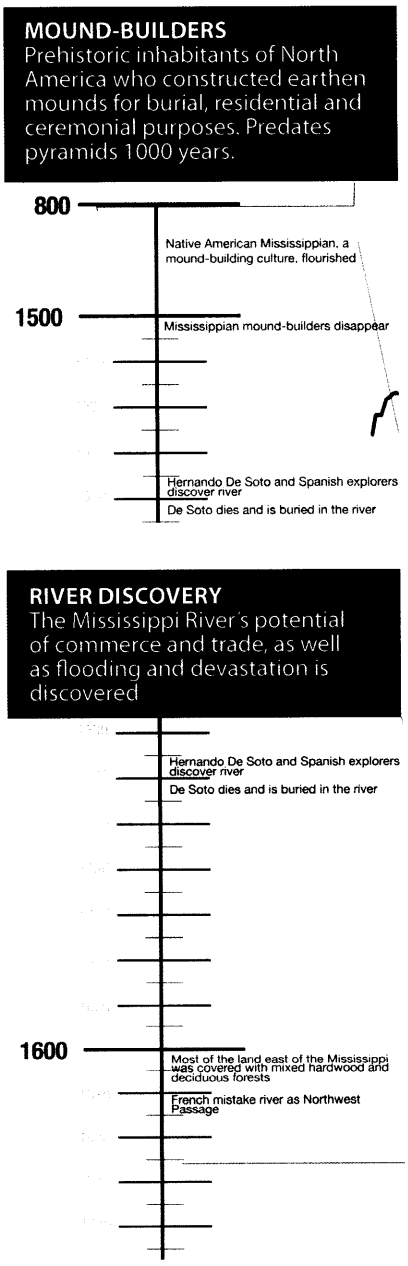
CHRONOLOGY OF THE RIVER

There have been several important events throughout the life of the Mississippi River. The events recorded in the Mississippi River's history are primarily the events caused by human interaction. The River's chronology has been categorized in the following eras: prehistoric, colonial, industrial, and modern.

Although humans have been influencing and have been influenced by the Mississippi River for thousands of years, it is important to note that effects humans have had in the past century have been the most significant.

Prehistoric Era- Mud Builders

Archeologists have found that the earliest human interaction along the Mississippi River dates back to around 800 AD. This is the first date of human presence along the river with the Mississippi Mound Builders. Between 800 and 1400 A.D., towns and cities crowded the banks of the Mississippi River. The people could focus their energies on other things such as blossoming art and crafts, since the burden of survival was lighter. These early natives began to construct large ceremonial mounds along the Mississippi River. These mounds could span up to 35 feet high or may have been included in a series of pattern-arranged structures. Mound Builders most often built several mounds that were arranged around a rectangular plaza, with the village at its edges. By 1500 AD, The Mound Building civilization began to disappear due to the fact that the Mississippi River Valley had deteriorated significantly.[26,27]



Policies and Geo-Ecologies: Time Line
This graphic to the right depicts the chronology of the Mississippi and where the corresponding events took place along the River. It also shows the cultural quality found along the River.

26 "Mound Builders of the Mississippi River - Four Rivers Realty."
27 Images on next page from top to bottow:
http://farm4.static.flickr.com/3509/3266803008_1c6367e903_m.jpg
http://www.city-data.com/forum/general-u-s/468075-pictures-americas-river cities-2.html
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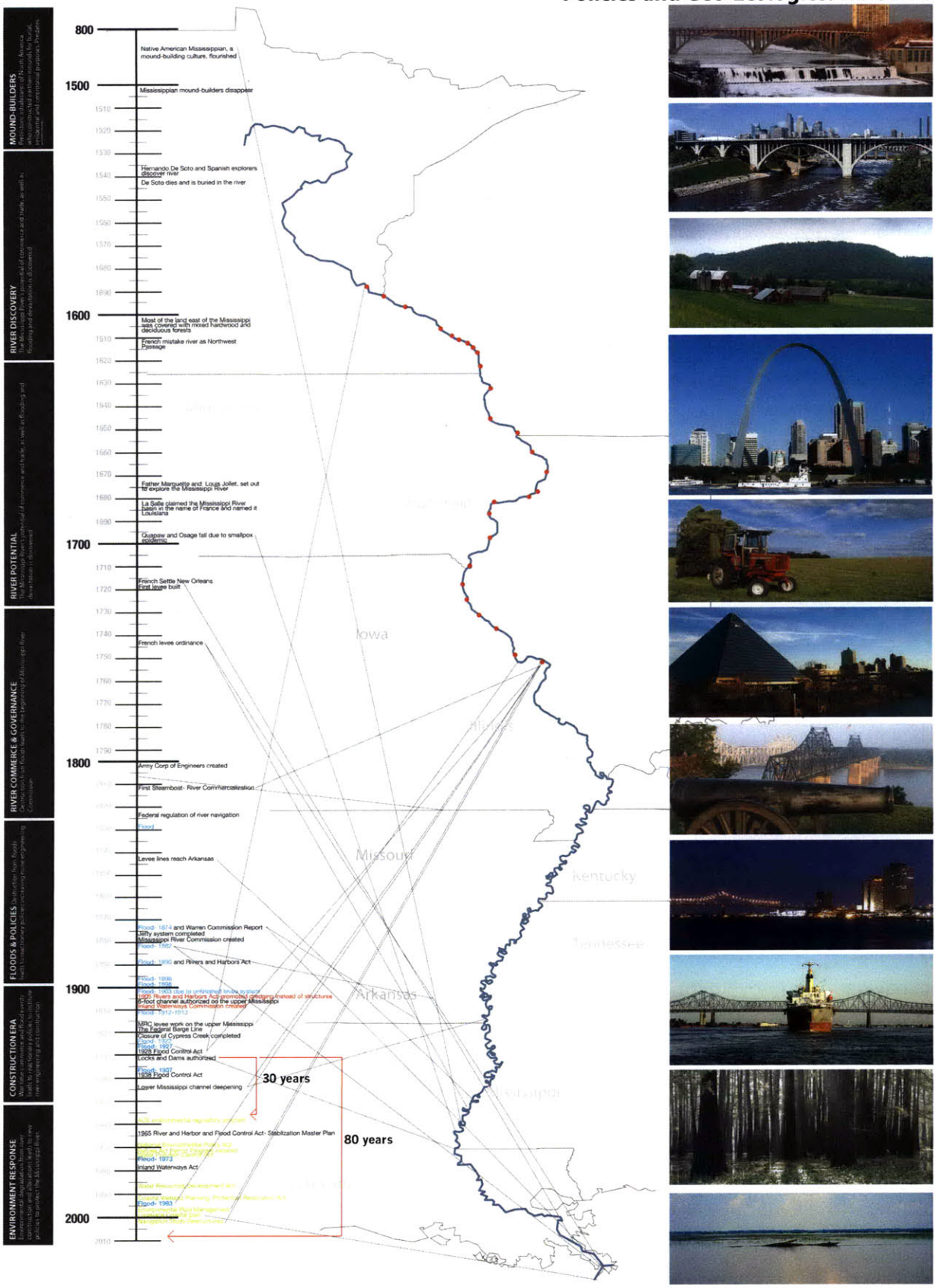
http://mri.audubon.org/news-events/obama-sutley-support-wetlandsrestoration
http://www.nola.com/politics/index.ssf/2010/01/west_bay_diversion_project_on.html

CHRONOLOGY OF THE RIVER

Policies and Geo-Ecologies: Time Line

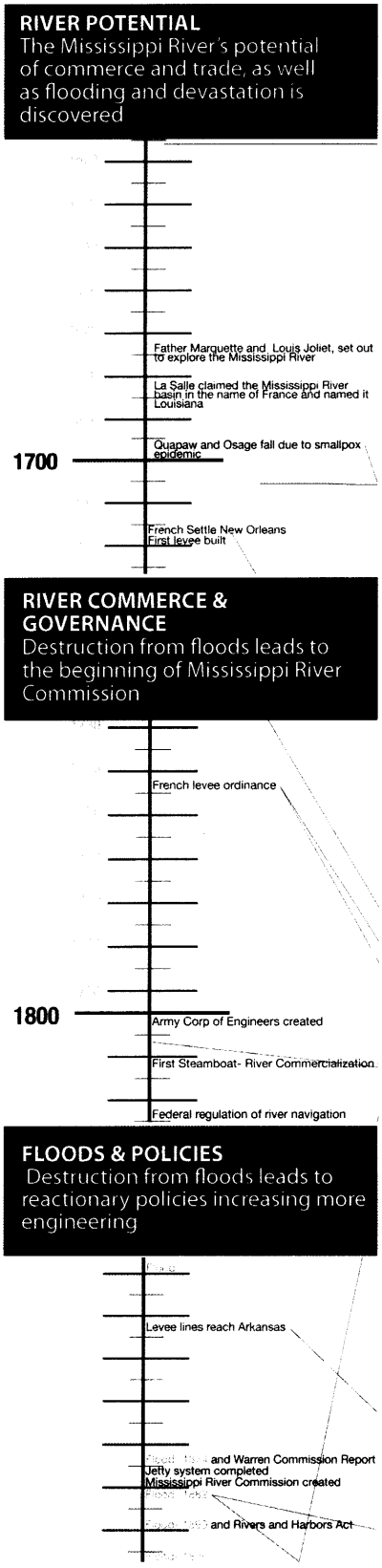


CHRONOLOGY OF THE RIVER

Colonial Era-River Discovery

The first Europeans discovered the River and began exploring in the 1500s and settling along the River in New Orleans in the 1700s. The first explorer credited with discovering the Mississippi River is Spanish explorer Hernando De Soto in 1541. However, the French were the first Europeans to establish settlements in the valley and extend their control. French explorer, Robert de La Salle settled New

Orleans in 1718, and claimed the Lower Mississippi River as French territory. France and Spain fought for control of the rich territory for many years, but the territory finally became property of the United States in 1803 with the Louisiana Purchase.[28]



Industrial Era

River Potential

Until the early 20th century, the River was perceived as a wild, incontrollable force and man would have to be flexible in order to live near it. At the beginning of this era, President Roosevelt realized the harm industrialization could have on the Mississippi River, as well as other river systems, and instituted the Inland Waterway Commission. The Inland Waterway Commission was President Roosevelt's attempt to mitigate the damage of development along the River and to have a commission of conservationists assemble a body of best practices for the River ecological health. The commission was an integral component of the Conservation Policy of 1907, which would prepare "a comprehensive plan for the improvement and control" of US river systems. The Inland Waterway Commission urged that future plans for navigation improvement take account of water purification, power development, flood control, and land reclamation.[29]

Although the early twentieth century was marked by strong conservation efforts, promoted by the incumbent political power, the conservation era ended with Theodore Roosevelt's presidential term. Dealing with a nation at war, the proceeding legislative powers viewed

28 "Mississippi River Information and History - Four Rivers Realty."
29 "Roosevelt Plans To Employ Rivers" The New York Times." 1907, March 17.

river control as a conduit to transport goods from the interior of the United State, stimulate the economy, and protection against floods. The need and desire to control the River and harness its energy had been present for many years, but in the 1930s, when the technology and legislative power became available, controlling the River became a real possibility.

Floods and Policies

Early in the twentieth century, many farms and urban areas began to experience flooding throughout the Mississippi River Valley. The Flood Control Act of 1928 authorized work that would give the various basins protection against Mississippi River floods only, although the tributary streams within the basins caused frequent flood damage that could not be prevented by the main stem Mississippi River

Inland Waterway Commission Announcement

Wants a Broad Plan.

In creating this commission I am influenced by broad considerations of National policy. The control of our navigable waterways lies with the Federal Government, and carries with it corresponding responsibilities and obligations. The energy of our people has hitherto been largely directed toward industrial development connected with field and forest and with coal and iron, and some of these sources of material and power are already largely depleted; while our inland waterways as a whole have thus far received scant attention.

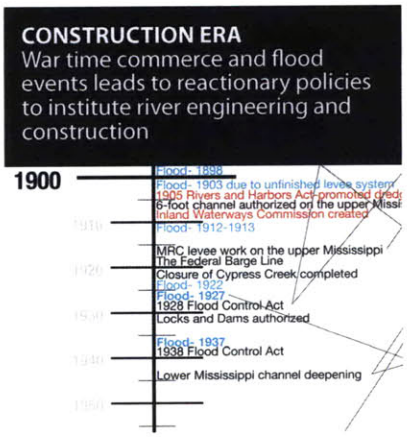
It is becoming clear that our streams should be considered and conserved as great natural resources. Works designed to control our waterways have thus far usually been undertaken for a single purpose, such as the improvement of navigation, the development of power, the irrigation of arid lands, the protection of lowlands from floods, or to supply water for domestic and manufacturing purposes. While the rights of the people to these and similar uses of water must be respected, the time has come for merging local projects and uses of the inland waters in a comprehensive plan designed for the benefit of the entire country.

Such a plan should consider and include all the uses to which streams may be put, and should bring together and co-ordinate the points of view of all users of water. The task involved in the full and orderly development and control of the river systems of the United States is a great one, yet it is certainly not too great for us to approach. The results which it seems to promise are even greater.

Inland Waterway Commission Announcement
This New York Times article on March 17, 1907 announces President Roosevelt's plan to create the Inland Waterway Commission to oversee the health of America's waterways and protect them during industrialization.

CHRONOLOGY OF THE RIVER

protective works. Later amendments to this act have authorized work to alleviation tributary flood problems.



Modern Era

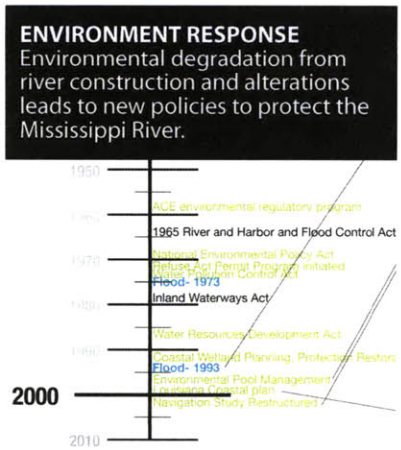
Construction

At the end of the 1920s and the beginning of the 1930s, the technology to build dams was invented and the United States was desperate for work. Congress saw this as the perfect opportunity to authorize the US navigational lock and dam system. Under the 1928 Flood Control Act, Congress authorized a series of locks and dams on the Mississippi River to secure national security and to spur economic growth. The lock and dam system deepened the shallow water of the Upper Mississippi River to create a 9' deep x 400'wide navigational channel to accommodate multiple-barge tow.[30]

After the navigational lock and dam system was finished, the negative effects required river improvements to become apparent throughout the River. The Mississippi River continued to change and adjust its course creating the need for sustained management by USACE. In the 1950's, the US government scientists determined the Mississippi River was starting to switch to the Atchafalaya River channel because of the much steeper path to the Gulf of Mexico. The change in course would destroy the navigation channel that USACE spent millions of dollars and years creating, as well as hurt the shipping economy. Therefore, Congress authorized another major engineering effort to control the Mississippi River by building a $300 million control station. The control station took several years to construct, but was finally finished and opened for use in 1986.

Engineering efforts, also known as, river improvements are still being practiced today. However, the effect of the engineering controls became very apparent shortly after they were put in place. Only 30 years after USACE built the river control mechanisms, the environmental systems began to show signs of distress, and even collapse.

30 "Mississippi River Commission."



Environmental Response

1972 Clean Water Act

The Clean Water Act, passed in 1972, was a landmark piece of legislation that vastly improved the health of US waterways by helping to eliminate toxic pollutants and runoff. Prior to the bill's passage, toxins, heavy metals and other industrial by-products too easily polluted rivers. The Clean Water Act has improved the health of the river drastically, but it has been a political uphill battle in doing so.

The implementation of the Clean Water Act stands as another example of how the current political overlays do not coincide with ecological systems. Many of the states along the Mississippi River, especially states in the Lower Mississippi Basin view the river's water quality as a federal responsibility. There is very limited coordination among the states to monitor the water and ensure that actions from the Upper Mississippi River states'are not impacting the water quality for the states downstream in the Lower Mississippi Basin. Therefore, the Mississippi River is an "orphan" from a water quality monitoring and assessment perspective as a result of limited interstate coordination.[31]

Looking at the chronology of the Mississippi River, it is easy to notice that humans, along with technological innovation, have had a dramatic impact on the Mississippi River. A system that took millions of years to create, and has experienced 1200 years of human interaction with virtually no impact, has now almost been completely destroyed. It only took 30 years for man-made technologies to undo the river system that has severely compromised the system's health, and 80 years to begin a spiral into total system collapse.

31 Committee on the Mississippi River and the Clean Water Act, National Research Council, "Mississippi River Water Quality and the Clean Water Act: Progress, Challenges, and Opportunities."

THREATS TO THE RIVER

THREATS TO THE RIVER

The main threat to the Mississippi River system is the disconnect between the environmental system and the political overlays along the system. More specifically, creating control mechanisms through engineering to protect and support the economies upstream creates a conflict between the artificial political boundaries and environmental systems and the way they interact. The conflict is literally a product of the way we engineer around those two frameworks.

The lock and dam system deepened the River and created a nine-foot navigation channel in the Upper Mississippi River. This allowed barges to access the inland waterway system of the Midwest, making America's "bread-basket" accessible to the world. In fact, 472 million tons of cargo, worth $54 billion, is transported via the Mississippi river every year.[32]

Engineering the River has created a navigational channel that has brought economic growth. In turn, this economy that the river helped create is now putting an increasing amount of pressure back onto the River, and thus creating a perpetual need for more control. This has lead to a collapse of many habitats along this system.

The control system created by the US Army Corps of Engineers has contributed to weakening the system. The infrastructure used to control the River also alters the River's natural hydrologic and geomorphologic processes. The threats to the system aren't foreign, they are natural processes that are being amplified due to the intervention.

32 "Water transportation of freight, not elsewhere classified (SIC...: Information from Answers.com."

Factors of Ecological Degradation

There are primarily five factors that have caused ecological degradation throughout the River System:[33,34]

1. Flood Control- Embankments, Floodwater storage techniques, Water diversion methods, Monitoring and regulation of carrying capacity.

2. Navigation- Canals, Dredging, Locks and Dams, Revetment, Channelization alters the natural hydrology of the river.

3. Accelerated Subsidence- Wetlands that act as a natural barrier for the coast, are no longer receiving nutrients and sediment due to dam and levee obstruction.

4. Urban encroachment- Wetlands within the riparian area of the river, act as a sponge absorbing toxins before they enter the water system. They are being drained for agriculture and real estate development.

5. Water Pollution- Urban storm water runoff, agriculture pesticides, transportation, industrial and petrol-chemical manufacturing damage the sensitive aquatic system by raising the temperature and/or adding toxic chemicals to the water.

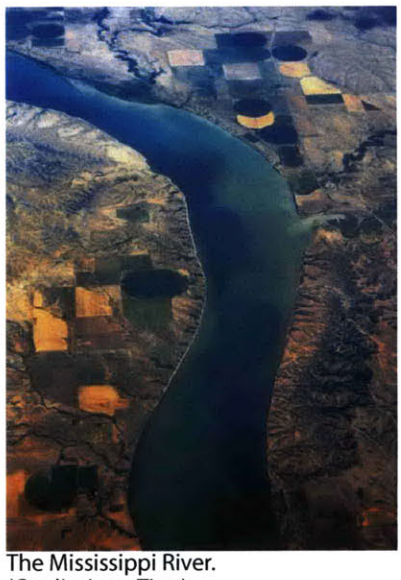
Regional Sedimentation Problems

All of the above-mentioned factors are harming the River, but the threat that has altered the Mississippi River's processes the most, causing the most damage, is the creation of the navigational channel through damming and channelization. Current commercialization along the Upper Mississippi River continues to further channelization of the River corridor for navigational purposes. The pooling effect caused by damming the River has been beneficial in that it created reservoirs for cities and industries in areas of the River, which would otherwise be very shallow. However, this interference has decreased the amount of sediment that is carried to the Mississippi Delta by the River. In turn, the backwaters and non-channelized areas are experiencing increased

33 "Gulf Coast's Mississippi Delta."
34 Walker, "Wetland Loss in Louisiana."

THREATS TO THE RIVER

sedimentation buildup at a rate of 1.5 to 2 inches per year.[35]



The Mississippi River.
(Credit: Jerry Ting)

Along the Lower Mississippi River a more critical situation is occurring. First, The levee system south of St. Louis has turned the River into a "pipe".[36] The levee system protects the surrounding communities from flooding, but it also interrupts the natural sedimentation processes. The bifurcation of the sedimentation process deprives the Mississippi River system's marshlands much-needed nutrients and sediment. River training structure and bank revetments cutoffs are also causes of sedimentation decline. Prior to the engineering efforts on the Mississippi River, meandering and riverbank erosion was a major source of suspended sediment. Riparian sediment-storage sites along the River have also been altered by river engineering, which plays a major role in their transfer deficiency.[37] Second, the inter-coastal wetlands are disappearing due to several factors including disappearing coastline, dredging which causes salt water to invade the freshwater marshes, killing trees and grass, while steadily increasing erosion. The loss of these wetlands is detrimental to the entire coast, because it will ultimately lead to lost habitat and wildlife, lost economies, and will leave coastal cities vulnerable and exposed to coastal storms. The sediment that is carried by the River no longer gets deposited along the riverbanks or wetlands. Instead the sediment is directly deposited at the mouth of the Gulf of Mexico, blocking the navigation channel. In order to unblock the navigational channels, taxpayers' dollars are spent each year to dredge sediment. Several million tons of nutrient rich sediment is pushed into the Gulf of Mexico, where it harms the sensitive aquatic ecosystems.

Gulf Coast Plume. (Credit: NASA)
At the mouth of the Mississippi River, a hotspot of land-based impact on marine ecosystems is re-occurring annually. The river's sediment plume can be seen in the satellite image above.

Another threat created by engineering the River, is the creation of a plume at the mouth of the Mississippi River. A plume is an area of concentrated nutrients that creates a "dead zone". The dead zone is caused by an overgrowth of algae that feeds on the nutrients

35BHOWMIK, "Sedimentation of four reaches of the Mississippi and Illinois Rivers."
36 DEAN, "Dams Are Thwarting Louisiana Marsh Restoration, Study Says."
37 Meade and Moody, "Causes for the decline of suspended-sediment discharge in the Mississippi River system, 1940 – 2007††," pp.44.

and takes up most of the oxygen in the water. [38] Over the past 30, years a plume has been forming in Gulf of Mexico at the delta of the Mississippi River. This plume forms in the spring and last until the fall. The plume extends over 20,720 square kilometers creating a "dead zone" due to the hypoxia created by nutrient discharge. Research has proven that this is due to the system's threats mentioned above that are compounded throughout the River System.[39]

38 "Human Impact on Coastal Areas and Marine Ecosystems."
39 "ScienceDirect - Geomorphology : Flood management along the Lower Mississippi and Rhine Rivers (The Netherlands) and the continuum of geomorphic adjustment."

THREATS TO THE SYSTEM

Threats at Every Scale

Local

The Upper Mississippi River System as well as the Lower Mississippi River System are experiencing different types of threats. The degradation to the entire Mississippi River is happening at several scales, as well.

Disruption to the river process starts at the local scale, with each individual dam. This is a very simple process that is creating serious impacts throughout the system. Through the natural erosion and the sedimentation processes, runoff from the surrounding landscape is deposited into the River. Some of the finer grain sediment, like silt, is very light and buoyant and is carried by the River until it is deposited into low-lying flood plains and/or to the mouth of the River (the Mississippi River Delta). However the coarser grain sediment, like sand, is too big and heavy to flow passed the dams and therefore is captured behind the structures.[40] The trapped sediment has raised the riverbed on average 33', which is backfilling and blocking the navigational channels, as well as, creating lost capacity in the reservoirs. It is also important to note that the coarser sediment carries less pollution, meaning the finer sediment that is carried to the Lower Mississippi River System has a higher concentration of pollution.[41]

Regional

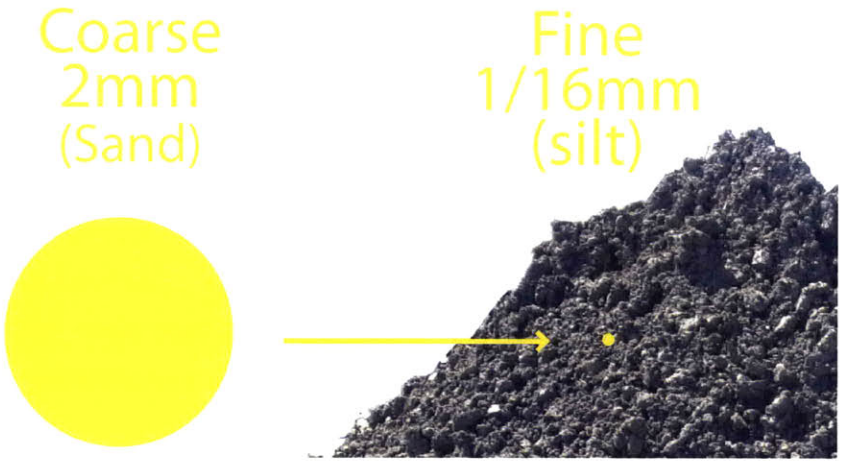
The local scale disruptions combine to have a larger impact on the Mississippi River system. Looking at the dams collectively as a system shows that the dams are causing a regional compounding effect on the River's hydrology and geomorphologic processes. A majority of the sediment loads originate from the west, primarily the Missouri River, collected by the highly erodible soils in the Great Plains. In contrast, the majority of water runoff is discharged for the east, primarily the Ohio River.[42] Prior to 1900, the Mississippi-Missouri River system carried over 400 million metric tons of sediment per year from the

40 "Sediment and Sedimentation - Sediment Size."
41 Julien, "Review of Sedimentation Issues on the Mississippi River," 47.
42 Meade and Moody, "Causes for the decline of suspended-sediment discharge in the Mississippi River system, 1940 – 2007††," 39.

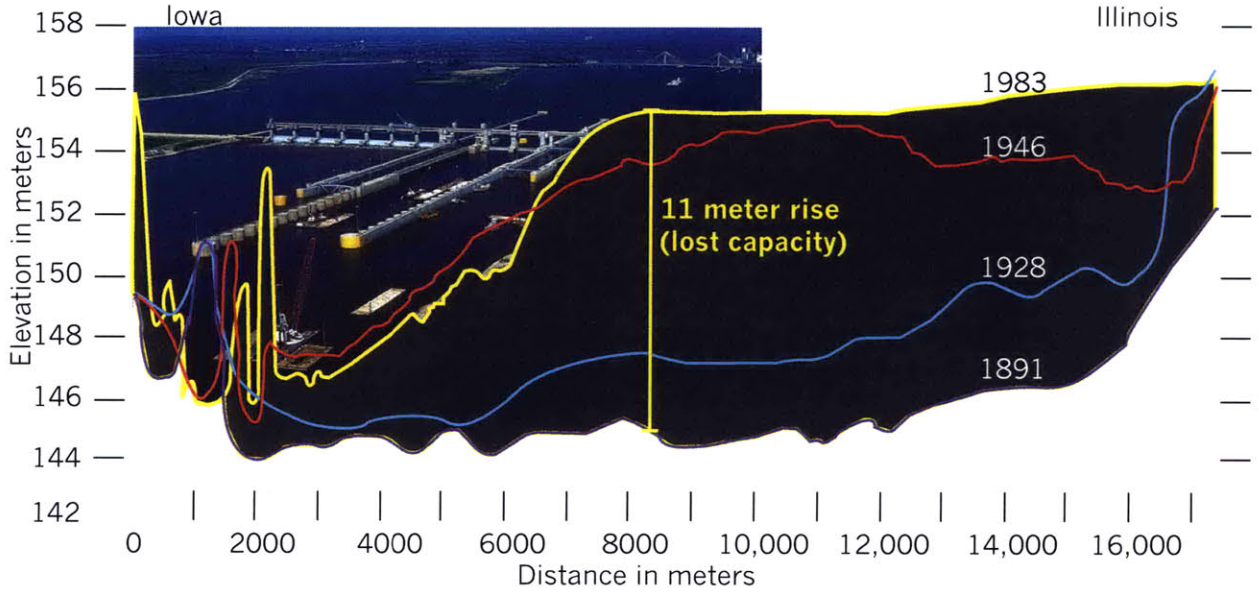
Navigational Dams

Source: USACE
Construction of Lock and Dam no. 22 on the Mississippi River

Sediment Separation



Sediment Backfilling at the Lock and Dams



Sediment Separation
This graphic to the top has magnified the size of coarse and fine sediment. It shows that there is significant variation between the sand that gets trapped behind dams and the silt that is carried past.

Sediment Backfilling the Lock and Dams
This graphic to the right and bottom is a cross-sectional profile illustrating the rise of the riverbed due to backfilling after construction of the dams in the Upper Mississippi River.

headwaters in the interior of the United States to the Gulf of Mexico. However, sedimentation transport has decreased substantially since the construction of dams along the Upper Mississippi River. The average transport in the past two decades (1986-2006) has decreased to 145 million metric tons per year.[43,44]

The backfilling of each individual dam has collectively decreased the sedimentation of the entire River approximately 60 percent over the last 100 years. Water and sediment discharge data that has been collected for over 60 years shows that the navigation dams have trapped 100-150 million metric tons. In 1980, the sediment discharge measured average 255 million metric tons per year, and in 2006 the discharge declined to 170 million.[45] The increased deposition in the Upper Mississippi River has lead to a compounding effect of subsidence in the Lower Mississippi River.

Continental

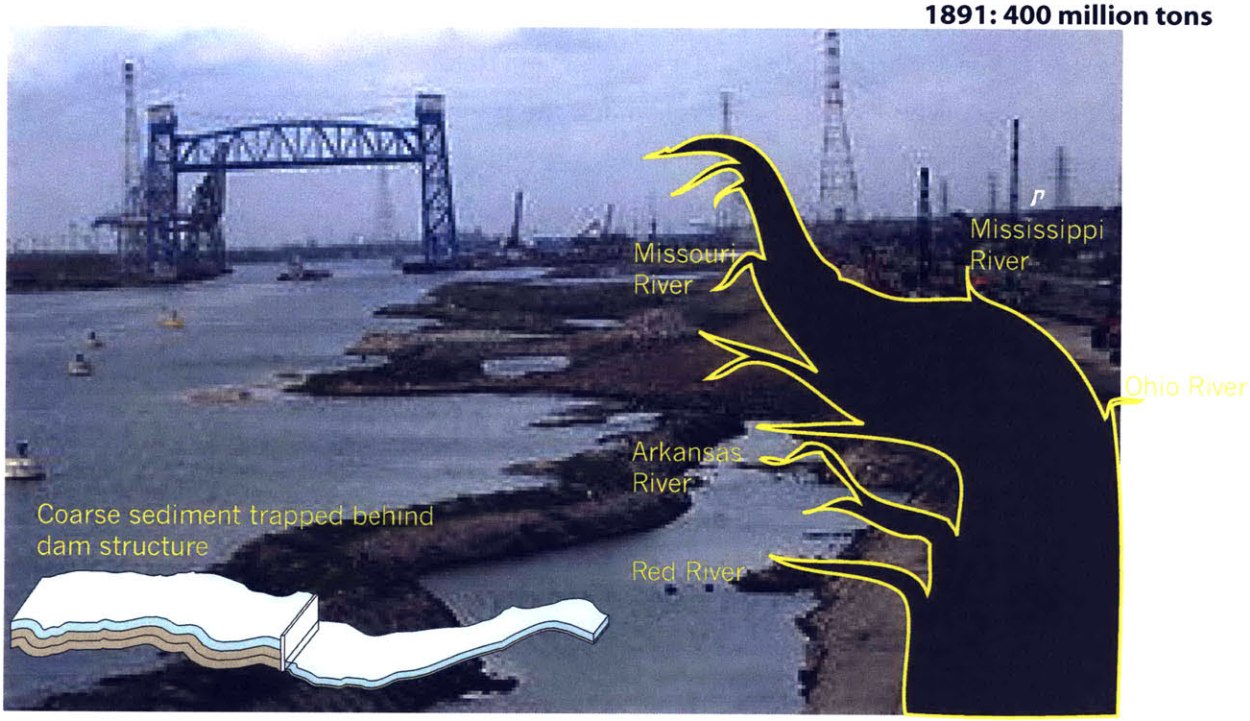
The compounding regional effects of sedimentation, along with other factors, are now leading to a continental system collapse. The Upper Mississippi River is experiencing backfilling, lost capacity, topsoil loss, habitat loss, and high concentrations of agricultural nutrients and pollutants. These effects compound throughout the system. As a result, the Lower Mississippi River is experiencing habitat loss, sinking marshes, hypoxia in the Gulf of Mexico, economic loss, coastal exposure and vulnerable cities. To put this in perspective, Louisiana has 40 percent of America's wetlands, yet is experiencing 90% of the wetland loss. This loss is equivalent to 35 square miles each year or a football field every 30 minutes.[46]

Sediment, which is the lifeblood for many of the habitats along the Mississippi River, has been declining at a rate of 3 percent per year

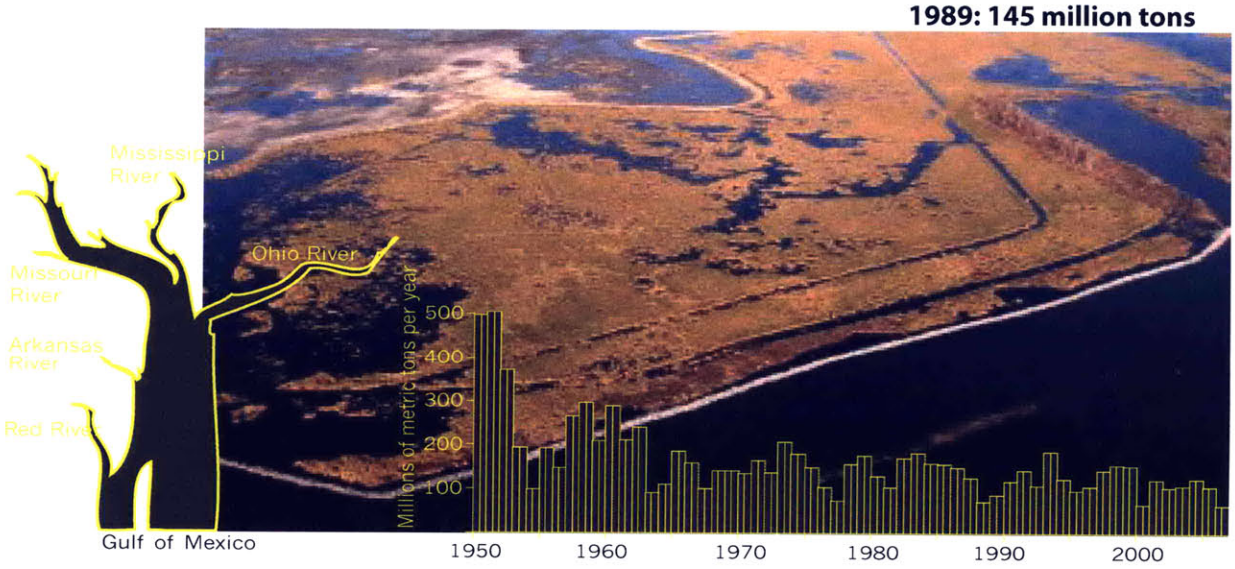
43 Meade and Moody, "Causes for the decline of suspended-sediment discharge in the Mississippi River system, 1940 – 2007††."
44 Data for graphics (right): Review of River Mechanics by Pierre Y. Julien Hsieh Wen Shen, J. Hydr. Engrg. 130, 377 (2004),
45 Ibid., pp. 40.
46 "Louisiana Begins Wetland Repair with Mississippi River Sediment."

Sediment Flow Measurement : 1981 to 1989

1891: 400 million tons



1989: 145 million tons



0 600

Suspended-sediment discharge, in millions of metric tons per year

Sediment Flow Measurement: 1891-1989

Sediment concentrations in the Mississippi River have decreased at least 70-80% from pre-development conditions. The sediment deposition behind dams on Upper Mississippi River is blocking navigational channels causing lost capacity for reservoirs, as well as, causing wetland loss for the Gulf Coast.

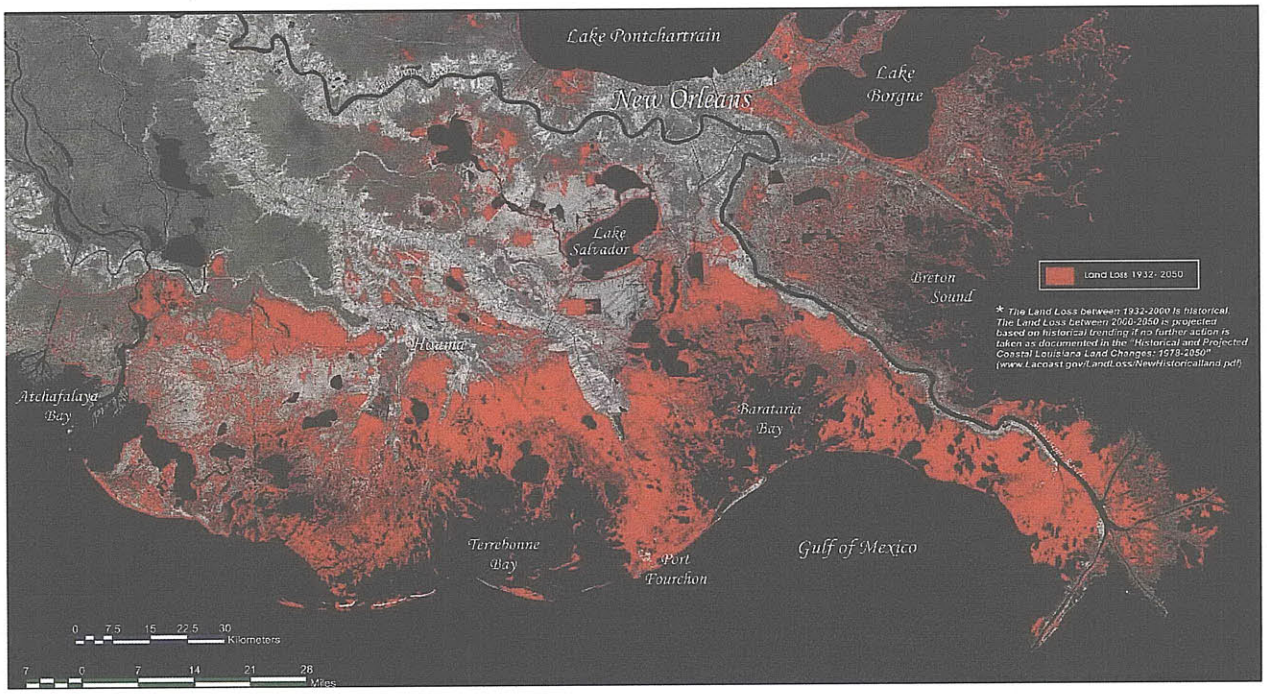
over the past 40 years.[47] Some scientists have suggested breaking the dams to restore the River's processes and allow sediment to continue pass the dam structures. Dr. Harry H. Roberts (a researcher with Nature Geoscience) claims that even if dams were broken and the trapped sediment was somehow released, that sediment is polluted and could potentially harm the deteriorating wetlands much more than leaving the dams intact.[48]

Another issue to touch on is how to give the issue of regionalism more traction. Incentivizing it economically is where the true American values come in. A redistribution of the way activities are played out along the River is necessary, because cities are the market drivers for the use of the adjacent floodplains. So how can the Mississippi River processes be restored without destroying the structures that is causing the River System to collapse?

47 Meade and Moody, "Causes for the decline of suspended-sediment discharge in the Mississippi River system, 1940 – 2007††," pp. 46.
48 DEAN, "Dams Are Thwarting Louisiana Marsh Restoration, Study Says."

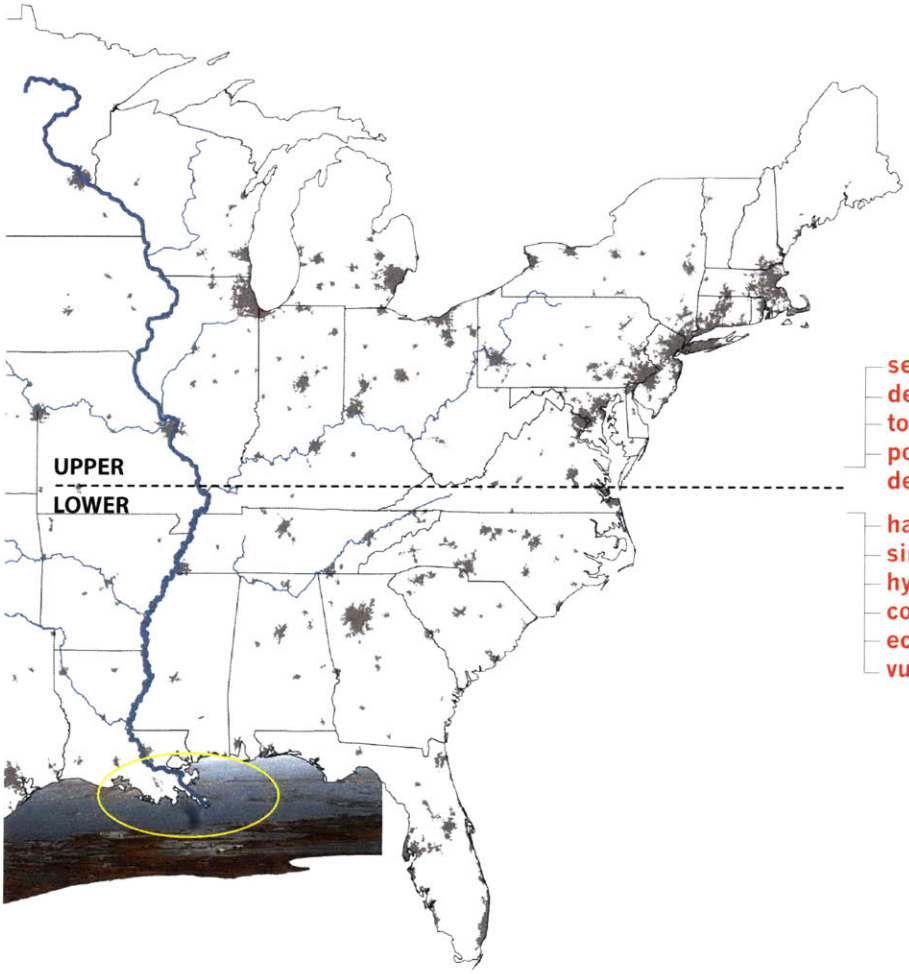
Continental Collapse
The graphic to the right shows the effect compounding threats throughout the Mississippi River Basin are having on the system. Collectively, the threats are causing unprecedented catastrophes on both cities and ecological systems

Louisiana Coast Wetland Loss
Source: USGS
The graphic below shows that amount of land Louisiana is predicted to lose (according to the historic rate of loss) between 1932 and 2050. This amount of erosion is unprecedented, due to the sedimentation loss after the navigational dam structures were built.



THREATS TO THE SYSTEM

Continental Collapse



- sediment backfilling
- decreased water capacity
- top soil & nutrient loss
- pollution from agriculture and development

- habitat loss
- sinking marshes
- hypoxia in the Gulf of Mexico
- coastal exposure
- economic loss
- vulnerable cities

Industrial waste on Upper Mississippi River
Source: US Fish and Wildlife Service

New Orleans after hurricane Katrina
Source: Colligan Wordpress

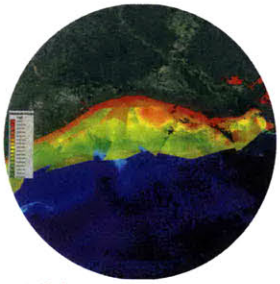
Dredging to clear navigation passages Source: USACE

Turbidity after dredging
Source: USACE

Sheet Erosion in the Upper Mississippi River Basin Source: USDA

Louisiana Wetland Loss
Source: USGS

Louisiana Coast, Gulf of Mexico 'Dead Zone'
Source: Louisiana University Marine Cosortium



Gulf of Mexico hypoxic 'Dead Zone'
Source: NOAA

DIRT ECONOMIES

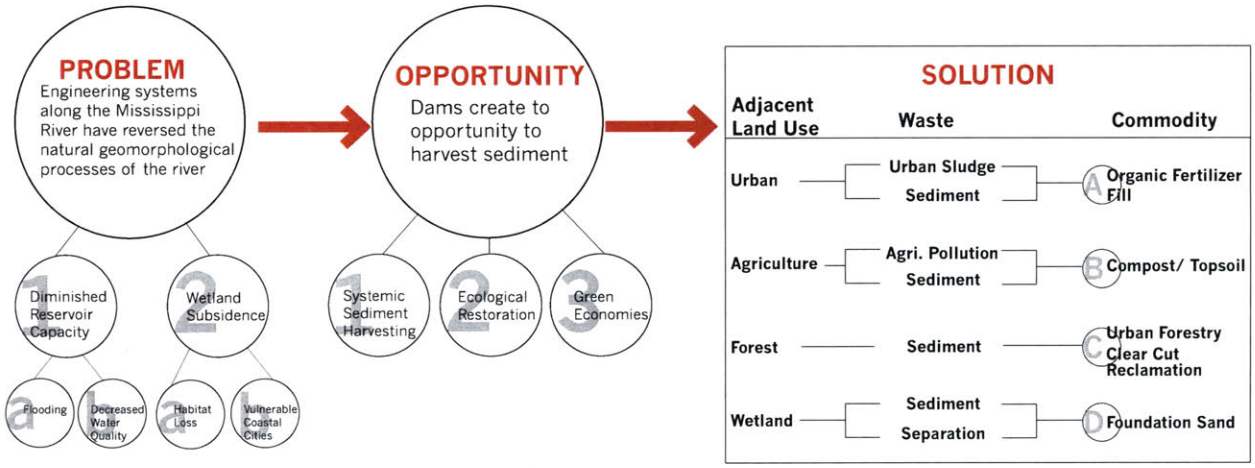
DIRT ECONOMIES

Instead of completely overhauling the system that currently causes destructive flooding, erosion, and decreased water quality, several opportunities can be explored. The opportunity this paper focuses on is sediment. Primarily, the problem is that sediment gets trapped behind dams and cannot be carried through the entire system. This thesis attempts to restore the sediment's ultimate fate, again allowing it be deposited at the mouth of the Mississippi River in the inter-coastal marshlands.

Removing the dams is not a reality for several reasons. First, it would destroy the navigation channels which is the lifeline to a large percentage of the mid-west's economy. Second, the investment for the infrastructure has already been made, and would create conflict with the powers that created the dam system. Finally, deconstructing the dam system would be even more harmful to the River than leaving it intact because the destruction of the dams would release polluted sediment trapped behind the dam downstream.

Rather than proposing to remove the dams, the intervention most appropriate for this system is to create a network that capitalizes on the way the system currently functions with the existing infrastructure. With this in mind, this proposal establishes a network that addresses issues with design and planning at the local, regional, and even at the scale of geography, with a medium that is as small as a grain of sediment. In other words, shifting the scale of urban design to the scale of territories.

Sediment Transfer Strategy & Network



Sediment Transfer Strategy and Network
The graphic above shows the liabilities that engineering the Mississippi River has created and opportunities and solutions that are the result of the problem.

Problem

In the upper stretches of the River there is too much sediment, and in the lower stretches there is too little. The problem is two pronged: First, agricultural runoff from the Upper Mississippi River creates sediment. The dams that have been built throughout the Upper Mississippi River system have disrupted the natural processes of the River, which leads to:

1. Blocked navigational channels and diminished capacity of the reservoirs in the Upper Mississippi River Basin.

2. The opposite is true of the Lower Mississippi River. The loss of sediment in the Lower Mississippi River Basin leads to subsidence, which is a natural process of erosion and compaction of soil. However, without the continual deposition of sediment to rebuild the land that naturally would maintain a balanced elevation, the wetlands are disappearing under the sea.

DIRT ECONOMIES

Opportunity

In the case of the Mississippi River, the problem is also the solution. The dams capture sediment and contain it behind the structure. This presents an opportunity to harvest the sediment and use it as a medium to create a commodity out of it. Changing the perception of dirt as waste to a new commodity allows the opportunity to restore ecological processes and habitats that our previous interventions have destroyed, but still facilitate economic gain. Ultimately, the right solution should not be a choice between economy and ecology, the effective solution should create an opportunity for them to reinforce each other.

Changing the perception also presents the opportunity to create a new economy from dirt that adds an economic benefit to the system. The new economies include, but are not limited to, systemic sediment harvesting for ecological restoration and the creation of a variety of green economies. These economic resources include soil fill for construction and brownfield remediation, nontoxic agriculture fertilizer and topsoil, and a medium for ecological system enhancement.

Solution

The solution to addressing concerns with trapped sediment is the sediment itself. Creating a commodity out of the sediment allows the opportunity to harvest and redistribute it throughout the Mississippi River System in many different forms. According to studies done by US Geologic Survey (USGS), there are seven land uses along the Mississippi River, but there are four major adjacent land uses that produce a particular type of sediment. These commodities are conducive for implementing the new commodities that use the sediment as a medium. The flexibility to use dirt in different ways at different scales is a testament to its value. Therefore, there are four different ways to use this commodity in order to have a positive impact at different scales.

The four sediment types include:

1. Urban- In urban areas the sediment can be used for brownfield reclamation and land fill for strip mines or low-lying areas. Mixing the sediment with urban sludge creates two types of commodities.

Organic Fertilizer- the high nitrogen content is very good for agriculture

Land Fill/ Brownfield Reclamation- the high nitrogen content also allows soil remediating plants to establish and grow faster, therefore remediate the soil faster.

2. Agriculture- Sediment runoff adjacent to agricultural land has a high nutrient content. This sediment can get recycled and turned into compost and topsoil

3. Forests- Cities can use the sediment to create urban forests that act as a buffer between communities and harmful, adjacent uses. The sediment can also restore topsoil from clear-cut forest.

Urban Forestry - sediment can also be used to facilitate the growth of urban forestry

Clear-cutting Remediation- sediment can also be used to remediate soil in forest that have suffered from significant erosion due to clear-cutting.

4. Wetlands- Wetland loss is occurring throughout the Mississippi River System in both the Upper and Lower basins. The sediment captured behind the dams in the Upper Mississippi River is extremely critical in reconstructing wetlands, particularly the coastal wetlands along the Gulf Coast. The coarse granular sand of the Upper Mississippi sediment is critical because it builds the foundation for the wetlands and resists compaction and sinking. The coarser sediment is able to do this because it is less dense than the clay silt.[49] Wetlands use the sediment as a foundation to stop subsidence and build them up to a healthy elevation.

49 Walker, "Wetland Loss in Louisiana."

SEDIMENT NETWORK

SEDIMENT NETWORK

The sediment network is an ideological way to look at a problem such as deconstructing the Mississippi River. Most problems at this scale try to change the entire system, instead of trying to build something positive out of a systemic problem.

The key as an urban designer and planner is to come in and incrementally identify opportunities within that system, which would then spin out large-scale positive effects on the system. The sediment network approach is incremental, in that it wedges itself between the site design scale and the systemic scale.

There is optimism in a network that approaches problem solving at a myriad of scales. The proposed sediment network literally takes an object as miniscule as a grain of sand and turns it into a local, regional, and even a national economy. It proposes that the sediment that is left behind dams to become a product of waste, invisible under the surface of the water, and turns it into a productive thing that can lend itself to a national authority.

Sediment Harvesting Process

The sediment harvesting process is essentially a process of moving dirt. Each step of the sediment transfer process creates new jobs, which will facilitate economic gain. Creating a sediment network along the River also helps to re-imagine industrial use to have a positive effect on the River, while still growing the economy.

Step 1: Dams

In areas where the riverbed has trapped and accumulated sediment, a hopper boat sucks dredged material and pumps it through an intake pipe (drag arm) to hoppers where it is stored. The slurry water is drained and discharged during the dredge operation.

Sediment Transfer Process
The graphic to the right shows literally how to move dirt- Each step of the sediment transfer process creates new jobs which will facilitate economic gain. Creating a sediment network along the river also helps to re-imagine the industrial use to have a positive effect on the river while still growing the economy.

Step 2: Dredging

Once the hoppers are full, the vessel moves to a sediment discharge station, where the sediment is pumped out of the hoppers.

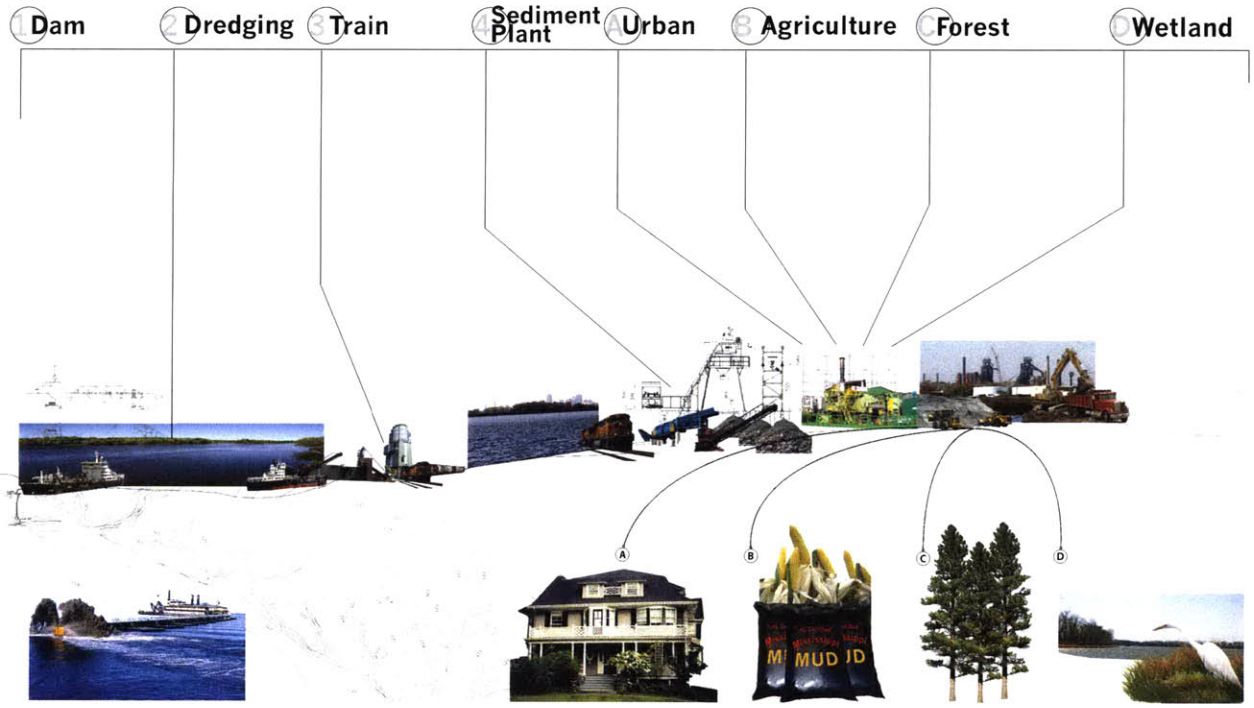
Step 3: Transport

After the sediment is unloaded, a conveyer belt moves it to an on-site storage silo. Sediment remains in the silo until the train arrives, where the sediment is then dispensed. The train transports the sediment to different areas to be distributed accordingly.

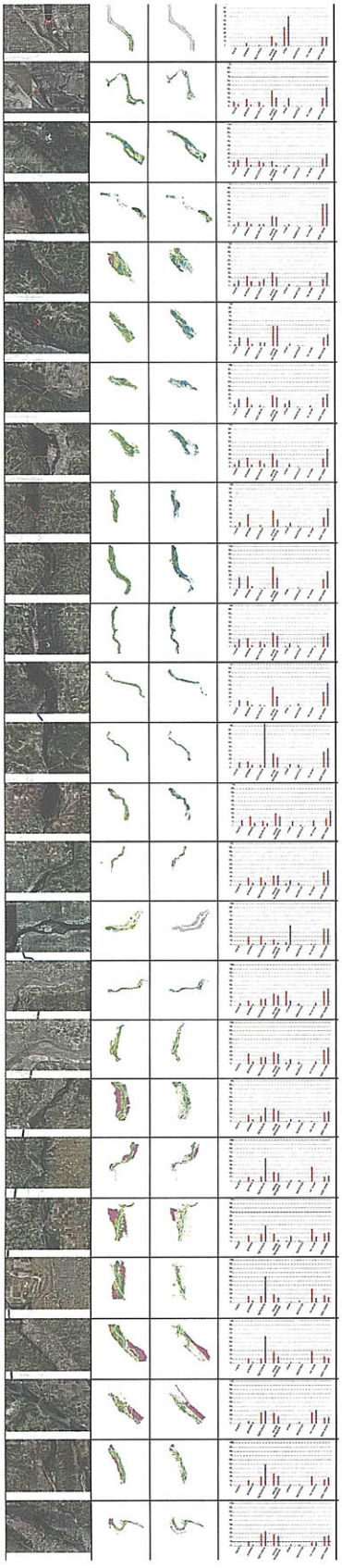
Step 4: Sediment Plant and Distribution

The sediment is transported from the dredging station using existing rail lines to a sediment plant. From there, the sediment is divided and categorized into one of the sediment commodities. The sediment is then sent to a distribution station where it will be directed to its final designated area.

Sediment Transfer Process



SEDIMENT NETWORK



Sediment Index

The Sediment Network turns the system on itself and asks the question, how can the perception of the whole watershed be changed? In order for this system to work, cities have to invest in the sediment without building something immediate and tangible out of it. [50] The Sediment Index organizes the Mississippi River's information to help the adjacent communities and the agency overseeing the sediment, how and where the best use of the sediment will be.

The Sediment Index is an incremental approach that compiles information from 26 navigation lock and dams in the first two reaches of the Mississippi River, and the adjacent land in between to establish sediment commodity type and need. Adjacent land uses indicate the type of nutrients that might have been collected and mixed with the runoff. The change in the adjacent land use indicates the need for certain types of sediments and therefore specifies where sediment will be redistributed. The Sediment Index assembles the following information:

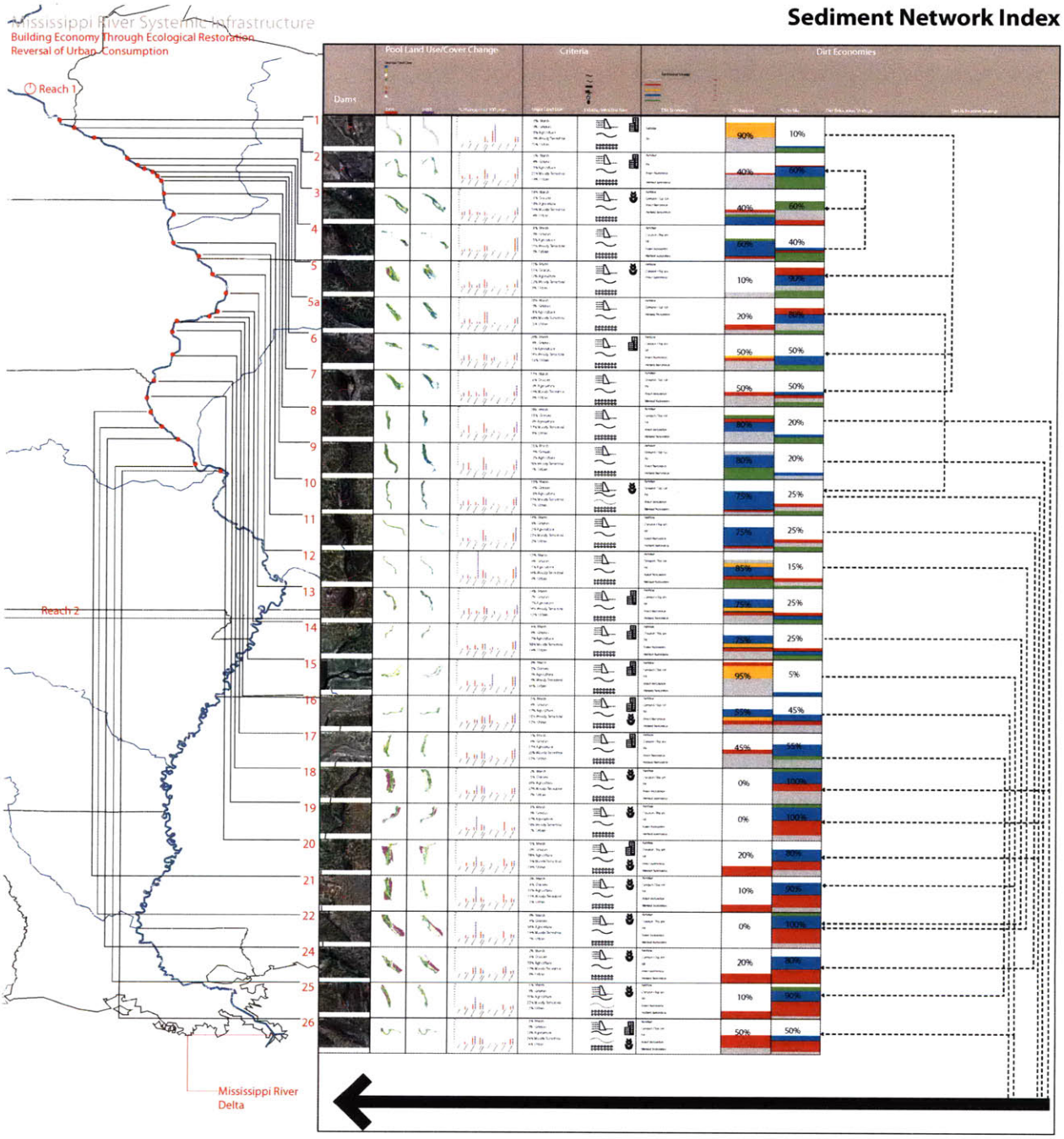
1. Navigational Lock and Dam System
2. Adjacent Land Use / Land Coverage
3. Percent Land Use Change Over 100 Years
4. Existing Infrastructure
5. Dirt Reallocation Strategy
6. Economic Impact of Sediment Network

Economic Impact

The Sediment Relocation Strategy is based on the decision to ship or retain sediment depending on how the current adjacent land use can facilitate it. For example, an urban area such as Minneapolis may gain more value monetarily by creating an industry that uses their sewage and sediment waste to produce organic fertilizer. In Minneapolis, the dam traps approximately 420 train carloads of sediment per year. This amount of sediment manufactured to become organic fertilizer would have a value of $30 million per year.

50 Berger, 2010, April 28. "Deconstructing the Mississippi River: Thesis Defense."

Sediment Network Index



Sediment Network Index
The graphic above shows what kinds of land uses and land use changes occur along the river at each dam. It also illustrates the strategy to redistribute sediment throughout the River System according to the needs of each adjacent land use.

SEDIMENT NETWORK

However, a less urbanized location along the Mississippi River, such as Debuque, Iowa adjacent to dam 11, will value sediment differently. Debuque, Iowa is located near one of The Nature Conservancy's priority conservation area, and therefore the sediment's environmental benefit is much more important. In this location the sediment will be used to rebuild wetlands as habitat for endangered species indigenous to this area of the river.

The sediment network is not confined to the Upper Mississippi River Basin. Areas in the Lower Mississippi River Basin that are not adjacent to the dams have ownership over the sediment, as well. Louisiana just launched a $28 million program this year to rebuild their wetlands; the state would use this sediment for this project.[51]

Moving forward, the proposed sediment index will evolve in order to relay the value of sediment and movement better. Adding weight to the sediment flows will create a new taxonomy of sites along the River based on their accumulation of sediment, a free resource that has been identified through this research. This is one way to inform a new agency of priority areas in which they should focus their resources. This will create a new series of surface evaluations across the Mississippi River Basin. The urban effect determines where this could be developed, assessing the value of sediment in accordance with all the surface typologies throughout the basin. In every urban area, there are surfaces, such as brownfields and strip mines, with no ecological productivity. Applying a percentage of the remediating soil from the sediment network to these places, will raise the ecological productivity, thus amplifying the value of urban surfaces. The family of surfaces will then create a new package of economies, creating a new market that can be speculated upon and then traded.[52]

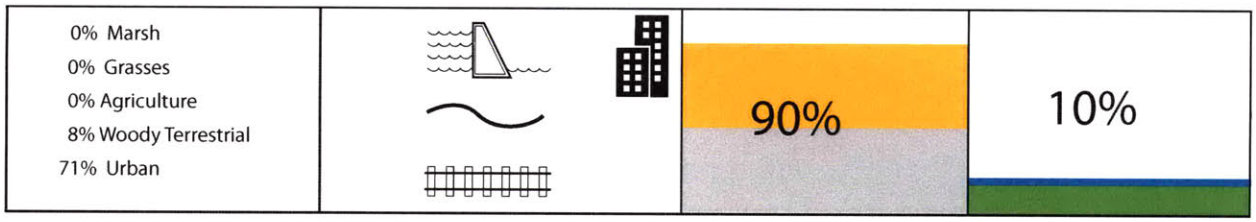
51 "Louisiana Begins Wetland Repair with Mississippi River Sediment."
52 Brown, 2010, April 28. "Deconstructing The Mississippi River- Thesis Defense."

SEDIMENT NETWORK

Sediment Utilization

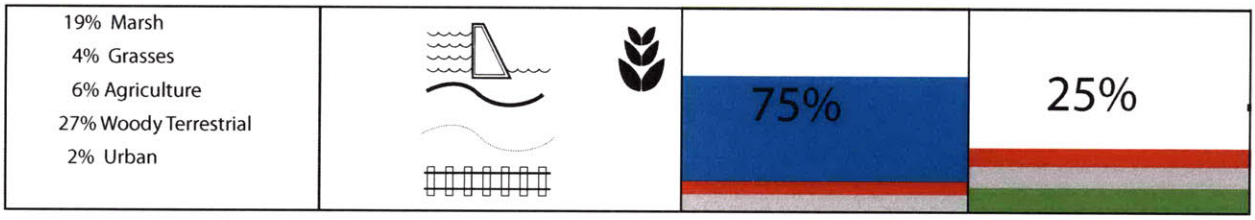
Dam 1
Minneapolis/ St. Paul, MN

Example of the Sediment Network being utilized in an urban area



Dam 11
Debuque, Iowa

Example of the Sediment Network being utilized in an environmentally vulnerable area.



Sediment Utilization
The graphic above is an enlargement of the Sediment Index. It illustrates how different areas throughout the Mississippi River will utilize the Sediment Network depending on the land use.

LOCAL STRATEGY

LOCAL STRATEGY

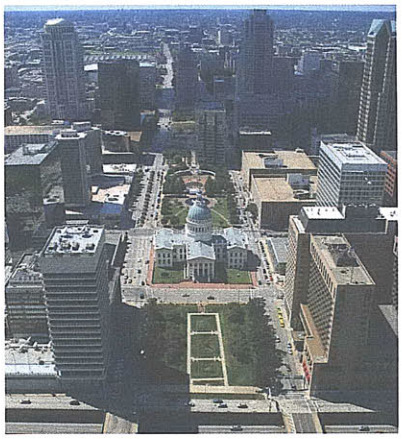
Regional planning has not been successful because cities are dealing with a spatial phenomenon right now, and the shifting scales confuses a lot of urban designers and planners. Currently, urban design and planning is realizing that in order to deal with systemic problems, there must be a leap to a regional scale. This leap is beyond the traditional scale of practice and therefore it becomes hard for the practitioner to visualize solutions to systemic problems. The regional scale is too big and a grain of sand is too small.

The creation of a Sediment Network along the Mississippi River allows urban designers and planners to address many different problems at many different scales through the use of one medium- sediment. The Sediment Index demonstrates how to redistribute sediment at a system-wide scale, but in order to make the proposal viable, the proposal must show how sediment is appropriated at the local level.

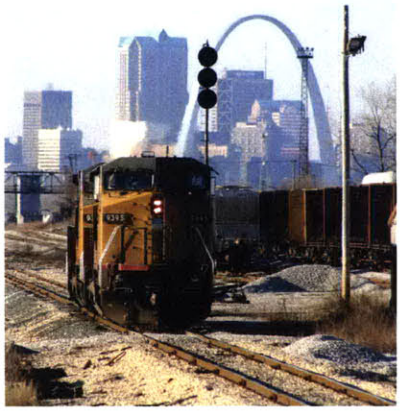
One of the aspirations of this thesis is to resist doing a site design, and yet still showing the Sediment Network can be implemented locally. This project does site design differently in that it is not bound by singular client site issues. Instead, the project shows how to engage the understanding of dealing with zoning land in parts. It is neither a planning project, nor a policy project. These implications exist, but mostly the design proposed here operates within the existing zoning.

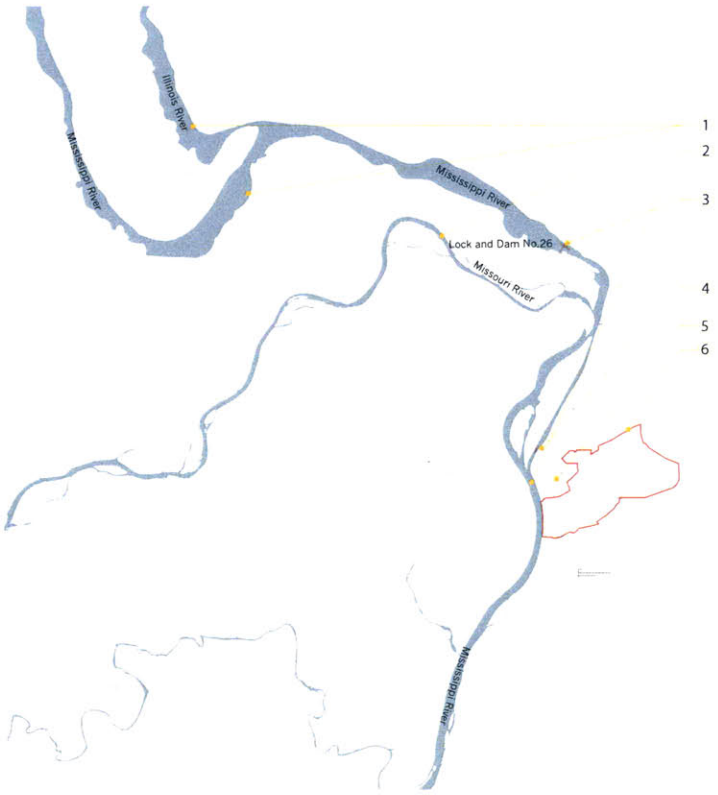
The local scale briefly illustrates the implementation of the sediment network in East St. Louis, Illinois. It shows how the network could be implemented at a municipal scale and create substantial change for that community. The purpose of translating the sediment into a new medium shows how a place, such as East St. Louis, Illinois could prop itself up both spatially and economically. Can a new sediment network become an economy that brings a neighborhood or a city out of a welfare state? The local implementation strategy helps to imagine how this could be possible.

St. Louis, MO



East St. Louis, IL





Site Selection Criteria

East St. Louis, Illinois is the site selected to demonstrate the Sediment Network implementation at a local scale. The site selection is based on the following criteria.

1. St. Louis and East St. Louis comprise the 2nd largest urbanized area on the Upper Mississippi River.
2. East St. Louis is located directly after navigational dam 26.
3. East St. Louis is located in an area of the Upper Mississippi River that has seen some of the most significant change over the past 100 years.
4. Infrastructure such as rail, industry, port exists, as well as all of the proposed land uses exist on site.
5. It has suffered from environmental degradation and is susceptible to increasing exposure to river processes.
6. There is historic polarization between the two cities. East St. Louis has historically been the poor, industrial dumping ground for St. Louis and suffers from an enormous amount of urban decay.

LOCAL STRATEGY

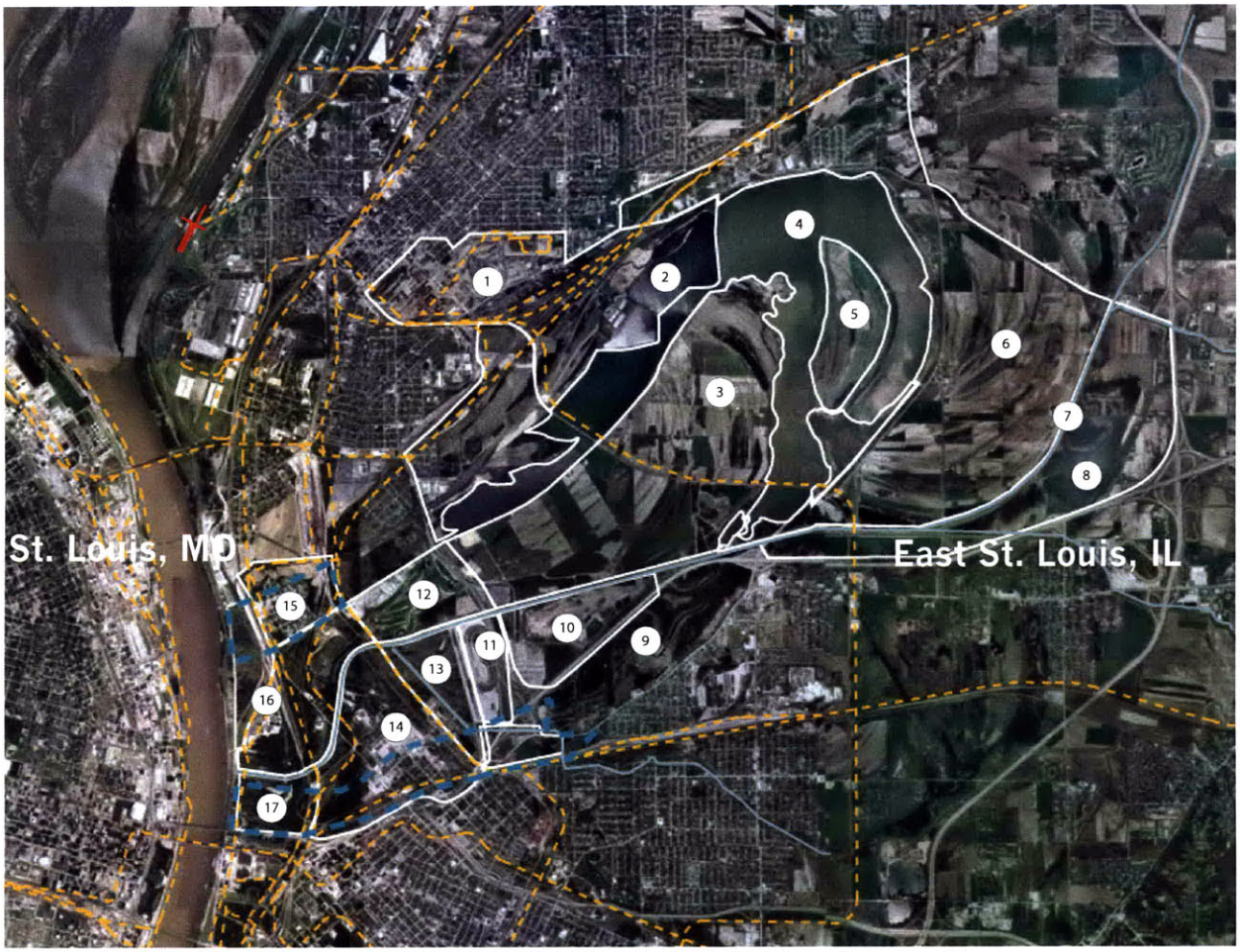
Site Analysis

Within the existing site there are several existing land uses. Many of the land uses create an interesting juxtaposition between industrialized, residential, rural, or agricultural land uses. These land uses include the following. [53]

1. U.S. Steel -mill and coking factory
2. U.S. Steel -cooling pond
3. Agriculture inside River cutoff
4. Lake Horseshoe- Oxbo Lake
5. Sediment Island
6. Agriculture
7. Runoff diversion channel
8. Existing Wetlands
9. Existing Wetlands
10. Abandoned Gravel Pit
11. Race Track
12. Golf Course
13. Empty Land
14. Abandoned Foundation Pad
15. Blighted Neighborhood
16. Water Treatment Plant
17. Existing Riparian edge

53 Site images for St. Louis, MO (pg. 74) and East St. Louis, IL (pg.75):
http://pool.twincitiesdailyphoto.com/2008/st_louis_downtown-01.jpg
www.ballparks.com/baseball/national/stlbpk.htm
http://aboutabride.wordpress.com/2008/09/
flickr.com/photos/78469770@N00/101527228/
http://www.flickr.com/photos/78469770@N00/84626049/
http://stl.prettywar.com/archives/2008_05.php
http://builtstlouis.net/eaststlouis/images/murphybuilding06.jpg
http://www.steeltrapmind.org/2005/08/four-aces-home-of-disco-riders-mc-east
html

Site Analysis



Legend

- Project Boundary
- Road
- Railroad
- Proposed River Connection
- Channel
- Dam

LOCAL STRATEGY

Urban Revitalization

1. Urban

Brown Field Reclamation: The existing U.S. Steel site is cleaned with sediment and sludge mixture to remediate the soil, allowing for future housing and retail development.

Strip Mine Reclamation: The strip mine and gravel pit are filled with the urban sediment mixture. The nutrient-rich mixture expedites the reclamation process.

2. Agriculture

Organic Fertilizer: The nutrients from agricultural sediment can be sequestered to create a rich, organic fertilizer. This fertilizer is a non-toxic alternative for the environment, while safe for the adjacent communities.

Top Soil Replacement: Due to improper farming and land cultivation, much of America's fertile topsoil has eroded away into the Mississippi River over the past 100 years. However, harvesting the nutrient-rich soil from the river can replenish agricultural topsoil.

Site implementation
The graphic to the right illustrates how different areas in East St. Louis, IL can be revitalized using sediment from the Sediment Network.

3. Forests

Urban Forestry: Planting forests within the urban realm creates a buffer between communities and less desirable land uses, mitigates storm water runoff, acts as a wildlife corridor, and establishes an interconnected open space network for the city. Planting these forests with a forest sediment mixture will promote growth in a hindering environment.

Forest Reclamation: Clear-cut forests are very susceptible to erosion and nutrient loss, making it difficult to regenerate. Replenishing the topsoil and adding nutrient-rich sediment can expedite the growing cycle, so that certain areas will be more productive, and virgin forests will be less susceptible to clear cutting.

4. Wetlands

Wetland Reconstruction: Wetlands are a vital habitat along the Mississippi River, offering respite for migratory birds and a home

Site Implementation

1 Urban

2 Agriculture

3 Forest

4 Wetland

for some of North America's most vulnerable wildlife. Wetlands also act as a riparian buffer, filtering water before it enters the river. The coarse sediment is a foundation for wetland plants and can be used to rebuild the 60% of wetlands that have largely been lost in North America.

What is Dirt Worth? Implementing Sediment Economies

The four sediment commodities create an opportunity for the sediment to be distributed to several different places, for various uses. Each commodity has its own spatial distribution, as well as, a specific value that is either economical or environmental. The value of each commodity is determined by the need of each user. The value assigned to each of the proposed commodities is based on the approximate net sediment accumulation behind each dam per year.

Each of the sediment commodities has a specific set of clientele. Cities and developers are the most appropriate clients for the urban sediment commodity. Farmers and gardeners are most likely to utilize the agricultural sediment commodity to add nutrients for healthier crops and gardens. Parks department, lumber companies, and the U.S. Fish and Wildlife Services can use the forests commodity to build buffers throughout the city and use it to build parks. The forest sediment can also be sold to parties interested in quickly rebuilding forested areas that have been clear-cut. The Nature Conservancy and the Gulf Coast states are the most likely candidates to utilize the wetland sediment commodity in order to rebuild the wetland habitats throughout the Mississippi River and Delta system.

The local scale sediment network strategy is a critical component in illustrating the significance waste sediment has as a medium for urban revitalization. It exemplifies the magnitude that physical, spatially-oriented design and planning can have on one place and system.

More importantly, the Sediment Network shows the impact urban design and planning can make when problem solving becomes a

Dirt Economies- What is Dirt Worth?

Landscape	Commodity	Users	unit price	acreage	Local Economy	National Economy
Urban	Brownfield Reclamation Medium	Cities Developers	$ 15/ cuft	6 acres/10'	$ 37.5 million	$ 975,000,000
	Land Fill	Cities Developers	$ 6/cuft	6 acres/10'	$ 15 million	$ 390,000,000
Agriculture	Organic Fertilizer	Farmers Gardeners	$0.05 / sqft	172 acres/ 4"	$ 370,000	$ 9,620,000
	Topsoil/ Compost	Farmers Gardeners	$ 18/ cuft	172 acres/ 4"	$ 45 million	$ 1,170,000,000
Forest	Urban Forestry Base	City Park Dept.		230 acres/ 3"		5980 acres
	Forest Reclamation Medium	Lumber Companies U.S. FWS		230 acres/ 3"		5980 acres
Wetlands	Wetland Reconstruction Foundation Material	Nature Conservancy Gulf Coast States		14 acres/ 4'		364 acres

Dirt Economies- What is Dirt Worth? The above graphic proposes commodities based on net sediment accumulation per year. These commodities are utilized by clients and will create new economies within the Sediment Network.

matter of instituting decision-making at a hierarchy of scales. When this happens, the decision-making process becomes less about being democratic and more about solving problems at the source, wherever the problems may lie. When the environment speaks louder than the local politics, the sediment can become an instrument to give power to the places that need it the most. [54]

54 Berger, 2010, April, 28. "Deconstructing the Mississippi River: Thesis Defense."

CONCLUSION

CONCLUSION

Over the past 80 years, the United States has spent billions of dollars building and maintaining the navigation lock and dam structures along the Mississippi River. This effort has allowed America's economy to grow considerably, but this growth has come at a price – an environmental cost. After 80 years of so-called "river improvements" we are now seeing signs that the River's entire ecological system is collapsing. Losing these irreplaceable resources are not just a loss to the natural environment; They also indicate the beginning of the urban system collapse as well.

Cities are built on and around ecological systems. These systems flow in and beyond the city limits and have an immense impact on the way cities are designed and function. When a city's ecological systems are degraded or even ignored, it is only a matter of time before the repercussions become apparent. In the case of New Orleans, this understanding came too late. However, the misunderstanding is not just in New Orleans, it is the compounding mistake from every city, every state, every commission, essentially every planning jurisdiction in the entire Mississippi River Basin.

In order to avoid catastrophes caused by the nescient failures of urban design and planning, the profession must begin to reimage what regional planning and environmental policy should be. This project pushes back at a much larger scale, illustrating that the issues surrounding many cities do not actually lie within the boundary of the city. Specifically, the challenges New Orleans is facing today and, will continue to in the future do not lie in New Orleans. New Orleans' future actually lies in the regional understanding of what is happing in the watershed of the Mississippi River Basin. The devastation that happened to New Orleans during Hurricane Katrina was not caused by a natural disaster; rather, it was a constructed disaster. Regardless of whether or not there was corruption in the federal government, US Army Corps of Engineers, or the state and local governments, is irrelevant. It is irrelevant because the devastation that culminated during Hurricane Katrina was the compounded affect of a much larger

problem.

Deconstructing the Mississippi River is less about tearing down the existing infrastructure, and more about tearing down the conventional management structure to create a new type of planning that is comprehensive in its approach, considering all scales of the landscape (from municipal to continental) and all uses (economic to environmental).

In order to create a more comprehensive approach to planning along the Mississippi River, this project proposes the creation of a new agency that will oversee all the planning agencies along the Mississippi River. The agency will consist of a varied board with representatives that are industrialist, environmentalist, urban designers and planners from all the jurisdictions along the Mississippi River System. They will be charged with harvesting and regulating the Sediment Network. They will create a planning system that promotes the health of environmental systems within our cities along the river, while also creating new industries from the Sediment Network. The power of the new agency will be distributed between all the jurisdictions along the River. The amount of power each jurisdiction receives will be determined annually, based on each jurisdiction's vulnerability within the system and their annual environmental performance.

The existing structure of authority, the Army Corps of Engineers, has been in place for over 100 years. They have proven that top-down authority is the most efficient way to make change, but they have also proven that without the right values or priorities, this management approach is detrimental. The shift in power will rely on the federal government bestowing power to an agency that values the holistic approach to problem solving. On the other hand, creating a new authority of conflicting interests throughout the Mississippi River Basin could create the same paralyzation in planning as the existing political juggernaut along the River.

CONCLUSION

There is more than one approach to create a new agency for the Mississippi River. One option is to create a new agency with less authority. This agency would be a watchdog over the Army Corps of Engineers. Another option is to keep the same agency, the US Army Corps of Engineers, and try to adjust their value system so that the priority shifts from control and maintenance of the navigational systems to overseeing the health of the entire system and its surrounding communities. Regardless of the form the agency eventually assumes, there is a call for "avant-gardism" associated with the regional project. The form of regional planning has not materialized yet, because there hasn't been a true shift in the ideology of regionalism. The new ideology in regional planning calls for the understanding of dis-urbanization. Dis-urbanization is not about taking cities apart and getting rid of buildings, but a restructuring of the regional urban pattern. Once this is achieved, only then will cities be restored and the field of Urban Design and Planning will gain the knowledge of how to solve problems at every scale.

APPENDIX

De-constructing the Mississippi

Restoring A Continental System

Ecological Systems are Defined By Two Key Characteristics:

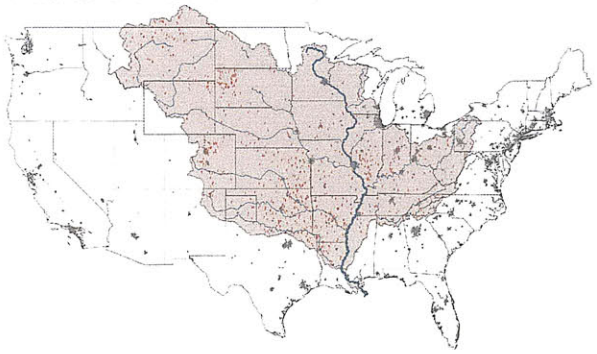
(1.) the unit of nature is often defined in terms of a geographical boundary, such as a watershed, and
(2.) abiotic components, plants, animals, and humans within this unit are considered to be interlinked.

The Mississippi River Ecosystem FACTS

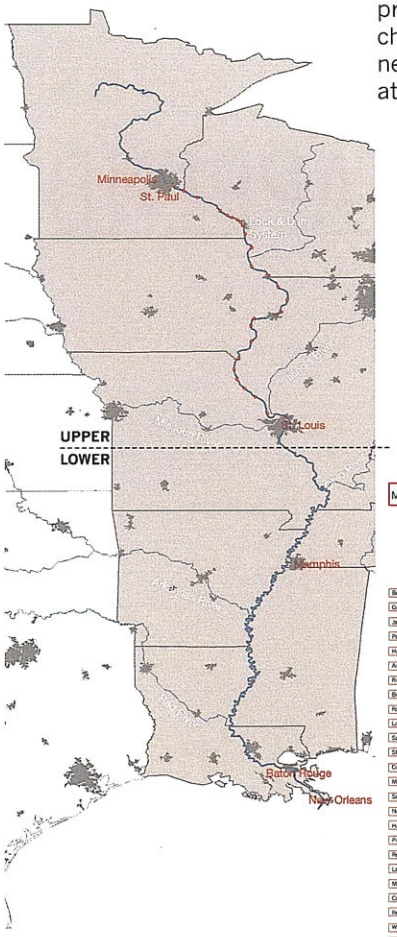
Length: 2,320 miles
Stretches the North American Continent spanning 2 countries
The Watershed : drains 41% of the US = 1.25 million sq mi
includes 31 states; 2 Canadian provinces

The River: Falls 725 feet
Touches 10 states
Is separated into 2 Regions, upper and lower defined by the convergence of the Ohio River

Mississippi Sub-Basin
Tributaries and Dam network

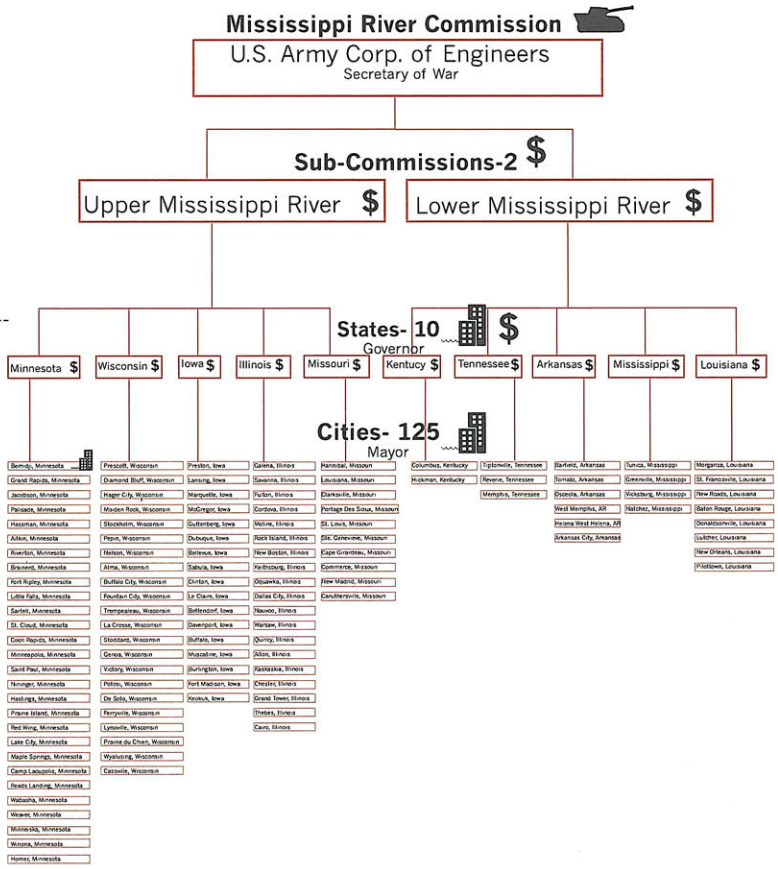


Mississippi River Valley
26 Navigational Dams



Mississippi Political Juggernaut

There is a disconnect in the design disciplines between the scale in which we affect ecological systems and the conventional scale professionals address urban problems. In order to address the challenges that have arisen out of the Mississippi River, designers need to operate beyond geopolitical boundaries and begin planning at a mega-region and even the continental scale.

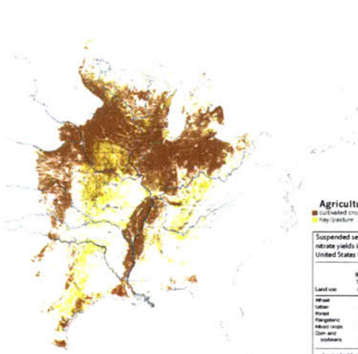


Threats to the System

Creating America's Super Highway

Lock and Dam System
Elevation of Upper Mississippi River

America's Bread-Basket
Damming the Mississippi River allows the transport of 472-million tons of cargo (petroleum, coal, chemicals, and grain) worth $54 billion each year



Suspended sediment, total phosphorus, and nitrate yields in runoff by dominant land use in the United States for 1980–1989.

Land use	Runoff (kilograms per square kilometer per year) Suspended sediment	Total phosphorus	Nitrate
Wheat	3503	3.5	11.2
Urban	8056	41.7	192
Forest	10,858	22.1	89.3
Rangeland	11,569	6.0	10.9
Mixed crops	27,671	28.1	107
Corn and soybeans	35,026	57.1	326

Source: Smith et al. (1996).

System Wide Threats

1. Geologic Factors
   a. Sea Level Rise- Regional Levels are higher than Eustatic Levels (18-24 cm/yr above global level)
   b. Susidence and Compaction:
      - Primary Consolidation- consolidation occurring in only one dimension due to vertical stresses and settlement of voids
      - Secondary Compression- compression of soil that takes place after primary consolidation. Secondary consolidation is caused by creep, viscous behavior of the clay water system, compression of organic matter, and other processes
      - Oxidation of Organic Matter
   c. Change in Deposition Centers

2. Catastrophic Factors
   1. Landslides
   2. Floods
   3. Hurricanes- highest surge and intense waves at the right of hurricane path--causing erosion and saltwater inundation

3. Biological Factors
   - Marsh maintenance and growth >= decomposition
   - Wetland Types:
     1. Saline
     2. Brackish- experiencing highest rate of erosion
     3. Freshwater
     4. Swamp Forest

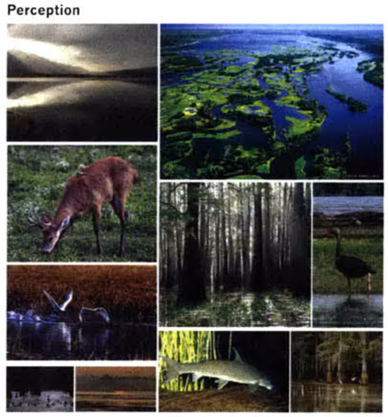
4. Human Factors
   1. Flood & Navigation Control- reduced sediment
      a. Dams
         - 434x106 tons(1850) reduced to 255x106 = 41% Reduction
         - Reduction in amount and in texture (coarser grain foundation sediment no longer passes dams)
      b. Levees
         - All sediment directed out of the mouth of distributaries
         - Overbank flooding- deprives marshes of nourishment, maintenance and subsidence compaction.
      c. Cutoffs
      d. Revetments
      e. Dredging
   2. Pollution
      a. Agricultural runoff: pesticides, nutrient runoff
      b. Sewage effluents
   3. Highway and Canal Construction
      a. Highways- North-South highways built on natural levees (minimal impact), East-West block natural drainage courses.
      b. Canals-
         - Hunting and trapping (historical use)
         - General Navigation
         - Petroleum Exploration Access

Direct Impact: Wetlands are converted to waterways, spoilbanks, widening from canal bank erosion.
Indirect Impact: Canals create an artificial drainage network which alters marsh hydrology--changes surface and ground water flows--restricting nutrient and sediment to some areas while over exposing other areas.

   3. Fluid Withdrawal: depressurization of
      a. Aquifers- mainly in Metropolitan areas (ie. New Orleans)--ground water withdrawal next to the largest fresh water source in North America
      b. Hydrocarbon- Subsidence from oil and gas fields.

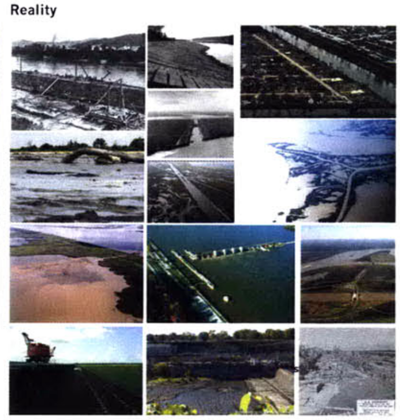
The Tale of Two Rivers

Perception



America's Landmark
America has a romantic vision of the Mississippi River that has been historically portrayed by authors such as Mark Twain. It is one of America's most prized landmarks.

Reality



America's Economic Conduit
In reality the river has been augmented to promote economic progress. The governing bodies of the Mississippi River value the economy of the river over the river's ecological health and have altered it to run as efficiently as possible.

Threatened, Endangered, & Sensitive Species

Due to Man-Made Alterations to the River
The Mississippi River Valley is critical habitat for 286 state-listed or candidate species and 36 federal-listed or candidate species of rare, threatened or endangered plants and animals endemic to the Mississippi River Basin.

Vertebrates

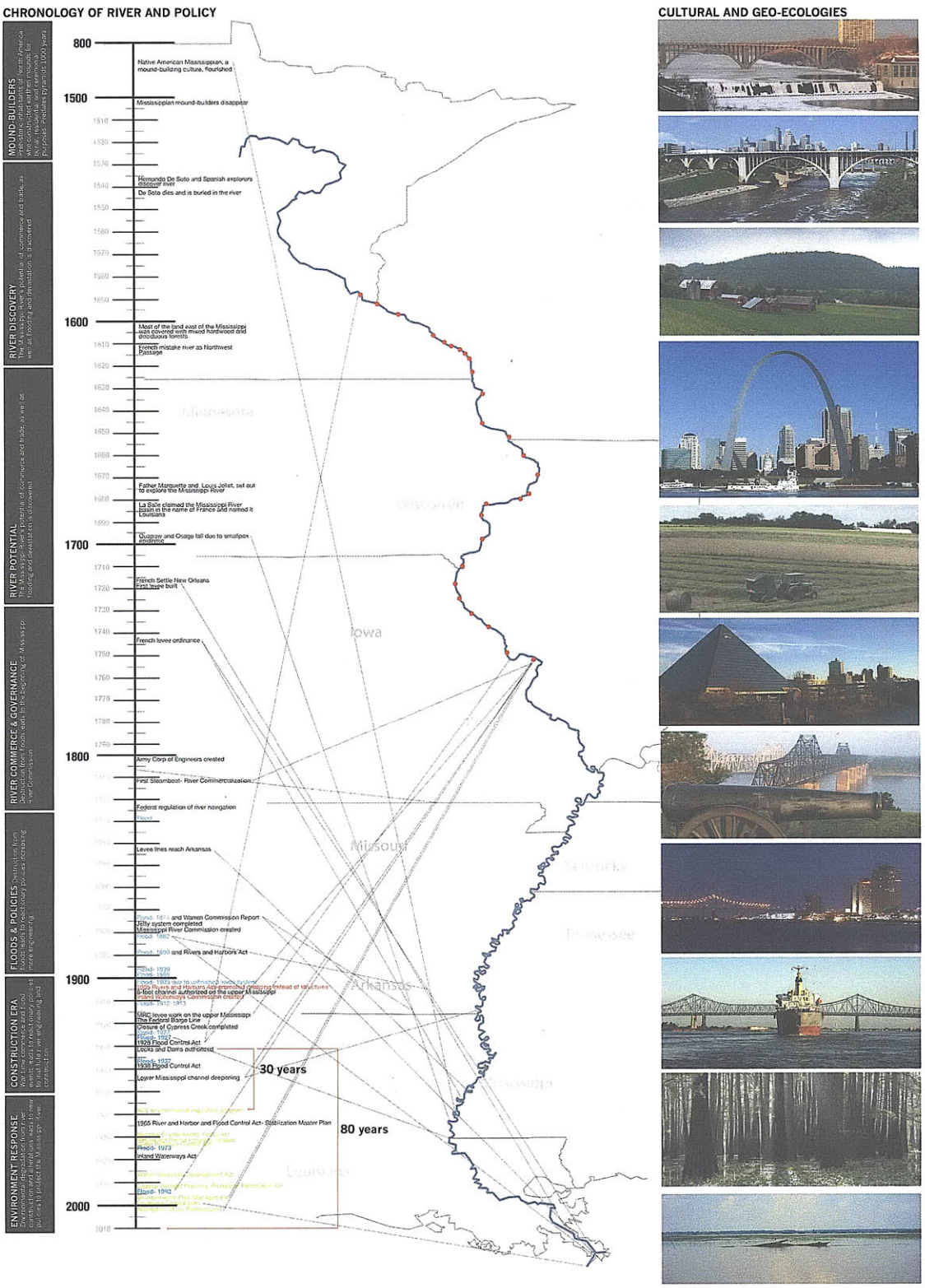
Invertebrates

APPENDIX

Political & Geo-Ecologies

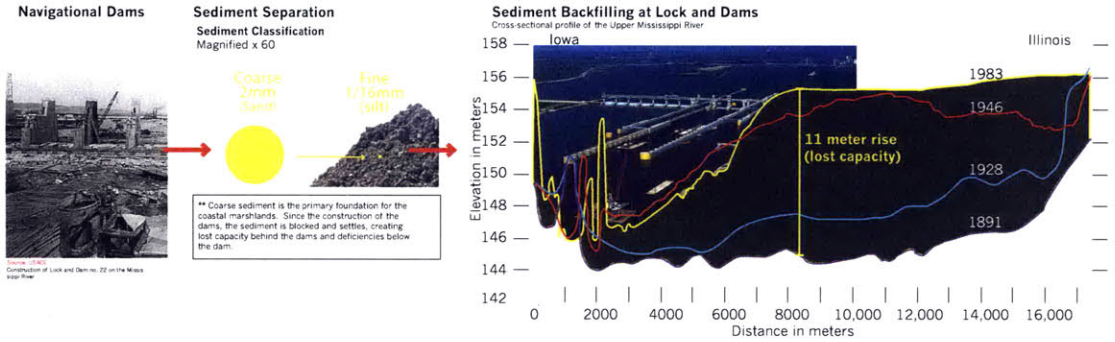
Time line: political augmentation of the river

Every political Act implemented along the river has been a reaction due to a crises or economic stimulous-
No comprehensive plan or master vision

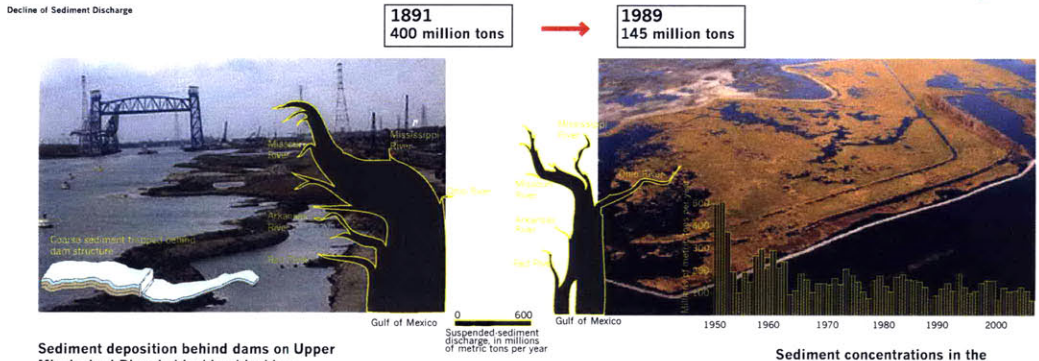


Threats at Every Scale

① Local: Engineering



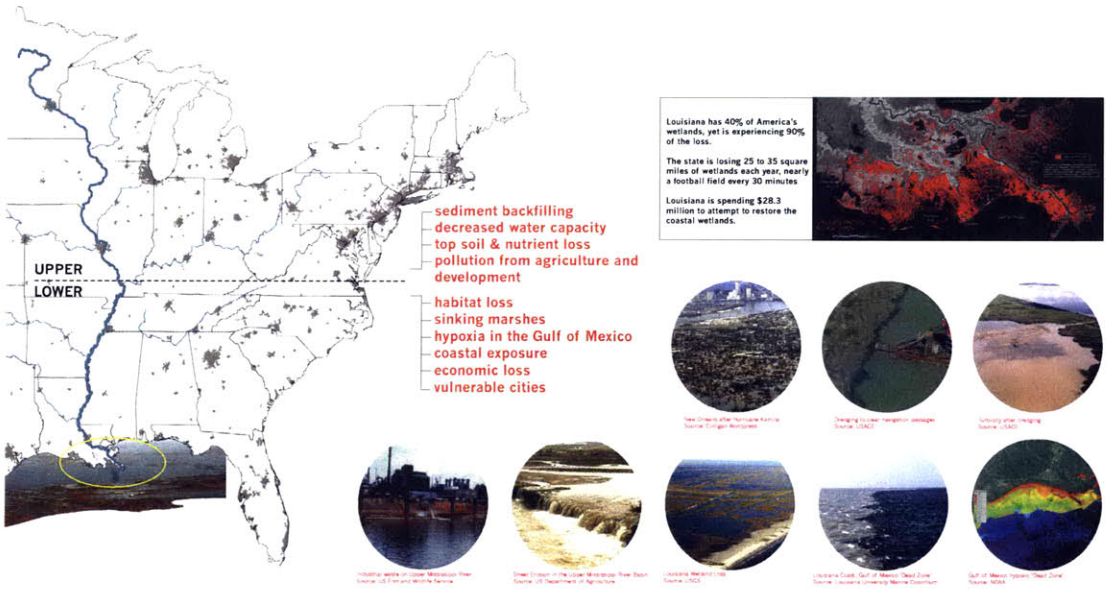
② Regional: Compounding



Sediment deposition behind dams on Upper Mississippi River is blocking blocking navigational channels as well as causing lost capacity for reserviors, which many cities, farms and industries rely on for their water supply

Sediment concentrations in the Mississippi River have decreased at least 70-80% from pre-development conditions

③ Continental: System Collapse

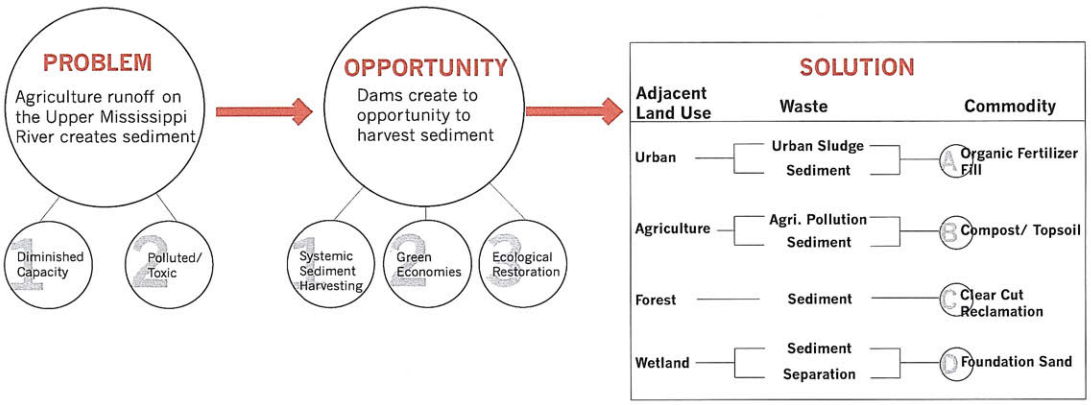


Dirt Economies
Sediment Transfer Strategy & Network

Commodity is sediment

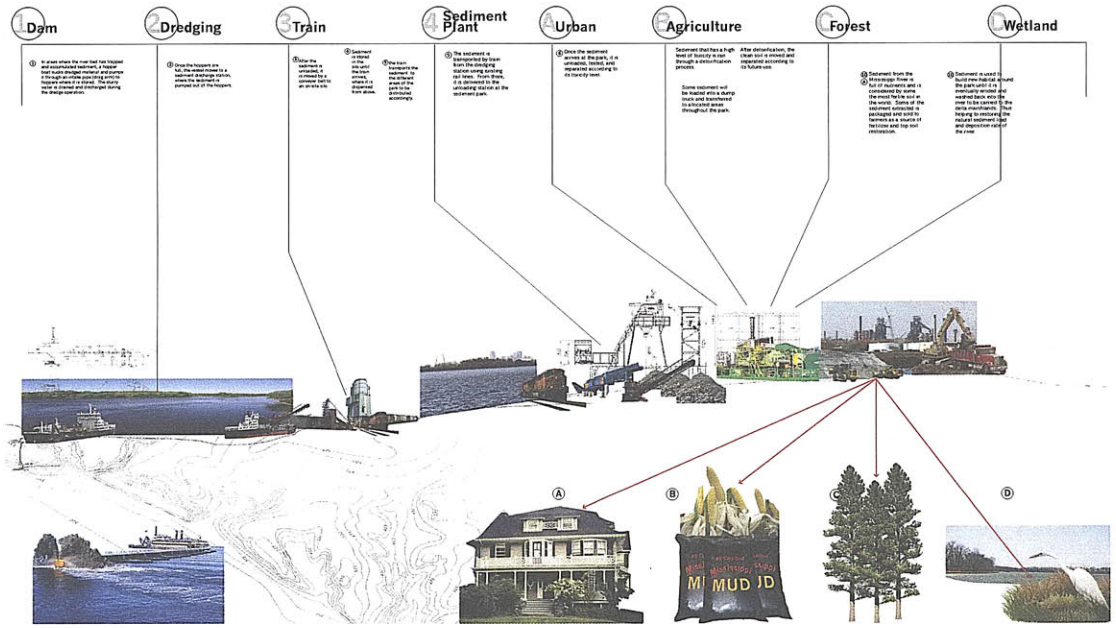
shift the value system- harness, exploit, the river's natural processes to promote the health of the river and create a new economy

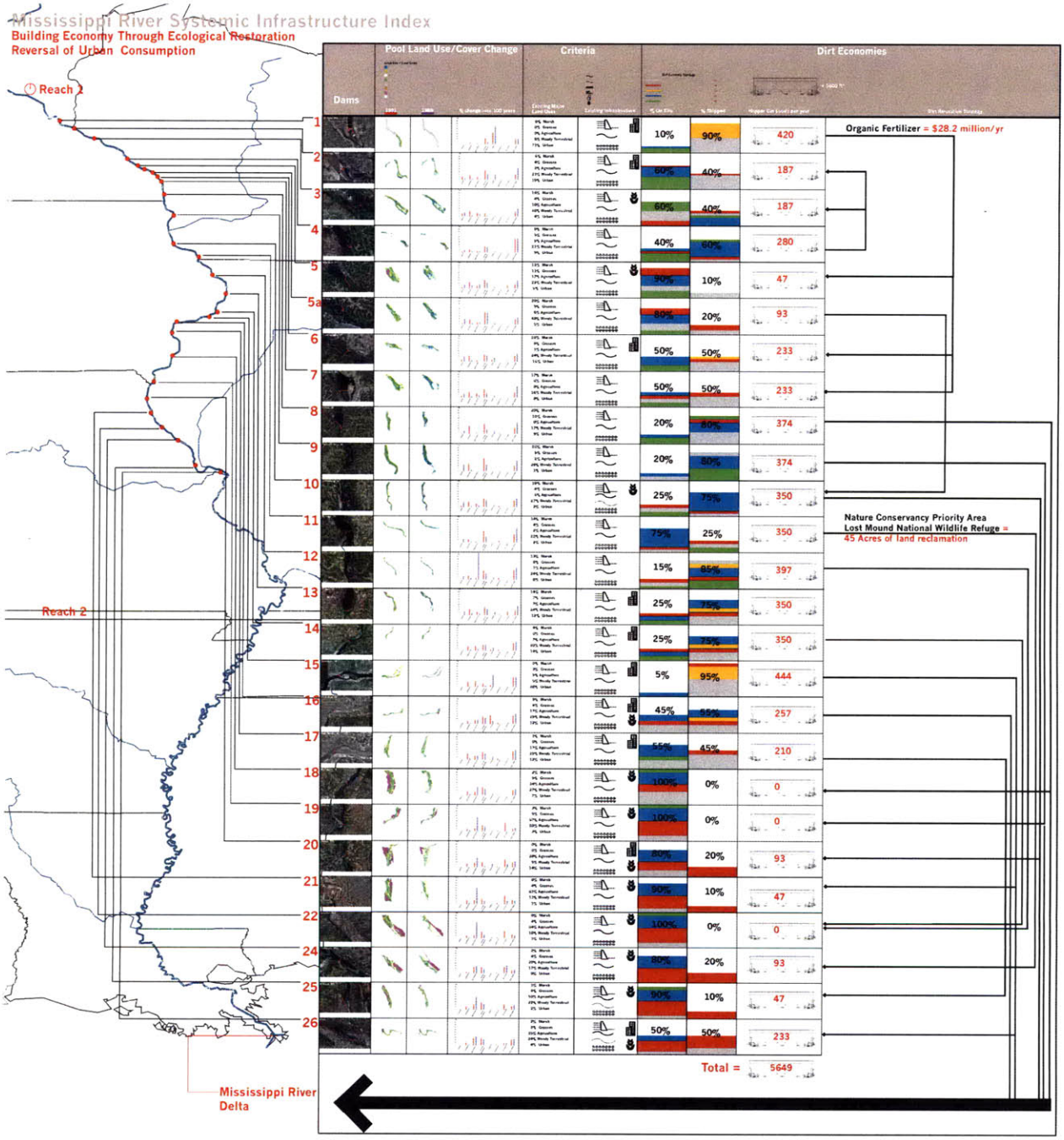
coupling natural infrastructure with the man-made infrastructure that has been a detriment to the river for over 100 years in order to create new clean industries depending on surrounding land uses.



Process

Moving Dirt- Each step of the sediment transfer process creates new jobs which will facilitate economic gain. Creating a sediment network along the river helps to re-imagine industries that have a positive effect on the river while still growing the economy.

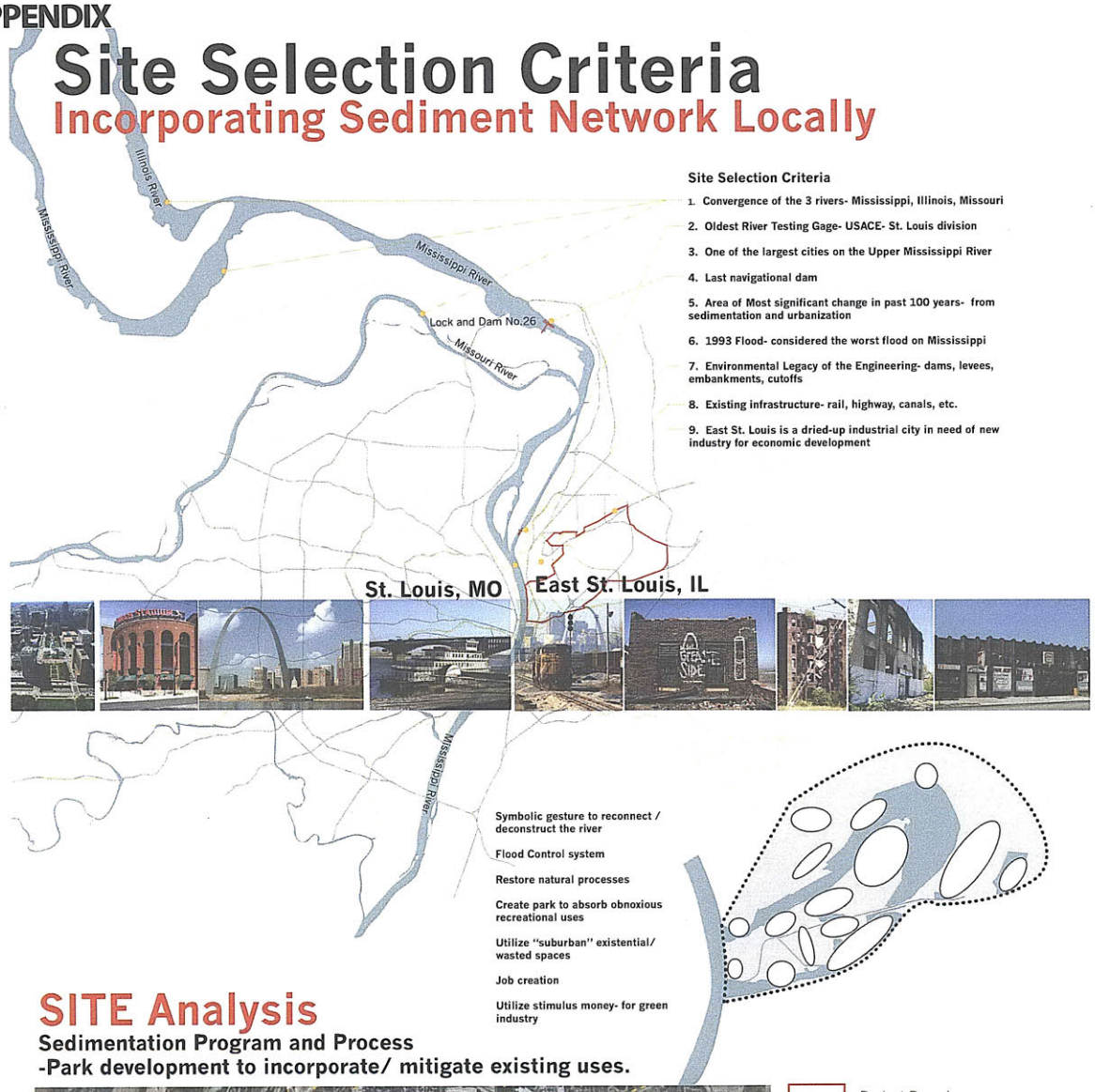



Mississippi River Systemic Infrastructure Index
Building Economy Through Ecological Restoration
Reversal of Urban Consumption
Reach 1
Reach 2
Mississippi River Delta
Dams
Pool Land Use/Cover Change
Criteria
Dirt Economies
Organic Fertilizer = $28.2 million/yr
Nature Conservancy Priority Area
Lost Mound National Wildlife Refuge =
45 Acres of land reclamation
Total = 5649

APPENDIX

Site Selection Criteria

Incorporating Sediment Network Locally



Site Selection Criteria

1. Convergence of the 3 rivers- Mississippi, Illinois, Missouri
2. Oldest River Testing Gage- USACE- St. Louis division
3. One of the largest cities on the Upper Mississippi River
4. Last navigational dam
5. Area of Most significant change in past 100 years- from sedimentation and urbanization
6. 1993 Flood- considered the worst flood on Mississippi
7. Environmental Legacy of the Engineering- dams, levees, embankments, cutoffs
8. Existing infrastructure- rail, highway, canals, etc.
9. East St. Louis is a dried-up industrial city in need of new industry for economic development

Symbolic gesture to reconnect / deconstruct the river

Flood Control system

Restore natural processes

Create park to absorb obnoxious recreational uses

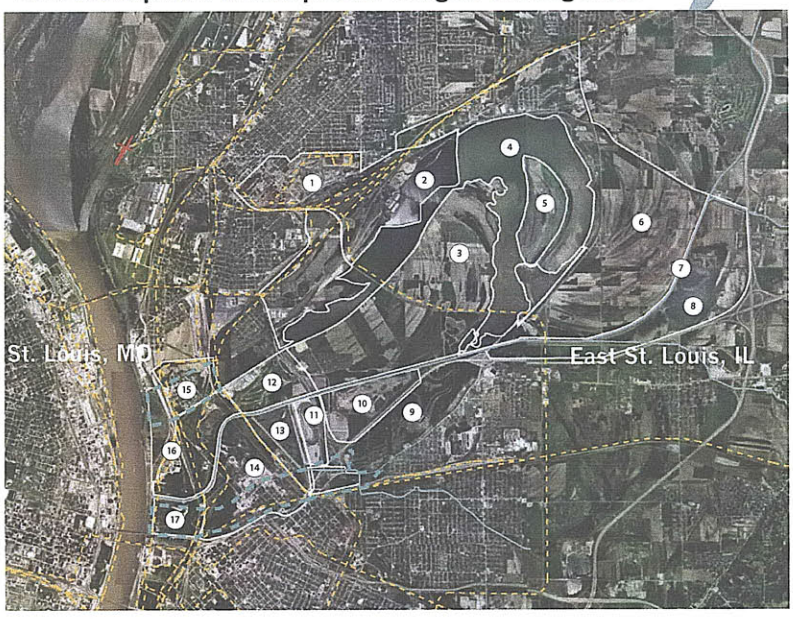
Utilize "suburban" existential/ wasted spaces

Job creation

Utilize stimulus money- for green industry

SITE Analysis

Sedimentation Program and Process
-Park development to incorporate/ mitigate existing uses.



Project Boundary
Road
Railroad
Proposed River Connection
Channel
Dam

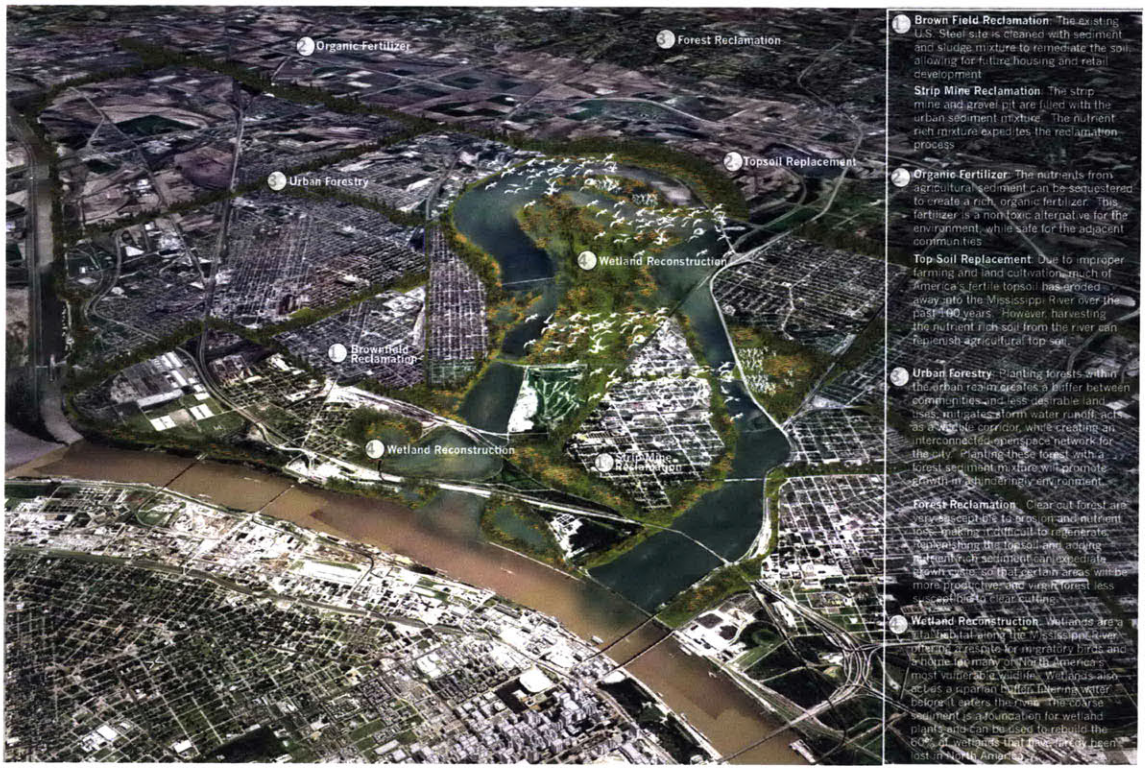
Catalogue of Existing Uses

1. U.S. Steel -mill and coking factory
2. U.S. Steel -cooling pond
3. Agriculture inside River cutoff
4. Lake Horseshoe- Oxbo Lake
5. Sediment Island
6. Agriculture
7. Runoff diversion channel
8. Existing Wetlands
9. Existing Wetlands
10. Abandoned Gravel Pit
11. Race Track
12. Golf Course
13. Empty Land
14. Abandoned Foundation Pad
15. Blighted Neighborhood
16. Water Treatment Plant
17. Existing Riparian edge

East St. Louis

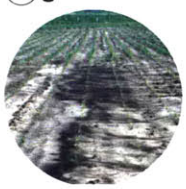
Urban Revitalization through Sediment Network

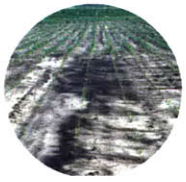
The sediment network can be implemented locally at a continental scale



1 Urban

2 Agriculture





3 Forest

4 Wetland

Dirt Economies- What is Dirt Worth?

Proposed industries to spur economic development

Landscape	Commodity	Client	unit price	Local Economy	National Economy
Urban	Brownfield Reclamation Medium	Cities Developers	$	$	$
	Land Fill	Cities Developers	$	$	$
Agriculture	Organic Fertilizer	Farmers Gardeners	$	$	$6.1 Billion
	Topsoil/ Compost	Farmers Gardeners	$	$	$
Forest	Urban Forestry Base	City Park Dept.	$	$	$
	Forest Reclamation Medium	Lumber Companies U.S. FWS	$	$	$
Wetlands	Wetland Reconstruction Foundation Material	U.S.A.C.E. Nature Conservancy Gulf Coast States	$	$	$

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BIOGRAPHICAL NOTE

Haley Heard is a graduate of the Department of Urban Studies and Planning at MIT; she holds a Bachelors of Landscape Architecture from Texas A&M University. Before attending the graduate program at MIT, Heard worked for several interdisciplinary design firms in Washington D.C., Dallas, Texas, and Atlanta, Georgia. Heard has won several awards including, High Recommendation from the 2010 3rd International Holcim Forum, first place in the 2009 Affordable Housing Development Competition and an Honorable Mention in the 2008 US Green Building Council's (USGBC) Natural Talent Design Competition. Additionally, Heard worked as a Teaching Assistant for the Mumbai Urban Design Studio in Fall 2008 and for the Advanced Seminar in Landscape + Urbanism in Spring 2010.