# Overview and Planning Process of the East Grand Lake Water Quality Improvement and Sediment Management Plan

**Project Approved in Atchafalaya Basin 2009 Annual Plan**

**Submitted to the Atchafalaya Basin Program, Louisiana Department of Natural Resources for Development of Water and Sediment Management Projects in the East Grand Lake Project Area**

**Prepared by Paul C. Chadwick**
**Contract ABFP-10-03**

## Introduction

Planning environmental management of the East Grand Lake Project area will be guided by the State Master Plan for the Atchafalaya Basin Floodway System. It will be an adaptive management process that uses continually updated scientific evaluation of conditions in the area to tailor a series of projects to the most recent knowledge of the area. The adaptive management approach will develop new projects that build on changes brought about by previous projects, and require a pre-conceived concept of the desired condition of the entire study area in the future. Under this scenario, projects developed early in the process will be designed to provide improvements that will be advantageous to projects that will be developed later in the process. This overview gives an account of how that process will work, describes general conditions regarding water movement and sedimentation in the study area as defined by the latest available science, outlines the concept of how the management team envisions guiding changes in the Project area, proposes a platform for integrating stakeholder desires with management recommendations, proposes a method for identifying management options to accomplish the common objectives of stakeholders and managers, and sets a preliminary timeline for developing projects.

## East Grand Lake Project

The East Grand Lake Project area covers both the Flat Lake and Upper Belle River Water Management Units as designated by the United States Army Corps of Engineers (USACOE). The area is approximately 202,424 acres, stretching approximately 31 mi long by 13 mi wide. The area is an important component of the local economy that supports commercial and recreational fishing and hunting activities, oil and gas development, commercial transportation of goods and services, and timber harvest. Much of this area is privately owned and managed for silviculture, hunting leases, campsites, and other land uses. The remainder is state owned and managed as public lands (Fig. 1). The Louisiana Department of Wildlife and Fisheries (LDWF) has estimated over 8.7 million pounds of crawfish with a dockside value of more than $7.5 million were harvested from the Basin from January to May, 2009. Additionally, the LDWF estimates the commercial and recreational fishing industry in the Basin has a combined value of $142.7 million (ABP 2011).

Although it is still one of the most productive floodplain ecosystems in the country, water quality, aquatic productivity, and forest health have declined as past alterations to the landscape have limited water movement, caused sediment to be distributed in an unnatural manner, and cause low oxygen conditions during spring and summer months. Low oxygen conditions are not unexpected in floodplain swamps like the Atchafalaya Basin, but low oxygen conditions now occur more frequently throughout the Project area and cover a much larger area than in the past. Poor water quality limits available habitat for fish to spawn and feed, and survival of fish species important to commercial and recreational fishermen is threatened when oxygen deficient water drains from swamps into areas that fish must use to seek refuge in low

water periods. Some aquatic species like crawfish are able to survive in water where oxygen is low by using vegetation to access more oxygenated water near the surface and can tolerate short periods out of water. However the condition has severe economic consequences for commercial crawfishermen as crawfish are confined to traps in oxygen depleted waters near the bottom and rapidly consume the limited supply of available oxygen and die before making it to market. Forest health declines in areas where sediment buildup results in poor drainage and causes ponding which prevents annual dry periods that species like bald cypress and tupelo trees require for regeneration and optimal growth.

Many causes of change to the landscape have been identified and are now regulated in a more environmentally beneficial manner, but challenges remain for managers of both private and public lands. While oil and gas exploration and production continue in the area with greater consideration for environmental impacts, research has documented that the existing production infrastructure and access canals has altered water flow and sediment distribution patterns and continue to cause problems for water movement. In addition, the Atchafalaya River Basin is managed as a floodway and the USACOE has limited the exchange of water into the Project area to increase the capacity of the main Atchafalaya River channel to carry flood waters to the Gulf and to facilitate navigation. Much of the lower part of the Project area is also subject to land subsidence which was historically countered by uniform distribution of sediment, but now continues to decrease in elevation as sediment is funneled and deposited along the main waterways that carry most of the sediment past areas where it would have historically deposited. Sediment continues to be deposited in areas that block water movement and fill open-water habitat. Only about 13 percent of the Atchafalaya Basin remains as persistent water during low-water periods and over the past 5 decades much of the open-water has been converted to forested habitat because of excessive and misdirected sediment. As sediment accretion continues in this manner, aquatic habitat necessary for aquatic organisms to survive the low-water periods continues to be reduced (Fig. 2). As sediment continues to divide the Project area into smaller segments and limits water movement between those segments, the ecological function of the system deteriorates and causes problems over an ever-increasing portion of the Project area.

In response to stakeholder desires to improve environmental conditions, the Atchafalaya Basin Program initiated the EGL planning effort in the 2009 Atchafalaya Basin Annual Plan. The Technical Advisory Group (TAG) agreed that the Project area needs better management of water flow and sediment distribution patterns and that the current trend in sediment accretion will continue to divide the area into smaller and smaller isolated and unmanageable segments.

**East Grand Lake Project Area Management Approach**

<u>Restoration vs Preservation</u>: Change is always a challenge. But the landscape in the Basin is changing daily and the livelihood, economic investment, recreational opportunity, and even daily life for the Basin community and stakeholders change with it. So it is important that we consider all of these factors before final decisions are made on plans to alter the way that the landscape is changing. There are a few concepts that will guide the EGL management plan and

these concepts are highlighted so that there is some understanding of how the objectives of the EGL Project are being accomplished. One of those concepts is to acknowledge that the goal of management is not to "restore" habitats to a previous state simply because those conditions existed in the past, but to forecast the best available options for managing the landscape as it exists today. Forests have developed where lakes once existed but there is not necessarily a benefit in removing the forest simply because it was once a lake. It can be difficult to set aside ideas for restoration that have been formulated by many people over decades of observation in the Atchafalaya Basin, but changes occur rapidly in the Basin and many ideas that may have been proposed in the past are simply no longer the best choice in the present. Many factors must be evaluated when considering which options are appropriate for each area of the basin, but this concept can be simply described as taking areas for what they are today and making them work or "function" better. The difficulty in managing this way is that some areas of the Basin will have to undergo changes that are not always popular and have not always been viewed as improvements in the past.

Tailored Project Design: The EGL Project area is very large and gets water from relatively few sources today compared to many sources that existed when it was formed. One difference in how it functions today is that areas near those sources of water function quite differently than areas further away from those sources. Accordingly, the designs to improve circulation and water quality will not be the same for all areas. Because water movement is not limited by the same factors in all areas, different strategies will be required to address the specific needs of different areas. Areas in the north and west suffer from restricted input of water where the river once supplied water along much of the western boundary. Areas in the south have almost no drainage relative to past conditions, and central areas are sandwiched between opposing flows and have little in the way of input or drainage. Past efforts to correct the problems associated with these changes to water flow have emphasized water management projects to introduce additional water into the Project areas to change water-flow patterns as a primary means of improving water quality. But those projects have been developed on a small scale and without full consideration for changes over such a large area. Small scale projects, like the ones submitted for construction in the 2010 Annual Plan will continue to be part of the EGL Project and serve an important role in management of isolated areas where limited options exist for improving poor environmental conditions. But additional emphasis needs to be placed on long-term transformation of the entire system that considers improvements over a larger area to make sure that smaller projects fit logically into plans that address the specific needs of different areas. The long-term planning of the EGL Project area is being implemented to provide a vision for reasonable management of the entire area well into the future as well as to guard against developing short term projects that may limit management options and that may not work together in the larger system.

Many parts of the EGL Project area require more than just water quality improvement and are well suited for management projects that simultaneously improve water quality and forest health by purposely directing sediment to places where forests no longer receive the sediment that they require to remain healthy. This type of purposeful redirection of sediment has received limited evaluation in the past, but is an example of how identifying specific needs for

different areas can be beneficial. It is important that benefits to aquatic habitats that support crawfish and fish species remain a primary focus of the EGL Project, but planning for the beneficial use of sediment must be part of the process. There are only a few tools available to improve water quality conditions in the Basin, and redirecting water flow by removing flow barriers is the primary mechanism to accomplish that objective. But redirecting water flow means redistributing sediment and the strategic redistribution of sediment should be a significant consideration in planning because of its impact on forest health, unwanted filling of open-water refuge areas for fish, and the longevity and connectivity of water management projects.

Stakeholder Input: The Atchafalaya Basin Master Plan outlines human use of the Basin as a significant reason for making improvements to the Basin. As projects are developed to better manage water and sediment, there must be simultaneous consideration given to the reasons that stakeholders want to improve wildlife, fisheries, and forest conditions beyond purely ecological change. Recreational users have voiced a desire to have these projects maintain or improve access to the waterways, water bottoms, and state-owned lands that provide recreational opportunities. Commercial fishermen seek improved harvest and access to lands that provide fishing opportunities. Landowners have property rights that must be honored as well as land management objectives that must be considered. Oil and gas activities are ongoing and continue to seek permits for exploration and production that will alter the Project area. These and other user groups represent independent planning efforts that have different expectations and plans for the same area into the future. Some are short-term expectations like improvements for fish or crawfish harvest and oil and gas production. Others are long-term expectations like timber production and preservation of cypress tupelo forests.

Given that some stakeholders have different expectations for the same area, it is expected that some of these expectations will be incompatible. There are also limited sediment and water resources that can be used to meet the goals of individual stakeholder groups in all areas where they seek change. This planning effort does not propose to develop priorities of one stakeholder group over another, but rather to understand the expectations of many stakeholders to seek solutions that combine objectives where possible and to provide alternatives where common solutions are not possible. Many stakeholder expectations are not necessarily focused on the kinds of traditional improvements that come from planning environmental management and planning environmental projects frequently overlooks the reality that stakeholder interests must be included in the planning process.

Outlining Flow Patterns: Realigning sediment and water distribution in EGL Project area requires the identification of existing flow patterns. One way to distinguish how water moves through the system is to use turbidity patterns derived from satellite images. Turbidity measurements from the imagery provide an estimate of the amount of particles that are suspended in the water. The extent of turbid water in different areas of the Basin is an indication of movement of fresh water through the system. Satellite images captured at a variety of river levels can therefore be used to outline water movement patterns indicated by turbidity because particles remain suspended in the water column where water moves and

turbidity is high (Fig. 3). However, it also important to have actual discharge and water quality measurements to provide quantifiable evidence of water movement that can not be determined from satellite information. These data are being collected by USGS and LSU and are being used to complement assessments derived from turbidity patterns. A more complete evaluation of how the water moves through the area will be possible after their data collection efforts are complete in late 2011, but preliminary evaluations using a combination of all these data have already identified areas of persistently good and bad water quality within the unit.

Dividing the Project Area: Forecasting change associated with multiple management projects that simultaneously sets out to alter a large area like the EGL Project area is difficult, if not impossible. It's especially difficult for areas that are farther away from the actual location of individual projects. So a project development dilemma exists in deciding where to initiate projects and how far to anticipate the benefits of those projects. Our initial assessment of water flow, elevation, and sediment distribution revealed 3 distinct regions that provide a good planning platform; an Upper Region, a Western Region, and a Lower Region (Fig. 4). These Regional divisions are still sufficiently large that individual projects within each of these boundaries may not effect significant changes in adjacent Regions, but are sufficiently restricted so that a series of projects within each Region could be expected to provide a reasonable positive benefit within the Region. It's also difficult to plan across Regions in the initial planning stage because there will be numerous projects in the future that rely on improved water and sediment conditions from the initial projects. Expanding the reach of improvements into each Region by adding additional projects will be a sequential process where new projects may be dependent on the success of the initial projects. The Regional divisions will set the stage for initiating project design.

*Upper Region*: The Upper Region covers the area south of Bayou Sorrel to Old River and east of Grand Lake to the GIWW. Turbidity patterns suggest a fairly homogenous distribution of good water throughout much of the Region relative to other parts of the Project area (Fig. 5). USGS is collecting discharge and suspended sediment measurements around the perimeter of the Region, and preliminary evaluation of these data indicates that most of the water that enters that Project area comes through this Region. The Upper Region also has fewer restrictions to flow than other areas of the EGL Project area which allows for good water to enter and circulate throughout a large portion of the Region. However, the highly channelized delivery of water through the Coon Trap, an Unnamed oilfield canal off of Bayou Sorrel, Indigo Bayou, Cannon Bayou, Williams Canal, and Bayou Pigeon has developed a sediment delivery network that carries sediment deep into the Project area which promotes further restriction of flow and isolation of small areas. This network of channelized water input will be the initial target for realignment. The ability to forecast expected benefits in the Upper Region is better simply because the target goal is to redirect the delivery of sediment to areas that have been bypassed by the current network of waterways and are left without the sediment resources to continue development into healthy forested areas. The strategy will also begin the realignment of water input through the Upper Region so that water is still supplied to areas in the central part of the

Upper Region after it has been filtered of sediment to reduce the rate of sediment buildup along the channelized delivery network.

*Western Region*: This Region occupies a large portion of the former extent of Chicot and Grand Lakes which has been isolated from the direct overflow of the Atchafalaya River to the west by natural sediment accretion and channel training works constructed by the Corps of Engineers in the 1970's. Sediment now enters the system through channelized waterways at the Coon Trap and Dog Leg inlets and funnels sediment into numerous isolated lakes and waterways, especially Grand Lake which is one of the few remaining natural areas that can provide fairly consistent and suitable water quality conditions for fish to take refuge when water quality problems occur in much of the EGL Project area. Turbidity patterns and preliminary USGS discharge data suggest that good water quality in the rest of the Project area is essentially confined to the main waterways traversing the Region (Fig. 5). The data also suggest that numerous natural barriers prevent water circulation to impounded areas except during extreme high water events. Restoring flow to large areas of this Region will therefore require numerous water realignment projects that will require further analysis regarding how drainage from the area will be achieved and its impact to Grand Lake. More bathymetry will be required to conduct these analyses, especially in Grand Lake, and those data will be collected in the coming year.

*Lower Region*: Turbidity patterns in the Lower Region, south of Old River to Flat Lake, and east of the Western Region to the GIWW, suggest that poor water quality persists throughout the central portion of the Region where an extensive network of oilfield and pipeline canal spoil banks impede water circulation except during all but extreme high water events. Water movement through the Project area has been increasingly restricted, especially after most of the natural connections to the Atchafalaya River that provided a place for water to move in and out of the area were closed off in the 1970's by the USACE's channel training efforts. All of the water that enters the Project area from the north must now drain through the Lower Region and exit through American Pass, Little Bayou Sorrel, and the Flat Lake area (Fig. 5). However, because American Pass and Blue Point Chute flow into the Project area for much of the year, the force of water entering through those channels restrict drainage from the Upper and Lower Regions and causes stagnation and poor water quality. Additional discharge measurements collected by USGS will help address this issue and updated accurate elevation data will help quantify the extent to which spoil banks prevent flow to critical areas of the Lower Region. Much like the Western Region of EGL, restoring flow to large areas of the Lower Region will require numerous water realignment projects and the information necessary to plan effective projects, especially accurate elevation and bathymetry, is currently lacking.

*Future Development of Assessment Units within each Region*: Many segments exist within each Region that can be outlined into smaller and more manageable parts using the same type of evaluations used to define the Regions. We anticipate dividing Regions into smaller isolated segments called Assessment Units (AU) so that more detailed assessments of these segments can be performed as projects are developed. While it may seem a rather complex set of boundaries, dealing with small areas will provide a more precise characterization of Regional

conditions and also provides a way to add new and specific information to the decision process that have been difficult to integrate accurately in the past. One significant contribution will be stakeholder input. Many stakeholders have vital information regarding the use and expectations for the area that has not been available to managers while plans are developed. Not that the information did not exist, but there was previously no mechanism to capture that information for specific parts of the EGL Project area. The Natural Resource Inventory and Assessment System provides that mechanism because it is a GIS based approach that can store and deliver information for specific geographic locations.

Natural Resource Inventory and Assessment System (NRIAS):

A more detailed account of how the NRIAS will handle various kinds of information is being developed, but the data that it will use are already being used by managers in the EGL Project area. Assessments of how land has been converted to water have been derived from historic photographs, satellite imagery, and lidar elevation and have been combined with flow and turbidity patterns to outline the Regional divisions and to develop preliminary options for projects. Flow analysis will feed the GIS structure to provide information specific to management needs, and the system will build on those evaluations to prioritize areas of importance, such as identifying water bodies that are at relative risk of being filled by sediment or healthy cypress tupelo forests that are located in areas where management has a good chance of preserving those forests into the future. As projects are developed, the NRIAS will also be used to forecast changes to land development, forests, water movement, and water quality.

**Realignment Strategy**

Both natural and human-induced changes to the landscape present a formidable challenge in reestablishing functional water flow patterns, but the elevation of land from Bayou Sorrel to Flat Lake remains lower than any other area of the Atchafalaya Basin (Fig 6). The low elevation provides favorable opportunities to redirect water flow and sediment in a beneficial manner that may not be as easily achieved in areas of higher elevation. The process will begin in the Upper Region where options to realignment of water and sediment into the Region will be proposed through a process of developing ideas through planning teams. Options will include water and sediment diversions, canal improvements, canal closures, bank shaving, and other potential management techniques that are consistent with the concepts in this overview. Each project will outline specific objectives and target goals and will include an anticipated area of influence. As new options are proposed, documentation will be developed to outline the thought process associated with the project and its potential strengths or weaknesses in contributing to overall EGL Project area improvements. The documentation will also include an account of how stakeholder input is considered and integrated into the various options prior to the development of final proposals.

The Upper Region was chosen as the initial point of developing the overall strategy for the EGL Project area because there is a reasonable confidence in the projected benefits for realignment of flow and sediment. The Western and Lower Regions present greater uncertainty in realignment and will require additional information before projects can be designed. However, general ideas are being considered for realignment in the Lower Region and the development of proposals in the Upper Region are being formulated with some expectation of the needs in the Lower Region.

The TAG has approved to date 5 small scale projects important to fisherman, mainly dredging to improve access, but these are much smaller scale projects designed to address localized issues that would not interfere with the system-wide water realignment plans required to manage EGL. In order to effectively manage flow at the broader EGL unit-scale, stakeholders believe the best approach is a north to south sequential realignment strategy. There has also been strong support among stakeholders that multiple small scale projects like bank shaving can be very effective, making the system more porous and connecting areas that are now isolated and independent.

As additional information is being collected to address planning needs in the Lower and Western Regions, the initial set of proposals for the Upper Region will be forwarded to the TAG for the 2012 Annual Plan. These proposals will come with options for development and recommendations for prioritizing project selection. We anticipate much discussion and the need to compromise among options so acceptance of the entire suite of proposed projects may not be finalized in time for the 2012 Annual Plan, but if there is agreement for the basic concept of realignment then there are some interim measures that will be proposed for that cycle. The proposed list of projects will be delivered to the Atchafalaya Basin Program by 31 August 2010.

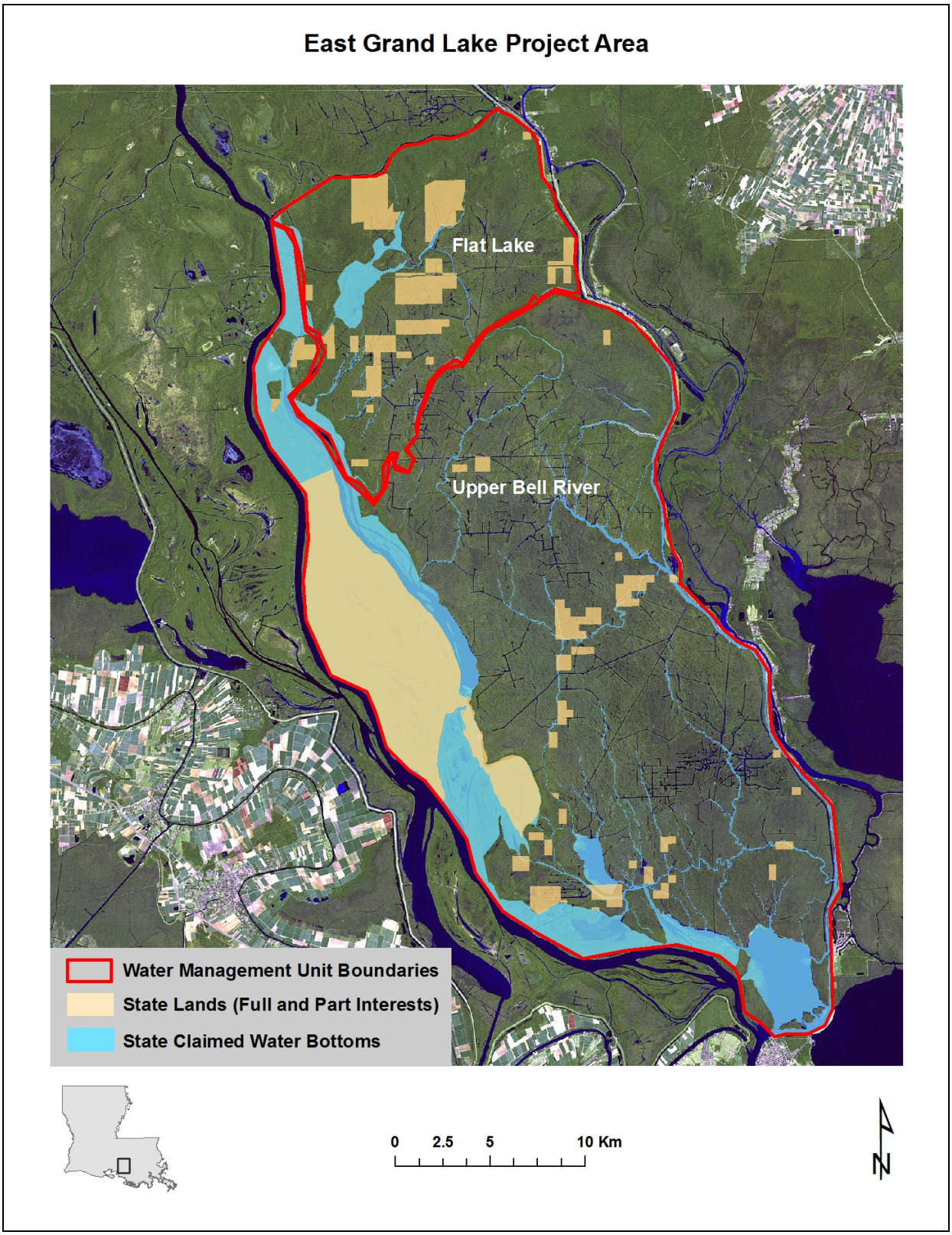


Figure 1. Louisiana state lands (full and part interest) and state claimed water bottoms within the East Grand Lake Project area.

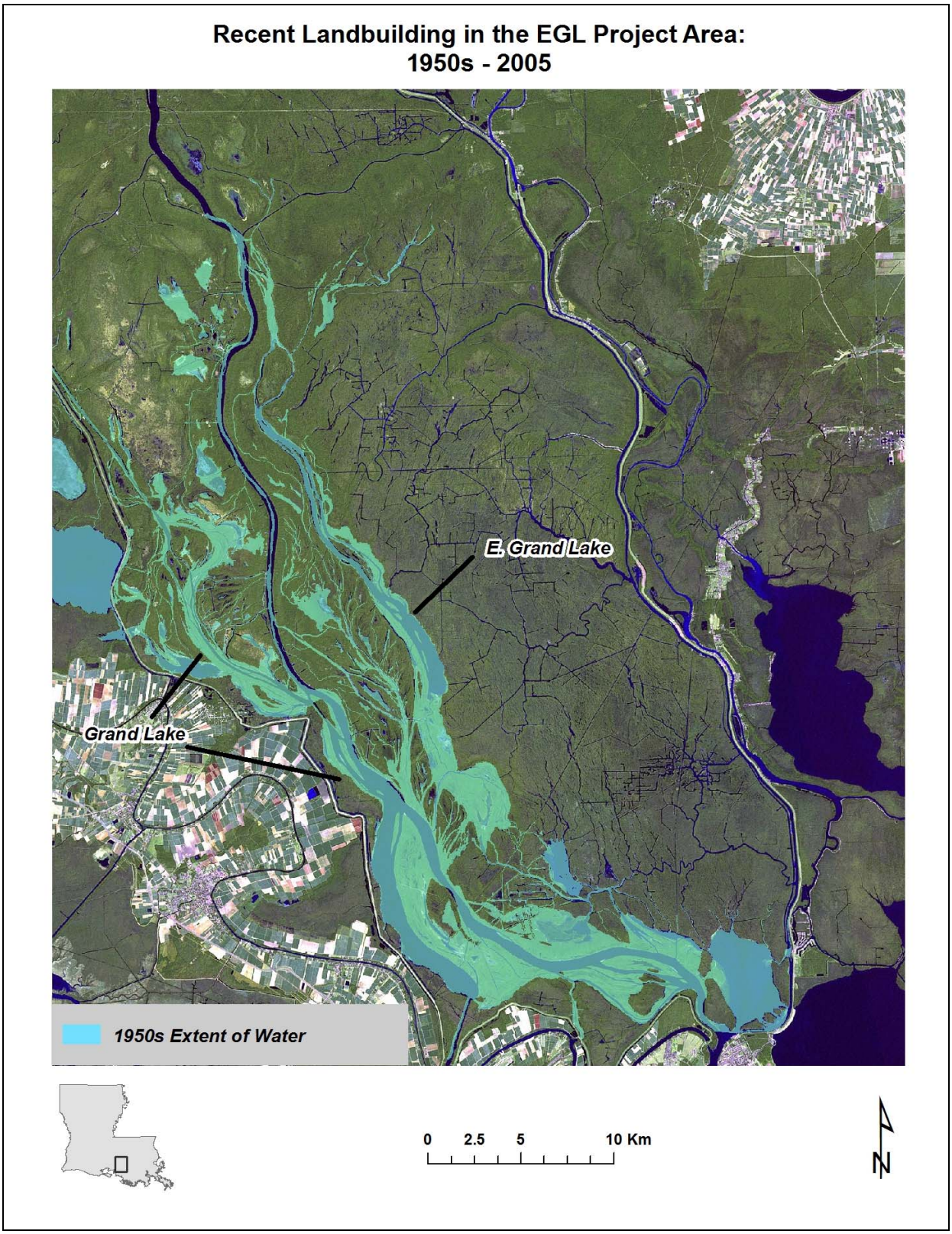


Figure 2. Transformation of open water to forested habitat due to excessive sediment deposition in Grand Lake and East Grand Lake from the 1950s to 2005. Extent of open water in the 1950s depicted as a semi-transparent light blue layer.

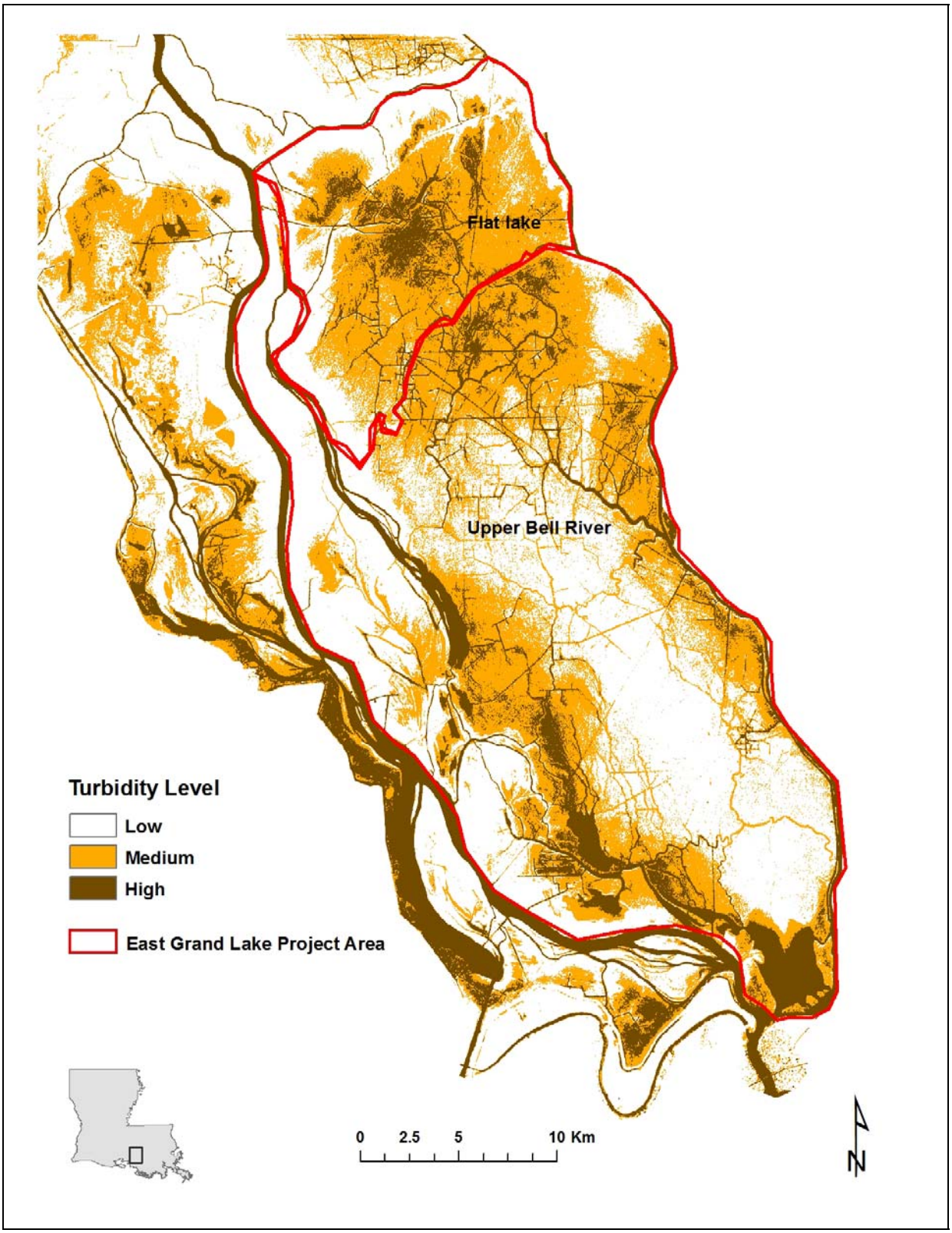


Figure 3. Turbidity levels derived from numerous satellite images of the East Grand Lake Project area. Faster moving turbid water is often associated with water having greater oxygen concentrations than slower moving non-turbid water.

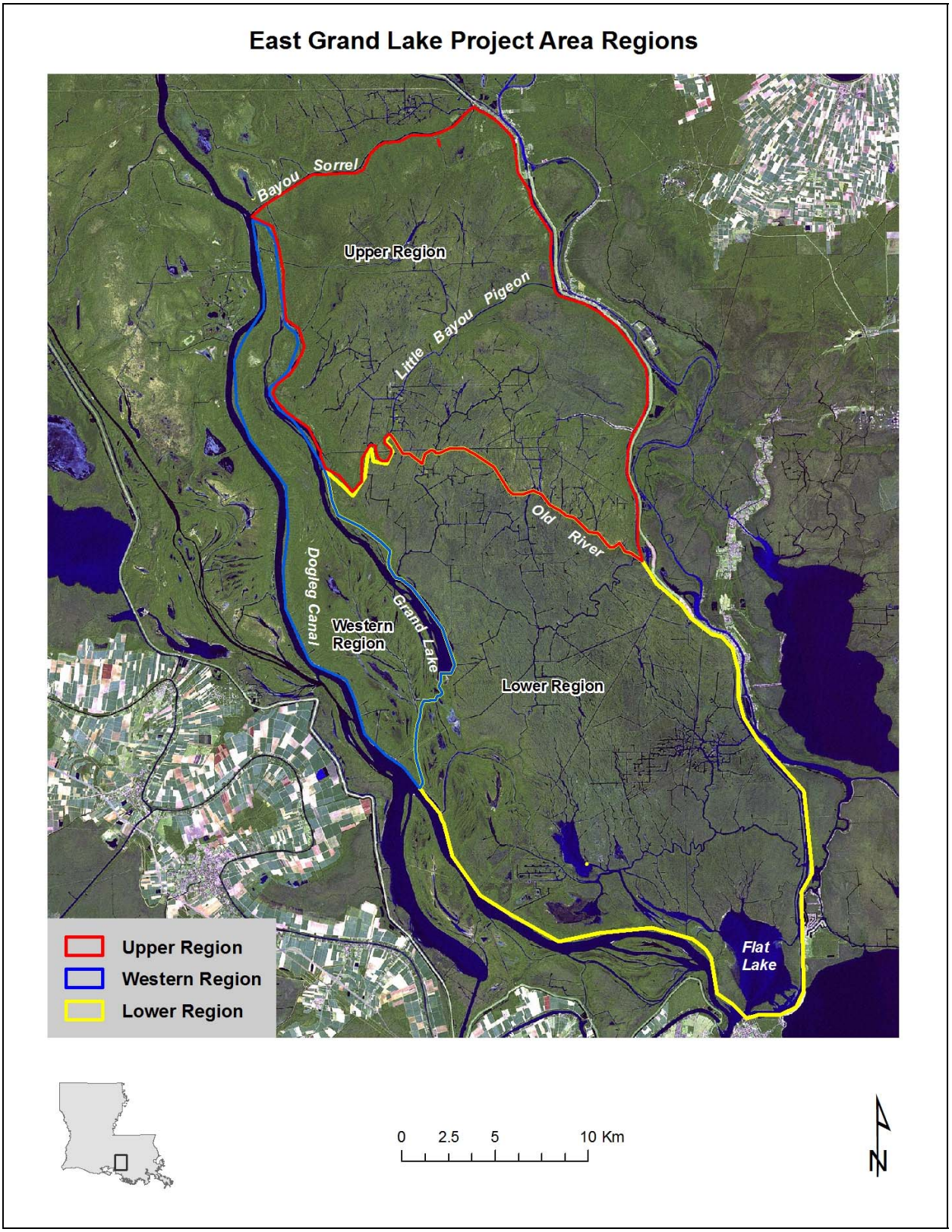


Figure 4. Regional divisions of the East Grand Lake Project area.

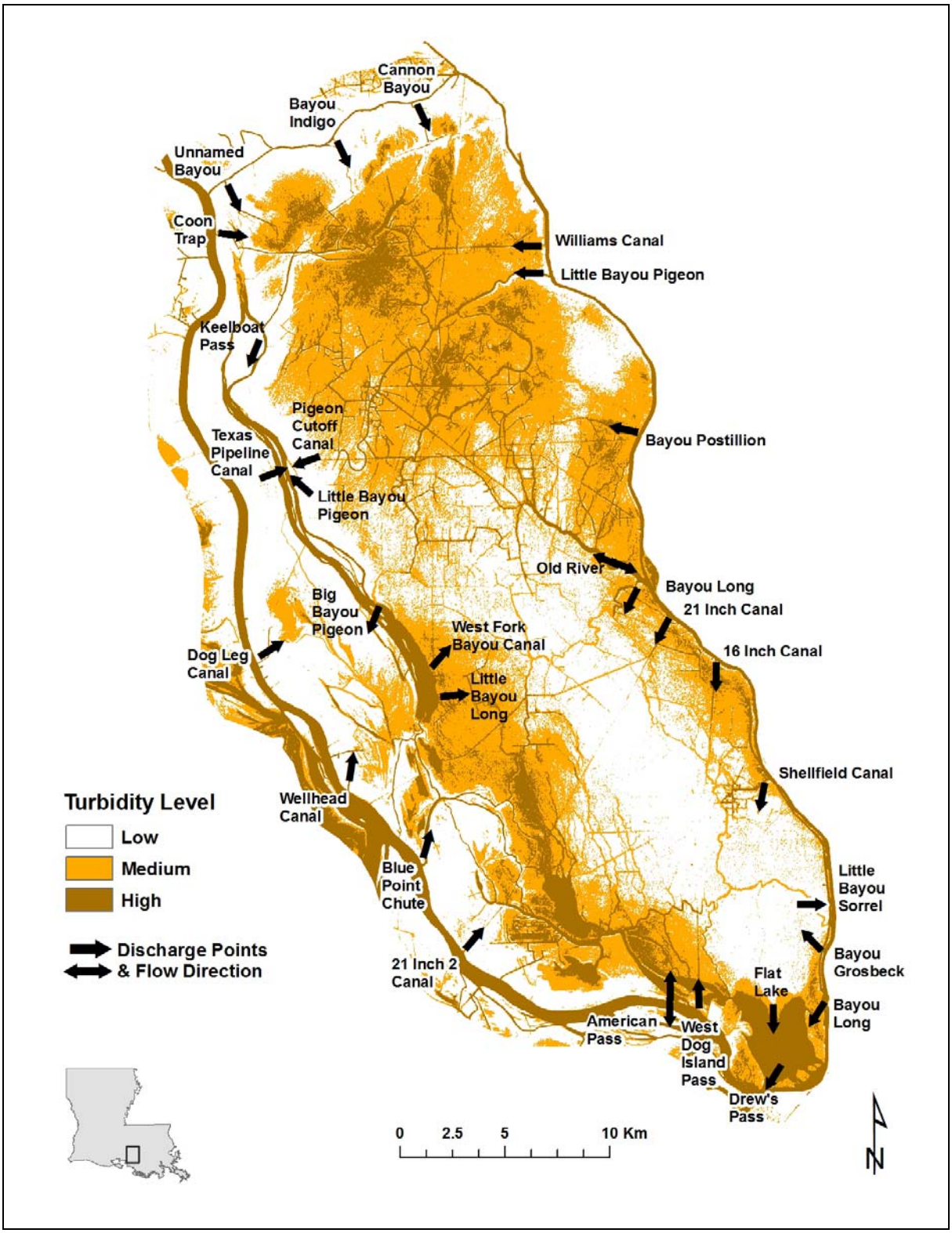


Figure 5. East Grand Lake discharge measurement sites. Direction of arrows depict direction of flow. Figure depicts the extent of turbid water relative to the close proximity of discharge entering the unit.

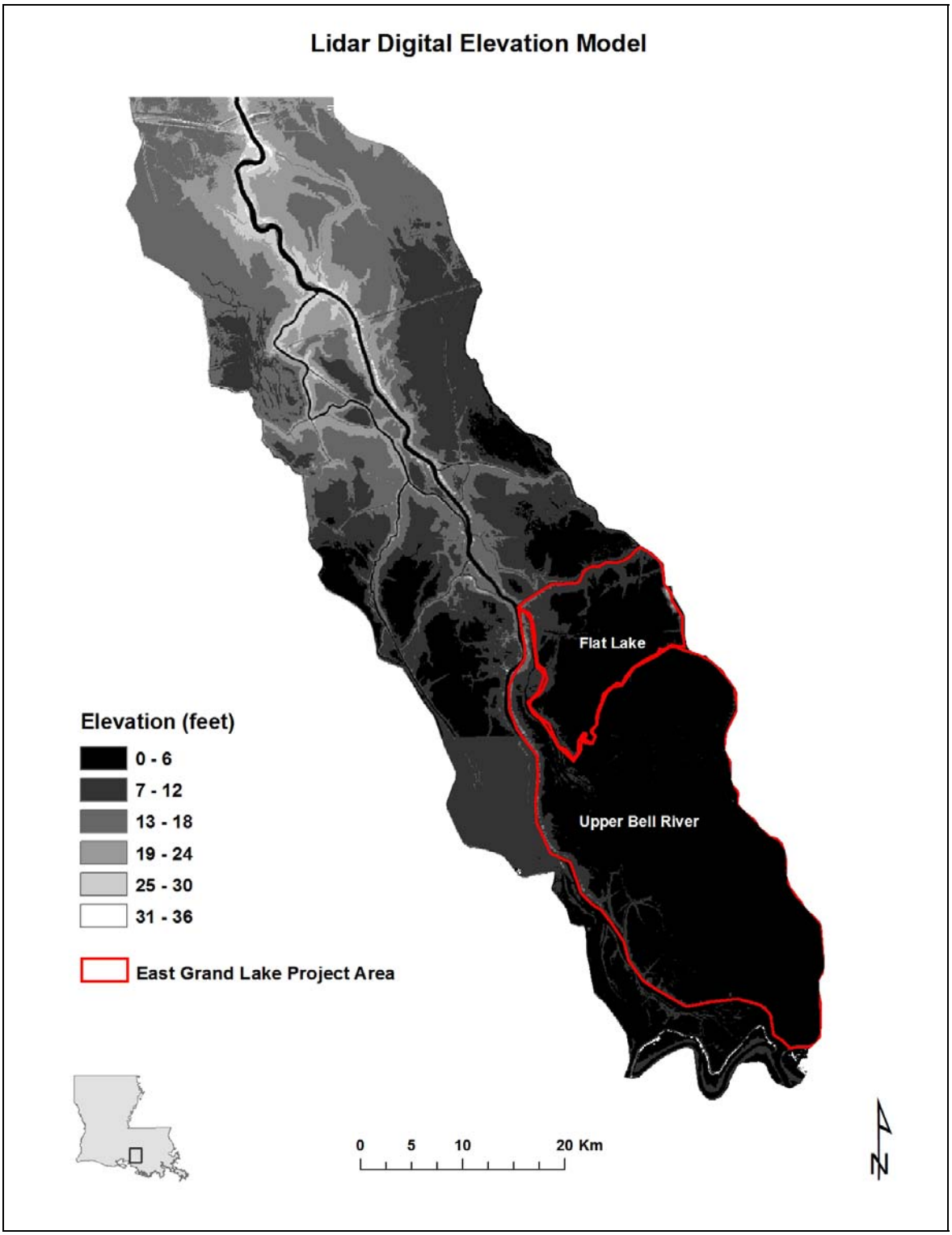


Figure 6. Lidar coverage showing the elevation of the Atchafalaya Basin from approximately 6 mi. N. of Krotz Springs, LA to Morgan City, LA. The elevation model depicts the relatively flat terrain within the East Grand Lake Project area as compared to the rest of the Atchafalaya Basin.