Flow-Ecology Workshop - Caddo Lake & Its Tributaries

October 2-4, 2006

Workshop Summary

I. Workshop Agenda, Purpose and Background: This second flow-ecology workshop was convened by the Caddo Lake Institute (CLI), the Texas Nature Conservancy (TNC) and the North East Texas Municipal Water District (NETMWD) in Jefferson, Texas for two purposes:

1) Continuing the work of the environmental flow evaluation begun at the orientation meeting in December 2004 and the first workshop in May 2005; and

2) Initiating the work of the Hydrology Concerns Workgroup of the Caddo Lake Watershed Protection Planning process.

The Agenda for the workshop is provided as Appendix A.

The names and affiliations of the 40 scientists and 40 others who attended the workshop are shown on Appendix B.

Before the meeting, background reports, which supplemented the reports prepared for the May 2005 workshop, were developed and posted on the CLI website, together with results of interim coordinating meetings and related information. These documents can be found on the Flows Project pages at www.caddolakeinstitute.us.

The role of the Hydrology Concerns Workgroup for the Watershed Protection Planning (WPP) process was defined at a stakeholders' meeting of the WPP in April 2005. A summary of the WPP process is provided as Appendix C. Details on that process can be found at the NETMWD website www.netmwd.com/Caddo%20Lake%20Protection%20Plan/Caddo_index.html. With the focus of the WPP on contaminants in Caddo Lake, the Hydrology Concerns Workgroup is charged with examining the role of the water flowing in the tributaries to Caddo Lake as well as the flow, levels, and effect of circulation of water in the Lake on contaminant levels.

The workshop began with field trips to Caddo Lake and to Big and Black Cypress Bayous on October 2nd. The formal meetings were held on October 3rd and 4th. The meeting on October 3rd started with presentations on the history and purpose of the workshop. Jeff Opperman from the Sustainable Waters Program of TNC coordinated the meeting, starting with presentations on the five areas of ongoing work - hydrology, biology, geomorphology, connectivity and water quality.

Wendy Gordon with the Texas Commission on Environmental Quality (TCEQ) then made a presentation on the status of the Texas Instream Flows Studies (TIFS) program and provided a basis for comparing the TIFS with the studies being done or proposed for the work on Caddo Lake. Breakout sessions followed in the afternoon.

Wednesday began with a presentation on the potential basis for developing building blocks for Little and Black Cypress Bayous. That was followed by a second round of breakout sessions and a concluding joint meeting.

The presentations and summaries of the breakout session can be obtained on the Flows Project pages at http://www.caddolakeinstitute.us/FlowsPresentations06.html.

The basic goals of the workshop and breakout meetings, other than to coordinate with the state TIFS, were:

- Review and, if appropriate, revise building blocks and the research priorities for Big Cypress & Caddo Lake developed at the May 2005 workshop;
- Determine if subsistence flow building blocks are needed for Big Cypress and Caddo Lake, and if so, the flows or levels;
- Evaluate the need to examine other tributaries;
- Determine the extent to which the decisions for Big Cypress can determine the building blocks and research priorities for other tributaries;
- Develop building blocks and research priorities for Little and Black Cypress and determine what role if any these tributaries can serve in the evaluation of Big Cypress; and
- Evaluate the research priorities in terms of the State environmental flow process.

The major limitation on the work of the October 2006 workshop was the lack of rain since the last meeting. Without sufficient rain, Lake O' the Pines (LOP) has not been able to provide releases needed to test the building blocks proposed at the May 2005 meeting. Other work, however, did provide additional information for review of the building blocks for Big Cypress Bayou and Caddo Lake. In addition, the participants were able to reach consensus on the approach for building blocks for Little and Black Cypress Bayous.

The meeting concluded with proposals to address all of the goals.

II. Building Blocks:

A. Building Blocks for Big Cypress Bayou: The building blocks for Big Cypress Bayou were determined in the May 2005 workshop and were not changed in the 2006 workshop. They are shown in Figure 1. These and the other building blocks, which are shown below, represent ecological outcomes that would be expected if certain flow conditions were attained.

The flows in Big Cypress noted in Figure 1 are targets for the "old" USGS flow-gauging location at Jefferson, Texas. Releases from Lake O' the Pines need to provide some of the flood flows and some high flow pulses that are proposed in Figure 1 cannot be attained until structural modifications are made to Ferrell's Bridge Dam (Lake O' the Pines) and other steps are taken to protect against flooding in Jefferson and other locations, as discussed further under "Implementation" below.

The low-flow targets noted in Figure 1 are based upon a variety of ecological objectives. Other targets were based upon the fish habitat modeling results as well as a review of the pre-dam low-flow conditions for each month, as derived from the "Indicators of Hydrologic Alteration" (IHA) software.

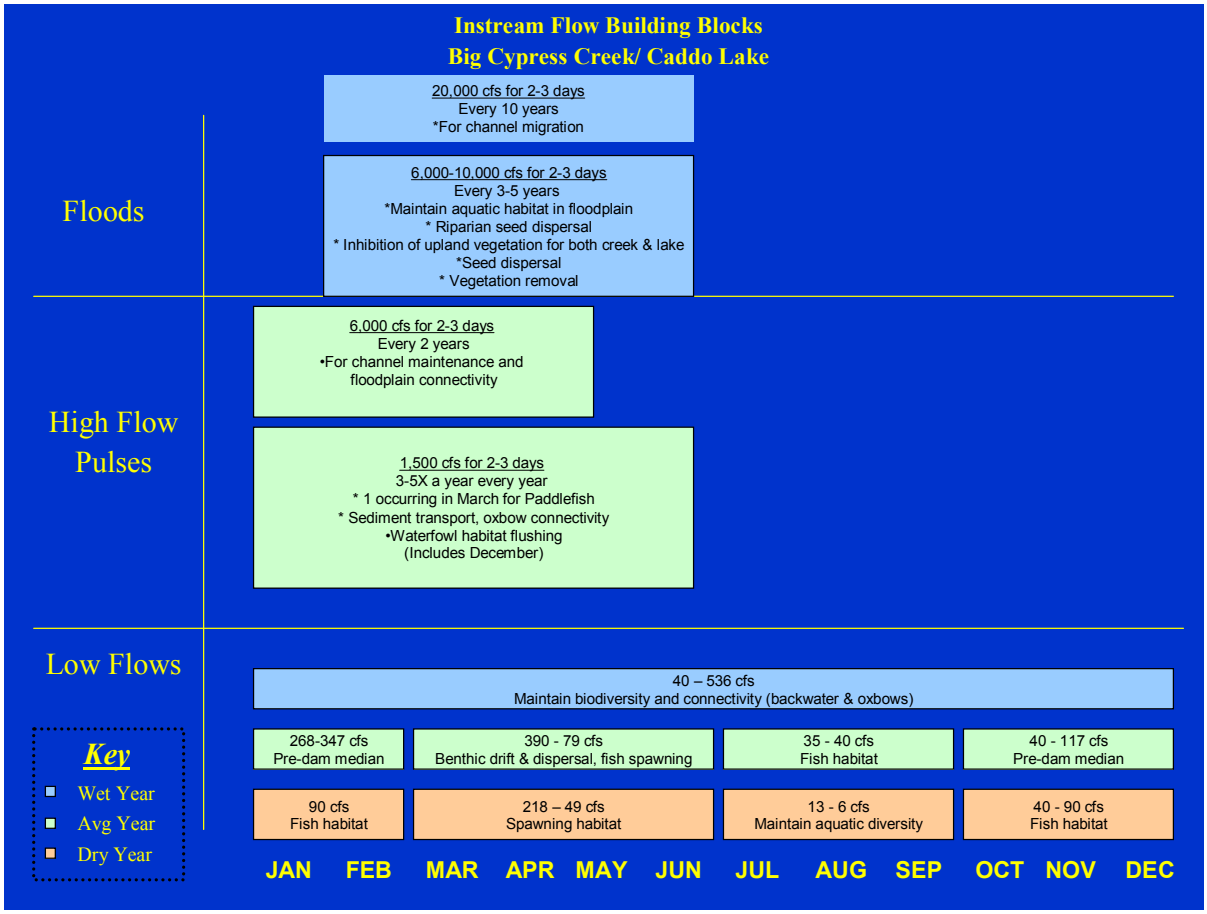

Figure 1. Flow-ecology building blocks for Big Cypress Bayou

The high-pulse flows in December-June were based upon pre-dam flow records, ecological information provided in the Summary Report, and professional judgment. One of the flood building blocks calls for a flow of 6,000 cfs for the purpose of channel maintenance. This target level is based upon the assumption that the pre-dam 2-year flood magnitude approximates the bankfull discharge level. The bankfull flow is assumed to be the 'effective discharge,' or the flow that is most responsible for maintaining the channel. This effective discharge is based not just on the magnitude and frequency, but the duration. The assumptions regarding the bankfull discharge were questioned at the meeting, and the matter left to be tested when releases are available from LOP.

Additional information on the Big Cypress building blocks can be obtained by reviewing the report from the May 2005 workshop, including Appendix C to that report.

B. Building Blocks for Little Cypress and Black Cypress Bayous: There was a general consensus that the building blocks for these two tributaries could be developed by using the same approach as was used to develop the building blocks for Big Cypress Bayou. The two breakout groups charged with developing building blocks for the tributaries, however, made fairly different reports back to the workshop. One group focused on the hydrologic statistics and developed specific numbers for building blocks while the other group focused more on potential research questions and proposed several new concepts to the building blocks approach.

New concepts:

Untouchable Stream: One group proposed that Black Cypress should be designated an "untouchable" building block. Although this could be expressed in individual building blocks that retain all natural flow characteristics and variability, the spirit of the recommendation was that there should be no major changes to flow in Black Cypress. Thus, one breakout group felt that Black Cypress should remain in a relatively natural state to serve as: (1) a source of unregulated flows to Caddo Lake; (2) a reference state for other creeks; (3) a refuge for biota. With the changes to Big Cypress, including the construction of Lake O' the Pines, it was argued that a natural flow in Black Cypress was needed to provide a natural system in the watershed and periodic high flows below the its confluence with Big Cypress and into Caddo Lake.

Historically Large Floods: This group also proposed 'historically large' events should still occur on Little Cypress. For practical purposes, this was often referred to as the 'hundred-year flood, however the group did not want simply to recommend that all large floods be maintained (i.e., that water storage projects could not capture any flows from large events). Thus, if Little Cypress has a hundred-year flood and then five years later another hundred-year flood occurs (or a similarly large event), the second flood may not be needed to satisfy the building blocks. The consensus was that water from some large floods could be captured, provided that the flows in building blocks were maintained.

To achieve this, the group recommended the desired 'outputs' from a historically large flood be defined, emphasizing those outputs that differ, in type or magnitude, from 10-year floods. Broadly, these outputs include channel migration and avulsion; the creation of new side channels, meander cut-offs and oxbows; connectivity with oxbows; removal of mature vegetation and addition and redistribution of large wood; and naturally high inflows to Caddo Lake. These outputs could be characterized through research and monitoring and grouped into 'indices' for the lake and creek channel. The following process would determine whether a large flood could be stored or attenuated:

1. For purposes of monitoring and research, the next large flood should occur with unmodified hydrological characteristics (e.g., a flood greater than a 25-year recurrence interval);
2. The lake and creek channel indices would be refined through research and monitoring;
3. When monitoring suggested that the indices were in a 'healthy' range, large events could be stored, attenuated, etc;
4. When monitoring suggested that the indices were declining, indicating that the creek and/or lake required a very large event, then the next very large flood would occur with unmodified hydrological characteristics;
5. Repeat steps 2-4.

Subsistence Flows - Extreme Low Flows: In keeping with the basic framework laid out by the Texas Instream Flow Program, there was discussion regarding the need to develop subsistence flow recommendations. The discussions centered on the ecological benefit that such flow might provide, thus, the setting of a goal of providing extreme flows verses the concept of an absolute minimum, notably to maintain water quality standards, i.e. 7Q2, which would be the absolute minimum below which the flow should never fall.

Several people suggested that we don't really know what 'natural' extreme low flows are, because: (1) the activities of beavers are affecting low flows and the water table; and (2) the historical log jam resulted in higher lake levels, and possibly higher regional water table levels, than exist today; and (3) other anthropogenic influences including changes in land use and groundwater extraction.

Neither group reached a consensus on the issue of subsistence flows.

Building Blocks

Base Flows/Low Flows: The entire group agreed that the IHA-EFC (what is EFC?) 25th, 50th and 75th monthly low flow percentile values were reasonable starting values for the base flows.

There was some discussion of augmenting the IHA-derived monthly percentiles with values developed in the Physical HABitat SIMulation (PHABSIM) study and it was suggested that the same could be done for Little Cypress. The recommended flow from PHABSIM for Black Cypress in September was 75 cfs while the monthly median flow was 3 cfs (the flow can be 0 cfs) and for Little Cypress the PHABSIM recommended September flow was 75 cfs while the median was 11 cfs. Stipulating an August and September low flow of 75 (seven to twenty times greater than the median flow) would change the creeks from ones that frequently had intermittent flow during the dry season to ones that had consistent elevated base flows. Consideration of the results of the earlier study will require further examination and discussion, particularly in light of the preliminary research cited by Josh Perkin that found that the stabilized and elevated low flows in Big Cypress may have favored generalist fish species over other native fish species.

It was suggested that the very low flows, specifically the 25th percentile flows for August-October, might result in a series of disconnected pools. In order to maintain the connectivity between pools, it was proposed that the absolute minimum flows for Little and Black Cypress should not be less than 5 and 4 cfs respectively.

High-flow Pulses/Small Floods: While there was a willingness in both groups to parallel the Big Cypress approach (the high flow pulse target was the 2-year flood), there was a lot of discussion about what this flow represents, i.e. the bankfull flow or the effective discharge. The bankfull flow is generally assumed to be the 'channel-forming' discharge or effective discharge, in that it performs the most work, moves the most sediment and, thus, is most responsible for channel morphology. It was pointed out, however, that in natural systems, there is actually great variability in the recurrence interval of bankfull discharge (i.e., it is frequently not between 1-2 years) and also the bankfull discharge is frequently not the dominant discharge or channel-forming discharge (the dominant discharge can range from being more frequent than 'bankfull', occurring 3-5 times a year, or can be less frequent than bankfull).

Further, it is important to understand linkages between fish behavior and life histories and high flow pulses to better understand how the timing and duration of pulses influence fish populations. There was also discussion as to whether it is more important to retain the frequency and seasonality of pulses during the year, but allow diminution of magnitude, or whether it is more important to retain the magnitude but allow a diminution of frequency.

Based on the USGS's preliminary analysis on Big Cypress, it was felt that the 2-year flood may over estimate the physical bankfull flow. Therefore, the lower bound on the 95th percentile

confidence interval of the 1.5-year flood, calculated by the USGS PeakFQ software program, was selected as the lower bound. An upper bound, to ensure that the water will rise to steep banks in some areas, was also proposed. The value of the upper bound was based on professional judgment.

Both groups articulated research questions to examine whether this flow (the 'bankfull' flow) provides the hypothesized ecosystem services including flushing accumulated fine sediments from gravel, scouring pools, building riffles, removing vegetation from active channel inundating bars, maintaining channel capacity, maintaining aquatic habitat in floodplain (i.e., resetting oxbow lakes), riparian seed dispersal, inhibition of encroachment by upland vegetation, adding woody material to channel, and providing connectivity between channel, floodplain, and floodplain water bodies. Although the building blocks in figures 2 and 3 include these flows under high flow pulses, it is likely that these functions will be satisfied by a combination of in-channel high flow pulses and bankfull small floods.

The high flow pulse recommendations for Little and Black Cypress do not include the recommendations for multiple pulses every year, as was done for Big Cypress. It should be noted that this absence was due to lack of time rather than a considered choice.

Large Floods/Overbank Flows: The group was comfortable prescribing a building block for large floods in a similar manner as the building block for Big Cypress. For Big Cypress, a building block for a large flood stipulated that a flood of 20,000 cfs (approximately 10-year recurrence interval) occur once every ten years.

- Thus, for Little and Black Cypress, floods of approximately 13,000 and 8,000 cfs should occur for 2-3 days every ten years, in the late winter or spring.
- The working hypothesis is that such a flood will promote channel migration.
- The group suggested that attributes (e.g., magnitude, duration) of a large flood be adjusted through monitoring and further research that examines the linkages between flood characteristics and physical processes such as channel migration.

Figure 1 Little Cypress Instream Flow Building Blocks

Figure 2 Black Cypress Instream Flow Building Blocks

C. Building Blocks for Caddo Lake: The building blocks for Caddo Lake were determined in the May 2005 workshop and not changed in the 2006 workshop. They are shown Figure 4. The basis for these building blocks can be reviewed in the report from the May 2005 workshop.

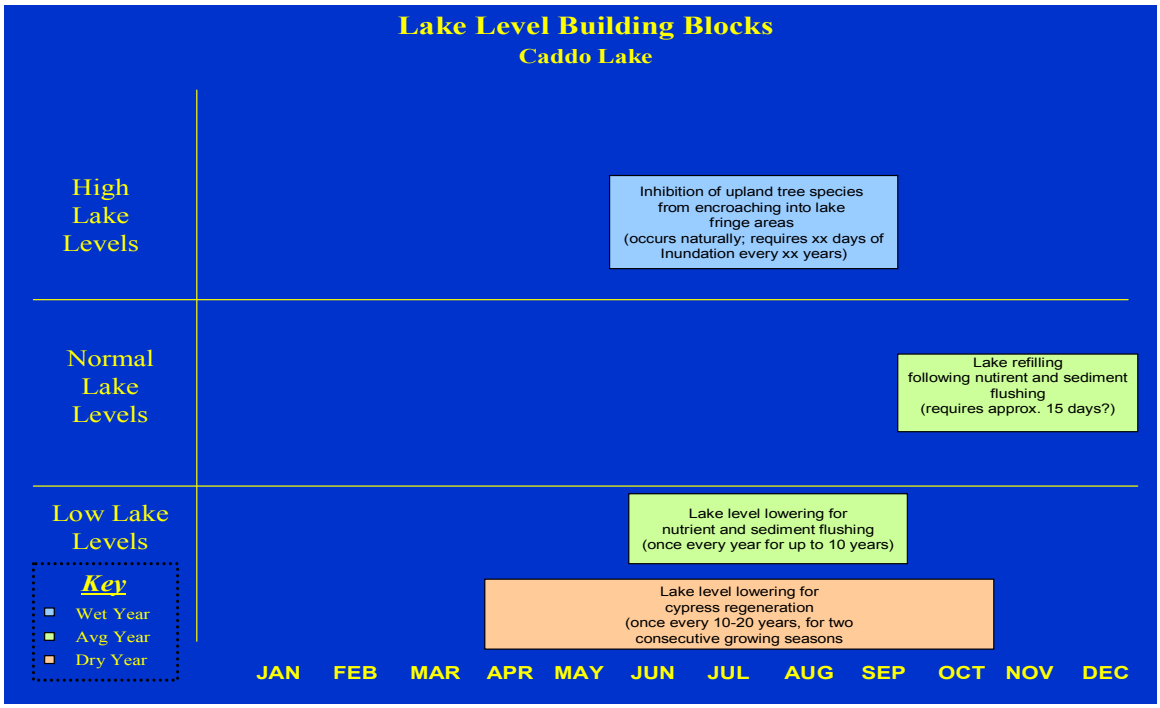

Figure 4. Lake level-ecology building blocks for Caddo Lake.

III. Implementation: Concerns with the impacts of the flows and lake levels proposed in the building blocks were naturally raised in both the May 2005 and October 2006 meetings. Those present were asked to ignore the problems of implementation for purposes of determining the best scientific options or assumptions. Nevertheless, the problems of implementing the building blocks needed to be discussed and were. The resulting list, which is not intended to be exhaustive, is provided in Appendix D.

One obvious example of implementation issues is the important flood control role that LOP plays. Potential flooding cannot be ignored for the purposes of testing the flow hypothesis for Big Cypress or in determining what releases can be made from LOP in the future. Presently, maximum releases from LOP are constrained to 3,000 cfs. This is substantially lower than the 6,000-20,000 cfs flood flows suggested by three of the building blocks in Figure 1.

Thus, a redesign of the outlet works for LOP will likely have to be considered if some of the building blocks are ever going to be met. Further discussion of such implementation issues can be found in the report on the May 2005 workshop on the CLI website.

Appendix A

2nd Flows-Ecology Workshop for Caddo Lake
&
1st Caddo Lake WPP - Hydrology Work Group Meeting

October 2-4, 2006
Jefferson, Texas

Monday, October 2nd

1:00 – 5:00pm	Field Trips: Caddo Lake and Tributaries

Tuesday, October 3rd

9:00-9:30am	Welcome & Objectives, Flows prescription process & the WPP *(Rick Lowerre, Jeff Opperman & Beverly Allen)*
9:30-10:15am	Panel Discussions (Part 1): review & update of on-going work on Big Cypress and Caddo, introduction to tributaries, proposed work to be done, (with additional focus on role with WPP) ▪ Hydrology & Connectivity *(Joe Trungale & Craig Loftin)*
10:15-10:30am	Break
10:30-12:00am	Panel Discussions (Part 2): review & update of on-going work on Big Cypress and Caddo, introduction to tributaries, proposed work to be done, (with additional focus on role with WPP) ▪ Biology & Geomorphology *(Bruce Moring, Josh Perkins & Ryan Smith)* ▪ Water Quality *(Paul Price)*
12:00-1:00pm	Lunch (provided)
1:00-2:00pm	Texas State Environmental Flows Process *(Wendy Gordon & Kevin Mayes)* And how Caddo process fits, and what the Caddo Process can add to state effort
2:00-2:15pm	Discussion of goals and process for breakout sessions (*Jeff Opperman)*
2:15-3:45pm	Breakout Sessions: research priorities and building blocks 1) Hydrology & Connectivity (also serves as the WPP Hydrology work group.) 2) Biology & Geomorphology 3) Water Quality
3:45-4:00pm	Break
4:00-5:00pm	Reports from breakout sessions – one for each session & plan for Wed AM (*Jeff Opperman)*

Wednesday, October 4th

9:00-9:30 am	Overview of potential starting point for building blocks for tributaries (*Joe Trungale)*
9:30-10:30am	Breakout Sessions: review/revise Tuesday's proposals: research priorities & building blocks 1) Tributaries (two sessions) 2) Caddo Lake
10:30-10:45am	Break
10:45-11:30am	Reports from breakout sessions - one for each session (*Jeff Opperman)*
11:30-12:00pm	Planning for the WPP workgroup report to WPP Stakeholders Meeting on October 26, 2006 (*Walt Sears & Rick Lowerre)*

Appendix B **Workshop Participants**

First	Last	Affiliation
Vanessa	Adams	Texas Parks & Wildlife Department
Beverly	Allen	N E Tx Municipal Water District
Richard	Anderson	Resident, City of Marshall
Kent	Becher	US Geological Survey
Jim	Bergan	The Nature Conservancy of Texas
Max	Berry	Tx State Soil & Water Conservation Board
Leroy	Biggers	Tx Commission on Environmental Quality
Tim	Bister	Texas Parks & Wildlife Department
Jan	Boydstun	LA Dept. of Environmental Quality
Henry	Bradbury	Caddo Lake Ramsar Clearinghouse
Brian	Breeding	City of Marshall
James	Broska	U.S. Fish & Wildlife Service
William	Brown	N E Tx Municipal Water District
Paul	Bruckwicki	U.S. Fish & Wildlife Service
Jack	Canson	Greater Caddo Lake Assn.
Sam	Canup	City of Uncertain
Greg W.	Carter	American Electric Power
Matthew	Chumchal	University of Oklahoma
Tom	Cloud	U.S. Fish & Wildlife Service
Rob	Cook	Tx Commission on Environmental Quality
Roy	Darville	East Texas Baptist University
Francene	DePrez	Historic Jefferson Railway
Jesse	DeWare	Jeffersonian Institute
Todd	Dickinson	TPWD Caddo Lake State Park
Charles	Dixon	Marshall Resident
Mike	Duran	The Nature Conservancy
Gary	Endsley	Caddo Lake Inst. & Jeffersonian Inst.
Frank	Espino	Tx Commission on Environmental Quality
Kyle	Fitch	Marshall, Texas
Neil	Ford	Univ. of Texas, Tyler
Paul	Fortune	Greater Caddo Lake Assn.
Jordan	Furnans	Texas Water Development Board
Wendy	Gordon	Tx Commission on Environmental Quality
Lucas	Gregory	Tx A&M Texas Water Resources Institute
Carol	Harrell	Jeffersonian Institute
Jim	Harris	Resident, City of Marshall
Raymon	Hedges	USACE, Piney Woods Project
Franklin	Heitmuller	U.S. Geological Survey
Robert (Bob)	Joseph	US Geological Survey
Mary	Kelly	Environmental Defense
Praveen	Kokkanti	Texas Parks & Wildlife Department

First	Last	Affiliation
Frank	Lang	Resident, City of Jefferson
Paul	Lauderdale	US Army Corps of Engineers
Richard	LeTourneau	NE TX Regional Water Planning Group
Craig	Loftin	US Army Corps Engineers
Richard	Lowerre	Caddo Lake Institute
Jeffrey	Mabe	US Geological Survey
Ricky	Maxey	Texas Parks & Wildlife Department
Kevin	Mayes	Texas Parks & Wildlife Department
Mike	McMurry	City of Marshall
Paul	Miliotis	Resident, Caddo Lake Area
Bruce	Moring	US Geological Survey
Jim	Neal	U.S Fish & Wildlife Service
Jeff	Operman	The Nature Conservancy
Joshuah	Perkins	Texas State University
Paul	Price	HDR Engineering, Inc.
Thomas	Rainwater	Texas Tech University
Anthony	Rasor	City of Mt. Pleasant
Paul	Rodman	US Army Corps of Engineers
John	Rosendale	US Geological Survey
Jack	Salmon	N E Tx Municipal Water District
Bob	Sanders	Cypress River Ranch
Jack	Sanders	Resident, City of Marshall
MaryJane	Sanders	Resident, City of Marshall
Walt	Sears	N E Tx Municipal Water District
Ken	Shaw	Cypress Valley Navigation District
Ryan	Smith	The Nature Conservancy
Robert	Speight	Greater Caddo Lake Assn.
Joe	Trungale	JFTrungale Engineering
Marie	Vanderpool	US Army Corps of Engineers
Tom	Walker	Cypress Valley Navigation District & GCLA
Jay & Patty	Webb	Caddo Lake Chamber of Commerce
Dan	Weber	The Nature Conservancy
Michael	Weber	Resident, City of Jefferson
Aaron	Wendt	Tx State Soil & Water Cons. Board
Adam	Whisenant	Texas Parks & Wildlife Department
Robert	Wigington	The Nature Conservancy
Mark	Williams	U.S. Fish & Wildlife Service
Jennifer	Wilson	US Geological Survey

Appendix C

SUMMARY OF WATERSHED PROTECTION PLANNING PROCESS FOR CADDO LAKE

10-2-06

The WPP process is similar to that used for the development of TMDLs. The WPP process is however, voluntary. The TMDL process can result in enforceable limitations on the contributions to pollutants by both point and non-point sources.

The WPP will address the stressors that could damage aspects of Caddo Lake that make it so valuable to humans and wildlife. There is no specific plan at this time. The Plan will be developed over several years, based on stakeholder input, additional research and evaluations by experts. The process will include:

- Significant input from a representative group of affected stakeholders.
- Emphasis on the common goals among competing interests.
- Reliance on science and focus on solutions.
- Integration across political boundaries, levels of government, and environmental media.

At least five general areas of concern have been identified, although other major and minor areas may be added to this list.

- Water Quality: Low dissolved oxygen, low pH (acidity) and mercury in fish tissue are the current impairments to the aquatic life and fish consumption uses. Concerns for future impairments are nutrient enrichment (from ammonia), bacteria, and sediment contamination (from barium, mercury, selenium, lead, and zinc).
- Water Quantity: This issue includes the amount of water in the Cypress Creek system, the impacts of drought and water withdrawals, and a flow regime that is significantly controlled by upstream impoundments.
- Aquatic and Riparian Habitat: Changes in land and water uses have altered critical aquatic and riparian habitat, and may continue to do so.
- Floodplain Management: Development in vulnerable areas of the Cypress Creek floodplain may be occurring as a result of inaccurate floodplain maps.
- Aquatic Vegetation: This issue includes the role of potential management strategies for native and exotic vegetation.

To date, there have been two full stakeholders' meetings and several meetings of workgroups. A third stakeholders' meeting is scheduled for October 26, 2006.

1st Stakeholders Meeting 2-3-06: Results:

Consensus to proceed with WPP process,

Identification of areas of concern, and

Agreement on need to identify additional stakeholders

2nd Stakeholders Meeting 4-26-06: Results:

Selection of NETMWD and Walt Sears for the Watershed Coordination for the WPP and a consensus to

Expand stakeholder list and participation,

Work with TCEQ on proposals for funding to EPA,

Coordinate expenditure and identify matching funds, and

Coordinate the implementation efforts that follow.

Establishment of three work groups:

Physical Concerns – Vegetation, septic tanks, economic impacts, etc (Met 5-16-06 & 8-30-96)

Water Quality Concerns – Coordinated with the Clean Rivers Program (Met 8-31-06)

Hydrologic Concerns – Coordinated with ongoing Flows-Ecology Effort (Met 10-2-4-06)

Appendix D

Implementation Concerns:
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III. Implementation Concerns:

- Assure public participation in flow restoration program and input to goal-setting for adaptive management.

- Articulation of expected ecological and ecosystem service benefits associated with flow restoration (for communication with stakeholders and water managers).

- Assess the impacts of lowering Caddo Lake on the local economy, sports fishing, etc., and the public acceptance and concerns of all stakeholders associated with such water management options that may be needed for regeneration of Cypress trees, management of invasive aquatic vegetation, etc.

- Evaluate the potential flood impacts on communities downstream of Lake o' the Pines.

- Evaluate the potential flood impacts on communities around and downstream of Caddo Lake.

- Assess the impacts of human developments on flooding and water quality (including impediments to flood implementation).

- Evaluate the implications of flow restoration on other water uses and needs (including Lake o' the Pines).

- Evaluate the improvements in the ability to forecast climate and water availability.

- *Evaluate infrastructure options for lowering the level of Caddo Lake.*