Ecological Design in the Ozarks

May 15-17, 2013

Workshop and Lake Frances Charrette

Arkansas Water Resources Center | Technical Publication MSC 368

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Executive Summary

Ecological design is "the development of sustainable ecosystems that integrate human society with its natural environment for the benefit of both"

— American Ecological Engineering Society

What if you could:

- Improve water quality in the Illinois River,
- Support existing river recreation,
- Create new recreation and education opportunities, including
- Demonstrating techniques and technologies that improve river water quality, and
- Could be implemented at many sites along the river, all the while
- Maintaining an important regional water supply?

Lake Frances and the lands surrounding it represent just such an opportunity.

Why Lake Frances?

- Lake Frances is located on the Illinois River, on the Oklahoma-Arkansas border, in the contentious Illinois River watershed.
- The Illinois River has been the focus of stakeholder issues and lawsuits between the states and other entities for many years.
- The State of Arkansas monitors water quality upstream from Lake Frances and State of Oklahoma monitors downstream.
- Lake Frances, however, is a water-quality transformer.
- Lake bottom sediments, accumulating since 1931 when the dam was constructed, are high in phosphorus.
- When oxygen is low in the overlying water those sediments release large amounts of that phosphorus--as much as 15 mg/square meter/day. (By way of comparison, other regional lake sediments release less than 4 mg/square meter/day under similar conditions.)
- Waters flowing from the shallow and frequently mixed lake also tend to be high in suspended sediments which, along with the nutrients released, contributes to a decrease in water clarity in the river downstream.
- A portion of the Lake Frances dam collapsed in 1990, lowering the lake level by over 8 feet and exposing much of the former lake bed.
- The former Lake Frances covered some 230 hectares (570 acres), and is today reduced to little more than river-width along its former length.
- The lake and much of the former lake bed is in public ownership.
- Lake Frances is owned by the City of Siloam Springs through an Oklahoma corporation, and is used as a municipal water supply.
- Lake Frances was formerly a recreational mecca, with a hotel on the hill above and a popular summer camp at its southern end; the now closed Gypsy Camp is listed on the National Register as a Historic District.

- A few miles upstream from the lake, the City of Siloam Springs is currently building a kayak park on the Illinois River, expected to bring many new visitors to the area.

- Downstream Illinois River recreation currently generates around $15 million per year of direct expenditures, and over 500,000 people visit the river each year.

New futures for Lake Frances

For three days in May 2013 thirty-plus engineers, ecologists, landscape architects, local area residents, students, and agency folk gathered in Fayetteville to explore possible futures for the lake. The workshop began with general discussions of ecological design that became increasingly focused on topics relevant to Lake Frances as the day went on. On the morning of the second day participants toured the historic Gypsy Camp buildings and grounds and surveyed the Illinois River at the southern end of the former lake. They then traveled to the northern end of the lake to see the dam, observe informal recreational use, the Siloam Springs water supply intake, and wetlands that have developed in the former lakebed.

After the site visit, the group divided into four teams and went to work. Design teams were mixed groups of students and professionals, from a diversity of backgrounds and with diverse expertise. Each team developed their own integrated proposal for Lake Frances. The pages that follow in this booklet record the results of their deliberations.

Photos show the historic entrance gate to the old Lake Frances hotel; fishing below Lake France dam; and the City of Siloam Springs water intake.

Photo By: Ed Fite


Photo By: Steve Patterson


Photo By: Steve Patterson

Next steps

Results from the workshop's design teams overwhelmingly say "yes!" to the potential of a valuable multipurpose future for Lake Frances. Designers developed innovative plans that found ways to both improve water quality and enhance recreation and education. They explored improvements to dam safety and maintenance of a water supply. The diversity of ideas presented are arguably more important than any particular plan—their diversity making the case for the future potential management of the site. Of course, more work needs to be done to develop the design concepts created during the charrette.

Key points emerging from the workshop include:

- **Agreement on a single interstate water quality monitoring location is essential.** Currently, the State of Arkansas monitors water quality upstream from Lake Frances and Oklahoma monitors downstream. Given what is known about Lake Frances as a water -quality modifier, and given the history of litigation between the states, it is imperative that the states agree on a single monitoring location. Having a single sampling site will help build agreement between the states. The logical place to sample is upstream of the lake, before the river is subjected to the modifying influences of Lake Frances.

  The existing lake is in Oklahoma. Its sediments have been enriched with phosphorus by decades of phosphorus loads from the watershed upstream in Arkansas. Work definitely needs to be done to improve water quality downstream from the lake, but Lake Frances effects need to be extracted from the interstate debates.

- **Remediation of phosphorus-rich lake sediments is feasible.** Alum or engineered clays could be added to the sediments and would permanently make the phosphorus to which they bind unavailable for algae growth.

- **Lake Frances could be a great place to build wetlands designed to remove phosphorus and sediment from the Illinois River.** A range of wetland design concepts were explored by the charrette teams. Though the teams' design concepts were diverse, all agreed that the former lake floodpool offers tremendous opportunities for wetland development.

- **The Lake Frances floodplain could become a research and education complex,** a place to examine the effectiveness of different types of wetlands in achieving Illinois River watershed goals--a place to compare, for instance, the performance of submerged aquatic vegetation, periphyton-based systems, emergent marsh, and hybrid wetlands (natural wetlands assisted by alum injection or other forms of more intensive management).

- **All teams were engaged by the potential for enhanced recreation at Lake Frances.** From dam bypass cascades for paddlers to boardwalks and observation platforms for birders, functioning wetlands, education, and recreation combine readily at Lake Frances.

- **Appropriate design criteria for any wetlands to be constructed in the former floodpool of Lake Frances depend on what the target is for water downstream.** Charrette discussions highlighted the need for increased clarity about design goals for Illinois River restoration. Oklahoma regulators want the water in their state to meet their standard, 0.037 mg/L phosphorus.

Most people who spend time on and in the river want to see improved ***water clarity--*** "They want to see their feet" is how Ed Fite, Oklahoma Scenic River Administrator puts it. Achieving 0.037 may help improve water clarity through a reduction in suspended algae, but meeting that standard alone will not be sufficient to achieve the commonsense desired outcome. Sediment reduction is also required. On the other hand, the recently approved *Second Statement of Joint Principles and Actions* selected the growth of benthic algae in the river as the standard to be measured. And, restoring Lake Tenkiller to its historic clarity will require additional in-lake action because it too suffers from decades of accumulated phosphorus.

The design of constructed wetlands at Lake Frances (and elsewhere along the river for that matter) will differ depending upon which of these standards or objectives one seeks to achieve.

- To take potential wetland and site design further ***three key information needs*** were identified:

  1. A good map of the current lake bottom (lake bathymetry)

  2. A high-resolution topographic map of the lands surrounding the existing lake

  3. A better understanding of how nutrients accumulated in lake bottom sediments and now exposed in the floodplain will behave if those soils are re-inundated, as they could be by wetland construction

- Other desirable information to be gathered includes:

  1. Laboratory analysis of lake sediment cores to estimate phosphorus concentration, release rates, and potential for phosphorus remediation

  2. Mapping lake sediment depths and estimating sediment quantities would complement the map of lake bathymetry

  3. Better maps and information on land ownership and parcel boundaries would also be helpful

A great outcome of the charrette would be if an interested agency or organization saw the potential benefit and helped finance the collection of some of this data.

Photo shows Lake Frances sediment cores being incubated at the Arkansas Water Resources Center lab

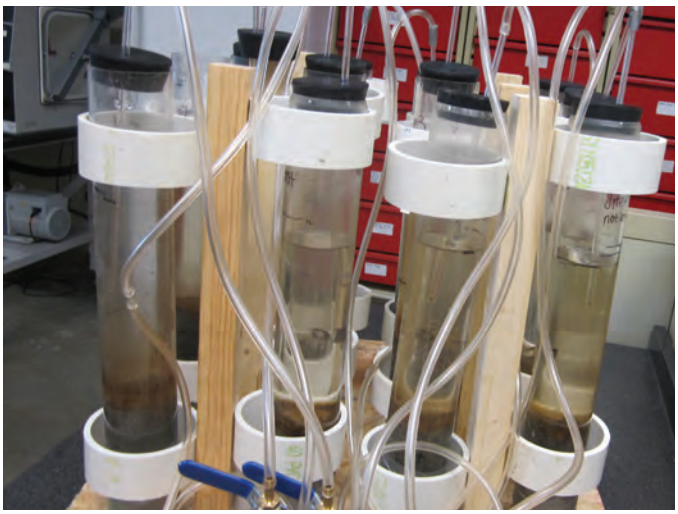


Photo By: Brian Haggard

Onward

A few weeks after the charrette a small group of workshop participants and friends launched canoes and kayaks upstream from the Arkansas Highway 59 bridge and floated and explored down the length of the former Lake Frances to the Siloam Spring water intake and the dam. So, while the charrette is over, the flow generated from it continues. Other ongoing activities include:

- At the University of Arkansas, professors Brian Haggard (Biological & Agricultural Engineering) and Mark Boyer (Landscape Architecture) are developing plans to incorporate the interactive, multidisciplinary collaborative charrette process into their design classes and projects. Possibilities being discussed include an intersession or summer class held as a multidisciplinary charrette that would then lead into the respective departmental design courses in the fall.

- Students from the University of Arkansas are analyzing soil from the former lake bed and sediments from the existing lake to determine phosphorus concentrations and release rates.

How can you help with next steps at Lake Frances and with future ecological design in the Ozarks?

Photo By: Steve Patterson

Introduction

Ecological Design in the Ozarks - A Workshop and Charrette was held May 15-17, 2013 in Fayetteville, Arkansas. Students, landscape architects, engineers, water quality specialists, ecologists, kayakers, and other interested individuals spent three days learning, brainstorming, and designing together.

The subject of their explorations was future possibilities for Lake Frances, a small but critical piece of ecological infrastructure on the Arkansas-Oklahoma border. Many ideas about Lake Frances' potential have been broached over the years, particularly regarding its role as a water quality transformer in contested terrain of the Illinois River watershed. Owned by the City of Siloam Springs and the water supply source for the city, Lake Frances has an interesting history and potentially an even more interesting future.

This pamphlet documents the workshop process and results, including suggestions for next steps to continue the work begun here.

The workshop was offered in conjunction with the 2013 Arkansas Water Resource Center's *Annual Watershed and Research Conference*[1] and the American Ecological Engineering Society's (AEES) *Certified Ecological Designer Program*[2].

Thirty-two people participated in the full three days of the workshop and charrette; about half were students from the University of Arkansas and other Arkansas and Oklahoma universities, and the other half were a diverse mix of professionals including practicing engineers and landscape architects and public agency staff.

What's a charrette?

A charrette is a short-term, intensive design process. The word comes from the French for "little cart" and refers to architectural students working furiously to complete their designs even as their drawings are being collected on a cart and wheeled away. Typically, a charrette will involve collaborative design work by small multidisciplinary groups, who then present their work to the full group to generate further discussion and innovation.

Certified Ecological Designer Program

The Certified Ecological Designer (CED) program promotes an integrated, multidisciplinary approach to ecological design, and certification is open to all interested practitioners from ecology, engineering, landscape architecture, architecture, planning and related disciplines.

How can we improve the practice of ecological design? How can we learn to work together better and build more successful projects? The best ecological designs are usually the product of collaborative, multidisciplinary teams. Engineers, landscape architects, other designers and planners, ecologists, and other scientists each make important contributions, but draw on different perspectives, speak different languages, and evaluate success by different criteria.

Participants in AEES CED workshops explore these differing perspectives through presentations and discussion, and then through practice in the design charrette.

1. For more information about the Arkansas Water Resources Center and their annual conference visit their website at http://www.uark.edu/depts/awrc/

2. For more information the American Ecological Engineering Society's CED program, see the AEES website at http://ecoeng.org/certification/certification.html

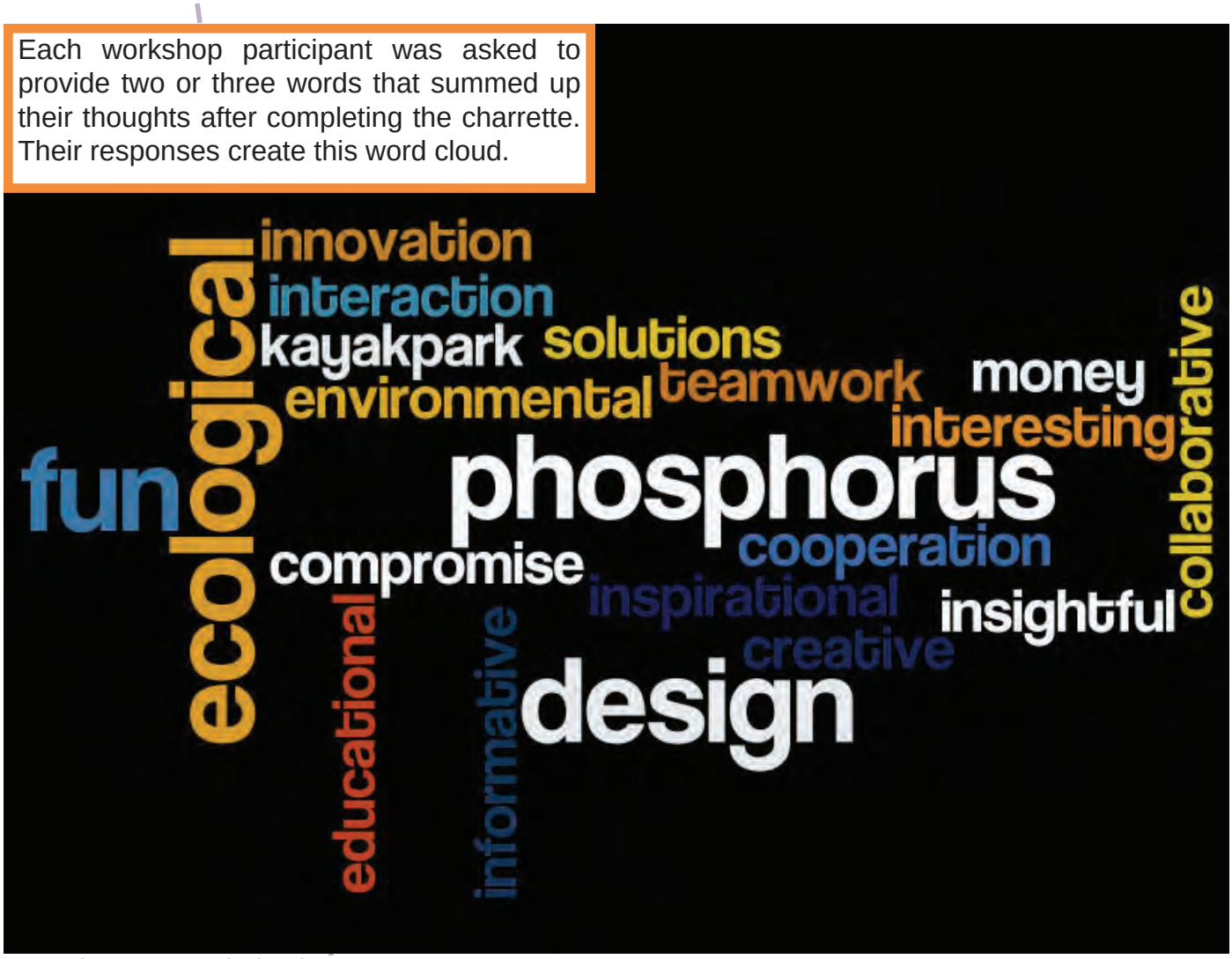
Ecological Design Presentations

Day one of the workshop began with a day of presentations and discussions covering a range of ecological design topics under three general rubrics: Perspectives & Practices, Design Tools & Tools of Thought, and Case Studies & Best Practices.

Presentations explored: the respective practices and perspectives of ecologists, engineers, and landscape architects; ecological modeling as a design tool; best practices for designing for public participation in design projects; stormwater design strategies to bring people and water together; principles of reservoir ecology with an emphasis on those relevant to Lake Frances; and ideas for how to design constructed wetlands so that they benefit both water quality and wildlife.

Discussion leaders brought a wealth of expertise to the workshop and help set a high bar for the design sessions to follow. We thank all of them for their willingness to share their time and knowledge with workshop participants.

Each workshop participant was asked to provide two or three words that summed up their thoughts after completing the charrette. Their responses create this word cloud.



Post-Charrette Word Cloud

Opportunities and Constraints

The instructions to the charrette design teams were straightforward:

Develop a comprehensive, integrated plan for Lake Frances re/development

Aspects suggested for consideration included:

- Water quality of the reservoir itself
- Effects of the reservoir on downstream water quality
- Potential to improve downstream water quality via lake management
- Potential to improve downstream water quality via wetlands or other activities on land surrounding the lake
- Opportunities for enhancing recreational use
- Opportunities for developing historical and natural history education and tourism
- Wildlife habitat, fishing
- Other economic development opportunities
- Larger regional plans and patterns of projected development
- Larger regional plans for greenspace and wildlands preservation
- Water supply opportunities and constraints

Photos document the workshop field trip to the historic Gypsy Camp located at the southern end of the lake's former footprint.

Photo By: Steve Patterson

Photo By: Nick Cerra

Photo By: Steve Patterson

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Photo By: Nick Cerra

Several speakers briefed participants with information on various aspects of these topics:

Brian Haggard gave an overview of water quality issues related to Lake Frances. He emphasized two points:

- Arkansas measures Illinois River phosphorus levels upstream from Lake Frances; Oklahoma measures downstream. This means that the two states are not measuring the same thing, a fact that contributes to differing perspectives on water quality, and to political and legal disputes.

- Lake Frances, under certain conditions, is a source of phosphorus to the Illinois River, leading to higher phosphorus measurements downstream than upstream. This is because the lake has accumulated phosphorus in its sediment over the years.

Dan Wagner from the USGS informed workshop participants on where in the watershed the USGS had gauges and conducted sampling, and showed them where to find the data online.

Dan Storm from Oklahoma State presented an overview of key aspects of wetland design opportunities at Lake Frances, and interpretations of some of the water quality data that Dr. Haggard and Dan Wagner had presented in terms of design criteria for the wetland(s)—how much phosphorus needs to be removed to achieve certain standards?

- A key point that Dr. Storm highlighted was the difference between what might be required to meet the Oklahoma in-stream phosphorus standard of 0.037 mg/L, and the phosphorus load reductions that will be required to restore water quality in Lake Tenkiller.

Finally, **Ed Fite**, Oklahoma Scenic Rivers Commission Administrator, gave a presentation on the economic and recreational value of the Illinois River downstream from Lake Frances, highlighting the numbers of visitors and the multiplier effect of their visits on the regional economy.

- Mr. Fite emphasized that what was most important to most visitors in terms of water quality was (1) that the water was safe—no pathogens or toxins, and (2) that the water was clear—and offered an handy standard for that: “they want to be able to see their feet” when they are standing in the river.

- The latter point on river clarity raises additional wetland design criteria, but turbidity in the river has two sources—one is algae, and is driven by nutrient levels, the other is suspended sediment, which comes from urban runoff, dirt roads, and stream bank erosion. Reducing sediment is not addressed by meeting the phosphorus standard, and sediment capturing wetlands are in some ways easier to design.

Following these introductory presentations, the workshop made a field trip to see Lake Frances first hand. The group made two stops, at the south-eastern end of what was once the lake, at the historic Gypsy Camp. Then the group traveled to the northwestern, downstream end to see the remaining dam and the water supply intake structure, as well as a portion of the former lake that is now grown up in trees and wetland vegetation.

At the Gypsy Camp, **Benjamin Stinnett** led the group through the remaining historic camp buildings and gave them an overview of the importance of the former lake as a recreational site. Mr. Stinnett is a Siloam Springs native and graduate of the University of Arkansas in Landscape Architecture. His project report on the history of the Gypsy Camp and the potential of the area for historical and environmental education was one of the resources made available to all charrette participants.

At the dam site, **Shanon Phillips**, Water Quality Director for the Oklahoma Conservation Commission talked about water quality in the Oklahoma Illinois River watershed and about the potential role that Lake Frances had both directly to improve water quality through wetlands, and by the potential of the site as an educational example of what could be done elsewhere as well.

After finishing lunch at the dam site, the charrette teams returned to Fayetteville to begin work.

Copies of the powerpoint presentations for the opportunities and constraints speakers, as well as a copy of Ben Stinnett's report on Gypsy Camp, are available for viewing at:
http://www.bioxdesign.com/ecological-design-in-the-ozarks/workshop-presentations

Photos show the existing conditions at the Lake Frances dam and spillway.

Photo By: Nick Cerra

Photo By: Nick Cerra

Photo By: Nick Cerra

Teamwork: Group 1

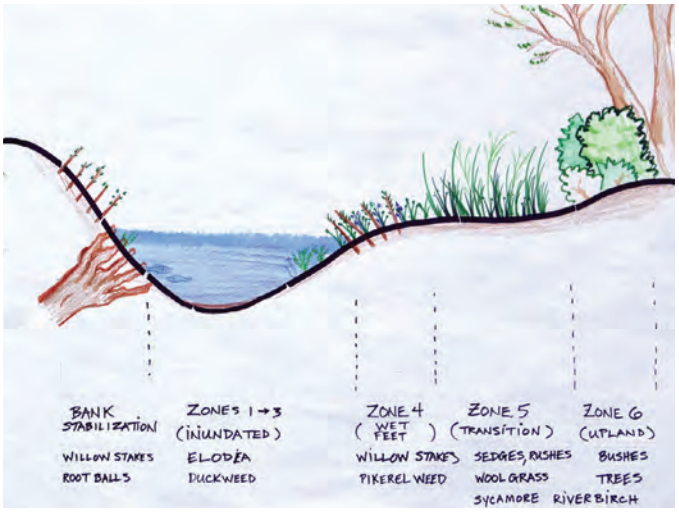

Photo By: Mary Fennel

Group 1's design for a multipurpose wetland follows a long meandering path through the former lake bottom area. They propose supplementing natural phosphorus and sediment removal processes within the wetland with the injection of alum to take phosphorus concentrations in the treated water to much lower levels. The team explored the use of a diversity of wetland plants and types, including deeper water areas and areas designed to support periphyton and submerged aquatic vegetation. Their wetland design includes an outlet from the wetland downstream of the dam,

Photo By: Mary Fennel

rather than returning treated water to the lake. To enhance recreation, the team created long boardwalks around and through the wetland area, and a new, safe overlook to view the dam and waterfalls.

Photo By: Brian Haggard

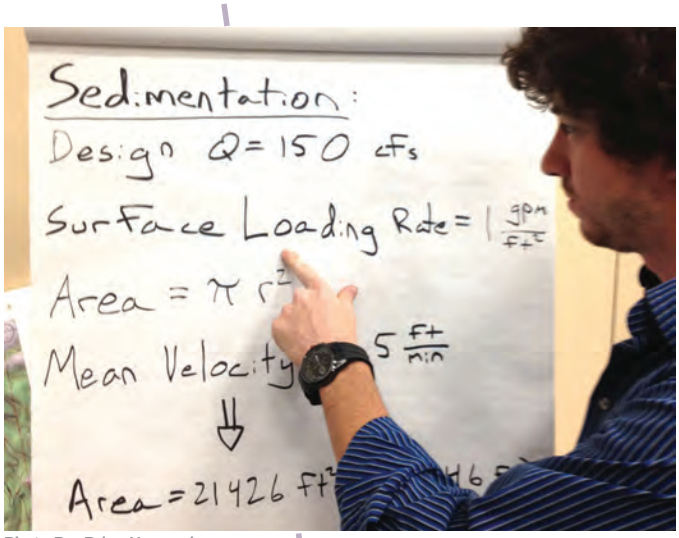

Photo By: Brian Haggard

Photo By: Mary Fennel

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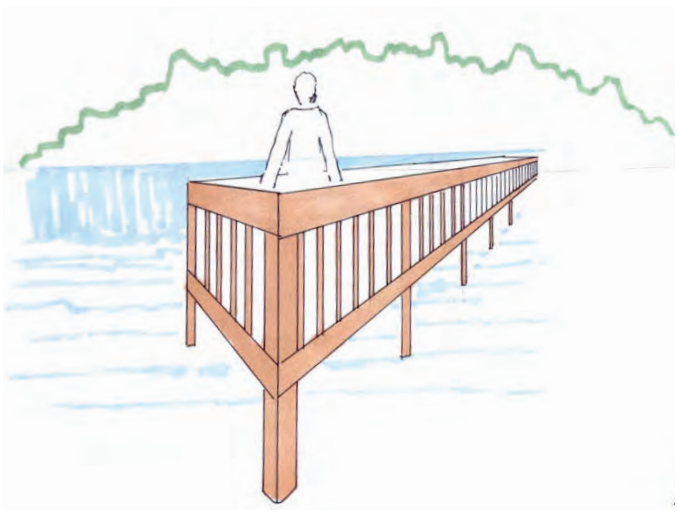

Photo By: Mary Fennel

Teamwork: Group 2

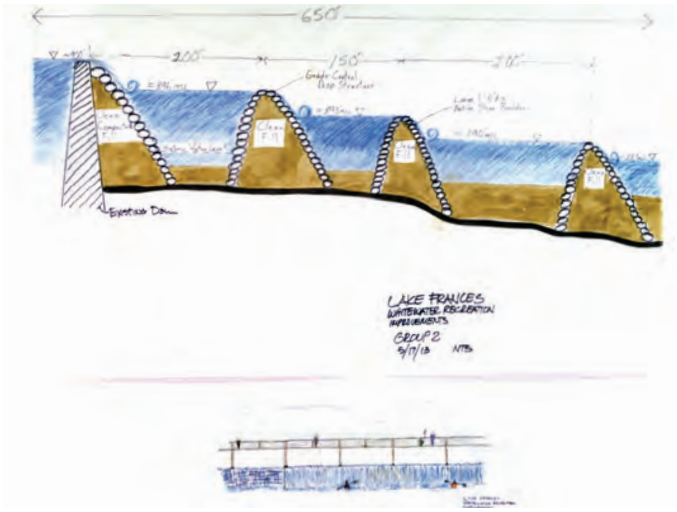

Photo By: Mary Fennel

Group 2's plans emphasize the imaginative expansion of river recreational opportunities. They created a cascading series of pools around the dam coupled with construction of a set of whitewater rapids downstream. Each drop in the cascade of pools is shallow and relatively easy to navigate and cumulatively they allow kayakers and canoeists to bypass the dam safely without a portage. Group 2's plans for a wetland in the former lake bottom area propose a series of linked wetland cells and include alum injection to enhance phosphorus removal. This team proposes to mitigate phosphorus release from

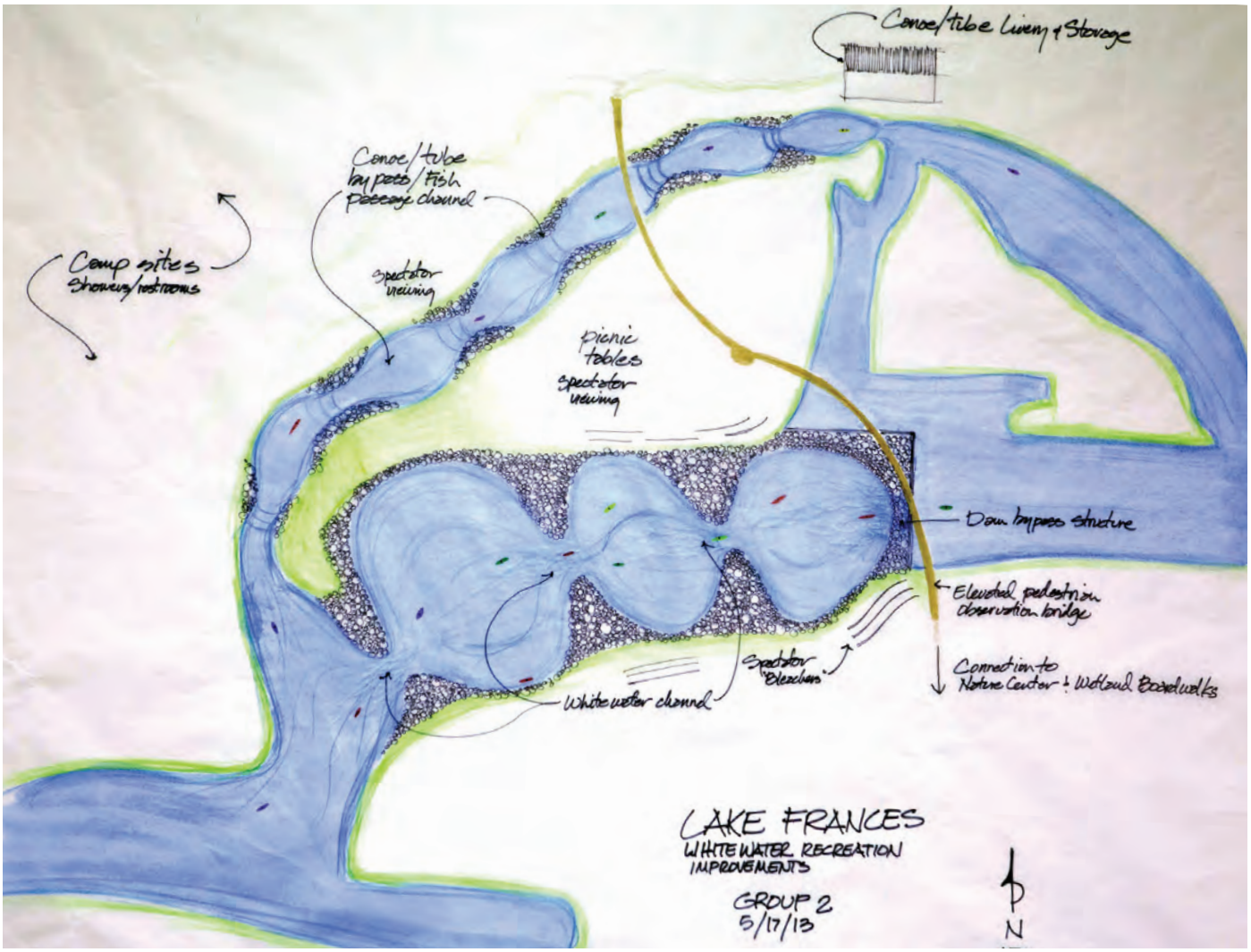

Photo By: Mary Fennel

existing lake sediments by an alum application rather than through dredging. Other recreational elements include a footbridge over the dam and development of a campsite near the dam.

Photo By: Brian Haggard

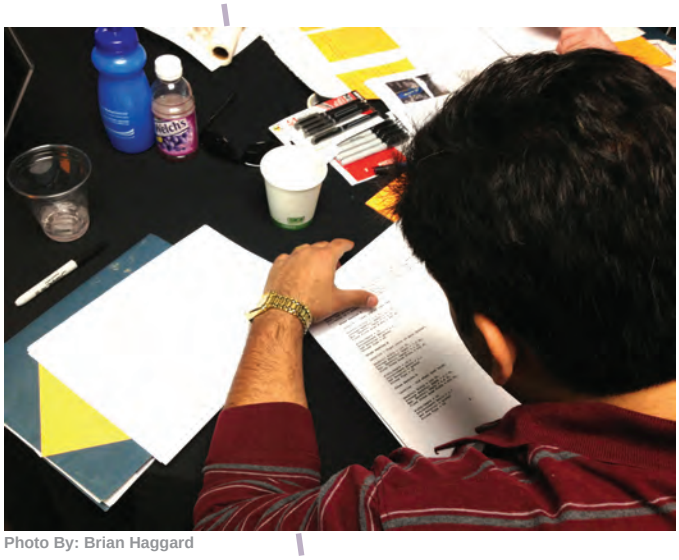

Photo By: Brian Haggard

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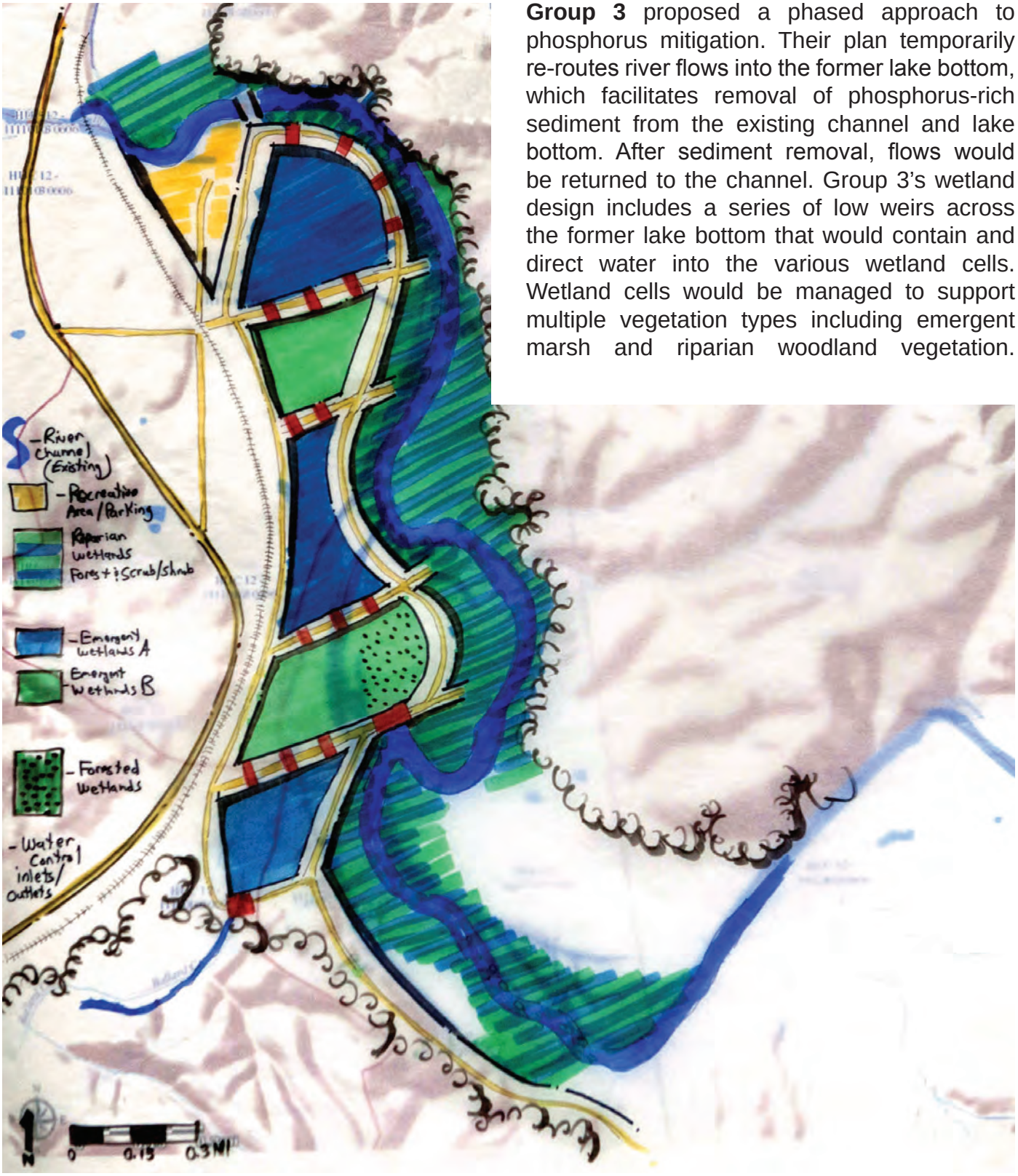
Photo By: Brian Haggard

Photo By: Mary Fennel

Teamwork: Group 3



Group 3 proposed a phased approach to phosphorus mitigation. Their plan temporarily re-routes river flows into the former lake bottom, which facilitates removal of phosphorus-rich sediment from the existing channel and lake bottom. After sediment removal, flows would be returned to the channel. Group 3's wetland design includes a series of low weirs across the former lake bottom that would contain and direct water into the various wetland cells. Wetland cells would be managed to support multiple vegetation types including emergent marsh and riparian woodland vegetation.

Photo By: Mary Fennel

This team's plan for weirs with water control gates provides more assured control over water flow than in most of the other wetland designs. Team 3 also planned for phosphorus removal over time through a long-term vegetation harvesting plan.

Photo By: Brian Haggard

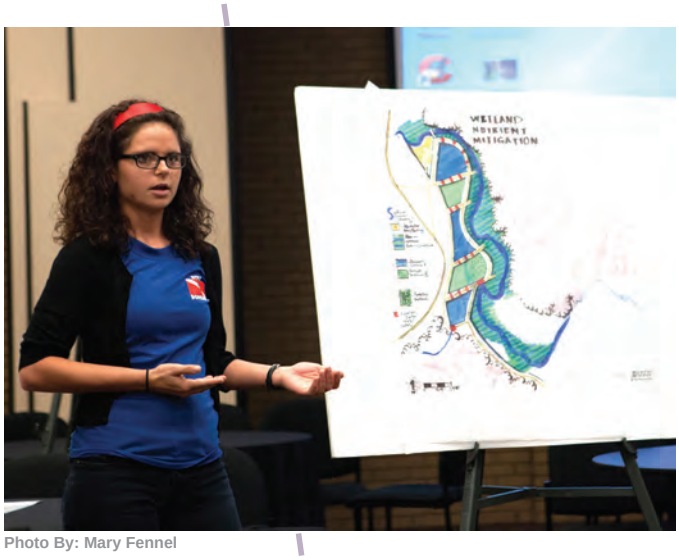


Photo By: Mary Fennel

Photo By: Brian Haggard

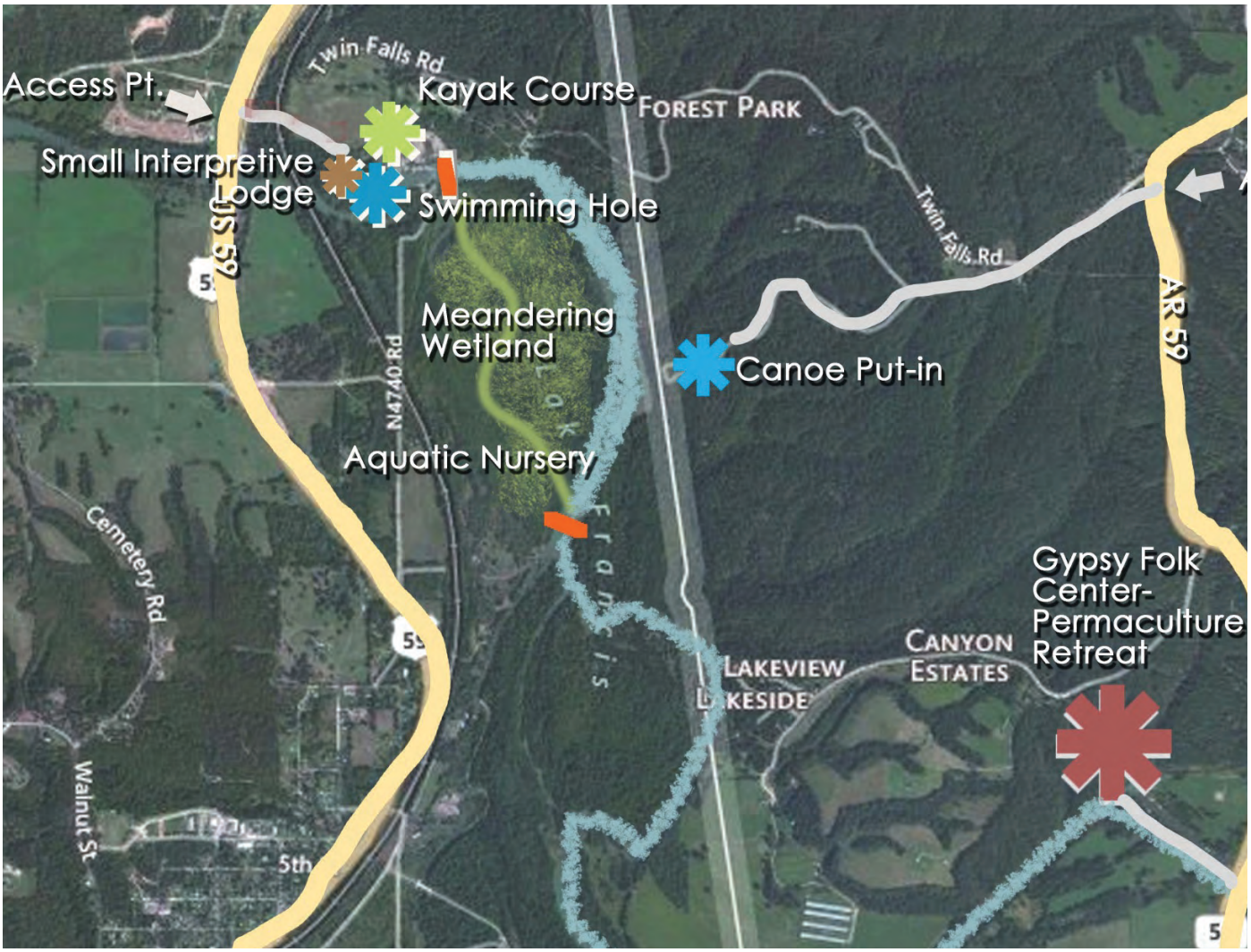
Photo By: Brian Haggard

Photo By: Brian Haggard

Teamwork: Group 4

Photo By: Mary Fennel

Group 4's plans included constructed wetlands and dredging of the stream to remove phosphorus-bearing sediments. They propose removing the dam completely for multiple reasons: safety, to facilitate the remediation of lake bottom sediment, and to reconnect canoe and kayak passage through the site. Concepts for enhancing recreation and education include constructing a kayak course as well as a new mid-reach canoe and kayak access point. The former Gypsy Camp at the southern end of the old lake will be developed into a revenue-generating Gypsy Folk Center-Permaculture Retreat.



This group paid significant attention to economic aspects--exploring the potential of remediation financing through nutrient trading, the sale of wetland plants from a nursery on site, and the creation of a wetland mitigation bank.

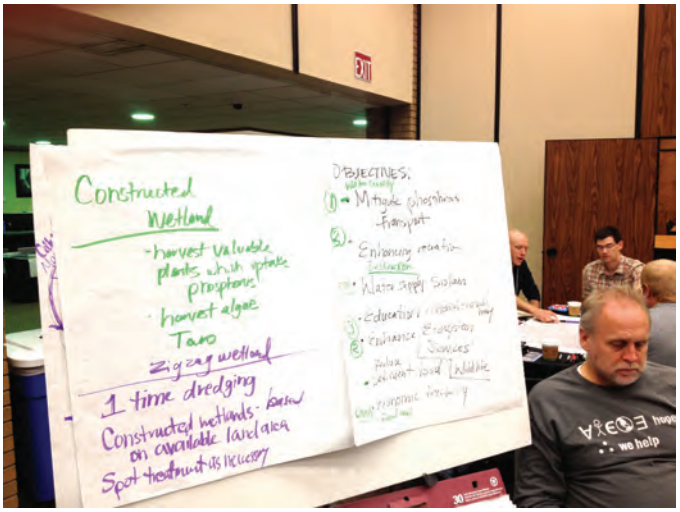


Photo By: Brian Haggard

Photo By: Brian Haggard

Photo By: Mary Fennel

Photo By: Brian Haggard

Participants

Workshop Organizers
Steve Patterson, Bio x Design
Brian Haggard, Arkansas Water Resources Center

AWRC Staff
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Leslie Massey

Booklet Design
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Paul Burns
Gina Levesque
Keith Patterson
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Noaa Frederick
James McCarty
Mark Boyer
Shanon Phillips
Josh Fluger
Eric Boles
Benjamin Stinnett

Charrette Group 3
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Jamie Gile
Greg Phillips
Ed Fite
Maia Singer
Alex McLemore
Iseyemi Oluwayinka
Nick Cerra

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Colby Reavis
Paul Burns
Thomas Soerens
Amanda Williamson
Matt Van Eps
Jeri Fleming
Aaron Thomason
Traci Hudson

Workshop & Charrette Speakers

Mark E. Boyer is Professor and Head of the Landscape Architecture Department at the University of Arkansas.

Ed Fite is Administrator of the Oklahoma Scenic Rivers Commission and member of the Oklahoma Water Resources Board.

Brian Haggard is Director of the Arkansas Water Resources Center and Professor in the Biological & Agricultural Engineering Department at the University of Arkansas.

Kristina Jones is a designer and project coordinator for the City of Fayetteville Sustainability and Strategic Planning Department.

Scott Osborn is an Associate Professor in the Biological and Agricultural Engineering Department at the University of Arkansas.

Jeremy Pate leads the Department of Development Services, consisting of City Planning, Community Services, Building Safety, and City Engineering for the City of Fayetteville.

Steve Patterson is a restoration ecologist with Bio x Design.

Shanon Phillips is Director of the Water Quality Division of the Oklahoma Conservation Commission.

Thad Scott is an Assistant Professor in the Department of Crop, Soil, and Environmental Sciences at the University of Arkansas, Fayetteville.

Maia Singer is a Senior Aquatic Ecologist and water quality scientist with Stillwater Sciences.

Martin Smith is a landscape architect and the President of Ecological Design Group, Inc.

Ben Stinnett is a graduate student in the Historic Preservation program at the University of Oregon.

Kent W. Thornton is a Principal at FTN Associates, Ltd., an interdisciplinary engineering and environmental consulting firm.

Dan Wagner is a Hydrologist at the Northwest Arkansas Project Office of the United States Geological Survey.