Tracy Armand
Grolee Elementary
Opelousas, La.

Grade Level
Middle School (6-8)

Duration
2 to 3 45-minute class periods

Subject Area
Inquiry
Life Science
Environmental Science
Social Studies

Materials List
- Plastic tub, wallpaper trough or similar pan
- Sand
- Modeling clay
- Small rocks
- Small containers for pouring water
- Packing peanuts or other small, floating objects to represent paddlefish
- Building blocks

Grade/Standard/GLE
Science
6-8/SI-M-A5/14, 16
6-8/SI-M-A3/7
7/SE-M-A4/39
7/LS-M-D2/32
Math
8/G-1D-M1/14

BM = Blackline Master

Do Dams Affect the Paddlefish Population ?

Focus/Overview:

Students will learn about dams – what they are, why they are built and what is affected by them.

Students will construct models of dams and infer how dams may adversely affect the paddlefish population.

Background Information:

A dam is a structure that blocks or diverts the flow of water. Dams have been used for thousands of years; the oldest were built more than 5,000 years ago in the Middle East to irrigate crops. Today, there are more than 500,000 dams in the world. They are built for many reasons, but mostly to control water flow during droughts or floods, to store water for drinking and irrigation and/or to generate electricity.

Before a dam can be built, a planning process involving the project developer, local, regional and federal officials, and the public occurs. Decisions must be made on the dam's structure, location, impacts, costs and benefits. A dam must be high enough to control flood waters and strong enough to hold back river water. The location of the dam must be evaluated to ensure that the benefits are greater than the costs. Dams are very expensive to build. Construction requires a large labor force and large quantities of building materials such as steel and concrete. The area also must be excavated to build a sturdy dam. In some cases, some existing structures on the site must be relocated while others such as roads, trees and buildings are buried underwater.

Once a dam is completed, the surrounding environment is significantly altered, and all forms of life in the local vicinity, including paddlefish, are affected. Dams form reservoirs with deep water and slow currents, which is ideal habitat for paddlefish most of the year. Unfortunately, dam reservoirs can destroy areas that were once ideal paddlefish spawning areas by reducing water flow and inundating clean gravel bars. In general, dams have had a negative affect on paddlefish populations because they create barriers that prevent migration to spawning grounds.

When biologists re-establish a paddlefish population in an area that has been altered by a dam, they stock fingerlings above the dam. This allows the paddlefish to migrate to spawning areas further upriver. Sometimes paddlefish will travel 100 to 200 miles to find ideal habitat for spawning.

Although paddlefish fingerlings are placed above the dam, they may not remain there through adulthood. Biologists have discovered that in the fingerling's first year, there is a 50 percent chance that it will travel through the dam to the waters below because of its small size.

Toledo Bend Dam and Generating Complex is a good example of a dam that has altered paddlefish habitat and where a restocking program has been successful. Built on the Sabine River, this dam has two hydroelectric power generators, one each in Texas and Louisiana. These generators together produce 205 million kilowatt-hours of electricity annually. The purpose of this dam is to produce electricity, to maintain water supply and support recreation, especially for game fishing. The Toledo Bend Reservoir covers 185,000 acres of land, is 65 miles long and 15 miles wide. It is the largest human-made body of water in the south.

Before the dam was built, the area that is now the reservoir contained many gravel bars, ripple areas and three waterfalls, which are ideal for paddlefish spawning. Unfortunately, pre-dam biological surveys were conducted only during the summer months when paddlefish are typically farther downstream in the coastal areas of the Sabine River. Consequently, these surveys have no record of paddlefish inhabiting the river near the dam's location, because paddlefish only use the area in the early spring to spawn. After spawning, the fish return downstream to areas with deep, slow-moving water.

In 1990, Texas Parks and Wildlife and the Louisiana Department of Wildlife and Fisheries worked together to restock paddlefish in the Toledo Bend Reservoir. Each agency committed to stock paddlefish fingerlings for 10 years. Texas began its stocking program in 1990 and Louisiana in 1991. The result of this joint effort is a healthy population of paddlefish above the Toledo Bend dam.

Once stocked, some paddlefish fingerlings move below the dam into Sabine Lake. These fish are unlikely to spawn because there is no suitable spawning habitat below the Toledo Bend dam.The one chance these fish have to spawn occurs during high water when the Toledo Bend Spillway is open. Under these conditions the fish in Sabine Lake may move up the Neches River in Texas where spawning habitat can support a small population of paddlefish.

Learning Objectives:

Students will:

- Construct models of dams.
- Examine a series of maps to determine the impact of dam construction over time.
- Examine maps of paddlefish distribution over time.
- Infer how dams may affect the paddlefish population.

Procedure:

1. Begin the lesson by asking students to recall the critical conditions for paddlefish spawning. (See Lesson "Critical Conditions for Paddlefish Spawning)". Tell students that they will focus on the environment of the paddlefish – the river system.

2. Students brainstorm and share what they know about the water conditions necessary for spawning.

3. Challenge students to create a model of such a system in a pan. Allow time for students to create and share their working models. Provide such materials as pans, sand, modeling clay, small rocks and water to create models. Also provide packing peanuts or other small, floating objects to allow the students to illustrate the capability of their river system to provide adequate spawning migration area for their paddlefish.

4. Once all groups have demonstrated their models, students will record in their journals their ideas about how humans have altered river systems. Students will lead a class discussion, recording their ideas on a bulletin board or poster. In addition, discuss whether the rivers were altered to purposefully harm the environment.

5. Tell students that their state is considering constructing a hydroelectric power plant as an alternative energy source for their area. They have been charged with considering the impact of the construction of the dam on their river system. Challenge students to return to their river models and construct a dam within their system. Provide them with a variety of materials and sufficient time to construct and test their models. Students record in their journals the changes to their system's structure and function.

6. Schedule a simulated town meeting. Students, as citizens of the town and other interested parties, must present their points of view. Some students will represent a company contracted to construct a dam; some represent biologists arguing that it will affect the natural environment; and others represent various parties of interest. Require evidence to support arguments in the simulated event, where appropriate. Students should demonstrate their working dams and share their findings, including their ideas on the benefits and/or risks to the environment as appropriate to their assigned role in the simulated event. Encourage students to use their models to support their positions where appropriate.

Review:

1. Why are dams useful?
   Dams provide a large containment of water for consumption, irrigation of crops, control of floods and drought resistance.

2. How did the flow of your river system change after the construction of the dam?
   Accept any reasonable answer with supporting evidence.

3. Why might dams affect paddlefish populations?
   They create barriers for paddlefish spawning migration.

4. Is it possible for dams and paddlefish to coexist in the same river system?
   Accept any reasonable answer with supporting evidence.

Assessment:

- Construction of dams
- Participation in the simulated event
- Responses to the review questions
- Journal entries assigned throughout this lesson

Extensions:

- Provide students with current and historical maps of paddlefish distribution and dam development over the same area. Use the Minnesota Department of Natural Resources site, http://www.nativefish.org/Articles/Paddlefigures.htm. It contains many historical maps of paddlefish distribution.

- Students examine locations of paddlefish populations over time, cross-referencing their findings with the locations of dams in the same area over time.

- Take a closer look at an area in Louisiana, Toledo Bend Reservoir, where paddlefish spawning habitat was altered. See BM's #1, 2, 3, 4 and 5 to see how the Toledo Bend Dam and Generating Complex on the Sabine River has altered surrounding habitat. Use the background information to explain how paddlefish habitat changed and describe the effect on the population.
  Note: For clearer viewing of Blackline Masters use digital copies on the *Native Fish in the Classroom* CD or online at http://www.lamer.lsu.edu/projects/nativefish/index.htm.

TEACHER REFERENCES:

Internet sources

"*An American Journey.*" Jackson Times. http://www.pasorobles-usa.com/paddlefish.htm.
Accessed January 21, 2004.
Article describes the journey of a tagged paddlefish that crossed dams.

Aswan High Dam. http://teacherlink.ed.usu.edu/tlresources/units/byrnes-africa/KAYMUR/.
Accessed January 21, 2004.
Lesson plan with additional background information.

ESPN Outdoors News Service. 2001. Paddlefish Pounds Pavement to Kentucky.
http://proxy.espn.go.com/outdoors/fishing/news/2001/0808/1236866.html.
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Map of the present distribution of paddlefish in the United States and the effect of river modifications.

Haddens LA-TEX Quadrangle. U.S.Geological Survey 1954, 1969, and 1984.

Jackson, Donald C. and Gerd Marmulla. The Influence Of Dams On River Fisheries.
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Minnesota Department of Natural Resources. Element Occurrence Records of Paddlefish.
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Maps of occurrence of paddlefish with observations dated 1899 – 1995. Includes indications of dams and other structures.

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Describes effects of dams on paddlefish.

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http://www.umesc.usgs.gov/aquatic/fish/paddlefish/video.html. Accessed January 21, 2004.
Six-minute comprehensive video overview of the USGS Paddlefish Project, including the impact of dam construction.

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Accessed September 10, 2004.
Information about the reservoir, hydroelectric generators and cost of construction, plus a graphic of the generator.

Sabine River Authority of Texas. Toledo Bend Project. http://www.sra.dst.tx.us/projects/tbp.asp.
Accessed September 10, 2004.
History of construction, the dedication and current weather conditions.

Schmidt, Konrad. The Distribution and Status of Paddlefish (Polyodon spathula) in Minnesota.
Minnesota Department of Natural Resources.
http://www.nativefish.org/Articles/PaddlefishDistribution.htm. Accessed July 31, 2004.
This site accompanies the elemental occurrence maps from the Schmidt link.

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Introduction to civil engineering and the construction of dams.

Texas Extension. Wildlife Distribution.
http://texas-extension.tamu.edu/agcom/multimed/wildlife/endanger/paddle2.html.
Accessed July 31, 2004.
Map of main and possible paddlefish distribution in the United States.

Toledo Bend Lake, Dam and Generating Station.
http://www.toledo-bend.com/toledo_bend/index.asp?request=tolbenddam.
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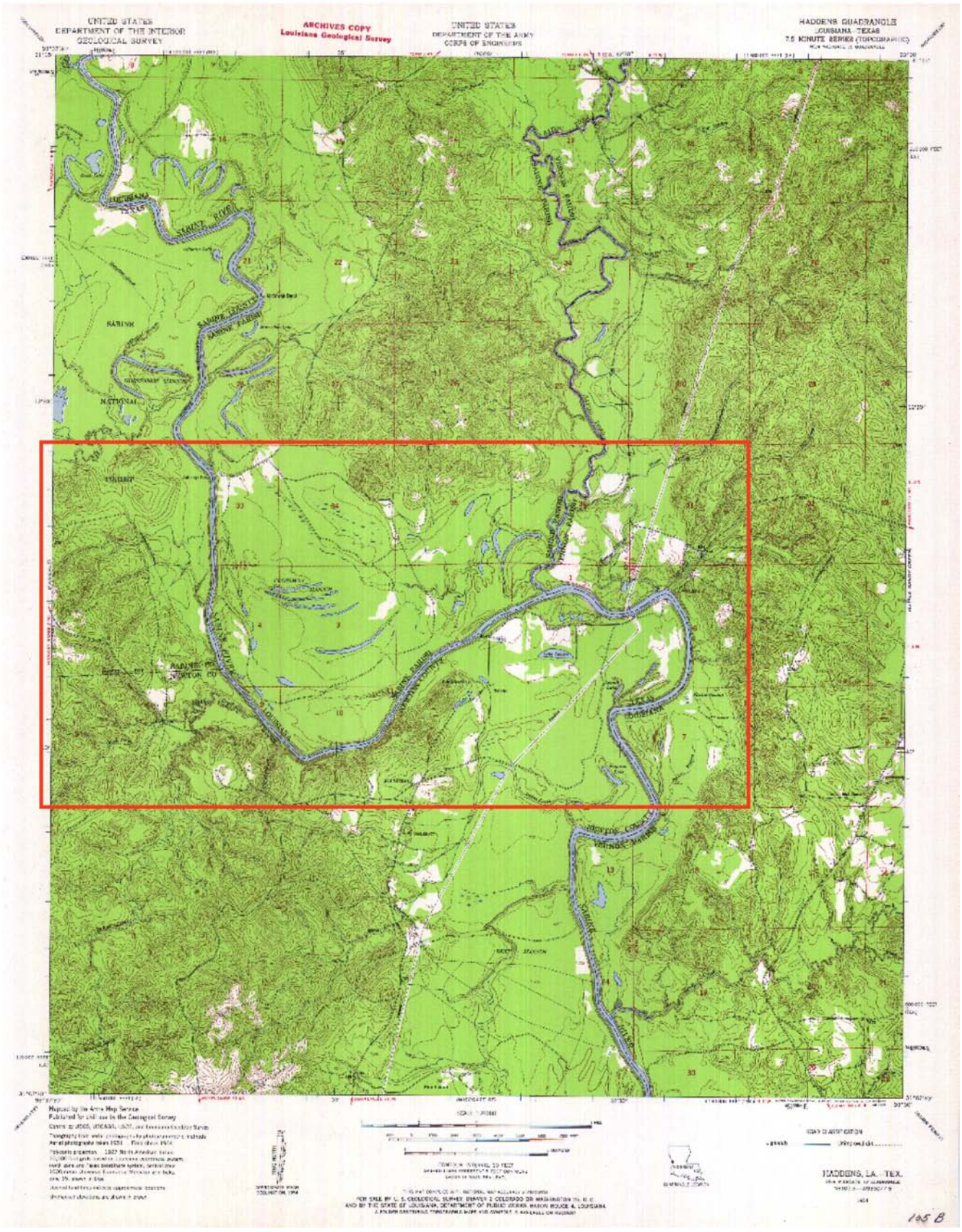
Facts about the dam and power plant.

Blackline Master #1

Haddens LA. — TEX. Quadrangle 1954



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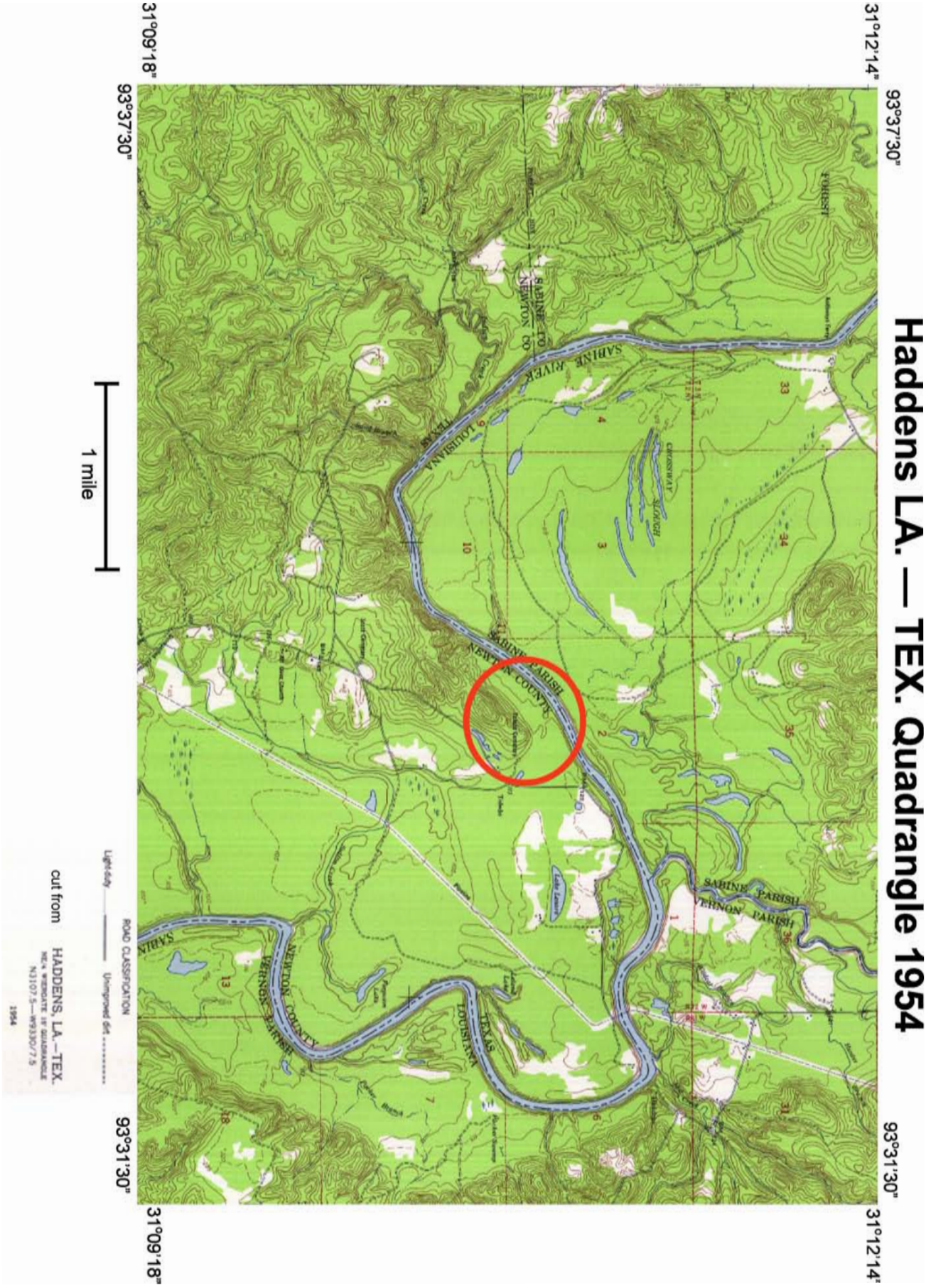

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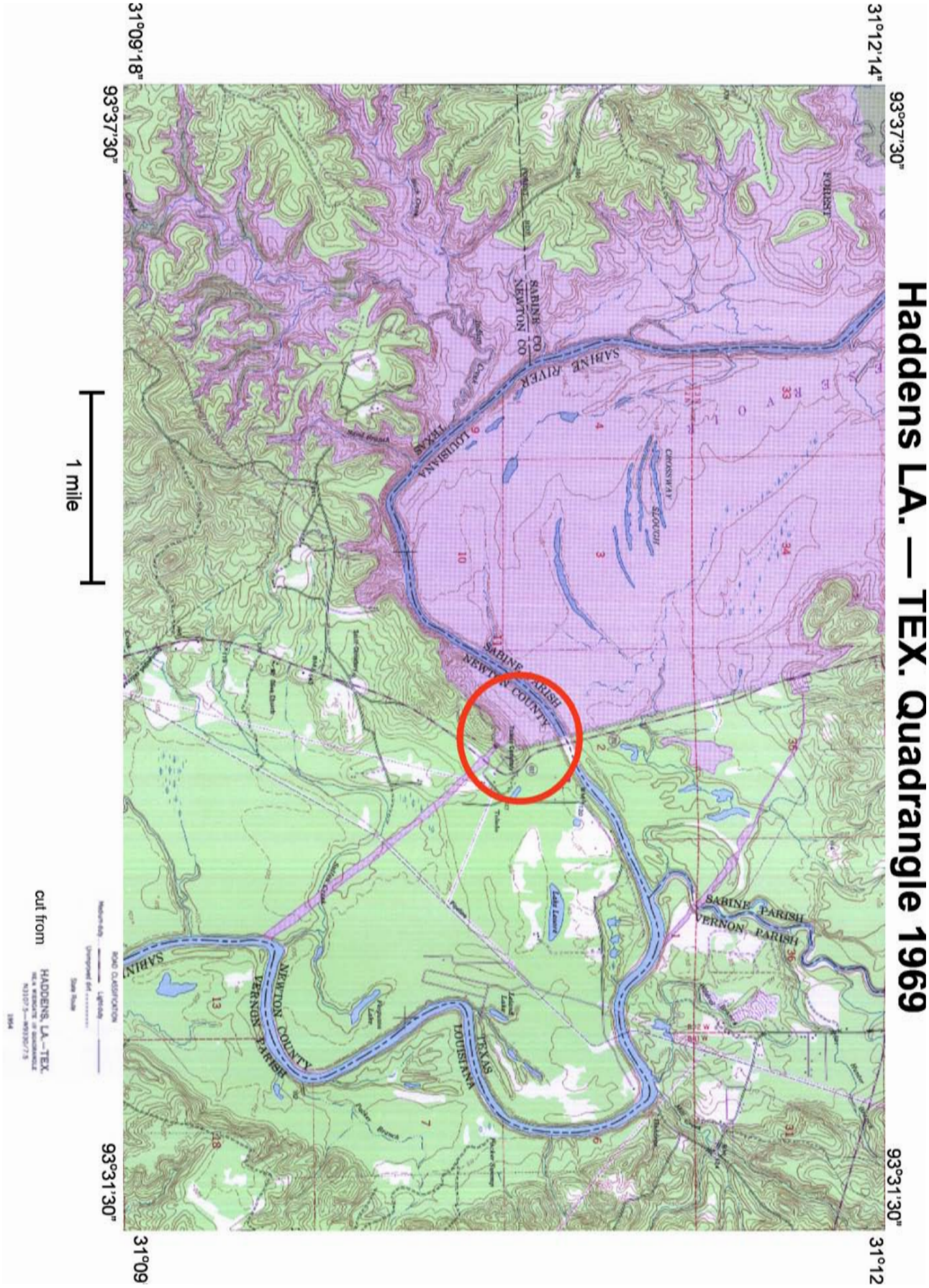
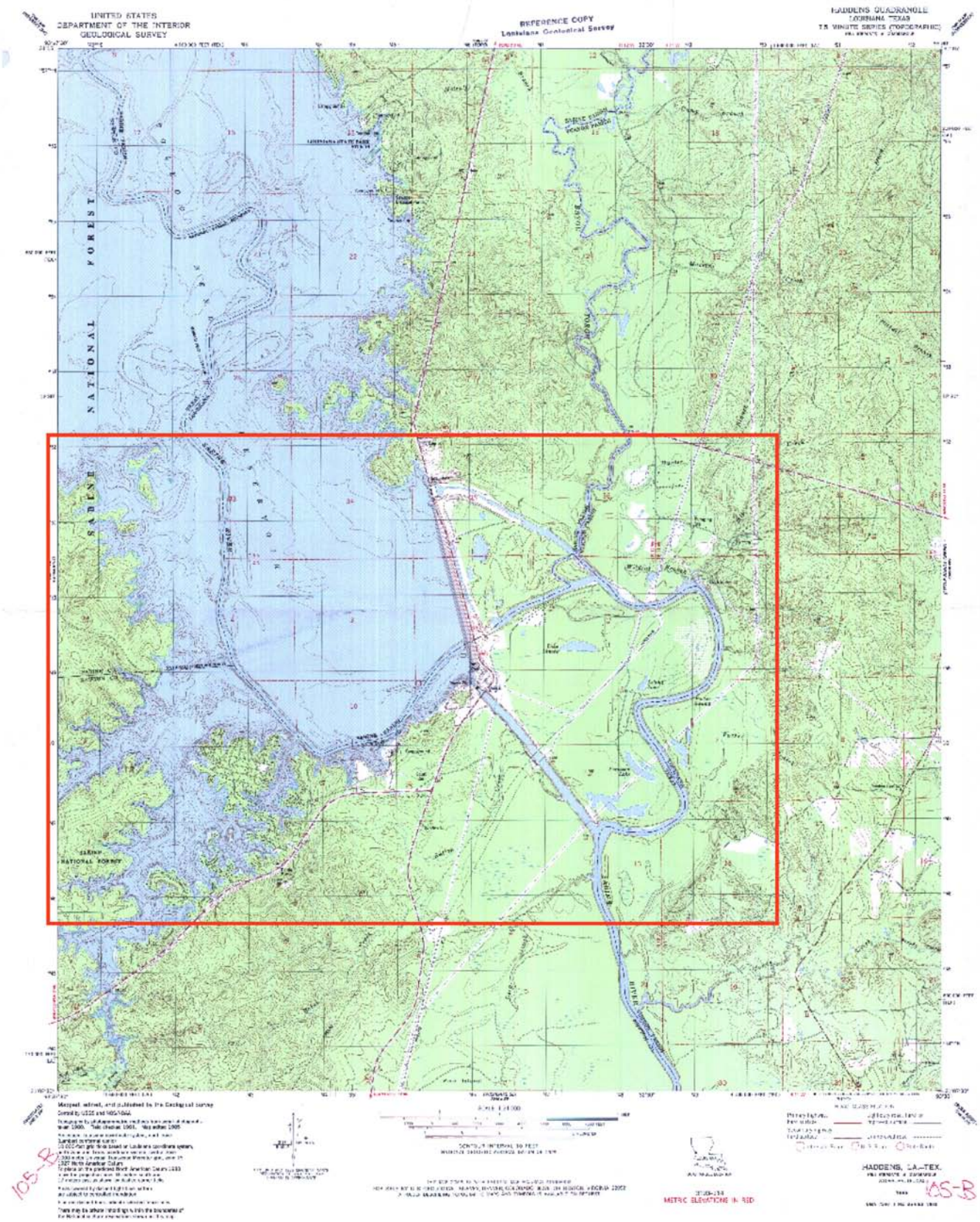


Blackline Master #4

Haddens LA. — TEX. Quadrangle 1985



Blackline Master #5