Daniel S. Sullivan
General Manager/Chief Executive Officer

GRDA
Grand River Dam Authority

February 1, 2017

Via E-Filing

Kimberly S. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington DC 20426

Subject: **Pensacola Hydropower Project (FERC No. 1494)**
Notice of Intent to File License Application and Pre-Application Document

Dear Secretary Bose:

Pursuant to the rules and regulations of the Federal Energy Regulatory Commission (FERC or Commission) at 18 CFR. §§ 5.5 and 5.6, the Grand River Dam Authority (GRDA) herewith electronically files with the Commission the Notice of Intent to File a License Application (NOI), and a Pre-Application Document (PAD) for the relicensing of the Pensacola Hydroelectric Project (FERC No. 1494), located on the Grand (Neosho) River in northeastern Oklahoma. GRDA has elected to use the Integrated Licensing Process (ILP) to provide the framework for its consultation with agencies, tribes, and other stakeholders for the Pensacola Project relicensing.

In conjunction with this filing, GRDA is requesting that the Commission designate GRDA as the Commission's non-federal representative for carrying out informal consultation, pursuant to (1) Section 7 of the Endangered Species Act and the joint agency regulations thereunder at 50 CFR part 402, Section 305(b) of the Magnuson-Stevens Act and the implementing regulations at 500 CFR 600.920; and (2) Section 106 of the National Historic Preservation Act and the implementing regulations at 36 CFR 800.2(c)(4).

The main body of the document and all but one attachment is being filed publically. Attachment I contains sensitive information related to archaeological and historic resources, therefore, pursuant to 18 C.F.R. §§ 388.112(b), GRDA accordingly requests designation and special treatment as Privileged material.

In accordance with the Commission's regulations GRDA is also transmitting electronic (via notification of posting on the relicensing website, www.grda.com/pensacola-relicensing, or CD) and/or paper copies of the PAD to relevant resource agencies, Native American tribes, local governments, non-governmental organizations, and other interested stakeholders (as identified on the attached Distribution List) concurrent with this filing. In addition, GRDA will provide a paper copy of the PAD to Commission Staff in the Office of Energy Projects and Office of General Counsel – Energy Projects, as required by the Commission's filing guidelines.

GRDA looks forward to working with the Commission and other interested parties on the relicensing of the Project. If there are any questions regarding the NOI or PAD, please contact Dr. Darrell Townsend by phone at (918) 256-0723 or by email at dtownsend@grda.com.

Sincerely,

Daniel S. Sullivan
Chief Executive Officer
Grand River Dam Authority

Enclosure
cc: Distribution list (see attached)

Distribution List

* A CD was mailed to relicensing participants without a known email address.

Mr. Ken Collins
U.S. Fish and Wildlife Service
9014 E 21st Street
Tulsa, OK 74129-1428
ken_collins@fws.gov

Ms. Jonna Polk
U.S. Fish and Wildlife Service
9014 E 21st Street
Tulsa, OK 74129-1428
jonna_polk@fws.gov

Mr. Kevin Stubbs
Field Supervisor
U.S. Fish and Wildlife Service
9014 E 21st Street
Tulsa, OK 74129-1428
kevin_stubbs@fws.gov

Mr. Paul McGuire
Administrative Officer
U.S. Bureau of Land Management
Oklahoma Field Office
201 Stephenson Parkway, Suite 1200
Norman, OK 73072
pmcguire@blm.gov

Chief Tom Tidwell
U.S. Forest Service
1400 Independence Avenue, SW
Washington, DC 20250
ttidwell@fs.fed.us

Mr. Eddie Streater
Regional Director
U.S. Bureau of Indian Affairs
Eastern Oklahoma Regional Office
PO Box 8002
Muskogee, OK 74401-6206
eddie.streater@bia.gov

Mr. Jessie Dunham
Deputy Regional Director
U.S. Bureau of Indian Affairs
Eastern Oklahoma Regional Office
PO Box 8002
Muskogee, OK 74401-6206
jessie.dunham@bia.gov

Mr. Mosby Halterman
Environmental Protection Specialist
U.S. Bureau of Indian Affairs
PO Box 8002
Muskogee, OK 74401
mosby.halterman@bia.gov

Ms. Jeannine Hale
Division Director
US Bureau of Indian Affairs
Eastern Regional Office
PO Box 8002
Muskogee, OK 74401
jeannine.hale@bia.gov

Chief Jason Weller
U.S. Natural Resources Conservation Service
1400 Independence Avenue, SW Room 5105-A
Washington DC 20250
Jason.Weller@wdc.usda.gov

Sue Masica
Regional Director
National Park Service
12795 Alameda Parkway
Denver, CO 80225
IMRextrev@nps.gov

Mr. Andrew Commer, Chief
U.S. Army Corps of Engineers, Tulsa District
Attn: CESWT-P-R (Regulatory Branch)
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Andrew.Commer@usace.army.mil

Mr. Mike Abate
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
mike.r.abate@usace.army.mil

Ms. Jennifer Aranda
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
jennifer.a.aranda@usace.army.mil

Distribution List

Mr. William Chatron
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
william.a.chatron@usace.army.mil

Ms. Tonya Dunn
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
tonya.n.dunn@usace.army.mil

Mr. Greg Estep
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
gregory.estep@usace.army.mil

Mr. Scott Henderson
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
scott.a.henderson@usace.army.mil

Mr. Mike Love
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128
michael.s.love@usace.army.mil

Mr. Steve Nolen
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
stephen.l.nolen@usace.army.mil

Mr. Terry Rupe
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
terry.d.rupe@usace.army.mil

Mr. David Williams
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
david.j.williams@usace.army.mil

Ms. Eva Zaki-Dellitt
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
eva.a.zaki-dellitt@usace.army.mil

Dr. William Andrews, Director
U.S. Geological Survey
Oklahoma Water Science Center
202 NW 66th Street, Building 7
Oklahoma City, OK 73116
wandrews@usgs.gov

Ms. Kimeka Price
NEPA Project Manager
U. S .Environmental Protection Agency
Region 6
Fountain Place
1445 Ross Avenue
Dallas, TX 75202-2760
price.kimeka@epa.gov

U.S. Department of the Army *
1645 Randolph Road
Fort Sill, OK 73503

Ms. Nicole McGavock
National Weather Service
Tulsa, OK Weather Forecast Office
10159 E 11th Street, Suite 300
Tulsa, OK 74128
nicole.mcgavock@noaa.gov

Mr. James Paul
National Weather Service
Tulsa, OK Weather Forecast Office
10159 E 11th Street Suite 300
Tulsa, OK 74128
james.paul@noaa.gov

Mr. Barry Bolton
Chief of Fisheries Division
Oklahoma Department of Wildlife
Conservation
PO Box 53465
Oklahoma City, OK 73152
barry.bolton@odwc.ok.gov

Distribution List

Mr. JD Strong
Director
Oklahoma Department of Wildlife Conservation
PO Box 53465
Oklahoma City, OK 73152
jd.strong@odwc.ok.gov

Mr. Josh Johnston
NE Regional Fisheries Biologist
Oklahoma Department of Wildlife Conservation
PO Box 1201
Jenks, OK 74037
josh.johnston@odwc.ok.gov

Mr. Josh Richardson
Wildlife Biologist
Oklahoma Department of Wildlife Conservation
PO Box 53465
Oklahoma City, OK 73152
josh.richardson@odwc.ok.gov

Mr. Alan Peoples
Chief of Wildlife Division
Oklahoma Department of Wildlife Conservation
PO Box 53465
Oklahoma City, OK 73152
alan.peoples@odwc.ok.gov

Mr. Brad Johnston
Fisheries Biologist
Oklahoma Department of Wildlife Conservation
61091 E 120 Road
Miami, OK 74354
brad.johnston@odwc.ok.gov

Mr. Ken Cunningham
Assistant Chief of Fisheries
Oklahoma Department of Wildlife Conservation
PO Box 53465
Oklahoma City, OK 73152
kenneth.cunningham@odwc.ok.gov

Ms. Julie Cunningham
Acting Director
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
julie.cunningham@owrb.ok.gov

Mr. William Cauthron
Acting Director, Water Quality Division
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
bill.cauthron@owrb.ok.gov

Ms. Nikki Davis
Staff Secretary, Water Quality Division
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
nikki.davis@owrb.ok.gov

Mr. Lance Phillips
Environmental Programs Manager
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
lance.phillips@owrb.ok.gov

Mr. Monty Porter
Section Head, Water Quality Standards
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
monty.porter@owrb.ok.gov

Ms. Beth Wilhelm
Planning and Management Division
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
beth.wilhelm@owrb.ok.gov

Mr. Joe Long
Environmental Programs Manager
Watershed Planning Section
Oklahoma Department of Environmental Quality
PO Box 1677
Oklahoma City, OK 73101-1677
joe.long@deq.ok.gov

Distribution List

Ms. Elena Jigoulina
Environmental Programs Specialist
Oklahoma Department of Environmental Quality
PO Box 1677
Oklahoma City, OK 73101-1677
Elena.jigoulina@deq.ok.gov

Dr. Kary Stackelbeck
State Archeologist
Oklahoma Archeological Survey
111 East Chesapeake, Bldg. 134
Norman, OK 73019-0575
kstackelbeck@ou.edu

Ms. Melvena Heisch
Deputy State Historic Preservation Officer
Oklahoma Historical Society
800 Nazih Zuhdi Drive
Oklahoma City, OK 73105-7917
mheisch@okhistory.org

Ms. Catharine Wood
Historical Archaeologist
Oklahoma Historical Society
800 Nazih Zuhdi Drive
Oklahoma City, OK 73105-7917
cwood@okhistory.org

Ms. Kris Marek
Oklahoma Tourism and Recreation Department
State Parks & Resorts
900 North Stiles Avenue
Oklahoma City, OK 73104
kris.marek@travelok.com

Mr. Mike Patterson
Executive Director
Oklahoma Department of Transportation
200 NE 21st Street
Oklahoma City, OK 73105
mpatterson@odot.org

Mr. Brooks Tramell
Director of Monitoring, Assessment & Wetlands
Oklahoma Conservation Commission
2800 North Lincoln Boulevard, Suite 160
Oklahoma City, OK 73105
brooks.tramell@conservation.ok.gov

Ms. Deby Snodgrass
Executive Director
Secretary of Commerce and Tourism
Oklahoma Department of Commerce
900 North Stiles Avenue
Oklahoma City, OK 73104
deby.snodgrass@okcommerce.gov

Mr. Jim Reese
Commissioner
Oklahoma Department of Agriculture Food and Forestry
2800 North Lincoln Boulevard, Suite 100
Oklahoma City, OK 73105
jim.reese@ag.ok.gov

Ms. Valauna Grissom
Secretary
Oklahoma Department of Health
1000 NE 10th Street
Oklahoma City, OK 73117
VaLaunag@health.ok.gov

Mr. Tim Rhodes
Director of Administration
Oklahoma Corporation Commission
2101 North Lincoln Boulevard
Oklahoma City, OK 73105
terryedrhodes@occemail.com

Mr. Luke Tallant
Office of State Fire Marshal
2401 NW 23rd Street, Suite 4
Oklahoma City, OK 73107
luke.tallant@fire.ok.gov

Mr. Charles Kerns
Oklahoma Office of Emergency Management
PO Box 53365
Oklahoma City, OK 73152-3365
charles.kerns@oem.ok.gov

Inter-Tribal Council Inc. *
PO Box 1308
Miami, OK 74354

Chairman Tamara Francis-Fourkiller
Caddo Nation of Oklahoma
PO Box 487
Binger, OK 73009
tffourkiller.cn@gmail.com

Distribution List

Chief Glenna J. Wallace
Eastern Shawnee Tribe of Oklahoma
12755 South 705 Road
Wyandotte, OK 74370
gjwallace@estoo.net

Mr. Chad Kelly
Tribal Administrator
Eastern Shawnee Tribe of Oklahoma
10080 S Bluejacket Road
Wyandotte, OK 74370
ckelly@estoo.net

Chief Ron Sparkman
Shawnee Tribe of Oklahoma
29 South Highway 69A
Miami, OK 74354
rondede1@gmail.com

Ms. Jodi Hayes
Tribal Administrator
Shawnee Tribe of Oklahoma
PO Box 189
Miami, OK 74354
shawneetribe@shawneetribe.com

Mr. Ernest Redbird III
Section 106 Contact
Apache Tribe of Oklahoma
PO Box 1330
Anadarko, OK 73005
tanequodle@yahoo.com

Mr. John Fox
Archaeologist
Osage Nation Historic Preservation Office
627 Grandview Avenue
Pawhuska, OK 74056
jfox@osagenation-nsn.gov

Ms. Andrea Hunter
Tribal Historic Preservation Officer
Osage Nation Historic Preservation Office
627 Grandview Avenue
Pawhuska, OK 74056
ahunter@osagetribe.org

Mr. Eddie Hamilton
Governor
Cheyenne & Arapaho Tribes
100 Red Moon Circle
Concho, OK 73022
ehamilton@c-a-tribes.org

Honorable Chief Chester Brooks
Delaware Tribe of Indians
170 NE Barbara
Bartlesville, OK 74006
cbrooks@delawaretribe.org

President Terry Parton
Wichita and Affiliated Tribes
PO Box 729
Anadarko, OK 73005
terri.parton@wichitatribe.com

Chief James Floyd
Muscogee Nation
PO Box 580
Okmulgee, OK 74447
jfloyd@mcn-nsn.gov

Chief Tarpie Yargee
Alabama-Quassarte Tribal Town
PO Box 187
Wetumka, OK 74883
chief@alabama-quassarte.org

Chief William Fisher
Seneca-Cayuga Nation
PO Box 453220
Grove, OK 74345-3220
wfisher@sctribe.com

Mr. Rick Dubois
Environmental Director
Seneca-Cayuga Nation
PO Box 453220
Grove, OK 74345-3220
rdubois@sctribe.com

Mr. Micca Emarthla
Seneca-Cayuga Nation
PO Box 453220
Grove, OK 74345-3220
memarthula@sctribe.com

Distribution List

Chief Bill Follis
Modoc Tribe of Oklahoma
418 G Street SE
Miami, OK 74354
modoctribe@cableone.net

Chairman John Berry
Quapaw Tribe of Oklahoma
PO Box 765
Quapaw, OK 74363
jerry@quapawtribe.com

Mr. Everett Bandy
Quapaw Tribe of Oklahoma
PO Box 765
Quapaw, OK 74363
ebandy@quapawtribe.com

Chief Douglas G. Lankford
Miami Tribe of Oklahoma
PO Box 1326
Miami, OK 74354
dlankford@miamination.com

Chief Ethel Cook
Ottawa Tribe of Oklahoma
PO Box 110
Miami, OK 74354
adawe.oto@gmail.com

Chief John Froman
Peoria Tribe of Oklahoma
118 South Eight Tribes Trail
Miami, OK 74354
jfroman@peoriatribe.com

Logan Pappenfort
Special Project Manager
Section 106 Coordinator
Peoria Tribe of Oklahoma
118 S Eight Tribes Trail
Miami, OK 74354
lpappenfort@peoriatribe.com

Ms. Karen Pritchett
THPO Assistant
United Keetoowah Band of Cherokees
PO Box 1245
Tahlequah, OK 74665
kpritchett@unitedkeetoowahband.org

Mr. Eric Oosahwee-Voss
THPO
United Keetoowah Band of Cherokees
PO Box 1245
Tahlequah, OK 74465
eoosahwee-voss@unitedkeetowahband.org

Ms. Kathleen A. Welch
Environmental Assistant
Wyandotte Tribe of Oklahoma
64700 East Highway 60
Wyandotte, OK 74370
kwelch@wyandotte-nation.org

Chief Billy Friend
Wyandotte Tribe of Oklahoma
64700 East Highway 60
Wyandotte, OK 74370
bfriend@wyandotte-nation.org

Ms. Regina Gasco-Bentley *
Little Traverse Bay Bands of Odawa Indians
7500 Odawa Circle
Harbor Springs, MI 49740

Chief Bill John Baker *
Cherokee Nation
PO Box 948
Tahlequah, OK 74465

Ms. Melissa Shackford
Director of Land Protection
The Nature Conservancy
408 NW 7th Street
Oklahoma City, OK 73102
mshackford@tnc.org

Mr. Jay Pruett
Director of Conservation
The Nature Conservancy
10425 S 82nd E Avenue, Suite 104
Tulsa, OK 73133
jpruett@tnc.org

Chris Wood, President
Trout Unlimited
1777 N Kent Street, Suite 100
Arlington, VA 22209
cwood@tu.org

Distribution List

American Rivers
1101 14th Street NW Suite 1400
Washington DC 20005
akober@americanrivers.org

American Whitewater
PO Box 1540
Cullowhee, NC 28723
info@americanwhitewater.org
Ducks Unlimited
Regional Director
Nathan Johnson
1812 Cinnamon Ridge Road
Edmond, OK 73025
njohnson@ducks.org

Mr. John Kennington
President
Tulsa Audubon Society
PO Box 330140
Tulsa, OK 74133
johnkennington@cox.net

Grand Lake Audubon Society *
PO Box 1813
Grove, OK 74345-1813

Grand Lake Watershed Alliance Foundation
PO Box 451185
Grove, OK 74345-1185
glwafadmin@gmail.com

Ms. Rebecca Jim
Local Environmental Action Demanded Inc.
223 A Street SE
Miami, OK 74354
rjim@neok.com

Scott Cox, Squadron Commander
Grand Lake Sail and Power Squadron
31380 S 628 Lane
Grove, OK 74344
slcox@suddenlink.net

Mr. Lowell Walker
Craig County Commissioner
District 1
210 W Delaware Avenue, Suite 106
Vinita, OK 74301
ccd1@junct.com

Mr. Hugh Gordon
Craig County Commissioner
District 2
210 W Delaware Avenue, Suite 106
Vinita, OK 74301
ccd2@ruralinet.net

Mr. Dan Peetom
Craig County Commissioner
District 3
210 W Delaware Avenue, Suite 106
Vinita, OK 74301
joni.jones_18@yahoo.com

Mr. Morris Bluejacket
Craig County Flood Plain Manager
210 West Delaware, Suite 103
Vinita, OK 74301-4236
ccem@junct.com

Cambra Fields
District Conservationist
Craig County Conservation District
235 West Hope Avenue
Vinita, OK 74301-1302
cambra.fields@ok.usda.gov

Eastern Trails Museum
215 West Illinois Avenue
Vinita, OK 74301
etmuseum@junct.com

Mr. Doug Smith
Delaware County Commissioner
District 1
2001 Industrial 10 RD
Grove, OK 74344
delcohwy@groveemail.com

Mr. Russell Martin
Delaware County Commissioner
District 2
327 South 5th Street
Jay, OK 74346
delbarn2@yahoo.com

Martin Kirk
Delaware County Commissioner
District 3
327 South 5th Street
Jay, OK 74346
delbarn3@yahoo.com

Distribution List

Mr. Robert Real
Delaware County Floodplain Administrator
PO Drawer 309
429 South 9th Street
Jay, OK 74346-0309
delawarecountyem@yahoo.com
Delaware County Historical Society & Museum *
538 Krause Street
Jay, OK 74346

Delaware County Conservation District
2749 State Highway 20
Jay, OK 74346
delawareccd@conservation.ok.gov

Kevin Whiteside
Mayes County Commissioner
District 1
One Court Place, Suite 140
Pryor, OK 74361
mayesdist1@yahoo.com

Darrell Yoder
Mayes County Commissioner
District 2
One Court Place, Suite 140
Pryor, OK 74361
darrellyoder2@yahoo.com

Ryan Ball
Mayes County Commissioner
One Court Place, Suite 140
Pryor, OK 74361
mayes3@sstelco.com

Johnny Janzen
Mayes County Floodplain Manager
One Court Place, Suite 140
Pryor, OK 74361
mayescountyem@yahoo.com

Mayes County Conservation District
4238 N E 1st
PO Box 36
Pryor, OK 74362
mayesccd@conservation.ok.gov

Coo-Y-Yah Museum *
847 Highway 69
South 8th Street
Pryor, OK 74361

Joe Dan Morgan
Ottawa County Emergency Management
Certified Floodplain Manager
123 East Central Ave., Suite 103
Miami, OK 74354
ocem.morgan@yahoo.com

Chairman John Clark
Ottawa County Commissioner
District #1
102 East Central Avenue, Suite 202
Miami, OK 74354
ottawacountyd1@sbcglobal.net

Gary Wyrick
Ottawa County Commissioner
District #2
102 East Central Avenue, Suite 202
Miami, OK 74354
ottawacountyd2@hotmail.com

Russell Earls
Ottawa County Commissioner
District #3
102 East Central Avenue, Suite 202
Miami, OK 74354
rearls@ruralinet.net

Ottawa County Conservation District
630 East Steve Owens Boulevard, Suite 3
Miami, OK 74354-7800
ottawaccd@conservation.ok.gov

Ottawa County Historical Society *
(Dobson Museum)
110 A Street SW
Miami, OK 74354

Afton Public Works Authority
PO Box 250
Afton, OK 74331
phyllistoa@att.net

Distribution List

Bill Keefer
City Manager
City of Grove
104 West 3rd
Grove, OK 74344
wmkeefer@sbcglobal.net

Debbie Bottoroff
Assistant City Manager
City of Grove
104 West 3rd
Grove, OK 74344
dbottoroff@sbcglobal.net

Mayor Rudy Schultz
City of Miami
PO Box 1288
Miami, OK 74355
rschultz@miamiokla.net

Mr. Dean Kruithof
City Manager
City of Miami
PO Box 1288
Miami, OK 74355
dean@miamiokla.net

Mr. Jordan Cash
Administrator
Integris Health Center
200 2nd Avenue SW
Miami, OK 74354
jordan.cash@integrisok.com

Mr. Jeremy Hogan
Superintendent
Miami Public Schools
26 N Main Street
Miami, OK 74354
jhogan@mpswardogs.com

Mr. Steve Gilbert
Director
Miami Regional Chamber of Commerce
2 N Main
Miami, OK 74354
sgilbert@miami-ok.org

Ms. Amber Prewett
City of Miami
PO Box 1288
Miami, OK 74355
aprewett@miamiokla.net

Fire Chief Robert Wright
City of Miami
PO Box 1288
Miami, OK 74355
rwright@miamiokla.net
Police Chief Thomas Anderson
City of Miami
PO Box 1288
Miami, OK 74355
tanderson@miamiokla.net

Ms. Alicia Hogan
Public Works Director
City of Miami
PO Box 1288
Miami, OK 74355
ahogan@miamiokla.net

Mr. Brian Forrester
Council Member
NE Ward 1
PO Box 1288
Miami, OK 74355-1288
bforrester@miamiokla.net

Mr. Doug Weston
Council Member
NE Ward 2
PO Box 1288
Miami, OK 74355-1288
dweston@miamiokla.net

Mr. Neal Johnson
Council Member
SW Ward 3
PO Box 1288
Miami, OK 74355-1288
njohnson@miamiokla.net

Ms. Vicki Lewis
Council Member
SE Ward 4
PO Box 1288
Miami, OK 74355-1288
vlewis@miamiokla.net

Distribution List

Ms. Jill Lambert
Ketchum Public Works Authority
PO Box 958
Ketchum, OK 74349
jclabornkpwa@wavelinx.net

Ms. Melissa Yarbrough
Town of Langley
PO Box 760
Langley, OK 74350
myarbrough@langleyok.org
Town of Afton *
PO Box 250
Afton, OK 74331

Town of Ketchum *
PO Box 150
Ketchum, OK 74349

Town of Fairland *
PO Box 429
Fairland, OK 74343

Town of Bernice *
209 S Broadway
Bernice, OK 74331

Town of Disney *
PO Box 318
Disney, OK 74340

Town of Wyandotte *
212 South Main
Wyandotte, OK 74370

City of Vinita *
PO Box 329
104 East Illinois Avenue
Vinita, OK 74301

Mr. Matt Outhier
RWD #3 Delaware County
PO Box 1228
Jay, OK 74346
aquazena@yahoo.com

RWD #3 Mayes County – Disney
PO Box 279
Disney, OK 74340
mayesrwd3@grand.net

Mr. Clayton Garner
Cherokee Grove Golf at Carey Bay
519 Quail Run Road
Grove, OK 74344
cghg@msn.com

Grand Bluffs Development *
32922 Pebble Beach
Afton, OK 74331

Mr. Justin May
Shangri-La Management
31000 South Highway 125
Afton, OK 74331
justin.may@shangrilaok.com

Mr. Kent Stewart
Shoreline, LLC
PO Box 6586
Grove, OK 74344
kent@patriciaisland.com

Mr. Robert Steinkirchner
Spinnaker Point, Manager
450779 East 341 Road
Afton, OK 74331
spinnptmgr@aol.com

Mr. Eric Grimshaw
Spinnaker Point Estates
2639 E 33rd Place
Tulsa, OK 74105
egrimshaw@oneok.com

Mr. Bruce Hensley
Tera Miranda Shores Inc.
28251 South 561 Road
Monkey Island, OK 74331
bruce@handhconstruction.com

The Honorable James Mountain Inhofe
United States Senate
205 Russell Senate Office Building
Washington DC 20515
jennie_wright@inhofe.senate.gov

The Honorable James Lankford
United States Senate
316 Hart Senate Office Building
Washington DC 20510
jeff_underwood@lankford.senate.gov

Distribution List

The Honorable Jim Bridenstine
216 Cannon House Office Building
Washington DC 20515
joseph.kaufman@mail.house.gov

The Honorable Markwayne Mullin
1113 Longworth House Office Building
Washington DC 20515
debbie.dooley@mail.house.gov

The Honorable Michael Bergstrom
Oklahoma State Senate, District 1
2300 N Lincoln Boulevard Room 522
Oklahoma City, OK 73105
bergstrom@oksenate.gov

The Honorable Wayne Shaw
Oklahoma State Senate, District 2
2300 N Lincoln Boulevard, Room 325
Oklahoma City, OK 73105
shaw@oksenate.gov

The Honorable Marty Quinn
Oklahoma State Senate, District 3
2300 N Lincoln Boulevard, Room 417B
Oklahoma City, OK 73105
quinn@oksenate.gov

The Honorable Josh West
House of Representatives, District 5
2300 N Lincoln Blvd, Room 242A
Oklahoma City, OK 73105
josh.west@okhouse.gov

The Honorable Chuck Hoskin
House of Representatives, District 6
2300 North Lincoln Boulevard, Room 509
Oklahoma City, OK 73105
chuck.hoskin@okhouse.gov

The Honorable Ben Loring
House of Representatives, District 7
2300 North Lincoln Boulevard
Oklahoma City, OK 73105
ben.loring@okhouse.gov

The Honorable Tom Gann
House of Representatives, District 8
2300 N Lincoln Boulevard, Room 500
Oklahoma City, OK 73105
tom.gann@okhouse.gov

The Honorable Mary Fallin*
Governor of Oklahoma
2300 North Lincoln Boulevard, Suite 212
Oklahoma City, OK 73105

The Honorable Michael Teague
Secretary of Energy and Environment
204 N Robison, Suite 1010
Oklahoma City, OK 73102
ee@ee.ok.gov
Dr. Robert Nairn
School of Civil Engineering
The University of Oklahoma
202 West Boyd Street, Room 334
Norman, OK 73109-3073
nairn@ou.edu

Oklahoma State University
Burns Hargis, President
107 Whitehurst
Stillwater, OK 74078
debbie.lane@okstate.edu

Mr. Jeffrey Hale
President
Northeastern Oklahoma A & M College
200 I Street NE
Miami, OK 74354
ebigby@neo.edu

Mr. Mark Rasor
Vice President for Business
200 I Street NE
Miami OK 74354
mrasor@neo.edu

Mr. Steve Stephens
General Counsel
OSU-A&M College Board of Regents
2800 N Lincoln Blvd
Oklahoma City, OK 74105
steve.stephens@okstate.edu

Dr. Keith Martin
Dean, Professor of Biology
Rogers State University
1701 West Will Rogers Boulevard
Claremore, OK 74017
kmartin@rsu.edu

Distribution List

Miami Flood Mitigation Advisory Board *
City of Miami
PO Box 1288
Miami, OK 74355-1288

Grand Seaplanes, LLC *
5200 South Chestnut Avenue
Broken Arrow, OK 74011

Anglers in Action *
PO Box 803
High Ridge, MO 63049
Grand Lake Association & Visitor Center *
9630 Highway 59 N, Suite B
Grove, OK 74344

Rusty Fleming *
Executive Director
Grand Lakers United Enterprise
PO Box 1
Langley, OK 74350

South Grand Lake Area Chamber of Commerce
PO Box 215
Langley, OK 74350
grandlakechamber@gmail.com

Director Michele Bolton
Miami Area Chamber of Commerce
103 East Central Avenue, Suite 100
Miami, OK 74354
michele@miamiokchamber.com

Oklahoma Association of Realtors *
9807 Broadway Ext
Oklahoma City, OK 73114-6312

Har-Ber Village *
4404 West 20th Street
Grove, OK 74344

Dr. Mark Osborn *
301 2nd Avenue SW
Miami, OK 74354

Mr. Jack Dalrymple *
54297 E 75 Road
Miami, OK 74354

Mr. Mike Williams
Director of Communications & Gov't Relations
Shangri-La Marina
57151 East Highway 125
Afton, OK 74331
mike.williams@shangrilaok.com

Mr. Charlie Russell
General Manager
Cherokee Yacht Club Marina
PO Box 600
Ketchum, OK 74349
charlie.russell@cherokeeyachtclub.com

Mr. Gary Stuart
Manager
Port Carlos
PO Box 780
Ketchum, OK 74349
gary.stuart@portcarlos.com

Mr. Joe Harwood
Owner
Arrowhead Yacht Club (North & South)
PO Box 600
Ketchum, OK 74349
joeharwood@aol.com

Mr. Mike Whorton
Owner
Clearwater Bay Marina
PO Box 219
Disney, OK 74340
clearwaterbay@grand.net

Judy Florida
General Manager
Harbors View Marina
451107 East 320 Road
Afton, OK 74331
jflorida@shmarinas.com

Jeff Rose
Regional Manager
Safe Harbor Marinas
14785 Preston Road, Suite 975
Dallas, TX 75254
jrose@shmarinas.com

Distribution List

Mr. Jason Macer
Manager
Thunder Bay Marina LLC
450780 Thunder Bay Road
Afton, OK 74331
jason.m@uglyjohns.com

Mr. Jerry Cookson
Manager
Cedar Port Marina
PO Box 600
Ketchum, OK 74349
jerry.cookson@cedarport.com

Mr. Tom Berry
Manager
Tera Miranda Marina Resort
28251 South 561 Road
Monkey Island, OK 74331
tom@teramiranda.com

Ms. April Cummins
Manager
Honey Creek Landing Marina
2520 South Main Street
Grove, OK 74344
april@honeycreeklanding.com

Mr. Greg Crenshaw
Willow Park Marina
PO Box 120
Ketchum, OK 74349
greg@willowparkmarina.com

Ted Peitz
Owner
Southwinds Marina
PO Box 3977
Bernice, OK 74331
tpeitz@southwindsmarina.com

Mr. Paul Staten
Owner
The Landings Marina
PO Box 61250
Oklahoma City, OK 73146
paullandingsmarina@att.net

Scotty's Cove, Inc *
PO Box 580
Langley, OK 74350

Mr. Nick Powell
Manager
Hammerhead Marina
PO Box 600
Ketchum, OK 74349
nick.powell@arrowhead.com

Grand Lakeside Marina *
11350 North Highway 59
Grove, OK 74344

Mr. Todd Elson
Manager
Indian Hills Resort and Marina
PO Box 3747
Bernice, OK 74331
indianhillsok@aol.com

Mr. Kevin McClure
Manager
Hi-Lift Marina LLC
196 Private Road 138
Eucha, OK 74342
yachtsrfun@yahoo.com

Mr. Harry Cole
Owner
Dripping Springs Yacht Club
200 Dripping Springs Landing
Eucha, OK 74342
drippingspringsyachtclub@gmail.com

Mr. Sam Chapman
Owner
Red Arrow Marina
453881 East 305 Road
Afton, OK 74331
sam@redarrowmarina.com

Mr. Russ Allard
Owner
Elk River Landing
1923 North Barrington Drive
Fayetteville, AR 72701
russell_allard@yahoo.com

Notice of Intent to File Application for New License
Pensacola Hydroelectric Project (FERC No. 1494)
Grand River Dam Authority

The following information regarding the Pensacola Hydroelectric Project (Project) is provided pursuant to 18 CFR§ 5.5(b):

(1) Existing licensee's name and address:

Grand River Dam Authority
Administrative Headquarters
P.O. Box 409
Vinita, OK 74301

Project Contact(s):

Dr. Darrell Townsend, PhD
Grand River Dam Authority
Assistant General Manager
420 Highway 28
Langley, OK 74359-0070
918-256-0616
dtownsend@grda.com

Jacklyn Jaggars
Grand River Dam Authority
Administrative Assistant
420 Highway 28
Langley, OK 74359-0070
918-256-0723
jjaggars@grda.com

(2) Project number:

Pensacola Hydroelectric Project, Federal Energy Regulatory Commission (FERC) No. 1494

(3) License expiration date:

FERC issued a license to operate the Project to the Grand River Dam Authority on April 24, 1992. The license expires on March 31, 2022.

(4) Statement of intention to file application:

Grand River Dam Authority hereby states its intent to file an application for a new license for the Pensacola Hydroelectric Project (FERC No. 1494), using the Integrated Licensing Process (ILP).

(5) Principal Project works:

The Project as licensed consists of: (a) a reinforced-concrete dam with a multiple-arch section 4,284 feet long, a spillway 861 feet long containing twenty-one radial gates, a non-overflow gravity section 451 feet long, and two non-overflow abutments, comprising an overall length of 5,950 feet and a maximum height of 147 feet; (b) a reinforced-concrete, gravity-type spillway section 886 feet long containing twenty-one radial gates and located about 1 mile east of the main dam; (c) the Grand Lake reservoir, which has a surface area of 45,228 acres and a storage capacity of 1,680,000 acre-feet at normal maximum water surface elevation of 745 feet Pensacola datum (PD); (d) six, 15-foot-diameter steel penstocks supplying flow to six turbines each rated at 17,446 kilowatts (kW) attached to six generators each rated at 24,000 kilovolt-ampere (kVA) or 21,600 kW, and one 3-foot-diameter penstock supplying flow to one turbine rated at 500-kW attached to an identically rated generator, located in a powerhouse immediately below the dam; (e) a tailrace approximately 300 feet wide and a spillway channel approximately 850 feet wide, both about 1.5 miles long; and (f) appurtenant facilities.

(6) Project location:

The Project is located on the Grand River in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma.

(7) Installed plant capacity:

The Project has an installed capacity of 105,176 kW.

(8) Names and mailing addresses:

i. Every county in which any part of the Project is located, and in which any Federal facility that is used or to be used by the Project is located:

Craig County
County Commissioners
210 Delaware Avenue, #106
Vinita, OK 74301

Mayes County
County Commissioners
One Court Place, Suite 140
Pryor, OK 74361

Delaware County
County Commissioners
327 S 5th Street
Jay, OK 74346

Ottawa County
County Commissioners
102 E Central Ave, Suite 202
Miami, OK 74354

2001 Industrial 10 Road
Grove, OK 94344

There are no Federal facilities used or proposed to be used by the Project.

ii. Every city, town, or similar political subdivision:

(A) In which any part of the Project is or is to be located and any Federal facility that is used or to be used by the Project is located:

City of Miami
PO Box 1288
Miami, OK 74335

Town of Wyandotte
212 S Main Street
Wyandotte, OK 74370

Town of Langley
PO Box 760
Langley, OK 74350

City of Grove
104 W 3rd Street
Grove, OK 74344

Town of Bernice
209 A Broadway
Bernice, OK 74331

Town of Disney
PO Box 318
Disney, OK 74340

There are no Federal facilities used or proposed to be used by the Project.

(B) That has a population of 5,000 or more people and is located within 15 miles of the existing project dam:

City of Vinita
PO Box 329
Vinita, OK 74301

iii. Every irrigation district, drainage district, or similar special purpose political subdivision:

(A) In which any part of the Project is or is proposed to be located and any Federal facility that is or is proposed to be used by the Project is located:

None.

There are no Federal facilities used or proposed to be used by the Project.

(B) That owns, operates, maintains, or uses any Project facility or any Federal facility that is or is proposed to be used by the Project:

Rural Wastewater District #3, Delaware County
PO Box 1228
Jay, OK 74346

Rural Wastewater District #3, Mayes County
PO Box 279
Disney, OK 74340

There are no Federal facilities used or proposed to be used by the Project.

iv. Every other political subdivision in the general area of the Project that there is reason to believe would be likely to be interested in, or affected by, the notification:

Town of Afton
PO Box 250
Afton, OK 74331

Town of Fairland
PO Box 429
Fairland, OK 74343

Town of Ketchum
PO Box 150
Ketchum, OK 74349

v. Affected Indian Tribes:

The following are Native American Tribes that may be interested in the Project area:

Caddo Nation of Oklahoma
Chairman Tamara Francis-Fourkiller
PO Box 487
Binger, OK 73009

Eastern Shawnee Tribe of Oklahoma
Chief Glenna J. Wallace
12755 S 705 Road
Wyandotte, OK 74370

Shawnee Tribe of Oklahoma
Chief Ron Sparkman
29 S Highway 69A
Miami, OK 74354

Apache Tribe of Oklahoma
Mr. Ernest Redbird III
PO Box 1330
Anadarko, OK 73005

Osage Nation
Mr. John Fox
627 Grandview Avenue
Pawhuska, OK 74056

Cheyenne and Arapaho Tribes, Oklahoma
Mr. Eddie Hamilton
100 Red Moon Circle
Concho, OK 73002

Cherokee Nation
Principal Chief Bill John Baker
PO Box 948
Tahlequah, OK 74465

Delaware Tribe of Indians
Honorable Chief Chester Brooks
170 NE Barbara
Bartlesville, OK 74006

Wichita and Affiliated Tribes (Wichita, Keechi, Waco, and Tawakonie), Oklahoma
President Terry Parton
PO Box 729
Anadarko, OK 73005

Muscogee (Creek) Nation
Chief James Floyd
PO Box 580
Okmulgee, OK 74447

Alabama-Quassarte Tribal Town
Chief Tarpie Yargee
PO Box 187
Wetumka, OK 74883

Seneca-Cayuga Nation
Chief William Fisher
PO Box 453220
Grove, OK 74345-3220

Modoc Tribe of Oklahoma
Chief Bill Follis
418 G Street SE
Miami, OK 74354

Quapaw Tribe of Indians
Chairman John Berry
PO Box 765
Quapaw, OK 74363

Miami Tribe of Oklahoma
Chief Douglas G. Lankford
PO Box 1326
Miami, OK 74354

Ottawa Tribe of Oklahoma
Chief Ethel Cook
PO Box 110
Miami, OK 74354

Peoria Tribe of Oklahoma
Chief John Froman
118 South Eight Tribes Trail
Miami, OK 74354

United Keetoowah Band of Cherokees
Ms. Karen Pritchett
PO Box 1245
Tahlequah, OK 74665

Wyandotte Tribe of Oklahoma
Chief Billy Friend
64700 East Highway 60
Wyandotte, OK 74370

Little Traverse Bay Bands of Odawa Indians, Michigan
Ms. Regina Gasco-Bentley
7500 Odawa Circle
Harbor Springs, MI 49740

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Pensacola Hydroelectric Project, FERC No. 1494

Pre-Application Document

February 2017

TABLE OF CONTENTS

ATTACHMENTS

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LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

°C .... degrees Celsius
°F .... degrees Fahrenheit
µg/L.......................... microgram per liter
µS/cm .... microSiemens/centimeter
ACHP........................ Advisory Council on Historic Preservation
APE .... Area of Potential Effects
AUC .... Allowable Use Categories
B.P. .... Before Present
BLH.......................... bottomland hardwood
BLM .... U.S. Department of the Interior, Bureau of Land Management
CEII.......................... Critical Energy Infrastructure Information
CFR .... Code of Federal Regulations
cfs .... cubic feet per second
CI .... confidence intervals
cm............................ centimeter
CPUE....................... catch per unit effort
CWAC...................... Cold and Water Aquatic Communities
DLA.......................... Draft License Application
DO .... dissolved oxygen
DOKARRS .... Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings
EA............................ Environmental Assessment
ECOS .... Ecological Conservation System
EFH .... essential fish habitat
EPA .... U.S. Environmental Protection Agency
ESA .... Endangered Species Act of 1973
FC............................ fish consumption
FERC........................ Federal Energy Regulatory Commission
FIB .... fecal indicator bacteria
FLA .... Final License Application
FPA.......................... Federal Power Act
GDP.......................... Gross Domestic Product
GLWAF .... Grand Lake O' the Cherokees Watershed Alliance Foundation, Inc.

GRDA .... Grand River Dam Authority
Hz .... hertz
IBI .... indices of biotic integrity
ILP .... Integrated Licensing Process
IPaC.......................... Information Planning and Conservation System
IWB........................... indices of well being
kcmil .... thousands of circular mils
km............................ kilometer
kV .... kilovolt
kVA .... kilovolt amp
kW .... kilowatt
lb.............................. pound
m.............................. meter
mg/L......................... milligrams per liter
MKARNS .... McClellan-Kerr Arkansas River Navigation System
mL............................ milliliter
MOA .... Memorandum of Agreement
MPN.......................... most probable number
MW .... megawatts
MWh .... megawatt hours
NAVD........................ North American Vertical Datum
NEPA........................ National Environmental Policy Act
NGO .... non-governmental organization
NGVD .... National Geodetic Vertical Datum
NHPA........................ National Historic Preservation Act of 1966
NMFS .... National Marine Fisheries Service
NOAA .... National Oceanic and Atmospheric Administration
NOI .... Notice of Intent
NPS .... U.S. National Park Service
NRCS .... U.S. Department of Agriculture, Natural Resources Conservation Service
NRHP .... National Register of Historic Places
NRI .... Nationwide Rivers Inventory
NTU .... nephelometric turbidity units
O.S. .... Oklahoma Statutes
OAC.......................... Oklahoma Administrative Code

OAS .... Oklahoma Archaeological Survey

OBRC .... Oklahoma Bird Records Committee

OBS .... Oklahoma Biological Survey

OBTF .... Oklahoma Biodiversity Task Force

OCES .... Oklahoma Cooperative Extension Service

ODAFF .... Oklahoma Department of Agriculture, Food, and Forestry Oklahoma Forestry Service

ODEQ .... Oklahoma Department of Environmental Quality

ODWC .... Oklahoma Department of Wildlife Conservation

OFS .... Oklahoma Forestry Services

OHR.......................... Oklahoma House of Representatives

OHV .... off-highway vehicle

OIPC......................... Oklahoma Invasive Plant Council

ONHI......................... Oklahoma Natural Heritage Inventory

OSU .... Oklahoma State University

OTRD .... Oklahoma Tourism and Recreation Department

OWRB .... Oklahoma Water Resources Board

PAD .... Pre-Application Document

PBCR........................ primary body contact recreation

PD............................ Pensacola datum

PLP........................... Preliminary Licensing Proposal

PM&E .... protection, mitigation and enhancement

PPWS .... public and private water supply

PRC .... Paddlefish Research Center

PSP .... Proposed Study Plan

RM .... river mile

RMP.......................... Recreation Management Plan

rpm .... rotations per minute

RSP .... Revised Study Plan

RV............................. recreational vehicle

SCORP..................... State Comprehensive Outdoor Recreation Plan

SD1........................... Scoping Document 1

SD2........................... Scoping Document 2

SHPO .... State Historic Preservation Officer

SMC.......................... Shoreline Management Classifications

SMP .... Shoreline Management Plan
SSP .... Standardized Sampling Protocol
STID .... Supporting Technical Information Document
TCP .... traditional cultural properties
THPO .... Tribal Historic Preservation Officer
TMDL .... Total Maximum Daily Load
TNC .... The Nature Conservancy
TP .... total phosphorus
TSMD .... Tri-State Mining District
USACE .... U.S. Army Corps of Engineers
USDI .... U.S. Department of Interior
USFWS .... U.S. Fish and Wildlife Service
USGS .... U.S. Geological Survey
USR .... Updated Study Report
VMP .... Vegetation Management Plan
WMA .... Wildlife Management Area
WNS .... white-nose syndrome
WPA .... Works Progress Administration
WQS .... water quality standards
WWAC .... warm water aquatic community

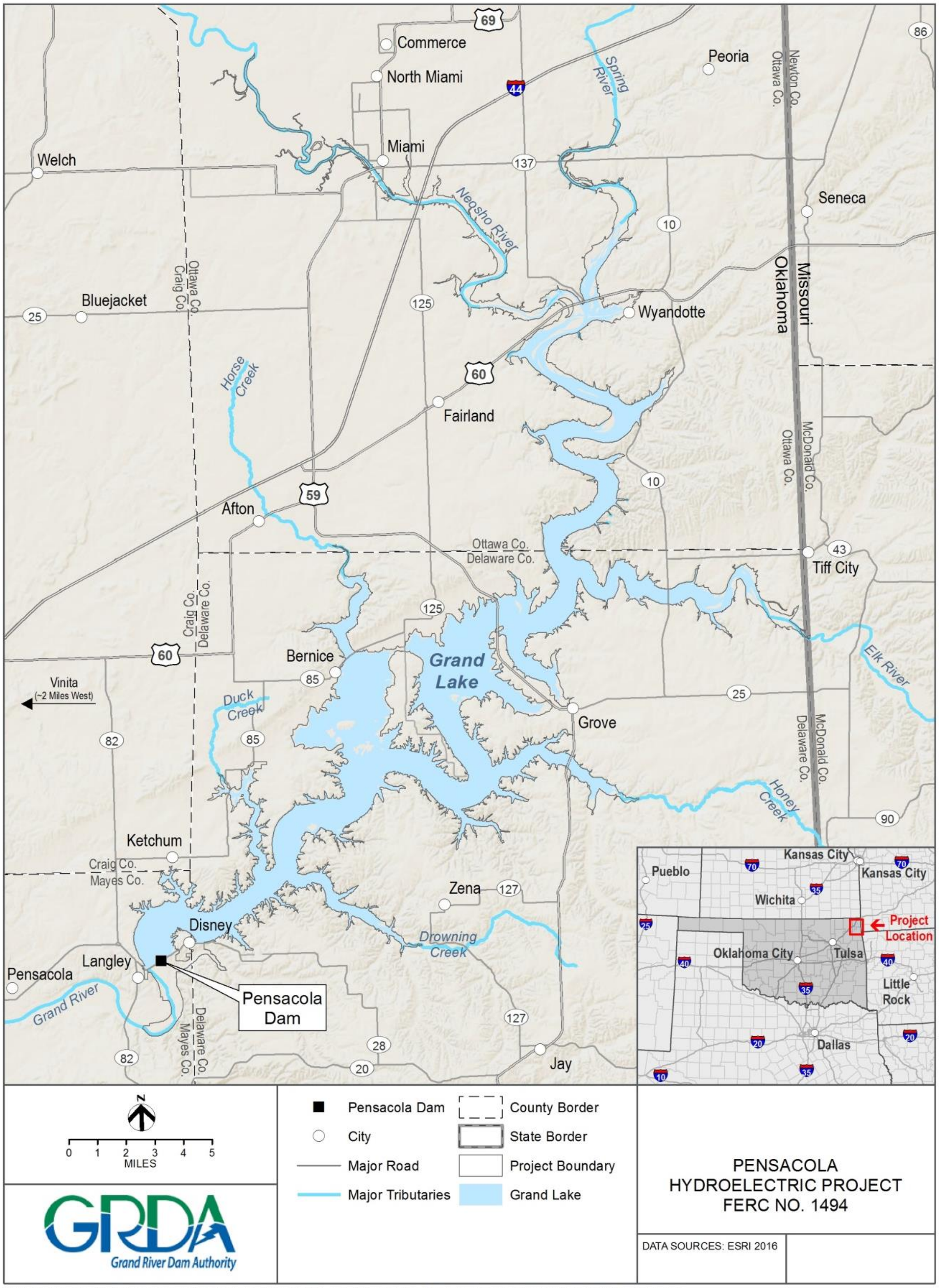
1.0 INTRODUCTION AND BACKGROUND

The Pensacola Hydroelectric Project (Pensacola Project or Project), owned and operated by the Grand River Dam Authority (GRDA), is licensed by the Federal Energy Regulatory Commission (FERC or Commission) as Project No. 1494. GRDA is a non-appropriated agency of the State of Oklahoma, created by the Oklahoma legislature in 1935 to be a "conservation and reclamation district for the waters of the Grand River." As licensed by FERC, the Project serves multiple purposes, including hydropower generation, water supply, public recreation, and wildlife enhancement. As directed by Congress under the Flood Control Act of 1944, 58 Stat. 887, 890-91, the U.S. Army Corps of Engineers (USACE) has exclusive jurisdiction over Grand Lake for flood control purposes.

GRDA fulfills its statutory responsibilities under state law by operating the Pensacola Project as well as the downstream Markham Ferry Hydroelectric Project (FERC No. 2183), the Salina Pumped Storage Project (FERC No. 2524), and managing three lakes (Pensacola Project's Grand Lake O' The Cherokees, Markham Ferry Project's Lake Hudson, and Salina Project's W.R. Holway Reservoir), along the Grand River system. GRDA produces reliable electricity that reaches into 75 of 77 counties in Oklahoma. GRDA sells electricity to three customer classes: municipalities, electric cooperatives, and industries. GRDA also cooperates with USACE in managing flood control by coordinating operations of the Pensacola and Markham Ferry projects as directed by USACE in its efforts to manage storm events throughout the Grand River Basin, from John Redmond Dam (located 339.8 miles upstream in Kansas) downstream to Fort Gibson Dam (located 69 miles downstream of the Project).

The Pensacola Project is located northeast of Tulsa on the Grand Neosho River (Grand River) in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (Figure 1.0-1). The Pensacola Dam is located at river mile (RM)[1] 77 on the Grand River and creates Grand Lake O' The Cherokees, which is also known as Grand Lake. The Project as licensed consists of: (a) a reinforced-concrete dam with a multiple-arch section 4,284 feet long, a spillway 861 feet long containing twenty-one radial gates, a non-overflow gravity section 451 feet long, and two non-overflow abutments, comprising an overall length of 5,950 feet and a maximum height of 147 feet; (b) a reinforced-concrete, gravity-type spillway section 886 feet long containing twenty-one radial gates and located about 1 mile east of the main dam; (c) the Grand Lake reservoir, which has a surface area of approximately 45,200 acres and a storage capacity of 1,680,000 acre-feet at normal maximum water surface elevation of 745 feet Pensacola datum (PD)[2], below which is known as the conservation pool; (d) six, 15-foot-diameter steel penstocks supplying flow to six turbines each rated at 17,446 kilowatts (kW) attached to six generators each rated at 24,000 kilovolt amp (kVA) or 21,600 kW, and one 3-foot-diameter penstock supplying flow to one turbine rated at 500-kW[3] attached to an identically rated generator, located in a powerhouse immediately below the dam; (e) a tailrace approximately 300 feet wide and a spillway channel approximately 850 feet wide, both about 1.5 miles long; and (f) appurtenant facilities (FERC 1996; GRDA 2010).

[1] River miles in this document are based on a dataset created by U.S. Geological Survey (USGS) November 14, 2016, NHD at 1:24,000 scale, unless otherwise noted.
[2] Unless otherwise noted, all elevations referenced are relative to PD. PD elevations can be converted to National Geodetic Vertical Datum of 1929 (NGVD) by adding 1.07 feet and to North American Vertical Datum of 1988 (NAVD) by adding 1.40 feet (for example, elevation 745 feet PD = 746.07 feet NGVD = 746.4 feet NAVD88)(http://ok.water.usgs.gov/projects/webmap/miami/datum.htm).
[3] The 2011 Supporting Technical Information Document (STID) mistakenly identifies the unit as 625 kW and will be corrected in a future revised STID.



PATH: X:\PROJECTS\GRANDRIVERDAMAUTHORITY\10027621_PENSICOLAPAD\MAP_DOCS\DRAFT\OCTOBER2016\FIGURE_1_0-1_PENSACOLA_PROJECT_VICINITY.MXD - USER: NLARUE - DATE: 1/4/2017

Figure 1.0-1. Pensacola Project vicinity.

The existing license for the Pensacola Project was issued on April 24, 1992, and will expire on March 31, 2022. GRDA is applying for a new license for the Pensacola Project. In accordance with FERC regulations at 18 Code of Federal Regulations (CFR) Part 5, GRDA is utilizing FERC's default Integrated Licensing Process (ILP) for preparing its relicensing application. Pursuant to FERC's regulations, GRDA is filing a Notice of Intent (NOI) to relicense the Project and this Pre-Application Document (PAD) no later than five years prior to the Project's license expiration date of March 31, 2022.

2.0 PURPOSE OF THE PRE-APPLICATION DOCUMENT

This PAD follows the content and requirements of Title 18, Part 5.6 of the CFR. The purpose of the PAD is to provide FERC and interested parties with existing information relevant to the Pensacola Project including Project background, relicensing process and schedule, operations, engineering, environmental and natural resources, recreation, cultural resources, and socioeconomic aspects of the Pensacola Project. This existing, relevant, and reasonably available information enables FERC, GRDA, and interested parties to identify issues and study needs and to develop focused study requests and plans where necessary. In addition, the PAD is the foundation for the license application. The PAD is also a precursor to FERC's Scoping documents and environmental analysis under the National Environmental Policy Act (NEPA).

In accordance with the regulations, the PAD and the associated NOI are filed with FERC and distributed to federal and state resource agencies, tribes, local governments, non-governmental organizations (NGO), and other interested parties (relicensing participants). The filing of the NOI and PAD with FERC formally initiates the relicensing process for this Project.

2.1 Search for Available, Relevant Information

In preparing the PAD, GRDA exercised due diligence in identifying, requesting, and obtaining relevant existing information concerning the Project and its surroundings. This information was obtained through a search of various public information and reference sources, existing GRDA resources and data, agency contacts, and consultation. A wealth of existing relevant information was identified, reviewed, researched, and analyzed in preparation of this PAD. On September 21, 2016, and prior to filing of the PAD in February 2017, GRDA initiated outreach to interested parties through transmittal of a PAD questionnaire. GRDA mailed 182 questionnaires to federal and state resource agencies, tribes, local governments, NGOs, area universities, and other entities that might have relevant information related to the Project. In response, 20 completed forms, and 6 emails/letters were received by GRDA. The questionnaire mailing, a summary of the communications and responses related to the PAD questionnaire exercise, as well as copies of the completed forms are included in Attachment A.

GRDA reviewed all information sources identified by those who responded to the questionnaire. All information sources cited in this PAD are appropriately referenced and a record of all contacts made with federal and state resource agencies, tribes, and other interested parties are summarized in Attachment A.

GRDA, in partnership with federal and state resources agencies, supports numerous water quality, wildlife, recreation, and natural resource monitoring efforts in the Project vicinity.

Recent license amendment applications regarding proposed changes to the operating rule curve and completion of the Shoreline Management Plan (SMP) for the Project also provide detailed Project vicinity information to inform the description of existing conditions and to support the analysis of potential effects of proposed Project operations for the new license term.

2.2 Consultation Process

The goals of the initial consultation process included providing the federal and state resource agencies, tribes, and interested parties with background information concerning the Project facilities and operation, briefing agencies on the ILP relicensing process, schedule and commitments, identifying potential issues, and anticipated study needs. For example, in September 2016, GRDA met with the U.S. Fish and Wildlife Service (USFWS), Oklahoma Water Resources Board (OWRB), Oklahoma Department of Environmental Quality (ODEQ), Oklahoma Department of Wildlife Conservation (ODWC), and Oklahoma Archaeological Society (OAS) to introduce the relicensing process prior to filing of the PAD. GRDA has incorporated the results of these early outreach and consultation efforts into this PAD.

3.0 PROCESS PLAN, SCHEDULE, AND PROTOCOLS

3.1 Process Plan and Schedule

In accordance with FERC regulations (18 CFR §5.6(d)(1)), the PAD must include a Process Plan and Schedule for all pre-application activities. GRDA developed the Process Plan and Schedule using the timeframes established by 18 CFR Part 5. As presented in Table 3.1-1, the Process Plan and Schedule outlines the specific timeframes, deadlines, and responsibilities of FERC, GRDA, and other relicensing participants involved in the ILP from the filing of the NOI and PAD through filing of the Final License Application (FLA). GRDA is committed to working with relicensing participants to maintain this schedule.

Table 3.1-1. ILP milestones for the Pensacola Project through filing of the FLA.

Pre-Filing Milestone	Responsible Party	Timeframe	Date[2]	FERC Regulation
File NOI and PAD	GRDA	As early as 5.5 years, but no later than 5 years prior to license expiration	2/1/2017	18 CFR §5.5(d)
Initial Tribal consultation meeting	FERC	No later than 30 days after filing NOI and PAD	3/3/2017	18 CFR §5.7
Issue notice of NOI/PAD and Scoping Document 1 (SD1)	FERC	Within 60 days of filing NOI and PAD	4/2/2017	18 CFR §5.8(a)
Conduct scoping meetings and site visit	FERC	Within 30 days of NOI/PAD notice and SD1 issuance	5/2/2017	18 CFR §5.8(b)(3)(viii)
Comments on PAD, SD1, and Study Requests	Relicensing participants	Within 60 days of NOI/PAD notice and issuance of SD1	6/1/2017	18 CFR §5.9(a)

Pre-Filing Milestone	Responsible Party	Timeframe	Date[2]	FERC Regulation
File Proposed Study Plan (PSP)	GRDA	Within 45 days of deadline for filing comments on PAD	7/16/2017	18 CFR §5.11
Issuance of Scoping Document 2 (SD2), if necessary	FERC	Within 45 days of deadline for filing comments on SD1	7/16/2017	18 CFR §5.10
PSP Meetings	GRDA	Initial meeting to be held within 30 days of filing PSP	8/15/2017	18 CFR §5.11(e)
Comments on PSP	Relicensing participants	Within 90 days after PSP is filed	10/14/2017	18 CFR §5.12
File Revised Study Plan (RSP)	GRDA	Within 30 days of deadline for comments on PSP	11/13/2017	18 CFR §5.13(a)
Comments on RSP	Relicensing participants	Within 15 days following RSP	11/28/2017	18 CFR §5.13(b)
Issuance of Study Plan Determination	FERC	Within 30 days of RSP	12/13/2017	18 CFR §5.13(c)
Formal Study Dispute Resolution Process if requested [1]	Agencies and Tribes with mandatory conditioning authority	Within 20 days of Study Plan Determination	1/2/2018	18 CFR §5.14(a)
Dispute Resolution Panel convenes	Dispute Resolution Panel	Within 20 days of notice of study dispute	1/22/2018	18 CFR §5.14(d)
Comments on Study Plan disputes	GRDA	Within 25 days of notice of study dispute	1/27/2018	18 CFR §5.14(i)
Third panel member selection due	Dispute Resolution Panel	Within 15 days of when Dispute Resolution Panel convenes	2/11/2018	18 CFR §5.14(d)(3)
Dispute Resolution Panel technical conference	Dispute Resolution Panel, GRDA, Relicensing participants	Prior to engaging in deliberative meetings		18 CFR §5.14(j)
Dispute Resolution Panel findings and recommendations	Dispute Resolution Panel	No later than 50 days after notice of dispute	2/21/2018	18 CFR §5.14(k)
Study Dispute Determination	FERC	No later than 70 days after notice of dispute	3/13/2018	18 CFR §5.14(1)
Conduct first season of studies	GRDA	—	April to October 2018	18 CFR §5.15

Pre-Filing Milestone	Responsible Party	Timeframe	Date[2]	FERC Regulation
Initial Study Report	GRDA	Pursuant to the Commission-approved study plan and schedule provided in §5.13 or no later than 1 year after Commission approval of the study plan	12/13/2018	18 CFR §5.15(c)
Initial Study Report meeting	GRDA and Relicensing participants	Within 15 days of filing the Initial Study Report	12/28/2018	18 CFR §5.15(c)(2)
File Initial Study Report Meeting Summary	GRDA	Within 15 days of study results meeting	1/12/2019	18 CFR §5.15(c)(3)
File Meeting Summary disagreements [1]	Relicensing participants	Within 30 days of study results Meeting Summary	2/11/2019	18 CFR §5.15(c)(4)
File responses to Meeting Summary disagreements	GRDA	Within 30 days of filing Meeting Summary disagreements	3/13/2019	18 CFR §5.15(c)(5)
Study Dispute Determination	FERC	Within 30 days of filing responses to disagreements	4/12/2019	18 CFR §5.15(c)(6)
Conduct second season of studies	GRDA	—	April to October 2019	
File Preliminary Licensing Proposal (PLP) or Draft License Application (DLA)	GRDA	No later than 150 days prior to the deadline for filing a new or subsequent license application	11/1/2019	18 CFR §5.16
File Updated Study Report (USR)	GRDA	Pursuant to the Commission-approved study plan and schedule provided in §5.13 or no later than 2 years after Commission approval	12/13/2019	18 CFR §5.15(f)
USR meeting	GRDA and Relicensing participants	Within 15 days of USR	12/28/2019	18 CFR §5.15(f)
USR Meeting Summary	GRDA	Within 15 days of USR meeting	1/12/2020	18 CFR §5.15(f)
Comments on PLP or DLA	Relicensing participants	Within 90 days of filing Draft License Application	1/30/2020	18 CFR §5.16(e)
File Meeting Summary disagreements [1]	Relicensing participants	Within 30 days of study results meeting summary	2/11/2020	18 CFR §5.15(f)
File responses to Meeting Summary disagreements	GRDA	Within 30 days of filing meeting summary disagreements	3/12/2020	18 CFR §5.15(f)(5)
Study Dispute Determination	FERC	Within 30 days of filing responses to disagreements	4/11/2020	18 CFR §5.15(f)

Pre-Filing Milestone	Responsible Party	Timeframe	Date[2]	FERC Regulation
File FLA	GRDA	No later than 24 months before the existing license expires	3/31/2020	18 CFR §5.17(a)

Notes:
1 Shaded actions are not necessary if there are no study disputes.
2 If the due date falls on a weekend or holiday, the deadline is the following business day.

3.2 Scoping Meeting and Site Visit

Pursuant to 18 CFR §5.6(d)(1) and §5.8(d), FERC will hold a site visit in conjunction with a Scoping Meeting. Typically, FERC holds two scoping meetings; one meeting will be held during the day and focus on the solicitation of comments from resource agencies and tribes. The second meeting will be held in the evening to facilitate involvement from the public and NGOs. FERC is to hold the scoping meetings within 30 days of FERC's notice of the PAD and NOI and issuance of SD1. All interested parties are invited to participate in the site visit and scoping meetings.

3.3 Integrated Licensing Process (ILP) Participation

Representatives of federal and state resource agencies, tribes, local governments, NGOs, and members of the public identified as potential participants in the Pensacola Project ILP are listed in Attachment B. Any interested parties wishing to be included on the distribution list should contact:

Jacklyn Jaggars
Grand River Dam Authority
Administrative Assistant
420 Highway 28
Langley, OK 74359-0070
918-256-0723
jjaggars@grda.com

3.4 Communications and Distribution Protocols

During the course of the Project relicensing process, communication will take place through public meetings, conference calls, and written correspondence. All phases of formal correspondence require adequate documentation to establish the consultation record. The following sections provide a general framework for the dissemination of information and for documenting consultation among all participants involved in the Project relicensing.

3.4.1 Meeting Notices and Summary

GRDA will hold public relicensing participant meetings at various times throughout the relicensing process. Additional agency meetings will be integrated into the relicensing schedule in a manner that will avoid or minimize scheduling conflicts as much as reasonably possible. For public meetings, GRDA will provide advance written notification to all parties on the relicensing distribution list and will seek to provide at least 15 days advance notice of the meeting date, although in some circumstances a shorter advance notice period may be warranted. In addition, FERC will publish notice announcing the date of the scoping meetings, which FERC is responsible for conducting, in an effort to obtain public involvement and comments. Where applicable, a meeting transcript (e.g., for FERC's scoping meetings) will be available via FERC's eLibrary system. Meeting summaries will be prepared and made available by GRDA.

3.4.2 Distribution of Relicensing Materials

Attachment B lists the federal and state resource agencies, tribes, local governments, NGOs, and other parties likely to be interested in the Pensacola Project relicensing. This list will be used to distribute electronic copies of major relicensing documents and will be updated with additions and modifications, upon request. GRDA will distribute relicensing materials and documents in electronic format through email and also post to the public relicensing website www.grda.com/pensacola-relicensing. Documents filed with FERC will also be available from FERC's eLibrary at http://www.ferc.gov/docs-filing/elibrary.asp by searching under Docket P-1494.

Upon request, GRDA will provide hard copies of applicable relicensing documents to relicensing participants. Requests for hard copies should be sent to Ms. Jacklyn Jaggars using the contact information provided in Section 3.3 of this PAD and should clearly indicate the name and publication date of the requested document as well as FERC Project No. 1494. A reproduction charge and postage costs may be assessed for hard copies requested by the public. Federal, state, and tribal entities will not be subject to document processing or postage fees.

Certain documents may be restricted from public access in accordance with FERC's regulations protecting Critical Energy Infrastructure Information (CEII)(18 CFR 388.113) or in cases where the document contains sensitive information (e.g., cultural resource sites and sensitive species locations). GRDA will address requests for such information on a case-by-case basis and in accordance with applicable laws, throughout the relicensing process.

3.4.3 FERC Communications

All communications to FERC must reference the **Pensacola Project FERC No. 1494 - Application for New License** clearly on the first page, and must conform to FERC's Rules of Practice and Procedure. Any hard copy filings with FERC must be provided to GRDA and all other entities listed on FERC's Official Service List.

FERC strongly encourages electronic filing of comments and interventions through its eFiling or eComments systems. Information and links to these systems can be found at the FERC webpage http://www.ferc.gov/docs-filing/ferconline.asp. In order to eFile comments and/or interventions, interested parties must have an eRegistration account. After preparing the comment or motion to intervene, go to www.ferc.gov and select the eFiling link; select the new user option and follow the prompts. Users are required to validate their account by accessing the site through a hyperlink sent to the registered email account.

An alternative method to eFile comments is through the “Quick Comment” system available via a hyperlink on FERC's homepage. “Quick Comments” do not require users to have a subscription, the comments are limited to 6,000 characters, and all information will be considered to be public. Commenters are required to enter their name and email address when providing “Quick Comments.” Commenters will receive an email with detailed instructions on how to submit “Quick Comments.”

Relicensing participants without internet access may submit comments to FERC at the address below via hard copy, but should be aware that documents sent to FERC by regular mail can be subject to docket-posting delays:

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

4.0 PROJECT LOCATION, FACILITIES, AND OPERATIONS

4.1 Agent for Applicant

The following person is authorized to act as agent for the applicant pursuant to 18 CFR §5.6(d)(2)(i):

Daniel S. Sullivan
Chief Executive Officer
Grand River Dam Authority
P.O. Box 409
Vinita, OK 74301
918-256-5545
dsullivan@grda.com

4.2 Project Location

The Project is located northeast of Tulsa on the Grand (Neosho) River (Grand River) in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (Figure 4.2-1). The Grand River originates as the Neosho River in Kansas and flows south through northeastern Oklahoma approximately 460 miles before discharging into the Arkansas River near the town of Fort Gibson. Below its confluence with the Spring River at RM 122.6,[4] near Wyandotte and State Highway 60, where the Twin Bridges crosses the river in Ottawa County, the Neosho River becomes the Grand (Neosho) River (Grand River). The Pensacola Dam is located at RM 77 and creates Grand Lake. Grand Lake extends approximately 66 miles upstream from the Pensacola Dam and covers approximately 45,200 acres at its normal maximum water surface elevation of 745 feet. As licensed by FERC, the Project serves multiple purposes, including hydropower generation, water supply, public recreation, and wildlife enhancement. Under the federal Flood Control Act of 1944, 58 Stat. 887, 890-91, USACE has exclusive jurisdiction over Grand Lake for flood control purposes, and USACE has designated a flood control pool for Grand Lake that extends above the 745-foot elevation of the conservation pool.

[4] In previous project documents this value is cited as RM 131, which comes from Holly 2004.

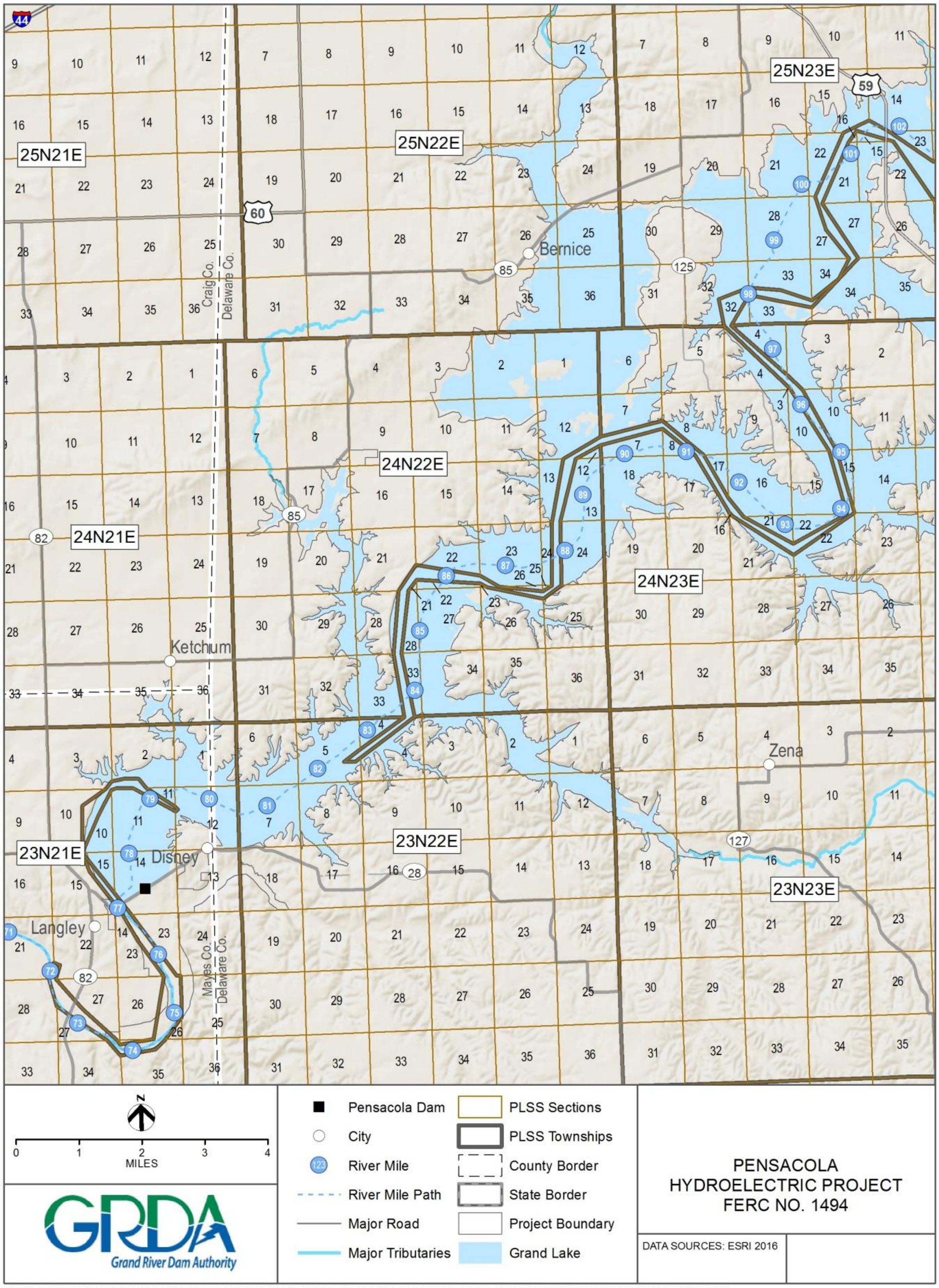


Figure 4.2-1. Location map of the Pensacola Project.

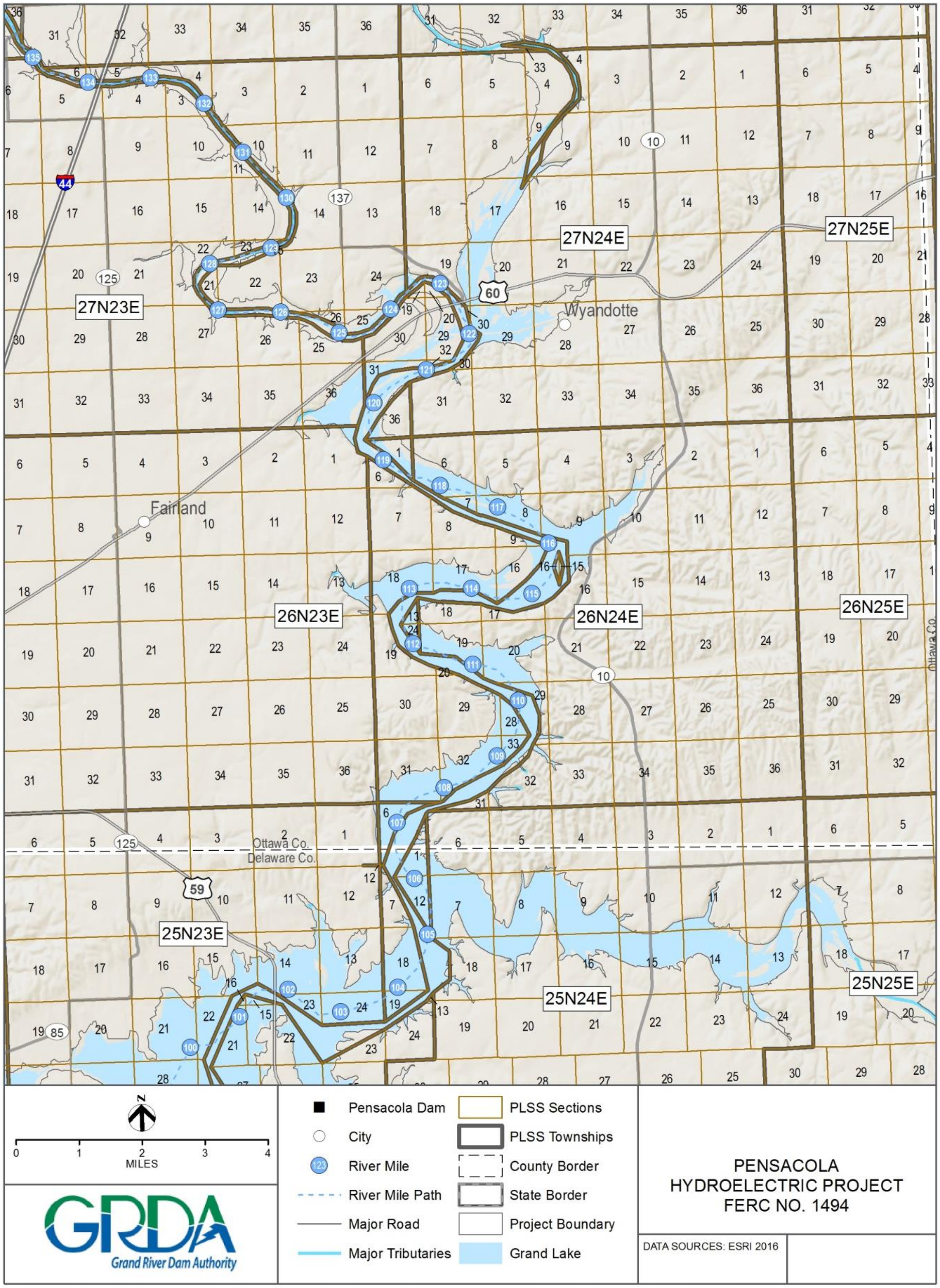


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Figure 4.2-1. Location map of the Pensacola Project.

There are two dams downstream of the Project on the Grand River. These dams are the Markham Ferry Project dam and the Fort Gibson Dam. The Markham Ferry Project (FERC Project No. 2183) is the first dam downstream of the Project at RM 47.1[5] on the Grand River (USACE 1992). The dam forms Lake Hudson, which serves as the lower reservoir for the Salina Pumped Storage Project (FERC Project No. 2524). FERC issued a new license for the Markham Ferry Project to GRDA in August 2006 and for the Salina Pumped Storage Project in October 2015. USACE's Fort Gibson Dam is located at RM 7.8[6] on the Grand River upstream from the confluence with the Arkansas River and forms Fort Gibson Lake (USACE 1992). During flood events (at a water surface elevation projected to be greater than 745 feet), USACE directs operations at the Pensacola, Markham Ferry, and Fort Gibson reservoirs for flood protection, which were authorized by the Flood Control Act of 1941, 55 Stat. 638, ch. 377.

4.3 Project Facilities

The Project consists of a main dam with a gated spillway, an auxiliary spillway, a powerhouse containing six generating units, a tailrace, a spillway channel, electrical substation, and transmission (Figure 4.3-1). GRDA constructed the Pensacola Project between 1938 and 1940, followed by installation of the fifth and sixth units in 1947 and 1951, respectively (GRDA 1985 and 2011a). Upgrades to turbines and generators occurred from 1998 to 2003 (GRDA 2011a). The following provides a summary of the facilities associated with the Pensacola Project.

4.3.1 Dam

The Project consists of a 5,950-foot-long, reinforced-concrete dam, which consists of two non-overflow abutments, a multiple-arch section, the main spillway, and a non-overflow gravity section. The non-overflow abutment is 54 feet long and is located on the west end of the dam. The multiple-arch section of the dam extends from the non-overflow abutment, approximately 4,284 feet across the Grand River and has a crest elevation of 757 feet (GRDA 2011a). The arch section transitions to the main spillway with a mass concrete closure buttress of 10 feet. The main spillway extends eastward 861 feet from the end of the arch section and consists of twenty-one radial gates. A 451-foot-long, non-overflow gravity section extends eastward from the end of the spillway. The non-overflow gravity section transitions with a 20-foot-long gravity, non-overflow closure into a 300-foot-long, non-overflow core wall abutment that ties the dam into the bedrock on the east end of the dam (GRDA 1985). A set of reinforced-concrete, gravity-type spillway sections (referred to as the east spillways) is located approximately one mile east of the main dam and is 886 feet long with twenty-one radial gates between the spillways (FERC 1996).

A highway bridge (State Highway 28) has been built across the length of the Pensacola Dam and the Project's east spillways. The bridge provides two 10-foot-wide vehicle lanes and a 4-foot-wide sidewalk for pedestrians (GRDA 2011a).

[5] In previous project documents this value is cited as RM 47.4, which comes from USACE 1992.
[6] In previous project documents this value is cited as RM 7.7, which comes from USACE 1992.

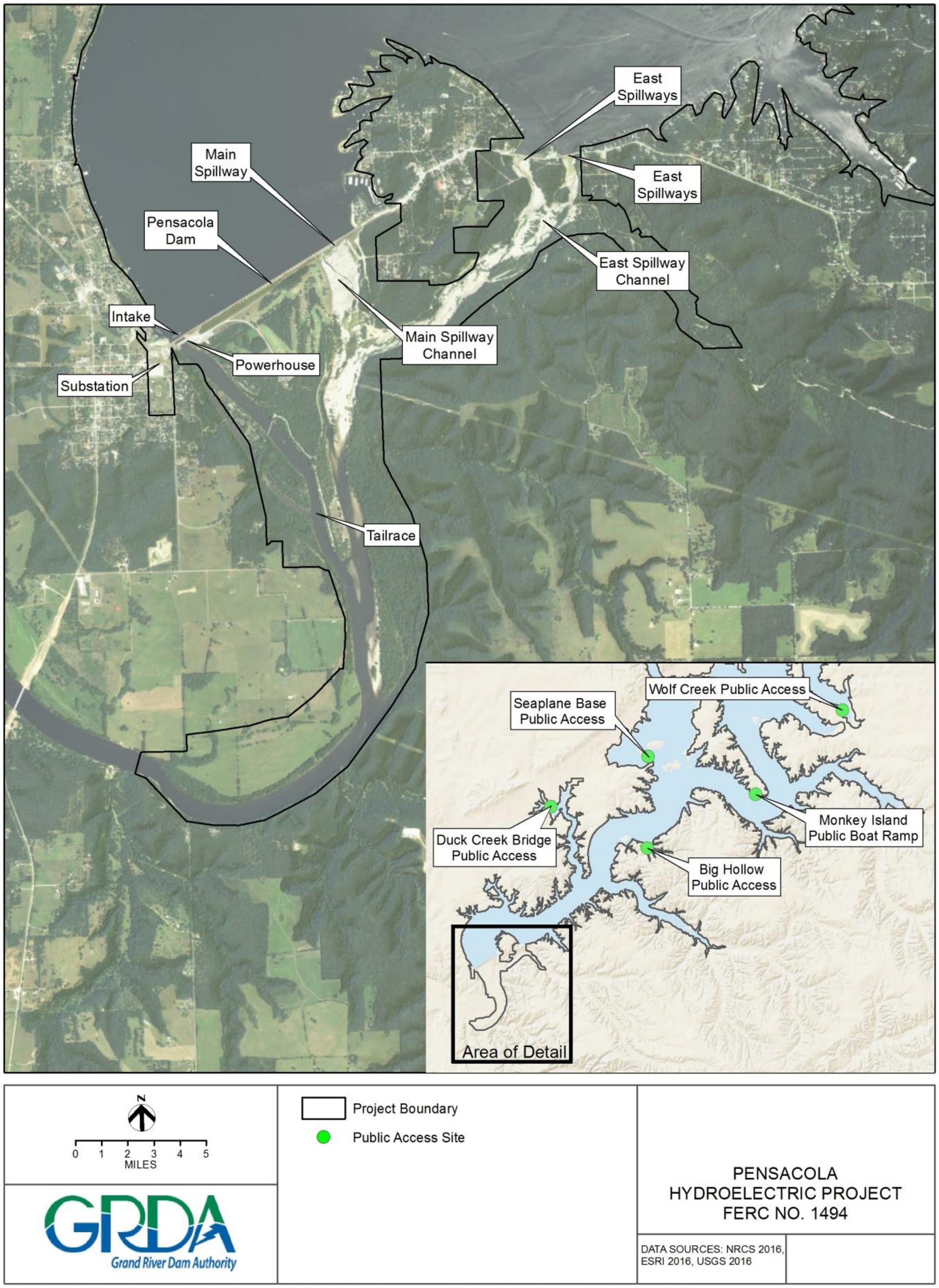

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Figure 4.3-1. General Project features and facilities.

4.3.2 Spillway

The Project's main spillway is an 861-foot-long gated (FERC 1996) controlled overflow structure with a crest elevation of 730 feet (GRDA 2011a). Discharge through this spillway is regulated by twenty-one 36-foot-long by 25-foot-high radial gates (GRDA 2011a). When the gates are closed, the top elevation of the spillway gates is equal to the top of the lake's flood control pool, 755 feet. The east spillways have an 886-foot-long combined length (FERC 1996) gravity concrete overflow structure with a crest elevation of 740 feet (GRDA 2011a). The east spillways include twenty-one 37-foot-long by 15-foot-high radial gates (GRDA 2011a).

Gate hoists are located at the spillways and are used to manually operate the gates and stop logs (GRDA 1985). When spillway releases are required from Grand Lake, initial releases are typically made through the east spillways. However, when several gates must be opened, GRDA will generally open gates in both the main and east spillways (GRDA 2011a).

4.3.3 Reservoir

Grand Lake has a surface area of approximately 45,200 acres and a storage capacity of 1.68 million acre-feet at a normal maximum water surface elevation of 745 feet (USACE 1992). The reservoir has approximately 667 miles[7] of shoreline that extends about 66 miles upstream from the dam (FERC 1996).

4.3.4 Intake

Water to the hydropower units is supplied through a concrete intake structure that sits atop the arches 2 through 4 of the dam. The intake structure is 246 feet wide and 75 feet tall, with a top deck elevation of 757 feet (GRDA 2011a). The bottom water intake elevation is 682 feet. The intake structure includes trashracks with 3.75-inch spacing (GRDA 2004b) to keep larger debris from entering the penstocks and turbines and also provides stop logs that can be used to isolate and dewater individual penstocks for maintenance. The stop logs are installed and removed using a traveling hoist (GRDA 2011a).

4.3.5 Powerhouse

The powerhouse is a multi-story, reinforced-concrete, 87.75-foot-wide and 279-foot-long structure located immediately below the dam on the (FERC 1992). Six 187-foot-long, 15-foot-diameter steel penstocks supply flow to six turbines (per Exhibit F) and one 3-foot-diameter penstock connected to a house unit (FERC 1996) which is no longer in service (GRDA 2011a). Flow through the penstocks is controlled by wicket gates at the entrance of each turbine and butterfly valves located at the entrance of each turbine's scroll case (GRDA 2011a).

[7] The Project license states there are 1,300 miles of shoreline around the Pensacola Project and, traditionally, GRDA has referenced 1,300 miles of shoreline for Grand Lake. However, it has been determined that the 1,300 value relates to the total shoreline miles of GRDA's three hydropower projects. For consistency in management and tracking of matters related to the SMP, in 2008, based on a new GIS system, GRDA hand digitized the data available at the time, which resulted in a total amount of shoreline within the Project boundary of 522 miles. With technological advances in the GIS field, more accurate data (including LiDAR) indicate that the amount of shoreline within the Pensacola Project boundary is 667 miles.

4.3.6 Turbines/Generators

The powerhouse contains six turbines, each a nominal 20 megawatts (MW), for a total generating capability of approximately 120 MW. The powerhouse also contains a small 500-kW house hydropower unit. The house unit's generator was originally used to provide the Project's black start capability; however, this generator is no longer in service (FERC 1996). Turbine and generator data are presented in Table 4.3-1. Each turbine is equipped with vacuum breaker bypass valves to improve dissolved oxygen (DO) in the tailrace throughout the low DO season (May-October).

Table 4.3-1. Turbine and generator data.

Turbine Rating	
Number of units[1]	6
Type	Allis Chalmers Francis
Net head (feet)	117.5
Rated output (horsepower)	23,395
Nameplate flow (cubic feet per second [cfs])	1,950
Minimum hydraulic capacity (cfs)	0
Maximum hydraulic capacity (cfs)	13,902 (2,317 cfs per unit)
Rated output (kW)	17,446
Generator Rating	
Type	Westinghouse A/C
Phase	3
Frequency (hertz [Hz])	60
Nameplate	24,000 kVA or 21, 600 kW
Power factor	0.9
Voltage	13,800
Amps	1,006
Operating speed (rotations per minute [rpm])	150

Source: FERC 1996; GRDA 2010.

Notes:

1 All six units are identical in turbine and generator data.

4.3.7 Tailrace

The tailrace is approximately 1.5 miles long and 300 feet wide (FERC 1996). Tailwater elevations below Pensacola Dam are highly influenced by the water surface elevation in the downstream Lake Hudson. When Lake Hudson is at its near normal elevation level (elevation 619 feet NGVD 29), the tailwater elevation at Pensacola Dam typically ranges between 620 and 625 feet; however, these tailwater elevations can rise to over 640 feet when Lake Hudson levels are at higher elevations. The top of the flood control pool at Lake Hudson is 636 feet NGVD 29 (634.92 feet PD)(GRDA 2011a).

4.3.8 Spillway Channel

The spillway channel is approximately 1.5 miles long and 850 feet wide (FERC 1996). The spillway channels begin as three individual channels merging together initially below the two east spillways at the “Little Blue Hole” and then merging with the main spillway before merging further downstream with the powerhouse tailrace channel. The spillways all discharge to a semi-dry rocky channel that is 50 to 70 feet above the Little Blue Hole and tailrace.

4.3.9 Transmission

The step-up substation originally commissioned for the Pensacola Project has been converted to a major system switching station. The Pensacola Project’s primary transmission lines terminate at breakers that are a part of the switching station. There are six generator leads made of parallel 500-thousands of circular mils (kcmil) copper, medium voltage cable operating at 13.8 kilovolts (kV). The length of the leads is approximately 450 to 650 feet depending on the physical relationship of the turbine-generator in the powerhouse out to the 15-kV breaker at the switching station. Figure 4.3-2 is a single-line electrical diagram for current conditions.

4.3.10 Recreation Facilities

GRDA operates and maintains five FERC-approved recreation sites at the Project including: (1) Duck Creek Bridge Public Access Area; (2) Seaplane Base Public Access; (3) Monkey Island Public Boat Ramp; (4) Big Hollow Public Access; and (5) Wolf Creek Public Access. These facilities provide public access to Grand Lake for boating, fishing, and other recreational activities. Recreational resources are discussed in greater detail in Section 6.7 Recreation and Land Use of this PAD.

4.3.11 Project Lands

The Project Boundary is defined by a combination of a metes and bounds description—around GRDA owned-lands—and generally following elevation 750 feet in other areas. It encompasses 53,965 acres, including the 45,200 acres of the Project reservoir (at the upper extent of the conservation pool of 745 feet). The Project Boundary encompasses the lands necessary to operate the Project, as licensed under the Federal Power Act (FPA), including a shoreline buffer around the entire reservoir (generally between 745 and 750 feet).

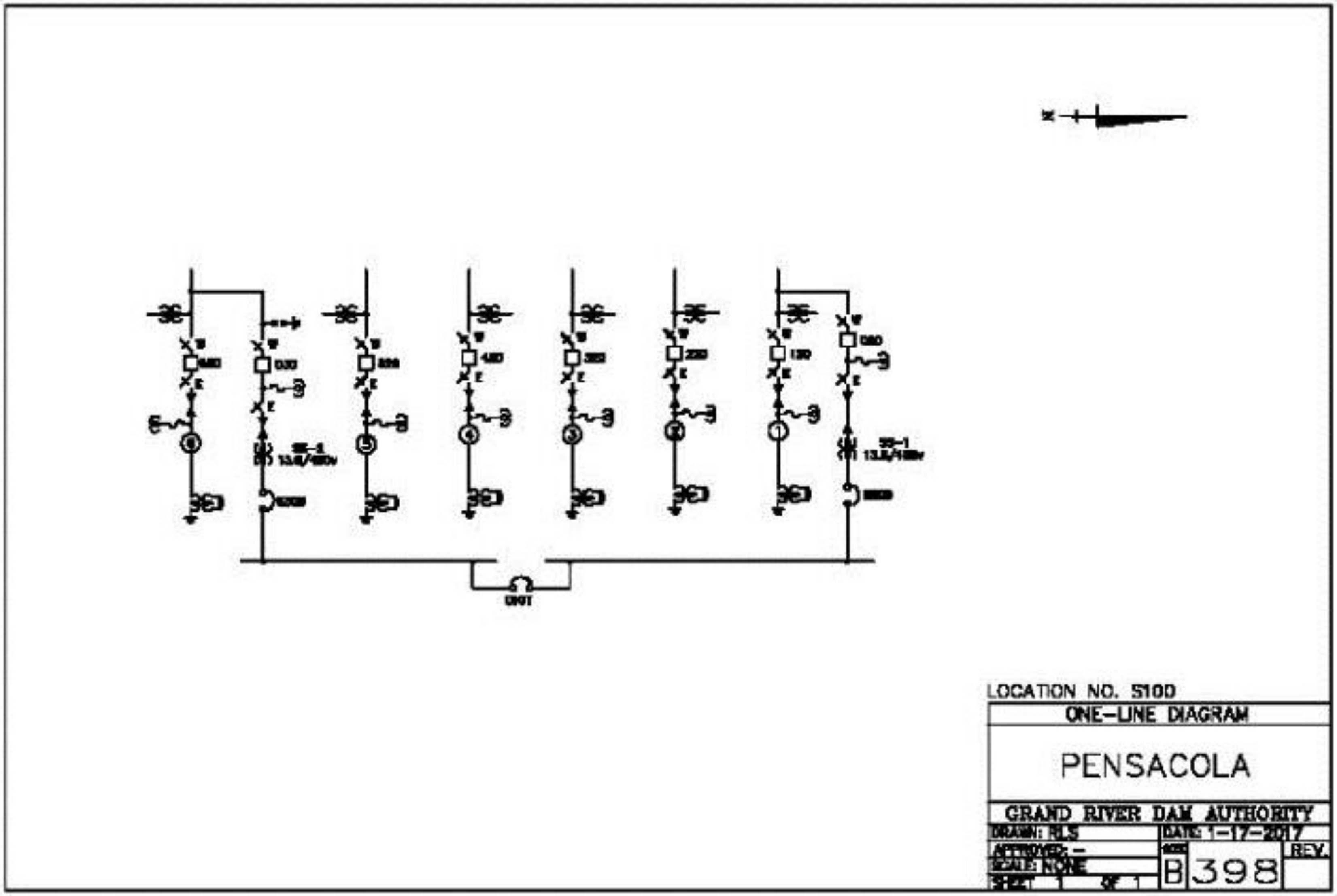


Figure 4.3-2. Transmission single-line diagram.

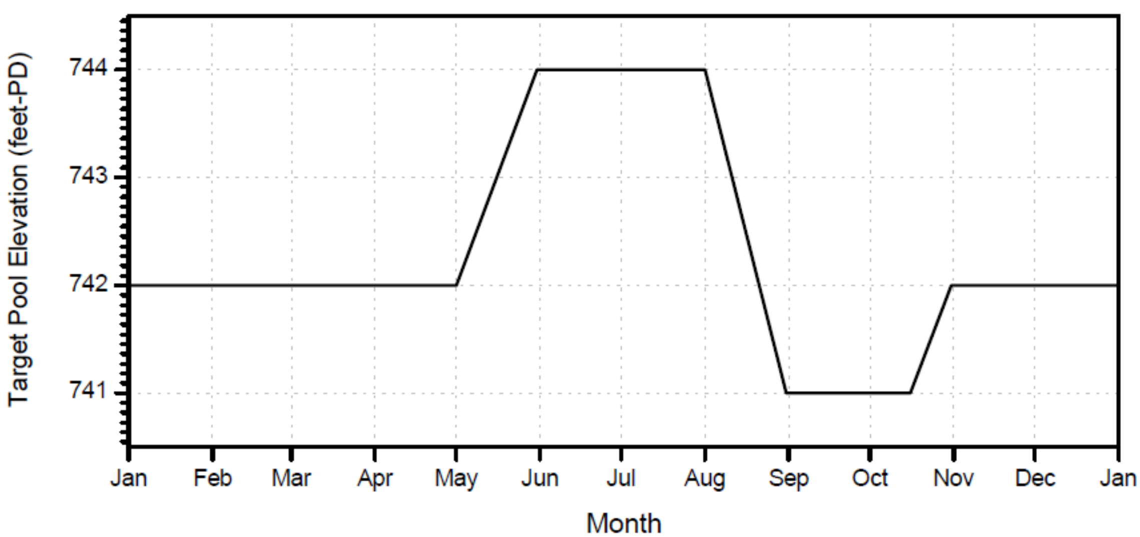
4.4 Current Operations

4.4.1 Reservoir and Hydropower Operations

As licensed by FERC, the Project serves multiple purposes, including hydropower generation, water supply, public recreation, and wildlife enhancement. In order to balance the multiple uses of the reservoir, GRDA currently operates the Project to target reservoir surface elevations known as the Project's rule curve (FERC 1996; GRDA 2011a), Table 4.4-1 and Figure 4.4-1.

Table 4.4-1. Target elevations for Pensacola Project.

Period	Reservoir Elevation (feet)
May 1 through May 31	Raise elevation from 742 to 744
June 1 through July 31	Maintain elevation at 744
August 1 through August 15	Lower elevation from 744 to 743
August 16 through August 31	Lower elevation from 743 to 741
September 1 through October 15	Maintain elevation at 741
October 16 through October 31	Raise elevation from 741 to 742
November 1 through April 30	Maintain elevation at 742



Source: GRDA 2011a.

Figure 4.4-1. Pensacola Project rule curve.

For purposes of flood control in the Grand River Basin, the Tulsa USACE office manages an expansive system of eleven large reservoirs, of which Grand Lake is one located in the middle of the expansive flood control system. Upstream of the Pensacola Project, USACE manages three federal reservoirs—Marion Reservoir, Council Grove, and John Redmond—with a combined storage capacity of approximately 465,000 acre feet. Downstream of Grand Lake and GRDA's Lake Hudson, USACE manages Fort Gibson Reservoir (919,000 acre feet) on the Grand River prior to its confluence with the Arkansas River. Within this large system, USACE must provide for the safe passage of flows in municipalities and lands as far upstream as

Emporia, Kansas, and downstream to Muskogee, Oklahoma—and even further down the Arkansas River system, including Fort Smith, Russellville, Van Buren, and even Little Rock, Arkansas (GRDA 2016b).

The flood control pool associated with Grand Lake consists of the storage volume available between the target pool elevation, which varies seasonally between 741 and 744 feet, and the upper elevation of 755 feet. When reservoir elevations are either within the flood control pool (i.e., above elevation 745 feet) or projected to rise into the flood control pool, the Tulsa District of USACE directs the water releases from the dam under the terms of Section 7 of the Flood Control Act of 1944, 58 Stat. 887, 890-91, as defined in the guiding protocol of the 1992 Letter of Understanding and Water Control Agreement between USACE and GRDA (FERC 1996). When directed to make lake releases by USACE, GRDA first discharges as much water as possible through the Project's hydropower units. Once the Project has reached the powerhouse's maximum hydraulic capacity, USACE may direct GRDA to open one or more spillway gates if the conservation pool is still rising, but typically not unless the water surface elevation exceeds, or is projected to exceed 745 feet. USACE will then determine if additional gates need to be opened. The target discharge rate at any time is based on the current Grand Lake water surface elevation, the current estimated Grand Lake inflow rate, and the amount of projected flooding downstream in the Grand or Arkansas River basins (GRDA 2011a).

The operating goal of the Project is to use any water in the Project's flood control pool for power generation, up to the maximum hydraulic capacity of the turbines, whenever possible. Typically, GRDA does not operate the Project's hydropower units when the Grand Lake water surface elevation is below target (GRDA 2011a).

GRDA has been granted three temporary variances from the rule curve requirements under Article 401[8] of the Project's FERC license, which were issued by the FERC on August 15, 2012, August 14, 2015, and August 12, 2016. The purpose of the 2012 variance was to alleviate drought conditions and the 2015 and 2016 variances were to increase water levels for recreation and boater safety and to maintain adequate DO levels downstream of the Project in the event of a drought event (FERC 2012, 2015, 2016). While tribes and other parties with interests in the upstream areas of Grand Lake raised concerns during the respective proceedings that the variance would cause greater flooding upstream of the Project in the vicinity of the City of Miami, each year GRDA implemented the variance consistent with the relevant storm and drought adaptive management plans without incident during the applicable timeframe (August 15 – October 31).

In 2016, GRDA filed an application with FERC to permanently amend the Article 401 rule curve during the August-October period each year, coupled with a proposed Drought Adaptive Management Plan and Storm Adaptive Management Plan. As proposed, these plans would provide for GRDA, in consultation with federal and state agencies, tribes, local governments, and other interested parties, to adjust reservoir operations in response to severe weather conditions through the year. GRDA's rule curve amendment application is separate and apart from this relicensing proceeding, and remains pending before FERC as of the publication of this PAD.

[8] As amended in a December 3, 1996 Commission order (77 FERC ¶ 61,251).

4.4.2 Shoreline Management

GRDA operates the Project consistent with the Project's SMP, which provides a comprehensive plan for Grand Lake that considers GRDA's enabling legislation, the FERC license, historical and current public use, and the need to accommodate future growth and changing use patterns; all while maintaining stewardship for the environmental and socioeconomic resources entrusted to GRDA. The SMP helps define management responsibilities of both GRDA and FERC under the Project's license and the FPA, respectively (GRDA 2008), and is further described in Section 6.7 Recreation and Land Use of this PAD.

4.4.3 Recreation Management

Grand Lake is a popular recreation spot and is maintained to promote recreation uses. GRDA maintains five FERC-approved public access sites to Grand Lake in conformance with the Project's Recreation Management Plan (RMP) and Article 407 of the current license. GRDA's ongoing recreation management goal for all of its hydroelectric projects is to provide free, undeveloped, open outdoor space (FERC 2014). Recreation management is discussed further in Section 6.7 Recreation and Land Use of this PAD.

4.4.4 Water Supply

The Project is operated to maintain water supply uses to the extent practicable. GRDA's commercial water customers hold 30- to 50-year contracts with GRDA for raw water. However, when drought conditions occur, GRDA does not have a dependable yield of water to provide to its customers without deviating from the rule curve (GRDA 2016a). Water supply is discussed in greater detail in Section 6.2 Water Resources of this PAD.

4.4.5 Wildlife Enhancement

GRDA operates the Project consistent with the SMP and Vegetation Management Plan (VMP), which provide for stewardship of riparian habitats surrounding Grand Lake (GRDA 2004a, 2011b) and management of wildlife management areas that are located either adjacent to streams entering the reservoir or as islands within the reservoir (GRDA 2015). Wildlife enhancement is discussed in greater detail in Section 6.4 Wildlife and Botanical Resources of this PAD.

4.5 Proposed Operations and Facilities

4.5.1 Reservoir and Hydropower Operations and Facilities

Although GRDA at this time is not proposing any changes to hydropower operations and facilities, GRDA is proposing as part of this relicensing effort to investigate Project operations within the conservation pool and determine whether any changes to the Project's seasonal rule curve, equipment replacements or modernization activities in support of extending the life of the Project, and/or general operational or facility efficiency improvements are warranted. Any proposal to change hydropower operations or facilities will be included in the FLA to be filed with FERC in 2020. Because USACE has exclusive jurisdiction over flood control operations at Grand Lake under Section 7 of the Flood Control Act of 1944, 58 Stat. 887, 890-91, issues related to flood control operations are beyond the scope of the FERC relicensing proceeding.

4.5.2 Shoreline Management

GRDA is not proposing any modifications to shoreline management activities at this time.

4.5.3 Recreation Management

GRDA is not proposing any modifications to recreation management activities at this time.

4.5.4 Water Supply

GRDA is not proposing any modifications to water supply activities at this time.

4.5.5 Wildlife Enhancement

GRDA is not proposing any modifications to wildlife enhancement activities at this time.

4.6 Current License Requirements

This section describes the current FERC license terms and a brief history of relevant amendments. The original license for the Pensacola Project was issued in 1939. FERC issued a new license order for the Pensacola Project on April 24, 1992 (Attachment C). The Project's existing license is effective for 30 years. GRDA is subject to Articles 1-28 of FERC's standard terms and conditions set forth in Form L-3, dated October 1975. A summary of the additional Project-specific license articles is provided below. In particular, Table 4.6-1 provides a summary of the Project's existing license articles, as amended. Attachment C includes the 1992 license order and relevant license amendments thereafter. Under the Project's existing license, GRDA has achieved and maintains compliance with each of these license requirements.

Table 4.6-1. Summary of current license article requirements for the Pensacola Project.

License Article	Description
Article 201	Requires GRDA to reimburse the United States for the cost of administration of Part I of the FPA; this article was amended as units were replaced and/or refurbished (most recently by FERC Order of September 4, 1996).
Article 202	Requires GRDA to establish and maintain amortization reserves pursuant to section 10(d) of the FPA.
Article 401	Directs GRDA to control fluctuations of the reservoir surface elevation for the protection of fish, wildlife, and recreation resources associated with Grand Lake. GRDA shall act, to the extent practicable (except as necessary for USACE to provide flood protection), to meet seasonal target reservoir surface elevation, as outlined in the license order, as amended December 3, 1996.
Article 402	Requires GRDA to consult with the ODWC to determine if the ODWC wishes to conduct an assessment of the impacts of water surface elevation fluctuation on fisheries recruitment. Documentation that the ODWC does or does not wish to conduct such fisheries studies shall be filed with the Commission within six months from the date of issuance of this license.
Article 403	Requires GRDA to file a plan with the Commission to monitor DO concentrations in the Grand (Neosho) River (Grand River) downstream of the Project tailrace during the critical summer period of June 1 through September 30, annually within six months from the date of issuance of the license.
Article 404	Required GRDA to annually seed mudflats for habitat improvement. The Commission removed Article 404 from the license in its May 22, 2003 Order, Approving Fish and Waterfowl Habitat Management Plan Under Article 411 and Deleting Article 404.
Article 405	Specifies that GRDA shall implement measures to protect the federally listed endangered gray bat (*Myotis grisescens*).
Article 406	Directs the use of 1,630 acres of Project lands as a Wildlife Management Area (WMA).
Article 407	Requires GRDA to file a long-term recreation plan for the Pensacola Project. The plan shall also provide for protection of the federally listed endangered bald eagle (*Haliaeetus leucocephalus*).
Article 408	Requires GRDA to upgrade, or arrange for the upgrading of, the Duck Creek boat launch facilities at the Ketchum Recreation Area.
Article 409	Directs GRDA to consult with the State Historic Preservation Officer (SHPO) before starting any land-clearing or ground-disturbing activities within the Project boundaries.
Article 410	Grants GRDA the authority to allow certain types of use and occupancy of Project lands and waters and to convey certain interests in Project lands and waters for certain types of use and occupancy, without prior Commission approval.
Article 411	Directs GRDA to provide a fish and waterfowl habitat management plan. [Article added per December 3, 1996, license amendment.]
Article 501	Stipulates GRDA to reimburse the owner of a storage reservoir or other headwater improvement during the term of the original license if those headwater benefits were not previously assessed and reimbursed to the owner of the headwater improvement in the same manner as for benefits received during the term of this new license.

A license amendment was issued September 4, 1996, to upgrade six of the Project's generating units, amending the Project description to increase the authorized installed capacity from 86,900 kW to 105,176 kW (FERC 1996).

A Memorandum of Agreement (MOA) documenting completion of consultation with ODWC, USFWS, The Nature Conservancy (TNC), University of Oklahoma, and OWRB regarding implementation of Articles 402, 403, 404, and 405 was filed with FERC May 27, 1993. On April 23, 1996, GRDA filed an application to amend Article 401. The purpose of the amendment was to allow GRDA to manage the reservoir elevations to better accommodate run-off from spring flows, to increase flood storage capacity, and to enhance recreational use during the peak recreation season. Article 401 of GRDA's license was amended December 3, 1996. This amendment order also added Article 411, requiring GRDA to provide a fish and waterfowl habitat management plan, unless otherwise modified by FERC.

4.7 Compliance History

GRDA has reviewed the compliance history for the Project and found no instances of non-compliance with the existing license. The Project is subject to regular Part 12 dam safety inspections by a FERC-approved independent consultant. The Project's last Part 12 inspection was performed on May 12-14, 2014. GRDA routinely addresses all recommendations arising from the inspections in a timely manner.

GRDA voluntarily submitted an SMP to guide management of the Grand Lake shoreline; the SMP was approved by FERC on October 17, 2013, and GRDA has managed the reservoir's shoreline consistent with the plan since FERC's approval. An initial DO Monitoring and Enhancement Plan (per Article 403) was approved by FERC on September 20, 1995. Since then, GRDA has continuously worked to provide the DO enhancement required by Article 403 and updated its methods accordingly. In compliance with Article 405, GRDA filed a Gray Bat Compliance Plan, approved by FERC on April 16, 2008. GRDA has developed and implements a long-term RMP pursuant to Article 407. The current plan was modified and approved by FERC on August 14, 1998 (with an amendment approved on October 17, 2013). A Fish and Waterfowl Habitat Management Plan (per Article 411) was approved by FERC on May 22, 2003. Annual water quality and wildlife management reports and periodic recreational resource reports are filed with FERC as required.

GRDA annually files property transaction reports and notifies FERC of non-project uses of Project lands in compliance with Article 410 which authorizes GRDA to grant permission for certain use and occupancy of Project lands and waters.

4.8 Energy Production

4.8.1 Dependable Capacity

Dependable capacity is generally defined as the amount of load a hydroelectric plant can carry under adverse hydrologic conditions during a period of peak demand; for example, during the hot, dry conditions typical in late summer in the Project vicinity. Under the Project's current license, the Project's estimated dependable capacity is approximately 107 MW.

4.8.2 Average Annual and Monthly Energy Production

Based on generation from 2011 through 2015, the Project has an annual average generation of approximately 343,113 megawatt-hours (MWh), which in combination with the Project's authorized capacity of 105,176 kW (FERC 1996), results in an annual plant factor of approximately 37.2 percent. Table 4.8-1 provides the Project's average and median annual and monthly generation from 2011 to 2015. Table 4.8-2 provides the Project's average and median monthly and annual outflow based on hourly Project operations records.

Table 4.8-1. Pensacola Project average and median monthly and annual generation from 2011 to 2015.

Energy (MWh)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Annual**
2011	6,522	21,651	79,278	50,222	75,267	32,636	3,428	15,295	3,102	983	12,780	21,932	**323,096**
2012	8,088	12,054	41,390	67,270	34,843	1,649	1,410	2,131	9,047	8,701	1,098	2,168	**189,849**
2013	5,981	16,274	33,958	64,192	70,508	64,024	16,982	84,091	45,389	4,884	34,278	18,946	**459,507**
2014	18,273	7,522	18,639	14,871	1,671	57,545	13,330	13,883	7,959	38,039	7,396	16,293	**215,421**
2015	8,308	7,772	31,806	63,982	69,636	83,638	85,390	43,501	14,512	2,750	32,154	84,245	**527,694**
Average	**9,434**	**13,055**	**41,014**	**52,107**	**50,385**	**47,898**	**24,108**	**31,780**	**16,002**	**11,071**	**17,541**	**28,717**	**343,113**
Median	**8,088**	**12,054**	**33,958**	**63,982**	**69,636**	**57,545**	**13,330**	**15,295**	**9,047**	**4,884**	**12,780**	**18,946**	**323,096**

Table 4.8-2. Pensacola Project average and median monthly and annual outflow from 2011 to 2015.

Outflow (cfs)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Annual**
2011	967	3,726	12,756	16,245	23,281	5,884	572	2,503	533	266	2,251	3,629	**6,068**
2012	1,527	2,326	14,927	11,509	9,844	408	328	427	1,687	1,579	337	498	**3,794**
2013	1,122	2,915	5,390	13,345	13,445	18,199	3,495	23,490	8,173	954	6,141	3,364	**8,346**
2014	3,214	1,451	3,345	2,650	407	10,752	2,225	2,403	1,486	7,681	1,476	2,880	**3,338**
2015	1,587	1,541	5,335	10,613	19,777	26,626	21,965	7,320	2,638	499	5,271	13,609	**9,585**
Average	**1,683**	**2,391**	**8,351**	**10,872**	**13,351**	**12,374**	**5,717**	**7,229**	**2,903**	**2,196**	**3,066**	**3,490**	**6,184**
Median	**1,527**	**2,326**	**5,390**	**11,509**	**13,445**	**10,752**	**2,225**	**2,503**	**1,687**	**954**	**2,251**	**3,364**	**6,068**

4.9 Current Net Investment

The current net investment of the Pensacola Project is approximately $506,000,000. This value should not be interpreted as the fair market value of the Project.

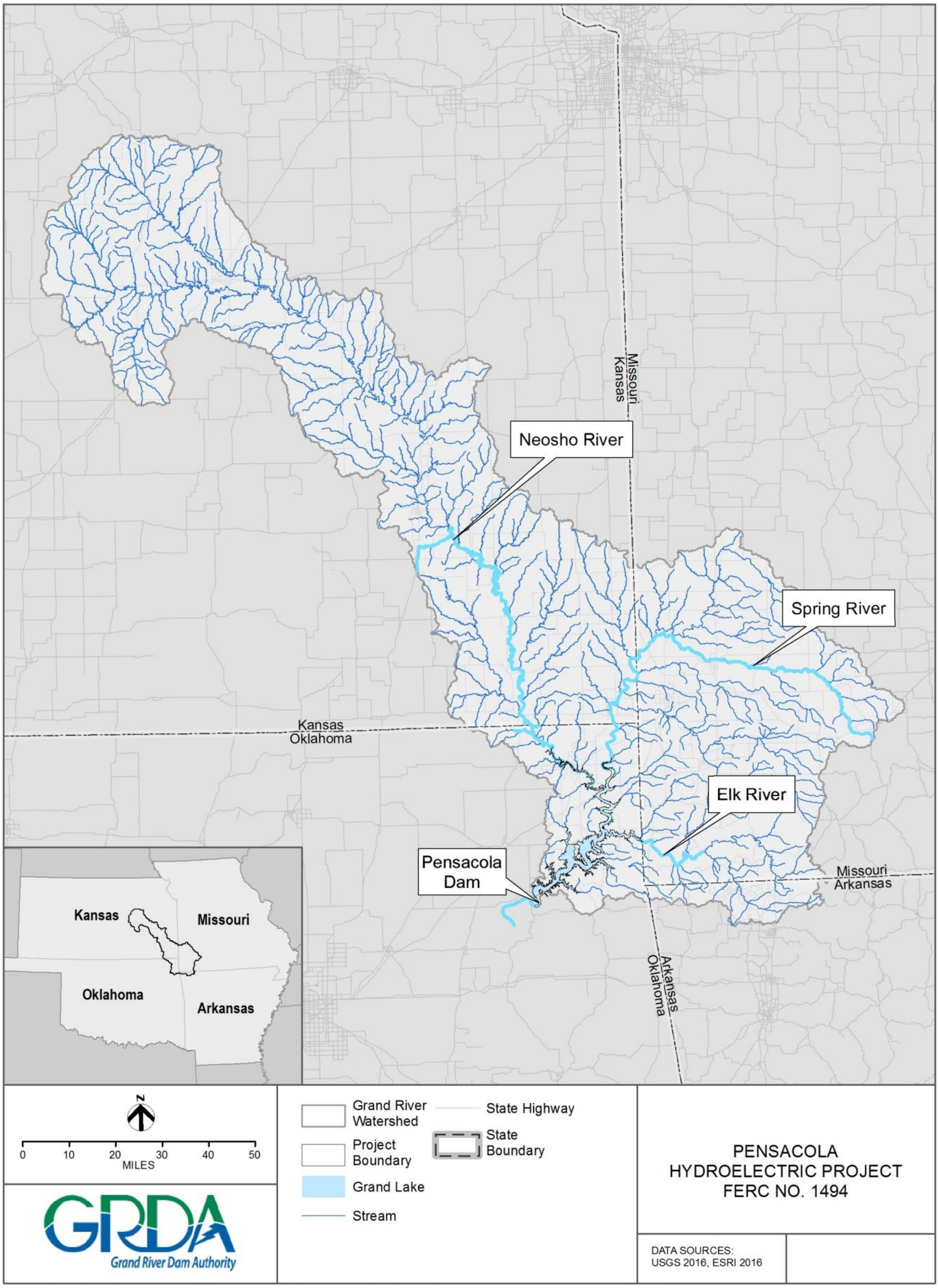
5.0 GENERAL DESCRIPTION OF THE RIVER BASIN

5.1 Overview of Watershed

The Grand River originates as the Neosho River in the Flint Hills in east central Kansas where it flows generally southeasterly for approximately 300 miles into Oklahoma. The Neosho River becomes the Grand (Neosho) River (Grand River) at its confluence with the Spring River at RM 122.6 (GRDA 2010). The Pensacola Dam of the Pensacola Project is located at RM 77 on the Grand River within the Grand River Basin (USACE 1992; GRDA 2011). The Grand River flows mostly southerly for approximately 160 miles to its confluence with the Arkansas River (FERC 1996).

The Grand Lake Basin covers approximately 10,300 square miles in Kansas, Oklahoma, Missouri, and Arkansas (USACE 1992; GRDA 2011)(Figure 5.1-1). The watershed is elongate, oriented northwest-southeast, and drains predominantly southward (Grand Lake O' the Cherokees Watershed Alliance Foundation, Inc. [GLWAF] 2008). The watershed is comprised of three major river systems, including the Neosho, Spring, and Elk rivers (GLWAF 2008). These rivers converge in Oklahoma in the upper portion of Grand Lake.

There are six major reservoirs located in the Grand River Basin, which are operated for flood control and/or hydropower generation. Upstream of the Pensacola Project, USACE manages three federal reservoirs—Marion Reservoir, Council Grove, and John Redmond—located in Kansas, with a combined storage capacity of approximately 465,000 acre feet. Grand Lake is the most upstream in Oklahoma with a surface area of approximately 45,200 acres and a drainage area of 10,300 square miles. Lake Hudson is located immediately downstream of Grand Lake and is formed by the Markham Ferry Project, with an area of approximately 10,900 acres and a drainage area of 11,533 square miles. Fort Gibson Lake is located immediately downstream of Lake Hudson and is created by USACE's Fort Gibson Dam. Fort Gibson Lake occupies an area of approximately 19,900 acres and has a drainage area of 12,492 square miles (Johnson and Luza, 2008, as cited in GRDA 2010).



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Source: GLWAF 2008.

Figure 5.1-1. Grand Lake watershed.

The climate of the Grand Lake watershed is characterized by mild winters and hot summers. Table 5.1-1 provides monthly temperature and precipitation data for Ottawa County from 2001 to 2015 obtained from Mesonet, an extensive network of environmental monitoring stations in Oklahoma (Mesonet 2016).

Table 5.1-1. Temperature and precipitation data for Ottawa County, Oklahoma (2001 – 2015).

Month	Temperature		Precipitation
	Average Minimum (Degrees Fahrenheit [°F])	Average Maximum (°F)	Average Total (Inches)
Winter			
December	28	49	2.67
January	25	46	1.67
February	27	48	1.88
Spring			
March	38	60	3.32
April	48	70	4.22
May	56	77	6.90
Summer			
June	66	86	4.97
July	69	91	3.55
August	68	91	3.17
Autumn			
September	59	82	4.07
October	47	71	3.93
November	38	60	2.64

Source: McPherson et al. 2007; Brock et al. 1995, as cited in Mesonet 2016.

Water volume in the Grand River varies seasonally with the highest flows during the spring. The maximum recorded flow in the Grand River near Langley (USGS Gage Number 07190500), approximately 3.5 miles downstream of Pensacola Dam, for the period 1940 to 2015 is 300,000 cfs, and reported daily average mean flow for the same period is approximately 7,600 cfs.

5.2 Tributaries

Primary tributaries of Grand Lake are the Neosho, Spring, and Elk rivers as well as the Duck, Horse, Honey, and Drowning creeks, Figure 5.2-1. The Neosho River drains approximately 6,000 square miles in Kansas and Oklahoma, approximately 5,800 square miles in Kansas, and provides approximately half of the inflow to Grand Lake. The Spring River drains approximately 2,600 square miles in Missouri, Kansas, and Oklahoma; and provides approximately 32 percent of the inflow to Grand Lake. The Elk River drains approximately 900 square miles in Missouri, Arkansas, and Oklahoma, and provides about 12 percent of inflow to Grand Lake. The Grand Lake Basin above the Pensacola Dam covers approximately 10,300 square miles (USACE 1992; GRDA 2011).

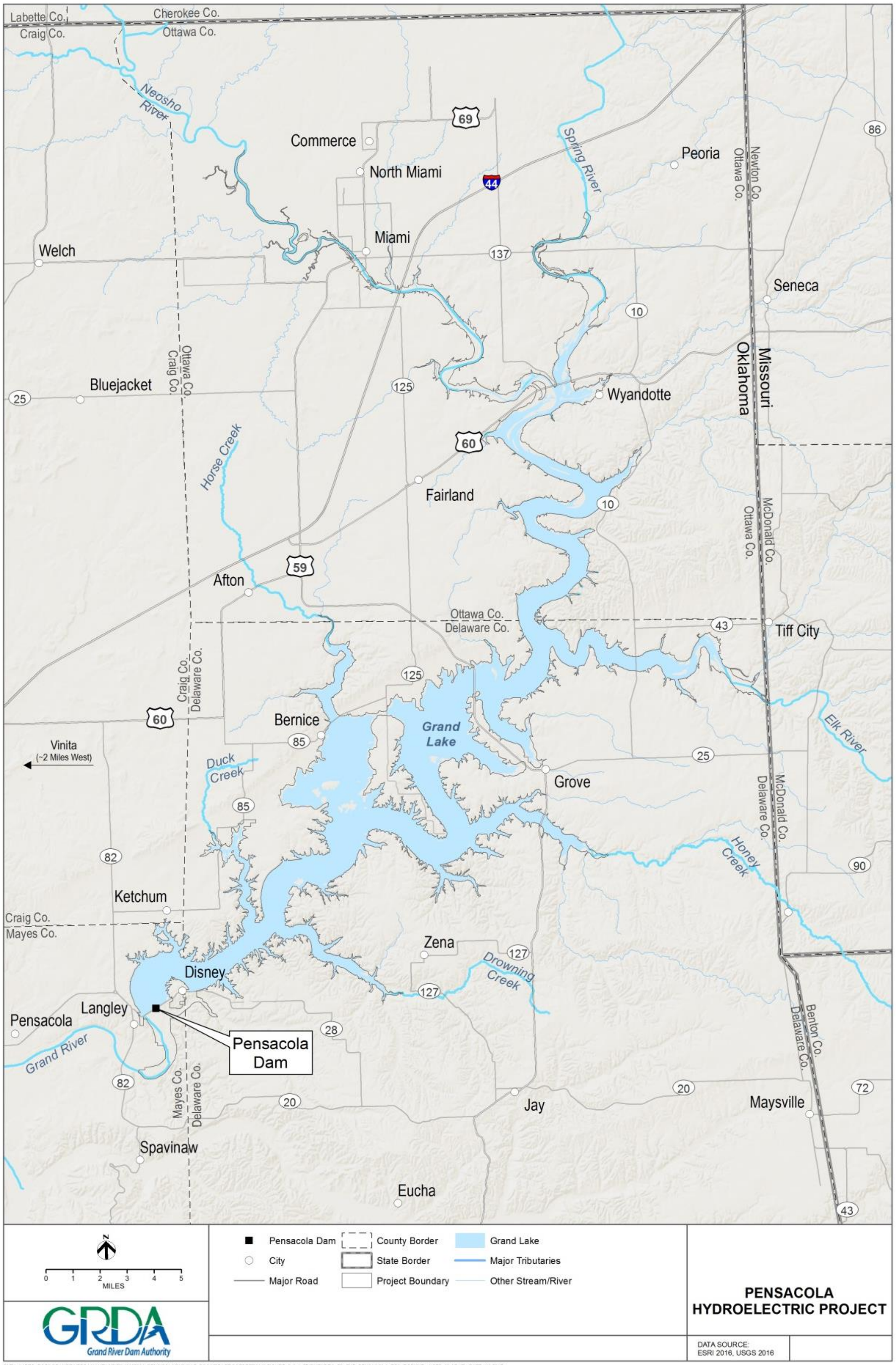


Figure 5.2-1. Tributaries to the Pensacola Project.

5.3 Dams and Diversions

Upstream of the Pensacola Project, USACE manages three federal reservoirs—Marion Reservoir, Council Grove, and John Redmond—all located in Kansas (USACE 1992). The Marion Reservoir, completed in 1967, is located at RM 126.7 on the Cottonwood River, a tributary of the Grand (Neosho) River at RM 382. Council Grove, fully operational in 1964, is located on the Grand (Neosho) River at RM 449.9. John Redmond, completed in 1963, is located on the Neosho River at RM 339.8 of the Grand (Neosho) River.

There are two dams downstream of the Project on the Grand River including the Markham Ferry Project [FERC Project No. 2183] and USACE Fort Gibson Dam. The Markham Ferry Project, completed in 1964, is the first dam downstream of the Project at RM 47.1 on the Grand River (USACE 1992). The dam forms Lake Hudson, which serves as the lower reservoir for the Salina Pumped Storage Project (FERC Project No. 2524). FERC issued new licenses to GRDA for the Markham Ferry Hydroelectric Project in August 2006 and for the Salina Pumped Storage Project in October 2015. USACE Fort Gibson Dam, completed in 1953, is located at RM 7.8 on the Grand River upstream from the confluence with the Arkansas River. The Fort Gibson Dam forms Fort Gibson Lake (USACE 1992).

5.4 Major Land Uses

Land use in the watershed is 36 percent planted pasture, 21 percent natural grassland, 20 percent cropland, 14 percent forest, 6 percent developed, with the remaining 3 percent open water and wetlands. The northwestern portion of the watershed consists primarily of cropland and grassland; whereas the southeastern part of the watershed is forest and pastureland with cattle and poultry operations prevalent. Cattle production is the major agricultural industry throughout the watershed. Poultry operations are most prevalent in the southeastern part of the watershed. In addition to agriculture, land use is becoming increasingly urban and suburban as small cities grow and lakeshore property is developed (GLWAF 2008).

Within the Project Boundary, there are three common land use/ownership types: commercial, residential, and municipal/public (GRDA 2008, as cited in GRDA 2016).

5.5 Major Water Uses

As licensed by FERC, the Project serves multiple purposes, including hydropower generation, water supply, public recreation, and wildlife enhancement. In addition, GRDA transmits and delivers wholesale electricity across its 24-county service area in northeast Oklahoma and produces reliable electricity that reaches into 75 of 77 counties. It supplies drinking water to approximately 21,000 residential households and 500 commercial customers (GRDA 2016). Grand Lake also provides numerous recreational opportunities for the public and provides habitat for wildlife. These uses are discussed in the applicable sections of this PAD.

In addition, Grand Lake is used for flood control throughout the Grand Lake and larger Arkansas River Basin, under direction of USACE pursuant to its exclusive jurisdiction under the Flood Control Act of 1944.

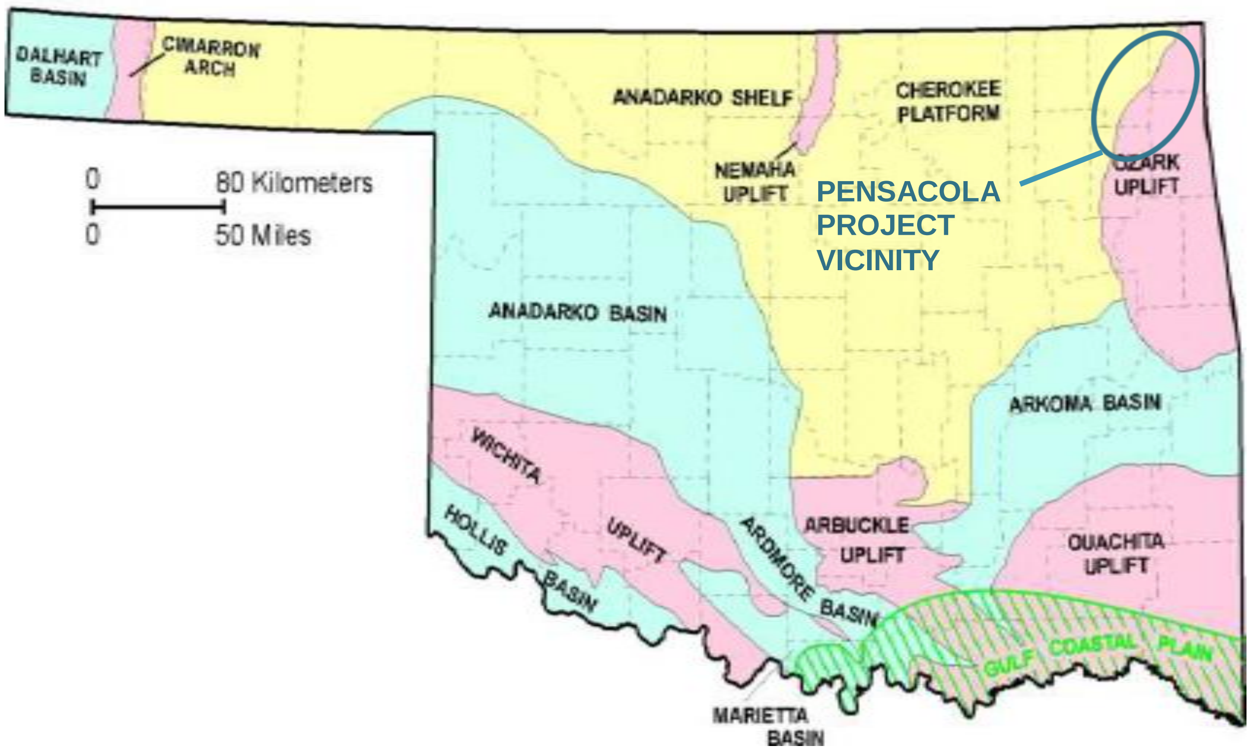
6.0 DESCRIPTION OF EXISTING ENVIRONMENTAL RESOURCES

6.1. Geology, Topography, and Soils

6.1.1. Overview

The Pensacola Project is located in northeastern Oklahoma. Structural development in northeastern Oklahoma is largely associated with the Ozark uplift anticline created by tectonic uplift and downwarping in the Earth's crust (Johnson and Luza 2008). This tectonic activity occurred mainly during the latter part of the Paleozoic Era, over 300 million years ago, and resulted in a number of major geologic provinces delineated by distinct structural features. The Project is located within two major geologic provinces: the Ozark Uplift and Cherokee Platform in the eastern and western portions of the Project vicinity, respectively (Johnson and Luza 2008)(Figure 6.1-1).

Bedrock in the Project vicinity includes limestone, chert, sandstone, and shale (FERC 1991). The Pensacola Dam was primarily constructed on chert—a sedimentary rock composed of silicone dioxide. Near the reservoir of Grand Lake, limestone formations, generally referred to as karst, are known to contain extensive cave systems (FERC 1991; GRDA 2004, 2008). The southern and eastern portions of the reservoir are primarily composed of limestone bluffs and steep, rocky beaches. The northern and western areas are typically more gradual slopes with mud substrates, silt deposits, and wetlands at the inlets and coves associated with numerous small tributaries (FERC 1996).



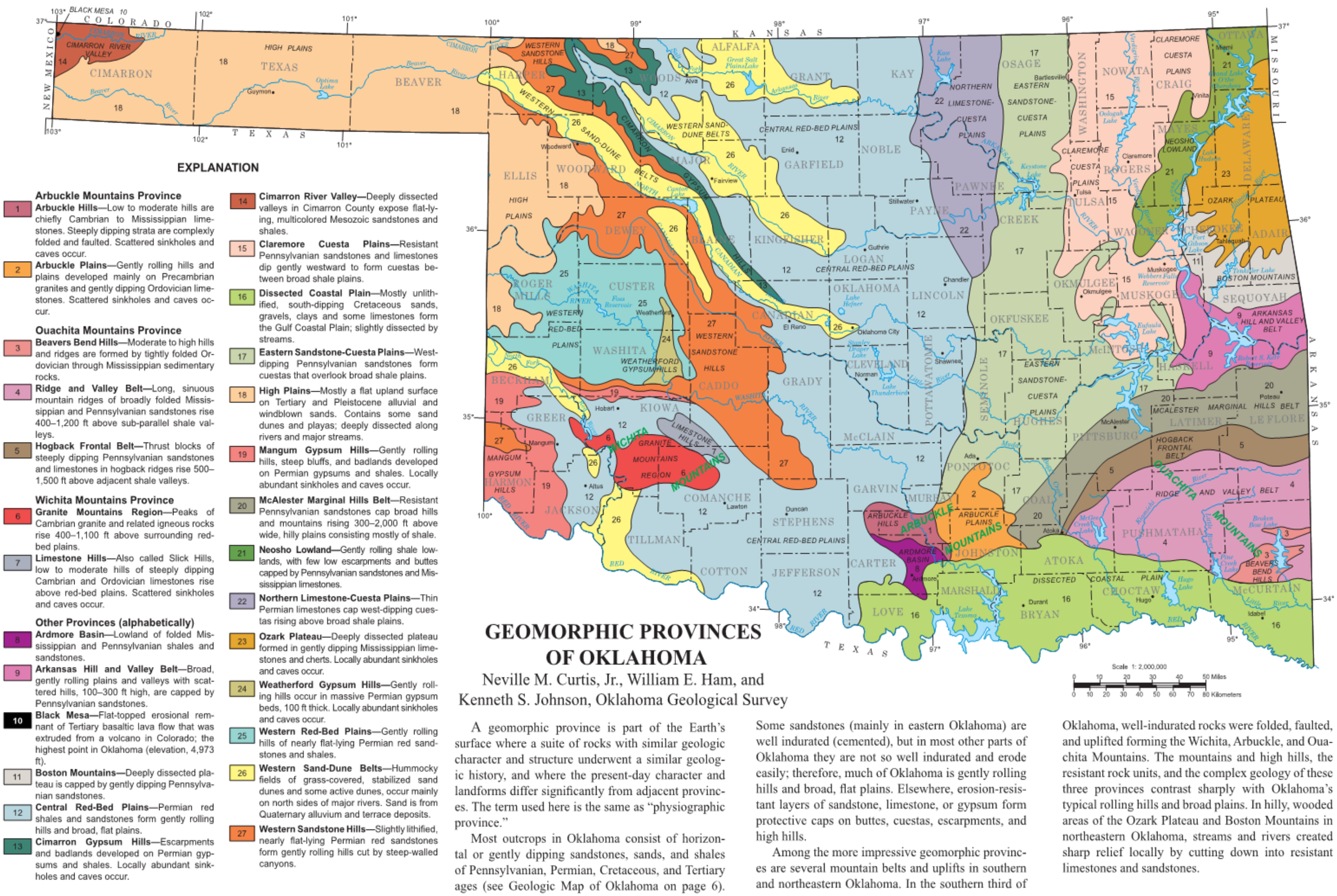
Source: (Johnson and Luza 2008).

Figure 6.1-1. Major geologic provinces of Oklahoma.

6.1.2. Topography

The Project reservoir, Grand Lake, is located in the Ozark Plateau and Neosho Lowland geomorphic provinces (Figure 6.1-2). Within this region of northeastern Oklahoma, the Ozark Plateau is further delineated into the Springfield Plateau Section, an area typified by locally rugged topography of deeply dissected limestones and cherts from the Mississippian subperiod (Figure 6.1-3). Here deep ravines and narrow stream valleys with branched systems transition into gently rolling uplands (Huffman et al. 1963; Johnson and Luza 2008).

The western portion of the Project vicinity lies within the Neosho Lowland, a geomorphic province typified by gently rolling plains with occasional hills and ridges (GRDA 2008). Generally, shorelines surrounding the Project reservoir in this province have gentler slopes, as compared to the geomorphology of the Ozark Plateaus. The Neosho Lowland province was formed on shales from the Pennsylvanian subperiod and is marked by occasional low escarpments and buttes capped by Pennsylvanian sandstones and Mississippian limestones. The Claremore Cuesta Plains province, located several miles west of the Grand River, is marked by low ridges of Pennsylvanian sandstones separated by broad shale plains (Juracek and Becker 2009).



Source: GRDA 2010; Johnson and Luza 2008.

Figure 6.1-2. Geomorphic provinces of Oklahoma.

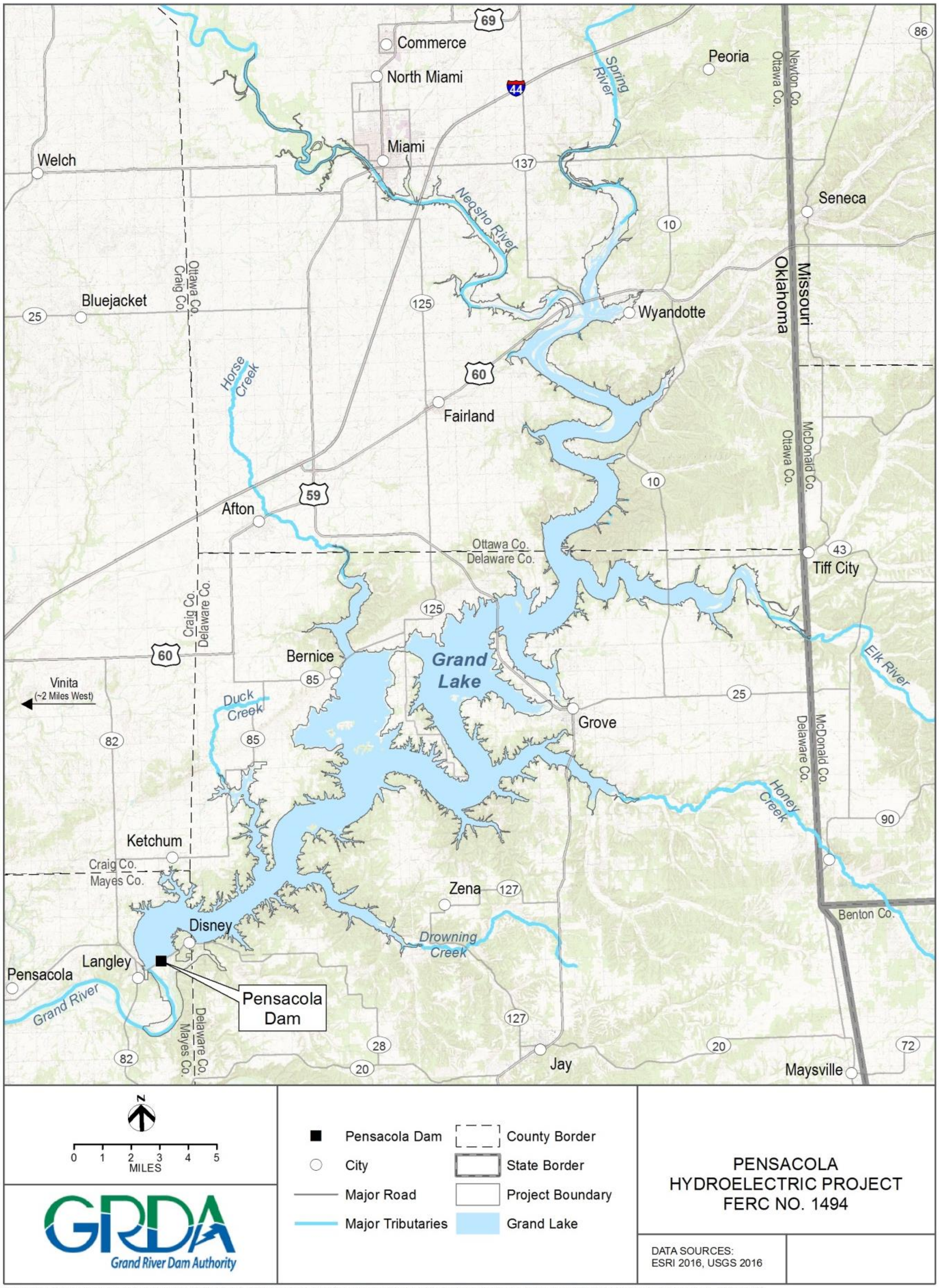


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Figure 6.1-3. Topography of the Pensacola Project vicinity.

6.1.3. Existing Geological Features

The stratigraphy of the Ozark Plateau is complex. Basement crystalline rocks are overlain by a sequence of sedimentary rocks of Paleozoic age. In some areas, the sequence of sedimentary rock is comprised of predominantly dolomites and limestones of Cambrian through Mississippian age, and in other areas, of sandstones and shales of Pennsylvanian age (GRDA 1985).

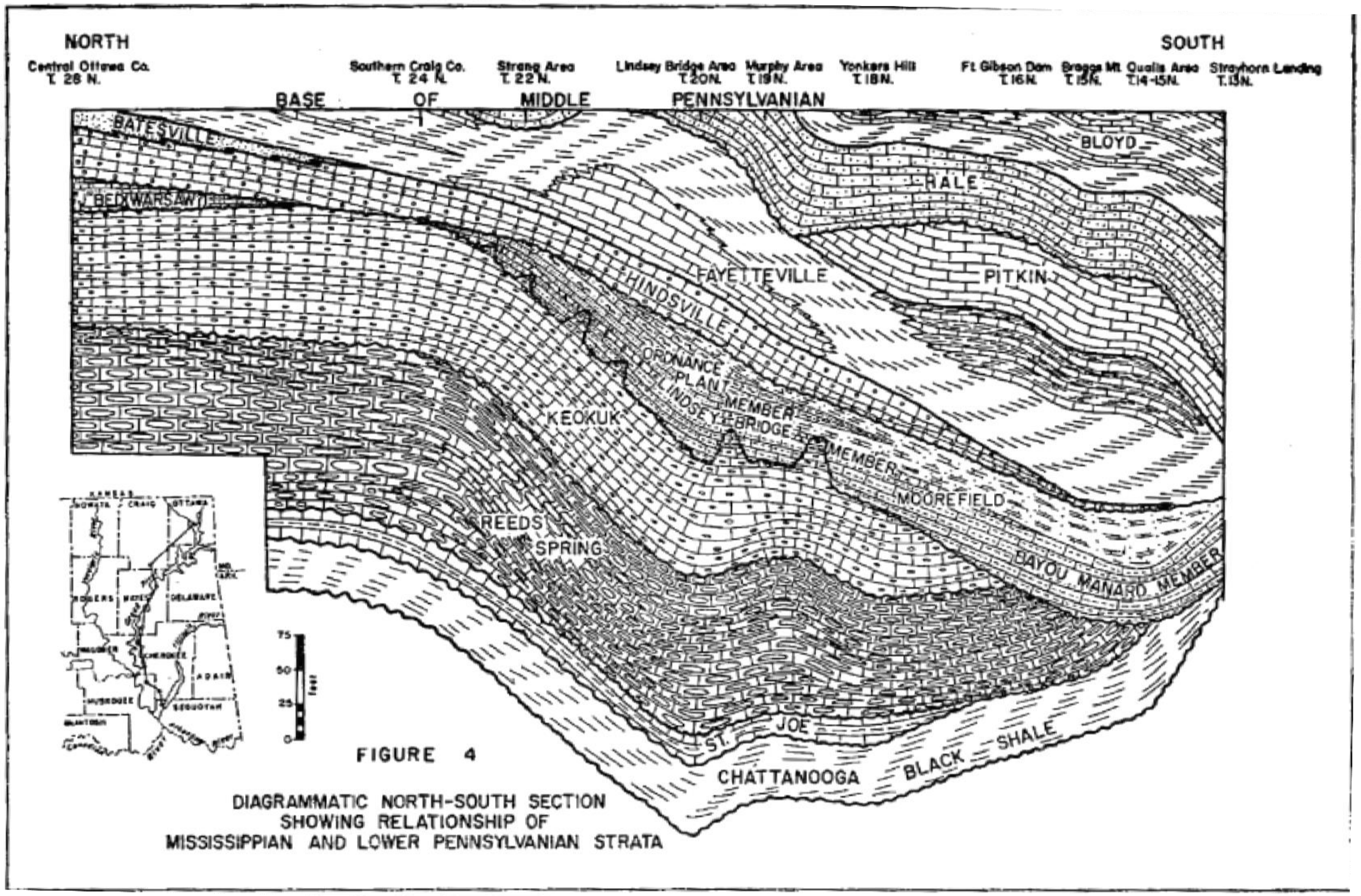
The Mississippian sedimentary bedrock of the Ozark Plateau is primarily composed of cherty marine limestone. The presence of karst formations in the Ozark Plateau is the fundamental geologic feature common throughout the province. Because limestone can be dissolved by acidic runoff, underground caverns, streams, sinkholes, and other formations typical of areas dominated by karst have formed during the millions of years that have passed since formation of the geologic province (Johnson and Luza 2008; USFWS 2002, as cited in GRDA 2010).

Precambrian and Cambrian era igneous and metamorphic rocks underlie all of Oklahoma; thus, providing the floor or basement on which younger rocks rest. In the Ozark Uplift in northeastern Oklahoma, the top portion of basement rock is typically about 1,000 feet below the Earth's surface, except where granite outcrops at Spavinaw, in Mayes County (Johnson and Luza 2008; GRDA 2010). Shallow seas covered most of Oklahoma during a majority of the first half of the Mississippian Period, which occurred 330 to 365 million years ago (GRDA 2010). Generally, limestone and chert are the dominant sedimentary rocks in most areas. Important units include the Keokuk and Reeds Spring Formations in the Ozarks (Johnson and Luza 2008). Figure 6.1-4 illustrates the location of the Keokuk and Reeds Spring Formations in the Mississippian Strata. The Keokuk consists of massive, white to buff-and-gray mottled, fossiliferous chert and irregular masses of dense, blue-gray, fine-grained limestone. Locally, reefs or bioherms of coarsely crystalline crinoidal limestone are present. The cherty phase is typically fractured or brecciated and weathered to a soft, white, earthy mass called tripoli.[9] Locally near the top of the Keokuk is a bed of white, oolitic limestone known as the Short Creek oolite. The Keokuk ranges in thickness from zero to nearly 250 feet, with an average of about 60 to 80 feet (GRDA 2010).

6.1.3.1. Mineral Deposits and Resources

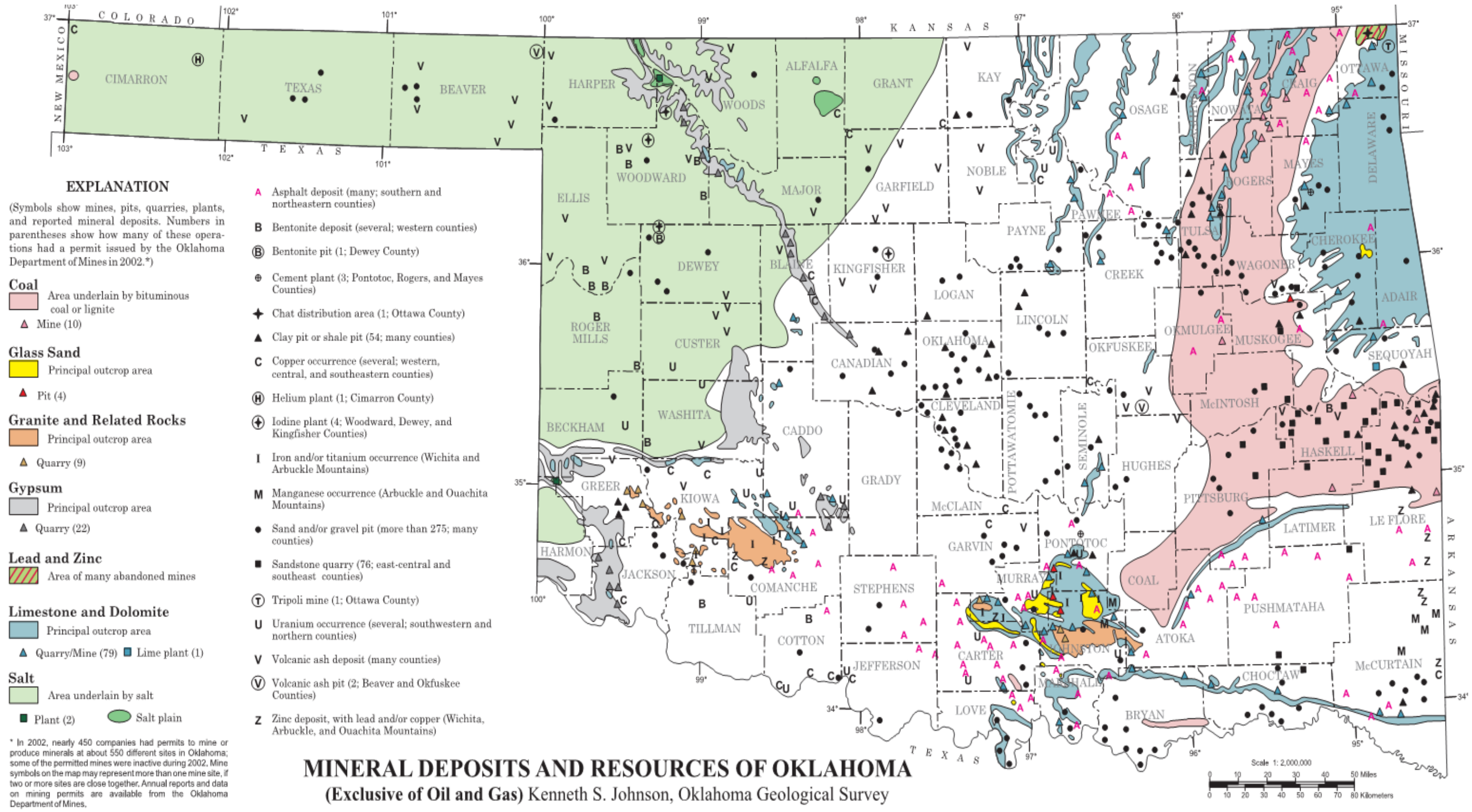
The Ozark Uplift in northeast Oklahoma, which includes the entire Project vicinity, is a principal source for limestone and dolomite, which is mined on the eastern edge of the Project vicinity (Figure 6.1-5). According to permits issued in 2002 by the Oklahoma Department of Mines, southeast of the Project vicinity mining operations include cement, clay, shale, sand, and gravel. A large portion of the region west of the Project is underlain by bituminous coal or lignite, and the upper northeast corner of Mayes County is an area of significant oil and gas production (Johnson and Luza 2008; GRDA 2010). In addition, in the most upstream reaches of the Project vicinity in far northeastern Oklahoma and extending into adjacent states, is the historical lead and zinc Tri-State Mining District. Many abandoned mines can be found here that contribute to heavy metals contamination in some waterways. Contaminated conditions, predominantly in sediments, has lead to the designation of U.S. Environmental Protection Agency (EPA) superfund cleanup sites, specifically the Tar Creek site, a tributary of the Neosho River in Ottawa County (further described in Section 6.2 Water Resources of this PAD).

[9] Stability investigations of the Pensacola Dam have found minimal tripoli and no indication of solutioning (Haas and Associates 1991; Haas and Afridi 1995; GRDA 1995; Afridi 1996).



Source: Huffman 1958, as cited in GRDA 2010.

Figure 6.1-4. Stratigraphy in Pensacola Project vicinity.



Oklahoma's mineral resources, produced in all 77 counties, include: nonfuel minerals such as limestone, gypsum, salt, clays, iodine, and sand and gravel; coal; and petroleum (crude oil and natural gas). In recent years, the mineral industry has been the State's greatest source of revenue. In 2004, the combined value of petroleum, coal, and nonfuel minerals produced in Oklahoma was about $12 billion; it reached a high of nearly $13 billion in 1982 and 1984. Total production of all minerals since statehood (1907) is valued at $231 billion.

Although Oklahoma petroleum production accounts for about 95% of Oklahoma's annual mineral output, nonfuel minerals and coal represent a significant part of the State's current economy and an important source of future wealth. The total estimated value of nonfuel-mineral and coal production in Oklahoma during 2004 was $558 million. Leading commodities produced during 2004 were crushed stone (valued at $195 million), portland cement (production data withheld), construction sand and gravel ($54 million), coal ($51 million), industrial sand and gravel ($32 million), gypsum ($21 million), and iodine ($16 million). Other commodities now produced in Oklahoma, or for which there are current mining permits, include clays and shale, salt, lime, granite, rhyolite, dolomite, sandstone, volcanic ash, and tripoli. Deposits and resources that are not mined now, or with no current mining permits, include asphalt, lead, zinc, copper, iron, manganese, titanium, and uranium. Oklahoma ranked first in U.S. production of gypsum and iodine (Oklahoma is the only producer of iodine in the U.S.); second in tripoli production; fourth in feldspar; seventh in common clays produced; and eighth in industrial sand and gravel.

Important reserves of certain high-purity minerals suitable as raw materials for manufacture of various chemicals include high-calcium limestone, high-purity dolomite, and glass sand in south-central and eastern parts of Oklahoma; gypsum and salt are widespread in western Oklahoma. Under proper economic conditions, the abundance and purity of these minerals would enable the manufacture of caustic soda, soda ash, chlorine, sulfur, sulfuric acid, lime, sodium silicate, and other chemicals. Oil, natural gas, and water, which are needed to manufacture these products, are plentiful in most of Oklahoma, and bituminous coal is abundant in eastern Oklahoma.

Historically, lead, zinc, and copper were very important to the economy of Oklahoma, although metals are no longer produced. The Miami-Picher area of Ottawa County was a center for lead-zinc production in the world-famous Tri-State Mining District of northeastern Oklahoma, southeastern Kansas, and southwestern Missouri. Ottawa County's underground mines produced approximately 1.3 million tons of lead and 5.2 million tons of zinc between 1891 and 1970, when the last mine was closed. Oklahoma led the nation in zinc production almost every year from 1918 through 1945. In the southwest corner of the State, near Altus (Jackson County), a surface copper mine produced approximately 1.88 million tons of ore between 1964 and 1975. A decline in copper prices and an increase in production costs caused the mine to close.

Source: Johnson and Luza 2008.

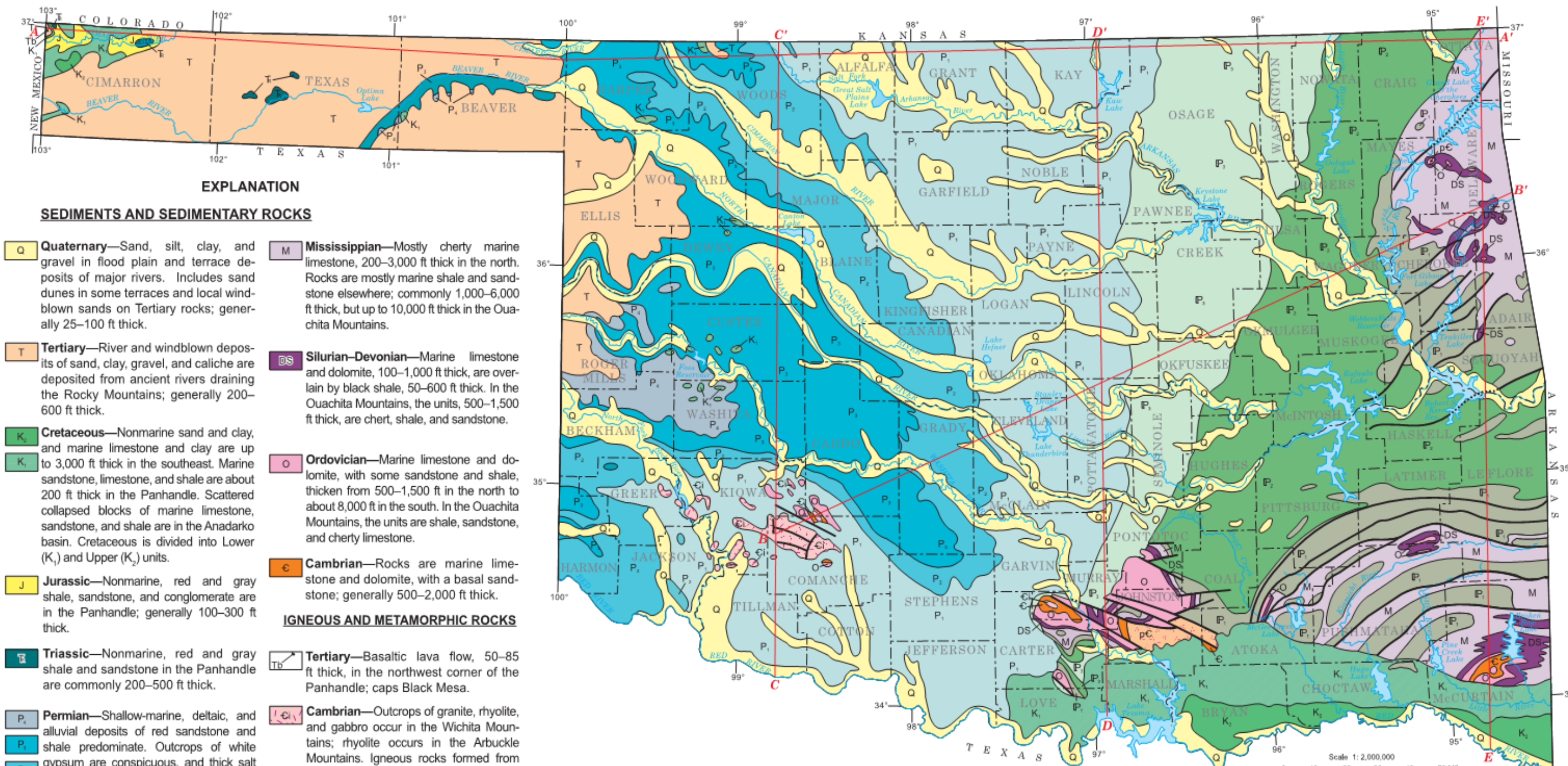
Figure 6.1-5. Minerals and resources Oklahoma.

6.1.3.2. Additional Geologic Features

One fault traverses Delaware County diagonally in a southwest direction from the Missouri State line though the middle of Grand Lake, where it is concealed by Quaternary sediments, crosses the Grand River and the upper-most part of Lake Hudson in Mayes County, finally terminating westerly of Lake Hudson (Johnson and Luza 2008; GRDA 2010)(Figure 6.1-6).

The Ozark Mountains in northeastern Oklahoma are a principal area where karst features develop in limestone and dolomite. Development of karst features occurs in areas where water-soluble limestone and dolomite are at, or near, the surface due to the dissolving action of circulating groundwater. Resulting sinkholes and caverns pose potential hazards should the land surface subside or collapse into underground voids. Limestone and dolomite beds that crop out, or are within 20 feet of the surface, represent the greatest potential for karst development and its associated environmental and engineering problems (GRDA 2010). Less potential for karst development exists where soluble rocks are 20 to 100 feet deep. In the Ozark Plateau, carbonates exist from zero to 100 feet deep (six percent of shale)(Johnson and Luza 2008).

Groundwater in fractures and cave systems in the rocks of the Ozark Plateau has a more rapid flow and typically results in less interaction with the rock matrix than water in the intergranular pore spaces of the rocks (USGS 2005). In areas where secondary porosity is substantial, dissolved and infiltrating particulates are rapidly transported through the aquifer with minimal removal by adsorption or filtering (USGS 2005). Fractures and cave systems allow groundwater to flow under surface drainage divides into adjacent drainage basins, thus making the source of infiltration difficult to determine.



EXPLANATION

SEDIMENTS AND SEDIMENTARY ROCKS

Q **Quaternary**—Sand, silt, clay, and gravel in flood plain and terrace deposits of major rivers. Includes sand dunes in some terraces and local wind-blown sands on Tertiary rocks; generally 25–100 ft thick.

T **Tertiary**—River and windblown deposits of sand, clay, gravel, and caliche are deposited from ancient rivers draining the Rocky Mountains; generally 200–600 ft thick.

K_1, K_2 **Cretaceous**—Nonmarine sand and clay, and marine limestone and clay are up to 3,000 ft thick in the southeast. Marine sandstone, limestone, and shale are about 200 ft thick in the Panhandle. Scattered collapsed blocks of marine limestone, sandstone, and shale are in the Anadarko basin. Cretaceous is divided into Lower (K_1) and Upper (K_2) units.

J **Jurassic**—Nonmarine, red and gray shale, sandstone, and conglomerate are in the Panhandle; generally 100–300 ft thick.

T̄R **Triassic**—Nonmarine, red and gray shale and sandstone in the Panhandle are commonly 200–500 ft thick.

P_4, P_3, P_2, P_1 **Permian**—Shallow-marine, deltaic, and alluvial deposits of red sandstone and shale predominate. Outcrops of white gypsum are conspicuous, and thick salt deposits are widespread in the subsurface in the west; generally 1,000–6,500 ft thick. Permian is divided into Lower (P_1) and Upper (P_2, P_3, and P_4) units; lower part of P_1 is marine red sandstone and shale, with some thin beds of limestone.

IP_3, IP_2, IP_1 **Pennsylvanian**—Mostly marine shale, with interbedded sandstone, limestone, and coal. Thickness is commonly 2,000–5,000 ft, but much greater in the Anadarko Basin (16,000 ft thick), Ardmore Basin (15,000 ft), Marietta Basin (13,000 ft), Ouachita Mountains (15,000 ft), and Arkoma Basin (18,000 ft). Thick conglomerates occur near the Wichita and Arbuckle Mountains. Units are divided into Lower (IP_1), Middle (IP_2), and Upper (IP_3) Pennsylvanian.

M **Mississippian**—Mostly cherty marine limestone, 200–3,000 ft thick in the north. Rocks are mostly marine shale and sandstone elsewhere; commonly 1,000–6,000 ft thick, but up to 10,000 ft thick in the Ouachita Mountains.

DS **Silurian–Devonian**—Marine limestone and dolomite, 100–1,000 ft thick, are overlain by black shale, 50–600 ft thick. In the Ouachita Mountains, the units, 500–1,500 ft thick, are chert, shale, and sandstone.

O **Ordovician**—Marine limestone and dolomite, with some sandstone and shale, thicken from 500–1,500 ft in the north to about 8,000 ft in the south. In the Ouachita Mountains, the units are shale, sandstone, and cherty limestone.

Є **Cambrian**—Rocks are marine limestone and dolomite, with a basal sandstone; generally 500–2,000 ft thick.

IGNEOUS AND METAMORPHIC ROCKS

Tb **Tertiary**—Basaltic lava flow, 50–85 ft thick, in the northwest corner of the Panhandle; caps Black Mesa.

Єi **Cambrian**—Outcrops of granite, rhyolite, and gabbro occur in the Wichita Mountains; rhyolite occurs in the Arbuckle Mountains. Igneous rocks formed from magma about 525 million years ago; nearly 20,000 ft thick.

pЄ **Precambrian**—Granite and gneiss (a metamorphosed igneous rock) crop out in the Arbuckle Mountains, and granite crops out in a small area in Mayes County. Formed about 1.4 billion years ago, these are the oldest rock outcrops in Oklahoma.

Symbols

Geologic contact

Fault; dotted where concealed by Quaternary sediments

A–A' Line of cross section (see p. 7)

GEOLOGIC MAP OF OKLAHOMA

Kenneth S. Johnson, Oklahoma Geological Survey

The geologic map of Oklahoma shows rock units that crop out or are mantled by a thin soil veneer. Quaternary sediments laid down by streams and rivers locally overly Precambrian through Tertiary bedrock. The geologic map helps one understand the age and character of Oklahoma's rocks in assessing petroleum reservoirs, mineral deposits, construction sites, engineering properties, ground-water-aquifer characteristics, and to remedy environmental problems.

About 99% of all outcrops in Oklahoma are sedimentary rocks. Remaining outcrops are (1) igneous rocks, mainly in the Wichita and Arbuckle Mountains, (2) metamorphic rocks in the eastern Arbuckles, and (3) mildly metamorphosed rocks in the core of the Ouachita Mountains.

Rocks formed during every geologic period crop out in Oklahoma. About 46% of Oklahoma has Permian rocks exposed at the surface. Other extensive outcrops are Pennsylvanian (about 25%), Tertiary (11%), Cretaceous (7%), Mississippian (6%), Ordovician (1%), and Cambrian (1%); Precambrian, Silurian, Devonian, Triassic, and Jurassic rocks each are exposed in less than 1% of Oklahoma. These outcrops do not include the Quaternary river, terrace, and lake deposits overlying older rocks in Oklahoma.

Bedrock geology on this map is derived from Miser (1954). Quaternary alluvium and terrace deposits are derived from nine hydrologic atlases of Oklahoma prepared jointly by the Oklahoma Geological Survey and the U.S. Geological Survey (Marcher, 1969; Marcher and Bingham, 1971; Hart, 1974; Bingham and Moore, 1975; Carr and Bergman, 1976; Havens, 1977; Bingham and Bergman, 1980; Morton, 1981; Marcher and Bergman, 1983).

Source: Johnson and Luza 2008.

Figure 6.1-6. Geologic map of Oklahoma.

6.1.4. Soils

Soil development is complex within the Project vicinity, as seen in Figure 6.1-7a, b, c, and d. Soil development is dependent on and varies with underlying geologic material, local topography, climate, and habitat/land use. 106 soil types have been identified within the Project vicinity (an area within a two-mile radius of the Project), of which 65 are found within the Project Boundary (NRCS 2016). Table 6.1-1 lists the soils found in the Project vicinity and the soil codes that correspond with the map in Figure 6.1-7a, b, c, and d.

In general, dominant soils of the Ozark Plateaus are ultisols, while those of the Prairie Plains and Neosho Lowlands are mollisols (Table 6.1-1 and Figure 6.1-7). Ultisols of the Ozark Plateaus are brown to light brown, silty soils with reddish clay subsoils on cherty limestones (Johnson and Luza 2008). In the Ozark Plateaus geomorphic province, ultisols are found under forests and are identified by intense leaching, a clay horizon, and a low supply of bases below the surface level. Ultisols are generally well suited for shifting cultivation; although, they can be highly productive if used with fertilizers (GRDA 1985). Overall, the ionic adsorption capacity of the alfisols and ultisols of the Ozark Plateaus province is minimal (USGS 1995). Kaolinite, illite, and hydroxide clays, which constitute the soil types of the Ozark Plateaus province, are relatively low in ionic adsorption capacity compared to expandable clays and organic matter, which constitute the soil types of the plains and lowlands (Brady 1984). Thus, most soils in the Ozark Plateau will not readily absorb ionic constituents found in infiltrating water (USGS 1995).

Found under grasses in the Prairie Plains and Neosho Lowlands, mollisols are steppe soils with a relatively thick, dark, and humus-rich surface layer. The mollisols in the Project vicinity are deep dark-colored soils mostly with clay subsoils developed on shales, sandstones, and limestones under tall grass prairies (Johnson and Luza 2008). These soils often have distinct layers rich in clay, sodium, calcium, and other materials. Mollisols are suitable for the cultivation of both grains and sorghum (GRDA 1985).

Dominant soils bordering the reservoir in the lower reaches are predominantly upland soils covering the hilly terrain inundated by the reservoir. These soils are primarily characterized as soils within both the Clarksville and Sallisaw series. The Clarksville series consists of deep, gently sloping to steep soils with a stony and cherty, medium-textured surface layer and a stony and cherty, moderately fine to finely textured subsoil (GRDA 1985). Generally, soils in the Clarksville series are well drained. Soils in the Sallisaw series are quite similar and consist of deep, gently sloping to sloping soils with a medium to gravelly textured surface layer and moderately fine to gravelly textured subsoil. Development of soils within the Sallisaw series occurred in loamy alluvium or benches along the major streams. These soils are also well drained.

Table 6.1-1. Map codes, names, and acres of soil types found inside and outside the Project Boundary, up to a two-mile radius. Example of soil types illustrated in Figures 6.1-7a, b, c, and d.

Map Code	Soil Name	Acres	
		Inside	Inside + Outside
Ad	Osage-Verdigris complex, 0 to 1 percent slopes, frequently flooded	686.1	2050.7
BaB	Bates loam, 1 to 3 percent slopes	2.0	2344.6
BaC	Bates loam, 3 to 5 percent slopes	6.5	2256.6
BaC2	Bates loam, 3 to 5 percent slopes, eroded	0.0	588.4
Bb	Coweta-Bates complex, 1 to 5 percent slopes	4.1	882.4
BcB	Macedonia silt loam, 1 to 3 percent slopes	2.2	4264.6
BcC	Macedonia silt loam, 3 to 5 percent slopes	0.0	188.3
BdB	Clarksville gravelly silt loam, 0 to 3 percent slopes	0.0	3264.5
BhB	Doniphan gravelly silt loam, 1 to 3 percent slopes	0.0	2591.9
BlC	Doniphan-Tonti complex, 3 to 5 percent slopes	0.0	1214.7
BnD	Clarksville very gravelly silt loam, 1 to 8 percent slopes	10.9	15354.5
BoE	Clarksville stony silt loam, 12 to 50 percent slopes	457.9	21892.5
Br	Eram-Verdigris complex, 0 to 20 percent slopes	11.9	904.8
Ca	Razort gravelly loam, 0 to 1 percent slopes, occasionally flooded	31.2	320.9
Ca	Pharoah silt loam, 0 to 1 percent slopes	0.0	37.1
CaB	Captina silt loam, 1 to 3 percent slopes	0.0	1030.6
Ce	Cherokee silt loam, 0 to 1 percent slopes	0.0	1411.7
ChA	Choteau silt loam, 0 to 1 percent slopes	116.2	2014.5
ChB	Choteau silt loam, 1 to 3 percent slopes	433.0	4520.6
CkD	Clarksville gravelly silt loam, 1 to 8 percent slopes	126.0	2931.8
CkD	Clarksville very gravelly silt loam, 1 to 8 percent slopes	32.4	17391.0
ClE	Clarksville very gravelly silt loam, 5 to 20 percent slopes, stony	294.1	13680.5
ClF	Clarksville very gravelly silt loam, 20 to 50 percent slopes, stony	760.4	22060.2
CmE	Clarksville stony silt loam, 5 to 12 percent slopes	10.1	439.1
CnD	Clarksville very gravelly silt loam, 1 to 8 percent slopes	3.6	399.1
Co	Collinsville stony loam, 3 to 20 percent slopes	0.0	1183.0
CoC	Coweta fine sandy loam, 3 to 5 percent slopes, very rocky	3.8	844.4
CoF	Collinsville-Vinita complex, 2 to 30 percent slopes	0.0	320.8
CrB	Craig silt loam, 1 to 3 percent slopes	6.1	5251.0
CrC	Craig silt loam, 3 to 5 percent slopes	0.0	1480.5
DnA	Dennis silt loam, 0 to 1 percent slopes	0.0	232.9
DnB	Dennis silt loam, 1 to 3 percent slopes	177.7	21299.9
DnC	Dennis silt loam, 3 to 5 percent slopes	19.1	513.4
DnC2	Dennis silt loam, 3 to 5 percent slopes, eroded	57.6	891.9
DsC3	Dennis silty clay loam, 3 to 5 percent slopes, severely eroded	0.0	13.1
DvE	Eram-Verdigris complex, 0 to 12 percent slopes	0.0	83.5
Ed	Eldorado gravelly silt loam, 1 to 8 percent slopes	5.5	3271.1
EdB	Eldorado silt loam, 1 to 3 percent slopes	69.2	9837.8
EdC	Eldorado silt loam, 3 to 5 percent slopes	42.1	5197.6
EhD	Waben gravelly silt loam, 3 to 8 percent slopes	499.7	1853.7
ElD	Eldorado stony silt loam, 1 to 8 percent slopes	3.6	555.8
ElD	Eldorado stony silt loam, 3 to 12 percent slopes	1372.8	8397.8
ElD	Eldorado gravelly silt loam, 1 to 8 percent slopes	0.0	370.6
EoC	Eldorado silt loam, 3 to 5 percent slopes	24.1	898.6
Es	Elsah very gravelly loam, 0 to 3 percent slopes, frequently flooded	420.5	541.8
Es	Elsah gravelly loam, 0 to 1 percent slopes, frequently flooded	0.0	153.7
EtA	Britwater silt loam, 0 to 3 percent slopes	888.1	3491.6
Hg	Razort gravelly silt loam, 0 to 1 percent slopes, frequently flooded	46.7	1069.0
HlC	Hector-Bolivar complex, 1 to 5 percent slopes	0.0	110.3
HlE	Hector-Bolivar complex, 5 to 20 percent slopes	0.0	182.8
Hu	Healing silt loam, 0 to 1 percent slopes, occasionally flooded	503.0	2642.1
JaA	Jay silt loam, 1 to 3 percent slopes	0.0	61.2

Map Code	Soil Name	Acres Inside	Acres Inside + Outside
Ka	Wynona silty clay loam, 0 to 1 percent slopes, frequently flooded	9.2	711.0
La	Captina silt loam, 0 to 1 percent slopes	0.0	615.0
Lg	Lightning-Healdton complex, 0 to 1 percent slopes, occasionally flooded	0.0	229.5
LkB	Bolivar fine sandy loam, 1 to 3 percent slopes	0.0	0.3
LkC	Bolivar fine sandy loam, 3 to 5 percent slopes	0.0	119.9
LkC2	Bolivar fine sandy loam, 3 to 5 percent slopes, eroded	0.0	16.5
Ln	Lightning silt loam, 0 to 1 percent slopes, occasionally flooded	197.1	823.8
LoB	Tonti gravelly silt loam, 1 to 3 percent slopes	0.0	1560.1
LrD	Lenapah-Rock outcrop complex, 1 to 8 percent slopes	0.0	38.5
Ma	Mayes silty clay loam, 0 to 1 percent slopes	0.0	75.3
Mp	Kanima gravelly clay loam, 1 to 30 percent slopes	0.6	146.1
NaA	Newtonia silt loam, 0 to 1 percent slopes	0.0	609.3
NaB	Newtonia silt loam, 1 to 3 percent slopes	0.1	3702.4
NaC	Newtonia silt loam, 3 to 5 percent slopes	0.0	361.7
NaC2	Newtonia silt loam, 3 to 5 percent slopes, eroded	0.0	697.6
NcB	Nixa gravelly silt loam, 0 to 3 percent slopes	0.0	43.5
Ns	Newtonia-Shidler complex, 1 to 8 percent slopes	5.7	602.6
NxB	Nixa gravelly silt loam, 0 to 3 percent slopes	7.2	2344.8
OeA	Okemah silt loam, 0 to 1 percent slopes	1.4	1269.0
OkA	Okemah silty clay loam, 0 to 1 percent slopes	0.0	160.7
OkB	Okemah silty clay loam, 1 to 3 percent slopes	38.3	684.5
Os	Osage silty clay, 0 to 1 percent slopes, occasionally flooded	645.3	8871.7
Os	Osage silty clay loam, 0 to 1 percent slopes, occasionally flooded	0.0	389.3
Ot	Mayes silty clay loam, 0 to 1 percent slopes	0.0	662.1
PaA	Parsons silt loam, 0 to 1 percent slopes	22.0	9019.6
PaB	Parsons silt loam, 1 to 3 percent slopes	8.4	3237.3
PaB2	Parsons silt loam, 1 to 3 percent slopes, eroded	0.0	149.2
Qu	Quarles silt loam, 0 to 1 percent slopes, occasionally flooded	0.0	130.5
Ra	Radley silt loam, 0 to 1 percent slopes, occasionally flooded	0.0	18.5
ReB	Riverton loam, 1 to 3 percent slopes	30.5	604.8
RvC	Riverton gravelly loam, 1 to 5 percent slopes	0.0	1699.8
SaA	Britwater silt loam, 0 to 1 percent slopes	0.0	59.7
SaB	Britwater silt loam, 1 to 3 percent slopes	382.8	3859.5
SgB	Britwater gravelly silt loam, 1 to 3 percent slopes	64.3	638.4
SgD	Britwater gravelly silt loam, 3 to 8 percent slopes	418.0	3635.9
Sm	Healing silt loam, 0 to 1 percent slopes, occasionally flooded	120.9	1087.0
Sm	Razort silt loam, 0 to 1 percent slopes, occasionally flooded	0.9	96.2
Sn	Razort gravelly loam, 0 to 3 percent slopes, occasionally flooded	487.6	5447.5
SrA	Stigler silt loam, 0 to 1 percent slopes	0.0	648.8
SuA	Apperson silty clay loam, 0 to 1 percent slopes	0.0	156.0
SuB	Apperson silty clay loam, 1 to 3 percent slopes	0.5	1113.2
SuC	Summit silty clay loam, 3 to 5 percent slopes	0.0	21.9
TaA	Taloka silt loam, 0 to 1 percent slopes	4.1	7950.1
TkA	Taloka silt loam, 0 to 1 percent slopes	135.2	1381.7
TrD	Shidler-Rock outcrop complex, 2 to 8 percent slopes	111.0	553.0
Vd	Verdigris silt loam, 0 to 1 percent slopes, occasionally flooded	513.2	6012.9
Ve	Verdigris silty clay loam, 0 to 1 percent slopes, occasionally flooded	547.2	1307.5
Vr	Verdigris silt loam, 0 to 1 percent slopes, frequently flooded	110.9	1076.4
Vs	Verdigris silty clay loam, 0 to 1 percent slopes, frequently flooded	301.5	347.9
Vs	Verdigris silt loam, 0 to 1 percent slopes, frequently flooded	0.0	13.6
Vt	Verdigris-Eram complex, 0 to 20 percent slopes	0.0	139.2
WoA	Mayes silt loam, 0 to 1 percent slopes	53.1	2571.4
WoA	Mayes silty clay loam, 0 to 1 percent slopes	0.2	1765.2
WoB	Mayes silty clay loam, 1 to 3 percent slopes	13.1	1007.8

Source: NRCS 2016.

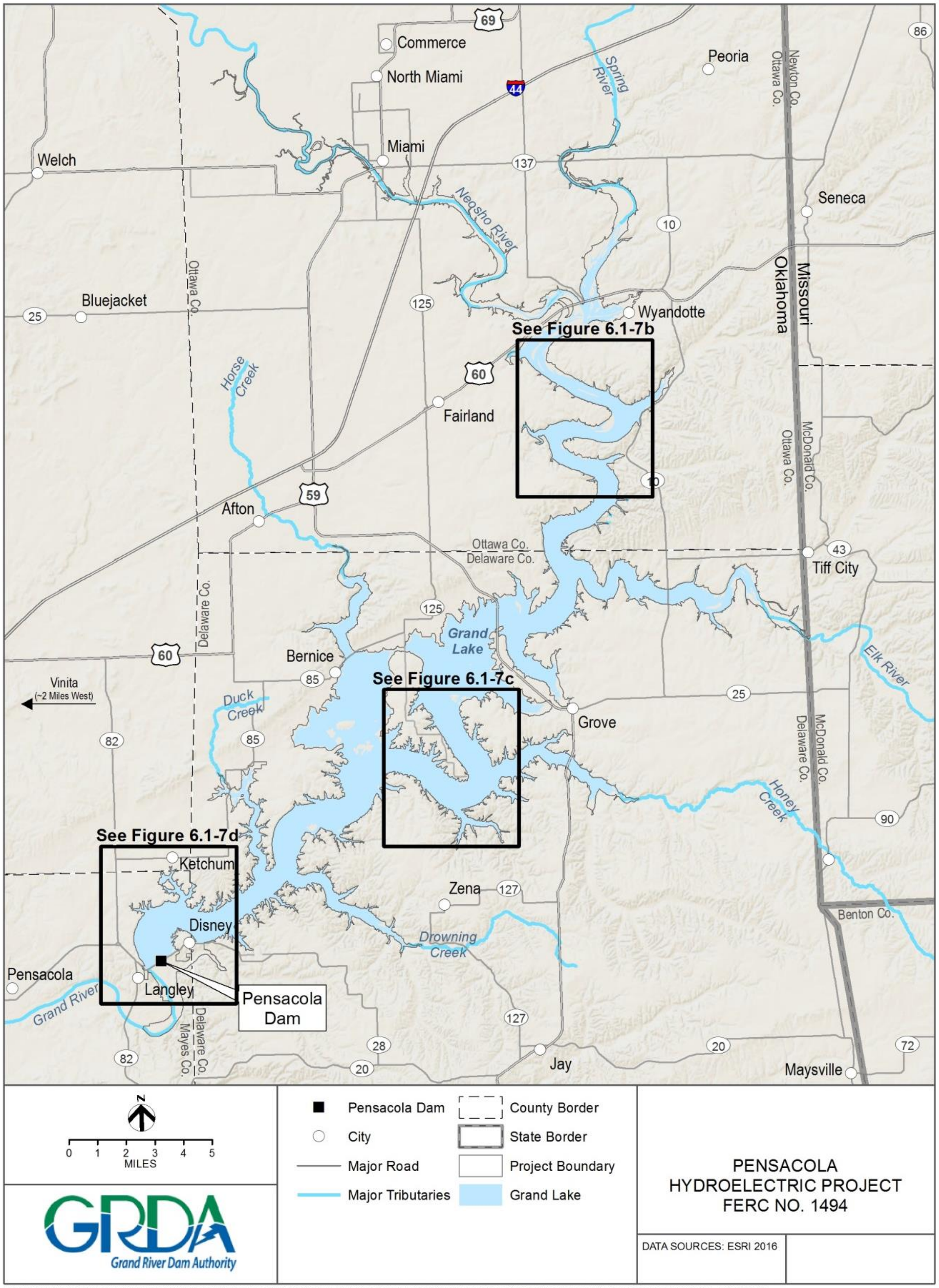


Figure 6.1-7a. Soil associations in Pensacola Project vicinity.

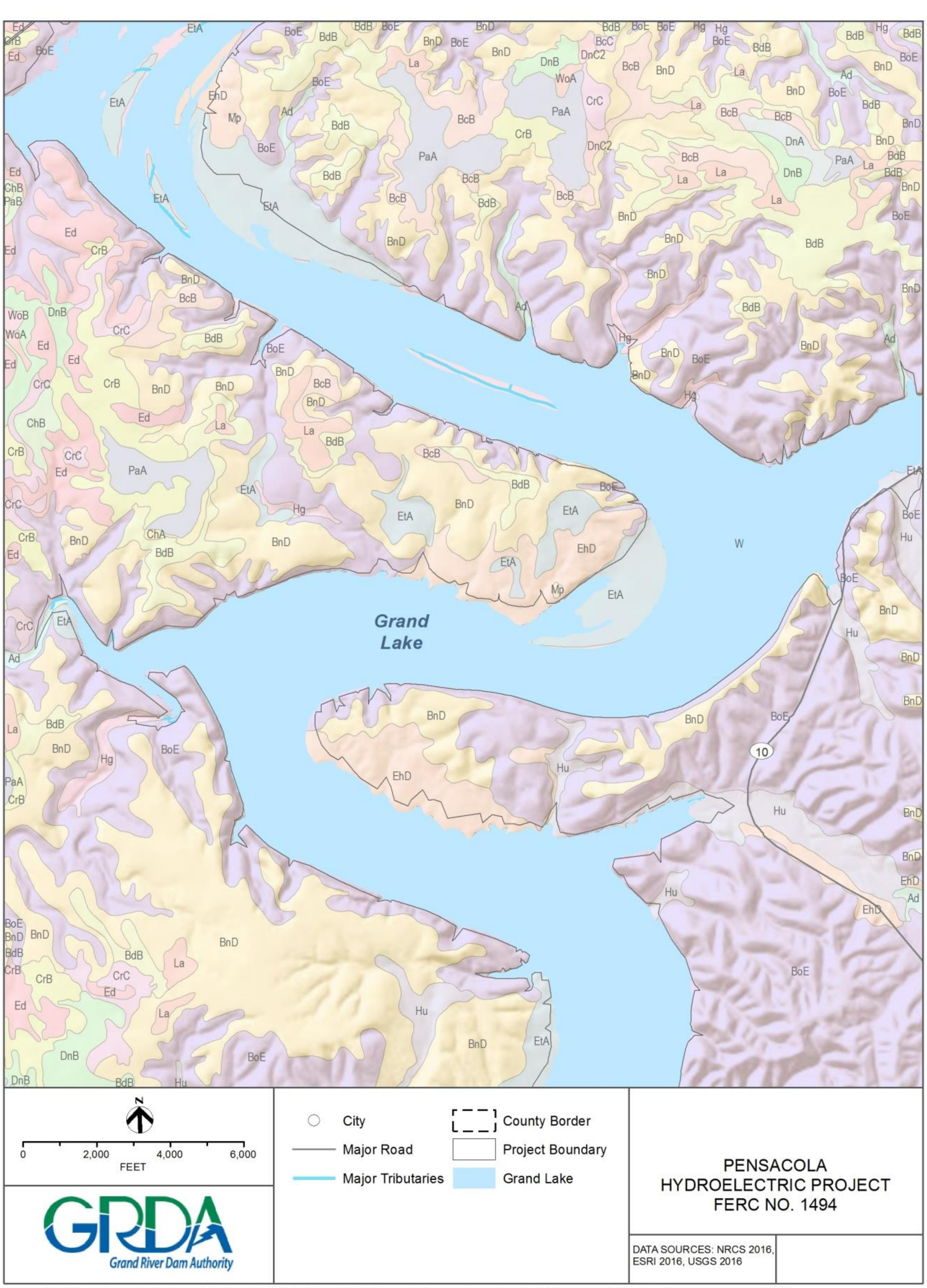


Figure 6.1-7b. Soil associations in Pensacola Project vicinity.

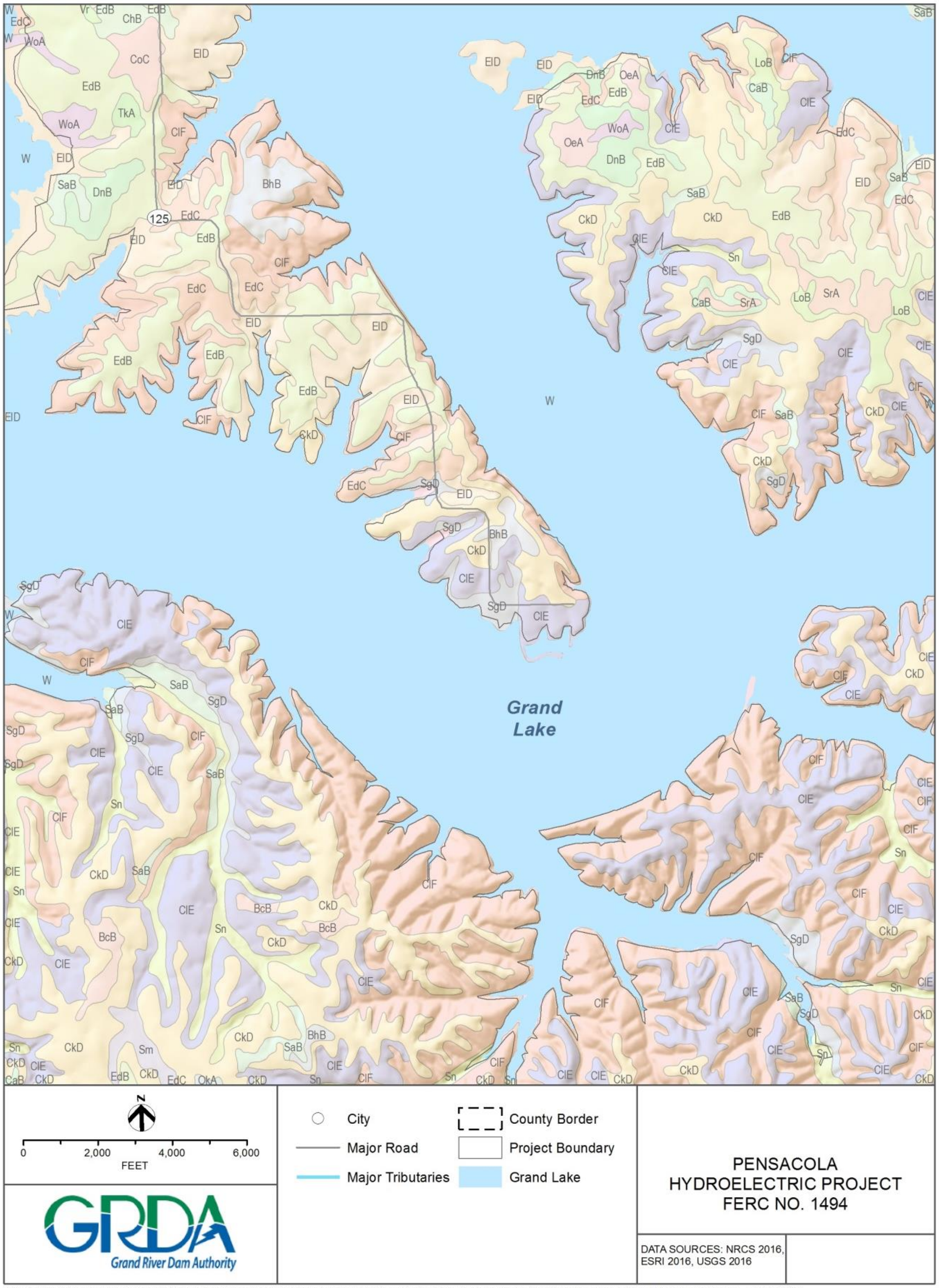


Figure 6.1-7c. Soil associations in Pensacola Project vicinity.

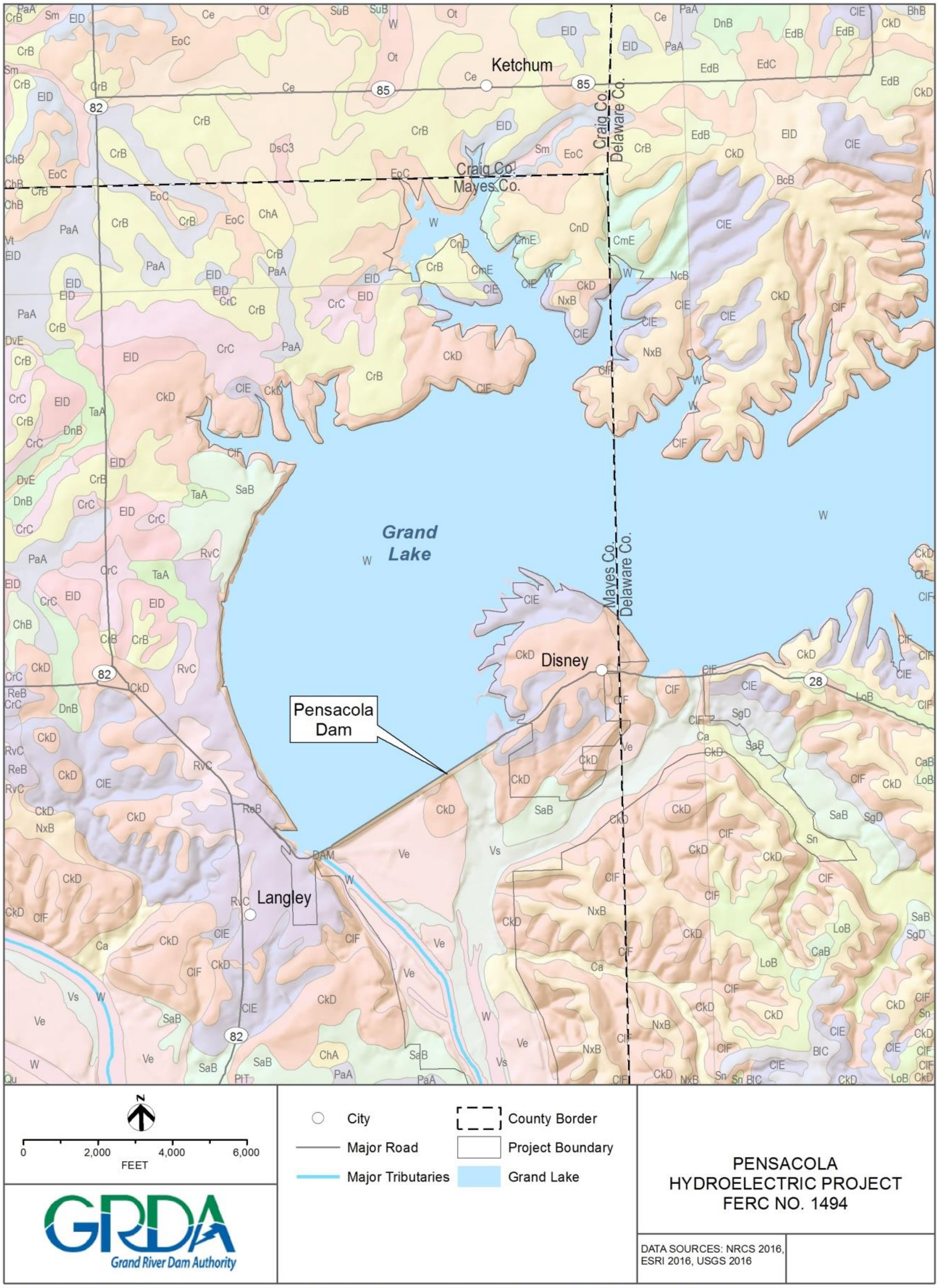


Figure 6.1-7d. Soil associations in Pensacola Project vicinity**.**

6.1.5. Reservoir Shoreline and Streambank Conditions

The shoreline of Grand Lake ranges from forested areas, with a variety of vegetative cover types, to areas largely developed both commercially and residentially (GRDA 2008). The river basin in the Project vicinity is dominated by deciduous forests (further described in Section 6.4 Wildlife and Botanical Resources and Section 6.5 Floodplains, Wetlands, Riparian, and Littoral Habitat of this PAD).

The shoreline of Grand Lake primarily consists of stony silt-loam soils on slopes ranging from 5 to 20 percent. Timbered upland ridges in cherty limestone areas are also characterized by this soil type (GRDA 2008). The upper two inches of this soil-type's surface layer appear dark grayish brown; the lower horizon is a pale brown. The subsoil—a brown, stony, silt/clay loam—is about sixty percent chert by volume (GRDA 2008). Overall, a broad range of soil thicknesses and permeability are present in the Ozark Plateaus.

Within the Ozark Plateau province, the Ozark Highlands ecoregion (further described in Section 6.4 Wildlife and Botanical Resources of this PAD) is primarily composed of Springfield Plateaus largely underlain by highly soluble and fractured limestone and chert of the Mississippi Boone Formation. Caves, sinkholes, and underground drainage occur, heavily influencing surface water availability, water temperature, and the potential for surface and groundwater pollution. Numerous sinkholes within the Springfield Plateau allow surface water to rapidly infiltrate into the subsurface and recharge the underlying shallow aquifers (USGS 1995). Clear, cold, perennial spring-fed streams with gravel or bedrock bottoms are common. Numerous small, dry valleys occur where overland flow is entirely runoff-driven. Losing streams are common, permitting the flow of water directly into the groundwater system through streambeds. During the summer dry period, springs and groundwater recharge sustain stream flows. Springs are a natural resurgence of groundwater, usually on a hillside or the valley floor. Soils are often cherty and have developed from carbonate rocks or interbedded chert, sandstone, and shale (GLWAF 2008).

Geohydrology of the Central Irregular Plains ecoregion and Neosho Lowlands geomorphic province portion of the watershed is characterized by soils derived from shale, sandstone, and limestone. Clay pan soils occur in some nearly level areas. On limestone slopes, exposed limestone slabs and gravels occur. Major streams have low gradients, meander considerably, and develop wide valleys except on areas of very hard rocks. Groundwater in the Central Irregular Plains tends to be saline and is more likely to be anoxic, as opposed to fresh, oxygenated groundwater generally found in the Ozark Highlands (GLWAF 2008).

The Grand Lake Shoreline Mapping Project, a hydrographic shoreline survey and data analysis, was completed in July 2016 (OWRB 2016). Focused on describing underwater sediments, the survey mapped reservoir substrates below a water surface elevation of 745 feet.

The shorelines of upper Grand Lake along the northern and western borders are generally typified by gentler slopes, while along the southern and eastern borders, shorelines are characterized primarily by steep rocky beaches and bluffs (GRDA 2008). Upper Grand Lake is primarily continuous sections of undeveloped shoreline (GRDA 2008). In the reservoir's lower reaches, shoreline areas primarily consist of limestone bluffs that are mainly developed. GRDA has a SMP and a VMP to manage activities within the Project Boundary for protection and maintenance of shoreline conditions (GRDA 2008, 2011). Shoreline protection structures, consisting of riprap, are in place in several developed areas of the reservoir. Maintaining vegetated shorelines is an integral component of both the SMP and VMP to help stabilize and control the potential effects of erosion (GRDA 2008, 2011). Guidelines outlined in the SMP and VMP are intended to mitigate ground-disturbing activities and to monitor the shoreline to ensure that erosion of Project lands that result from permitted uses is addressed (FERC 2009). Restrictions on boat traffic, shoreline use, and vegetation, are among the regulations in the SMP (FERC 2009; GRDA 2008, 2011). Except for some slumping in an area of the Grand River downstream of the dam following the 2015 flood of record, no instances of mass soil movement, slumping or other forms of instability are present.

6.2 Water Resources

6.2.1 Drainage Area

The Pensacola Project is located within the Grand River Basin (Figure 5.1-1 in Section 5 General Description of River Basin of this PAD). The Grand Lake Basin has a drainage area of approximately 10,300 square miles (USACE 1992; GRDA 2011). The Grand River originates as the Neosho River in the Flint Hills in east central Kansas where it flows southeast for approximately 300 miles into Oklahoma. The Neosho River becomes the Grand (Neosho) River (Grand River) at the confluence with the Spring River at RM 122.6 (GRDA 2010). The Grand River then flows south for approximately 160 miles to its confluence with the Arkansas River (FERC 1996). The Pensacola Dam is located at RM 77 on the Grand River.

6.2.2 Morphometric Characteristics of the Reservoir

Grand Lake has a surface area of approximately 45,200 acres with 667 miles of shoreline extending 66 miles upstream of the Pensacola Dam and powerhouse. Other morphometric characteristics of Grand Lake are provided in Table 6.2-1. A bathymetry map for Grand Lake based on the 2009 data collected by the OWRB is shown in Figure 6.2-1.

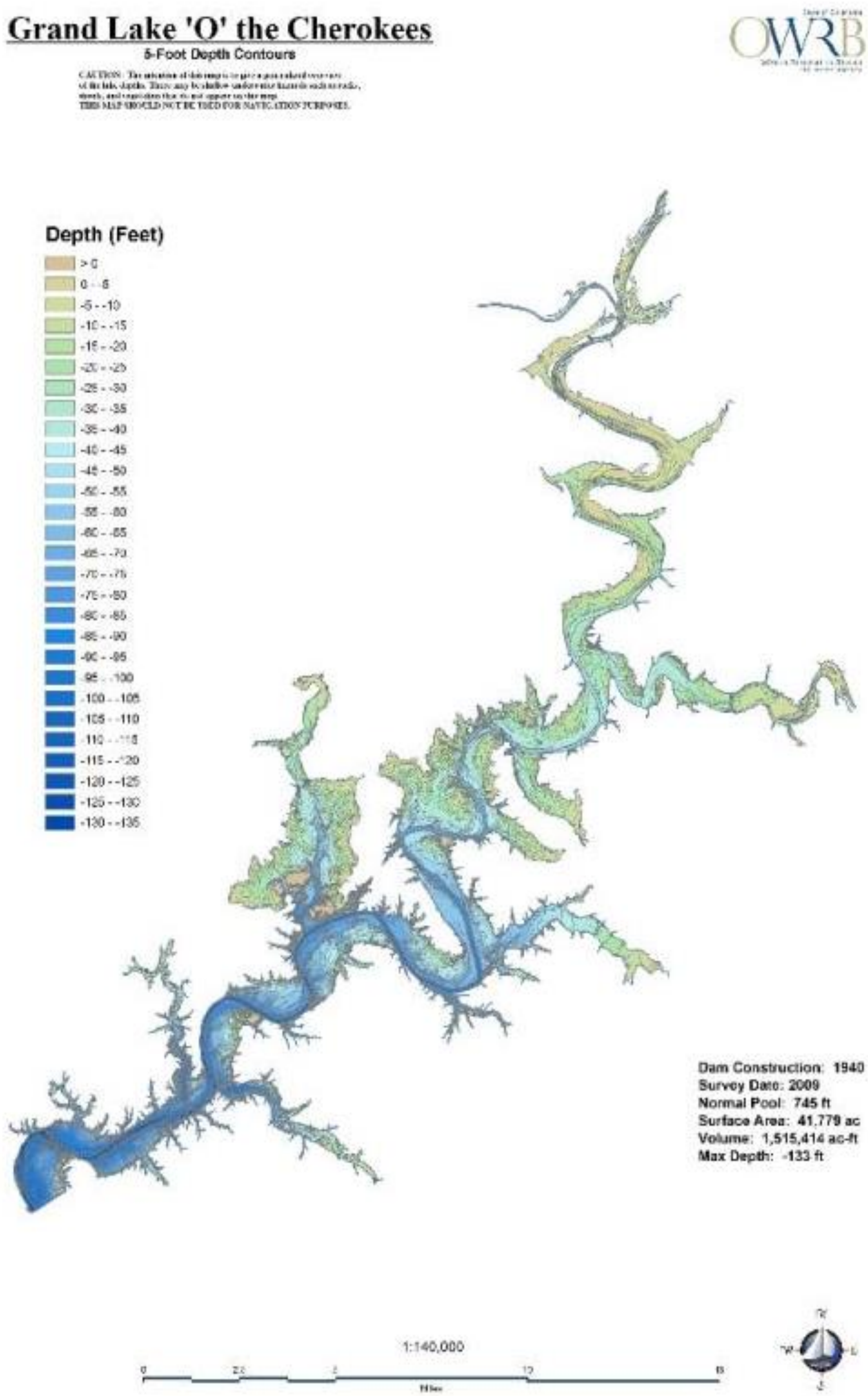
Table 6.2-1. Morphometric characteristics of Grand Lake.

Morphometric Characteristics	Grand Lake
Surface Area	45,200 acres
Volume	1,672,000 acre-feet
Maximum depth at maximum water surface elevation	133 feet
Mean depth at maximum water surface elevation	36 feet
Shoreline length	667 miles

Source: OWRB and Oklahoma State University (OSU) 1995; GRDA 2016; OWRB 2009.

6.2.3 Gradient for Downstream Reaches

A hydrographic survey of the Pensacola Dam tailwater was conducted in 2011 that included the area 1,000 feet downstream of the dam. The survey indicated a pool approximately 80 feet wide and 12 feet deep directly below the dam and a relatively flat gradient (0 percent slope) in the first 1,000 feet below the dam (OWRB 2011). The gradient of the tailrace remains relatively flat for approximately 1 mile below the dam, at which point the gradient increases to approximately 3.4 feet-per-mile for the next half of a mile (FERC 2015).



Source: OWRB 2009.

Figure 6.2-1. Grand Lake bathymetry with 5-foot contour intervals.

6.2.4 Water Quantity

6.2.4.1 Streamflow, Gage Data, and Flow Statistics

Inflows to the Project were estimated by Mead & Hunt utilizing historical Project operations data as well as reported flows at the three USGS gages: Neosho River near Commerce 07185000, Spring River near Quapaw 07188000, and Elk River near Tiff City 07189000.

The recorded USGS gage flows were routed to Grand Lake using the same routing equations and parameters as the USACE Tulsa District HEC-HMS model of the Lower Grand (Neosho) River basin (USACE 2016). Historical hourly ungaged tributary inflows were calculated for Pensacola Dam (Grand Lake) using a volume conservation approach and assuming negligible infiltration/evaporation (Ungaged Tributary Inflow = Outflow + ΔStorage – Routed USGS Gage Flows). It was assumed that tributary inflow for a given time step was equal to the outflow recorded for the same time step, minus the routed inflow from upstream gaging stations, plus the change in reservoir storage from the given time step to the next.

A negative inflow value spreading procedure was used to mitigate calculated negative inflows resulting from the recorded reservoir level fluctuations. Small fluctuations in the recorded reservoir level may or may not be indicative of an actual change in storage volume within the reservoir; the reservoir level readings are susceptible to wave action. At an elevation of 742 feet, a fluctuation of 0.01 feet in the reservoir level is equivalent to an hourly discharge of 5,600 cfs. The average outflow at the Project is 7,900 cfs for the period of record. Therefore, reservoir level gage fluctuations on the order of a few hundredths of a foot can significantly alter the back-calculated inflow time series values; therefore, the following spreading algorithm was applied to eliminate negative inflow values:

- If a one-hour inflow value is less than zero, set it equal to zero. If an adjacent timestep inflow value (i.e., previous or next hour) is less than zero, add half the negative value to the current timestep inflow value. This algorithm was chosen to both conserve volume and eliminate negatives while “legitimate” peak flow values remain unchanged.
- Set all remaining negative inflow values to zero, and then multiply all inflow values by a factor of 0.352541 to conserve volume. Total inflow volume plus total change was maintained.

For the 12-year period of record (4/1/2004 through 3/31/2016), monthly average flows ranged from 3,839 cfs to 16,261 cfs (Table 6.2-2). The highest flow during the period of record was 254,228 cfs and the lowest flow was 126 cfs. Flow duration curves have been developed for the Pensacola Project and are located in Attachment D.

Table 6.2-2. Monthly average and median inflows to Pensacola Project (April 2004 through March 2016).

	Minimum (cfs)	90% Exceedance (cfs)	Average (cfs)	Median (cfs)	10% Exceedance (cfs)	Maximum (cfs)
Annual	126	446	7,916	3,006	18,005	254,228
January	256	378	5,158	2,112	10,593	108,945
February	377	952	4,729	2,261	12,039	45,322
March	278	1,081	8,249	3,984	16,629	133,651
April	270	1,300	11,826	6,503	26,132	156,436
May	750	1,675	16,261	9,657	42,169	156,309
June	336	1,321	14,807	9,793	33,924	139,919
July	127	340	9,372	5,615	19,232	148,812
August	126	212	5,070	1,421	11,670	101,449
September	180	404	5,033	1,550	11,682	74,572
October	173	293	3,839	833	8,307	133,833
November	195	363	4,026	1,204	10,715	66,523
December	302	353	6,470	1,709	11,389	254,228

6.2.4.2 Existing Uses and Water Rights

GRDA has all the water rights necessary to operate the Project. GRDA is the state agency responsible for allocation of water rights of the Grand River and its tributaries. Water users must be permitted by GRDA prior to using basin waters.

As licensed by FERC, the Project serves multiple purposes, including hydropower generation, water supply, public recreation, and wildlife enhancement. With regard to water supply, Grand Lake is a drinking water source and is used by approximately 21,000 residential households and 500 commercial customers. In addition, GRDA issues yearly permits for domestic and agricultural water use (GRDA 2016). Water use for hydropower generation, recreation and wildlife enhancement are described in more detail in Sections 4.4.1, 6.7, and 6.4 of this PAD, respectively.

6.2.5 Water Quality

Grand Lake and the Grand River support a productive warm water fishery and are popular recreation areas. Grand Lake water quality is typical of other lakes in the area, and is affected by similar stressors. Grand Lake is dendritic with numerous major and minor coves. Grand Lake exhibits longitudinal zonation including a riverine zone, transition zone, and lacustrine zone. Each zone possesses unique physical, chemical, and biological characteristics. Grand Lake can be classified as warm monomictic with the water column mixing freely in the winter at or above 4 degrees Celsius (°C) while thermal stratification occurs from mid-spring through mid-autumn. Grand Lake is classified as eutrophic based off of measurements of chlorophyll *a*, water clarity, and phosphorus.

Water quality in Grand Lake is largely flow dependent; changing depending on inflow from its major tributaries. Major influences on water quality in Grand Lake include nutrient runoff from non-point sources (agriculture), internal nutrient loading, point source discharge (municipal and industrial effluent), and runoff from abandoned mines within the tri-state mining district upstream of the Project Boundary.

GRDA and others have collected extensive water quality information in the watershed over the past 30 years. Water quality in Grand Lake generally supports designated beneficial uses, while being listed as impaired for several pollutants that are largely a result of anthropogenic activities in the watershed. Water quality standards for each of the beneficial uses in the Project watershed and vicinity are summarized in the following sections, along with a summary of available water quality data.

6.2.5.1 Federally Approved Water Quality Standards

Oklahoma's Water Quality Standards are promulgated under statutory authority of the OWRB (authorized under 82 Oklahoma Statutes (O.S.) §1085.30 and enforced by the ODEQ). Water quality standards are published in Oklahoma Administrative Code Title 785, Chapter 45 (OAC 785:45) and consist of designation of beneficial uses, water quality criteria to protect the designate uses, and antidegradation policies (OWRB 2016). Beneficial use designations are found in Appendix A in OAC 785:45 and are provided in Table 6.2-3. The beneficial use designations for Grand Lake include public and private water supply (PPWS), fish and wildlife propagation as a warm water aquatic community (WWAC), agriculture irrigation, and primary body contact recreation (PBCR). Beneficial uses for Spring River and Elk River include Cold and Water Aquatic Communities (CWAC) criteria for the incoming Spring River and Elk River as well as the aforementioned criteria listed for Grand Lake (Table 6.2-3). Criteria to protect beneficial uses are provided in Subchapter 5 Part 3 and Appendix G of OAC 785:45. Applicable criteria are summarized in Table 6.2-4 and Table 6.2-5. According to ODEQ, Grand Lake does not meet water quality standards (WQS) for several parameters (ODEQ 2014). Impaired sections of the Neosho River, Spring River, Elk River and Grand Lake are provided in Table 6.2-6.

Table 6.2-3. Waterbody identification and beneficial use designation in the Project vicinity (OAC 785:45).

Waterbody Name and Sequence	Waterbody ID	Beneficial Uses[1]				
		Water Supply	Fish and Wildlife Propagation	Agriculture	Recreation	Aesthetics
Neosho River	121600040010 121600040120 121600040220	PPWS	WWAC	*	PBCR	*
Grand Lake, Upper	121600030040	PPWS	WWAC	*	PBCR	*
Grand Lake Middle	121600030030	PPWS	WWAC	*	PBCR	*
Grand Lake, Lower	121600030020	PPWS	WWAC	*	PBCR	*
Grand River, Below Pensacola Dam	121600020170	PPWS	WWAC	*	PBCR	*
Spring River	121600070010	PPWS	CWAC	*	PBCR	*
Elk River	121600030440	PPWS	CWAC	*	PBCR	*

Notes:
1 Asterisk ("*") refers to default beneficial use as described in OAC 785:45.

Table 6.2-4. Water quality criteria applicable to the Pensacola Project (OAC 785:45).

Parameter	Narrative/Numeric Criteria
Temperature	No heat of artificial origin shall cause receiving stream water to exceed the critical temperature plus 2.8 °C in warm water aquatic communities.
pH	The pH values shall be between 6.5 and 9.0 in waters designated for fish and wildlife propagation; unless pH values outside that range are due to natural conditions.
DO	Except for naturally occurring conditions the DO criteria are as shown in Table 6.2-5. Additionally: (i) For streams, no more than two DO samples shall exhibit a DO concentration of less than 2.0 mg/L in any given year. (ii) For lakes, no more than 50 percent of the water volume shall exhibit a DO concentration less than 2.0 mg/L. If no volumetric data is available, then no more than 70 percent of the water column at any given sample site shall exhibit a DO concentration less than 2.0 mg/L. If a lake specific study including historical analysis demonstrates that a different percent volume or percent water column than described above is protective of the WWAC use, then that lake specific result takes precedence.
Bacteria	90 percent one-sided confidence level for all other beneficial use areas (#/millliter [mL]): 406 and 108 for In waters designated for Primary Body Contact Recreation the following limits for bacteria set forth in (c) of this section shall apply only during the recreation period of May 1 to September 30. The criteria for Secondary Body Contact Recreation will apply during the remainder of the year. (c) Compliance with 785:45-5-16 shall be based upon meeting the requirements of one of the options specified in (1) or (2) of this subsection (c) for bacteria. Upon selection of one (1) group or test method, said method shall be used exclusively over the time period prescribed therefor. Provided, where concurrent data exist for multiple bacterial indicators on the same waterbody or waterbody segment, no criteria exceedances shall be allowed for any indicator group. (1) Escherichia coli (*E. coli*): The *E. coli* geometric mean criterion is 126/100 mL. For swimming advisory and permitting purposes, *E. coli* shall not exceed a monthly geometric mean of 126/100 mL based upon a minimum of not less than five (5) samples collected over a period of not more than thirty (30) days. For swimming advisory and permitting purposes, no sample shall exceed a 75 percent one-sided confidence level of 235/100 mL in lakes and high use waterbodies and the 90 percent one-sided confidence level of 406/100 mL in all other Primary Body Contact Recreation beneficial use areas. These values are based upon all samples collected over the recreation period. For purposes of sections 303(d) and 305(b) of the federal Clean Water Act as amended, beneficial use support status shall be assessed using only the geometric mean criterion of 126/100 mL compared to the geometric mean of all samples collected over the recreation period.

Parameter	Narrative/Numeric Criteria
	(2) Enterococci**:** The Enterococci geometric mean criterion is 33/100 mL. For swimming advisory and permitting purposes, Enterococci shall not exceed a monthly geometric mean of 33/100 mL based upon a minimum of not less than five (5) samples collected over a period of not more than thirty (30) days. For swimming advisory and permitting purposes, no sample shall exceed a 75 percent one-sided confidence level of 61/100 mL in lakes and high use waterbodies and the 90 percent one-sided confidence level of 108/100 mL in all other Primary Body Contact Recreation beneficial use areas. These values are based upon all samples collected over the recreation period. For purposes of sections 303(d) and 305(b) of the federal Clean Water Act as amended, beneficial use support status shall be assessed using only the geometric mean criterion of 33/100 mL compared to the geometric mean of all samples collected over the recreation period.
Biological Criteria	Aquatic life in all waterbodies with the beneficial use designation of Fish and Wildlife Propagation (excluding waters designated "Trout, put-and-take") shall not exhibit degraded conditions as indicated by one or both of the following: • Comparative regional reference data from a station of reasonably similar watershed size or flow, habitat type, and Fish and Wildlife beneficial use subcategory designation or; • Comparison with historical data from the waterbody being evaluated. Compliance with the biological criteria to protect Fish and Wildlife Propagation set forth in this paragraph shall be based upon measures including, but not limited to, diversity, similarity, community structure, species tolerance, trophic structure, dominant species, indices of biotic integrity (IBI), indices of well being (IWB), or other measures.
Turbidity	Turbidity from other than natural sources shall be restricted to not exceed the following limits: • Lakes: 25 nephelometric turbidity units (NTUs); and • Other surface waters: 50 NTUs. In waters where background turbidity exceeds these values, turbidity from point sources shall be restricted to not exceed ambient levels. Numerical criteria of this paragraph apply only to seasonal base flow conditions. Elevated turbidity levels may be expected during, and for several days after, a runoff event.
Sediments	Concentrations or loads of suspended or bedded sediments that are caused by human activity shall not impair the Fish and Wildlife Propagation use or any subcategory thereof.

Table 6.2-5. DO criteria to protect fish and wildlife propagation for WWAC (OAC 785:45).

Life Stage	Dates Applicable	DO Criteria[1, 2] (Minimum)(mg/L)	Seasonal Temperature (°C)
Early life stages:	April 1 to June 15	6.0[3]	25[4]
Other life stages:			
• Summer conditions	June 16 to October 15	5.0[3]	32
• Winter conditions	October 16 to March 31	5.0	18

Notes:

1 DO shall not exhibit concentrations less than the criteria magnitudes expressed above in greater than 10 percent of the samples as assessed across all life stages and seasons.

2 For lakes, the WWAC DO criteria are applicable to surface waters.

3 Because of natural diurnal DO fluctuations, a 1.0 mg/L DO concentration deficit shall be allowed for not more than eight hours during any twenty-four hour period.

4 Discharge limits necessary to meet summer conditions will apply from June 1 of each year. However, where discharge limits based on Early Life Stage (spring) conditions are more restrictive, those limits may be extended to July 1.

Table 6.2-6. 2014 impaired waterbody segments in the Neosho River, Spring River, Elk River, Grand Lake, and Grand River.

Waterbody Name	Waterbody ID	Within Project Boundary	Waterbody Size [1]	Category [2]	Impaired Use [3]	Cause of Impairment
Neosho River	121600010010	N	1.00 miles	4a	PBCR	Enterococcus
	121600010220	N	14.26 miles	5a	WWAC	Lead
					WWAC	DO
	121600020120	N	10.89 miles	5a	WWAC	DO
Spring River	121600070010	N	22.11 miles	5a	FC	Lead
					CWAC	Turbidity
Elk River	121600030440	N	3.29 miles	2	N/A	N/A
Grand Lake O' the Cherokees, Upper	121600030040	Y	8,670 acres	5a	FC	Lead
					WWAC	Turbidity
Grand Lake O' the Cherokees, Middle	121600030030	Y	19,584 acres	5a	FC	Lead
Grand Lake O' the Cherokees, Lower	1216000300020	Y	10,051 acres	5a	FC	Lead
					WWAC	DO
Grand River, Below Pensacola Dam	121600020170	Y	10.89 miles	5a	WWAC	DO

Source: ODEQ 2014.

Notes:

1 From ODEQ 2014.

2 Category 2 – attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened; Category

4a – Impaired or threatened for one or more designated uses and the Total Maximum Daily Load (TMDL) is completed; Category 5a – The water quality standard is not attained. The waterbody is impaired or threatened for one or more designated uses by a pollutant(s), and a TMDL is underway or will be scheduled (ODEQ 2014).

3 PBCR = primary body contact recreation; WWAC = warm water aquatic community; CWAC = Cold and Water Aquatic Communities; FC = fish consumption.

6.2.5.2 Water Quality Data

Water quality in Grand Lake and in the tailwater supports a healthy warm water fishery and is a popular recreation area. Ongoing water quality data collection in the Grand River watershed identified several water quality stressors on Grand Lake which include both point and non-point sources of nutrients and metals that may impact water quality (OWRB and OSU 1995). Non-point source pollution into Grand Lake originates primarily from agricultural activities in the basin, and possible trace metal contamination coming from local surface mining activities (GRDA 2008, as cited in FERC 2009). Point sources of pollution entering Grand Lake include discharges from multiple wastewater treatment facilities, and heavy metal contamination from acid mine drainage originating in the Neosho River and Spring River watersheds.

GRDA has been monitoring water quality in Grand Lake from 1986-1992 and from 2011 through the present. The current monitoring program includes both near-surface sampling and water column profiles and has been in place since 2013. GRDA collects water quality samples in Grand Lake at 15 sampling sites. Figure 6.2-2 shows the locations of the 15 sampling sites, as well as the 3 DO sampling sites in the tailrace. Samples are collected on a roughly seasonal schedule: fall, winter, spring, and summer. The grab samples collected within the top one meter of the water column are sent to a laboratory for analysis. The water profile samples measure water quality parameters in situ. Table 6.2-7 lists the water quality parameters currently measured. OWRB, ODEQ, and tribes within the watershed also collect water quality data. Summary information from GRDA's recent dataset is provided in Table 6.2-8. Results of profile sampling are represented in graphical form in Attachment E. The graphs show results for temperature, DO, pH, conductivity, and chlorophyll *a* for each season during years 2011 through 2016. Like the surface water data, these results are organized by region: lower, middle, and upper Grand Lake.

Overall, although the water quality data shows evidence of stressors to Grand Lake, water quality has been stable to improving when comparing data from the late 1980s dataset to the current data. Generally, Grand Lake water quality is comparable to that of other similar sized eutrophic, subtropical reservoirs. The current monitoring program will continue to allow GRDA to make long-term observations of any possible changes to water quality.

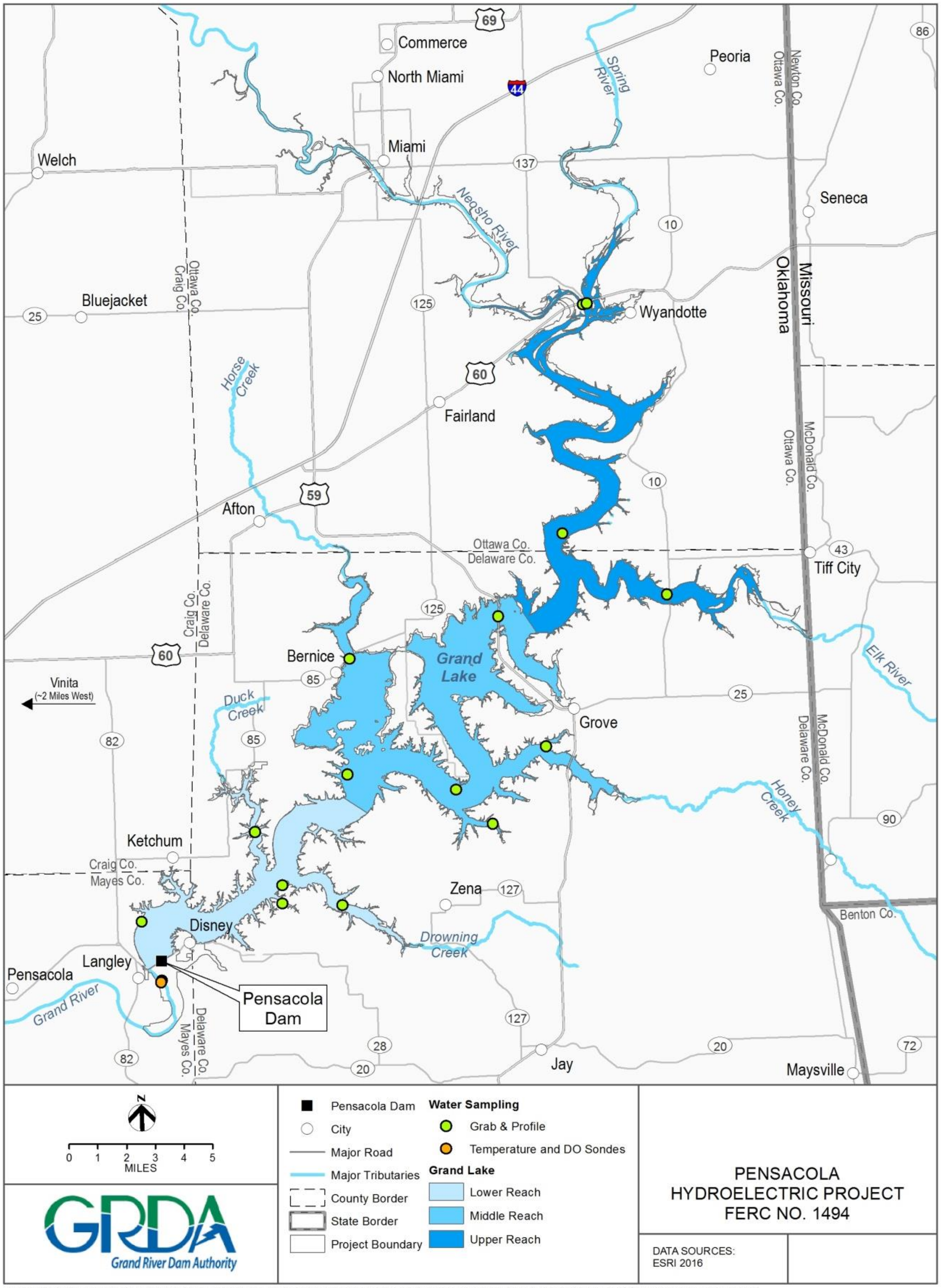


Figure 6.2-2. Grand Lake water quality monitoring sites, 2011-2016.

Table 6.2-7. Water quality parameters currently monitored in Grand Lake.

Laboratory Analytes	Field Analyses
Total Suspended Solids (mg/L)	Temperature (°C)
Total Hardness (mg/L)	Dissolved Oxygen (%Sat and mg/L)
Total Alkalinity (mg/L)	Conductivity (microSiemens[uS]/cm)
Total Nitrogen (mg/L)	pH
Ammonia Nitrogen (mg/L)	Chl-a in-vivo (microgram per liter [µg/L])
Nitrate+Nitrite Nitrogen (mg/L)	BGA PC (cells/mL)
Total Phosphorus (mg/L)	Turbidity (NTU)
Orthophosphorus (mg/L)	Secchi Disk (m)
Chlorophyll *a* (µg/L)	
Total Coliforms (most probable number [MPN]/100 mL)	
E. coli (MPN/100 mL)	
Enterococci (MPN/100 mL)	

Table 6.2-8. Results of surface water quality monitoring in lower, mid, and upper Grand Lake from 2011 through 2016.[1]

Parameter	LOWER				MIDDLE				UPPER			
	winter	**spring**	**summer**	**autumn**	**winter**	**spring**	**summer**	**autumn**	**winter**	**spring**	**summer**	**autumn**
Secchi (m)	1.40 ± 0.80	1.24 ± 0.68	1.26 ± 0.44	1.66 ± 0.57	0.99 ± 0.44	1.02 ± 0.56	0.99 ± 0.33	1.07 ± 0.29	0.77 ± 0.28	0.52 ± 0.25	0.57 ± 0.23	0.53 ± 0.21
TSS (mg/L)	4.6 ± 4.0	5.5 ± 2.2	4.8 ± 2.4	2.8 ± 1.2	9.2 ± 5.8	10.4 ± 10.1	6.7 ± 3.6	7.0 ± 9.9	14.4 ± 9.0	14.7 ± 2.6	22.9 ± 21.3	40.5 ± 60.2
Hardness (mg/L)	102.1 ± 30.0	100.6 ± 17.4	110.6 ± 9.1	125.2 ± 3.7	118.0 ± 24.1	124.4 ± 22.7	112.3 ± 17.1	129.9 ± 5.8	154.4 ± 33.1	129.9 ± 42.4	135.6 ± 27.1	132.7 ± 22.6
Alkalinity (mg/L)	86.0 ± 23.3	82.0 ± 18.6	91.2 ± 11.7	107.4 ± 3.2	92.7 ± 16.4	97.8 ± 16.6	94.4 ± 12.1	115.0 ± 5.9	123.1 ± 17.4	104.2 ± 32.1	115.1 ± 21.2	107.9 ± 25.4
TN (mg/L)	1.10 ± 0.23	1.62 ± 0.63	1.07 ± 0.62	0.50 ± 0.19	1.52 ± 0.41	1.97 ± 1.03	1.05 ± 0.54	0.52 ± 0.32	2.19 ± 0.57	2.24 ± 0.90	1.50 ± 0.57	1.25 ± 0.69
NH_3-N (mg/L)	0.10 ± 0.07	0.12 ± 0.13	0.07 ± 0.13	0.05 ± 0.05	0.10 ± 0.09	0.14 ± 0.15	0.07 ± 0.13	0.06 ± 0.09	0.06 ± 0.10	0.22 ± 0.19	0.09 ± 0.12	0.10 ± 0.10
NOX-N (mg/L)	0.46 ± 0.29	0.79 ± 0.55	0.32 ± 0.34	0.17 ± 0.11	0.65 ± 0.52	0.94 ± 0.60	0.28 ± 0.30	0.17 ± 0.16	1.44 ± 1.01	1.24 ± 1.01	0.63 ± 0.59	0.63 ± 0.49
TP (mg/L)	0.16 ± 0.09	0.14 ± 0.04	0.09 ± 0.06	0.10 ± 0.06	0.19 ± 0.12	0.16 ± 0.07	0.12 ± 0.10	0.14 ± 0.08	0.15 ± 0.13	0.22 ± 0.10	0.19 ± 0.10	0.26 ± 0.16
PO4 (mg/L)	0.10 ± 0.02	0.08 ± 0.05	0.04 ± 0.05	0.05 ± 0.02	0.10 ± 0.03	0.09 ± 0.06	0.05 ± 0.05	0.07 ± 0.04	0.08 ± 0.07	0.12 ± 0.08	0.09 ± 0.06	0.09 ± 0.07
Chl-a (µg/L)	1.40 ± 1.59	8.02 ± 12.68	13.81 ± 13.70	9.69 ± 8.78	3.81 ± 5.4	7.26 ± 8.14	19.78 ± 19.88	11.87 ± 13.81	8.35 ± 8.30	22.08 ± 68.60	18.20 ± 16.94	21.71 ± 23.03
Total Coliforms (MPN/100mL)[2]	248.1 (59.7-563.5)	127.9 (28.6-399.275)	1732.9 (454.6-2420.1)	771.7 (330.2-1361.0)	923.4 (63.6-1459.8)	273.9 (38.0-648.8)	2419.6 (692.8-2420.1)	686.7 (333.3-1299.7)	748.6 (234.0-1227.4)	712.0 (323.7-2419.6)	2419.6 (1119.9-2420.1)	816.0 (435.2-2420.1)
E. coli (MPN/100mL)[2]	12.2 (3.6-16.9)	1.5 (1.0-3.3)	1.5 (1.0-4.1)	1.0 (1.0-5.5)	18.5 (5.5-29.0)	3.1 (1.0-7.5)	1.0 (0.5-4.1)	1.0 (0.5-12.0)	11.1 (5.2-32.4)	16.0 (5.2-132.8)	3.1 (1.0-26.0)	3.1 (0.5-648.8)
Enterococci (MPN/100mL)[2]	24.9 (7.4-49.3)	12.0 (6.1-16.5)	15.3 (5.2-31.4)	11.5 4.4-29.1)	30.1 (14.5-68.9)	12.2 (7.2-25.3)	12.5 (4.1-73.0)	9.4 (3.6-30.0)	20.7 (11.2-100.8)	48.7 (19.9-435.2)	57.1 (17.1-554.2)	24.3 (9.1-1859.6)
Temp (°C)	8.71 ± 3.36	15.46 ± 6.03	27.92 ± 2.14	23.16 ± 4.17	8.55 ± 2.70	17.17 ± 5.76	28.04 ± 2.02	21.67 ± 5.64	7.81 ± 2.81	17.00 ± 5.53	28.36 ± 2.04	19.43 ± 5.58
DO (mg/L)	10.3 ± 1.2	9.1 ± 3.7	8.8 ± 2.0	7.3 ± 1.7	10.8 ± 1.1	8.7 ± 3.8	8.9 ± 2.2	8.4 ± 2.1	11.1 ± 0.8	8.5 ± 3.7	8.2 ± 2.9	9.0 ± 2.0
Cond (µS/cm)	212 ± 80	268 ± 64	244 ± 48	247 ± 37	272 ± 50	288 ± 51	250 ± 56	267 ± 31	347 ± 74	310 ± 60	310 ± 70	287 ± 46
pH	8.28 ± 0.74	8.19 ± 0.54	8.52 ± 0.66	8.08 ± 0.56	8.12 ± 0.31	8.09 ± 0.41	8.48 ± 0.63	8.24 ± 0.53	8.04 ± 0.41	7.95 ± 0.45	8.19 ± 0.48	8.08 ± 0.60
Chl-a *in-situ* (µg/L)	5.1 ± 7.4	5.6 ± 4.5	16.3 ± 15.3	10.9 ± 8.0	6.6 ± 4.0	9.0 ± 11.0	16.0 ± 11.7	14.0 ± 9.7	8.6 ± 5.5	13.4 ± 13.7	17.2 ± 10.1	20.5 ± 13.4
BGA PC (cells/mL)	1319 ± 2945	949 ± 1514	7162 ± 3929	5604 ± 4764	1007 ± 537	1850 ± 2732	11009 ± 26064	5377 ± 3430	1614 ± 1983	2264 ± 2101	7094 ± 3900	6727 ± 4423
Turbidity (NTU)	47.1 ± 168.6	19.2 ± 101.4	5.8 ± 62.4	13.9 ± 107.2	12.0 ± 11.5	10.7 ± 12.1	9.5 ± 74.7	5.8 ± 7.2	23.1 ± 56.4	25.9 ± 26.6	15.8 ± 18.5	18.6 ± 18.0

Notes:

1 Means and standard deviations are reported, unless otherwise stated. Parameters below the second double line were measured *in situ* at the surface (i.e., <1.5 meters [m] of water).

2 All fecal indicator bacteria reported as median (interquartile range Q1-Q3) because standard bacterial tests provide truncated data (i.e., values range from <1 to >2419.6; values from tests indicating <1 or >2419.6 were included in calculations by subtracting or adding 0.5 according to the sign of inequality).

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Temperature and Dissolved Oxygen (DO)

Heat in water, measured as temperature, is primarily derived from incoming solar radiation absorbed by water molecules, dissolved organic compounds, turbidity, and other physiochemical properties of the impinged water. Average water temperatures in Grand Lake range from 4°C in the winter months to 30°C in the summer months (Table 6.2-8). Water temperatures can vary both spatially and temporally within the reservoir. Spatially, water temperatures in the spring are cooler in the lacustrine zone, warmer in the riverine zone, and vice versa in fall. This phenomenon is likely the result of differences in water volume as the high specific heat of water retards temperature changes between the riverine and lacustrine parts of the lake (OWRB and OSU 1995).

Grand Lake water column mixes at or above 4°C in the winter months and is thermally stratified during the late spring, summer, and early fall (Figure 6.2-3; Table 6.2-9). Thermal stratification is observed in late April/early May as the day length increases past the spring equinox and the lake surface water absorbs solar energy and dissipates it as heat. As the surface water absorbs the solar energy, the water layers where light is extinguished remain the same temperature or increase as a slower rate. This uneven heating of the water creates a temperature and density difference at depth; forming a stratified epilimnion and hypolimnion.[10] The less dense epilimnion, or surface layer, is characterized by increased water temperature, pH, and DO due to its exposure to the air, wind mixing, and photosynthesis. The hypolimnion is characterized by cooler denser water isolated from the surface; receiving no wind mixing and not enough light for photosynthesis. Thermal stratification typically dissipates by November.

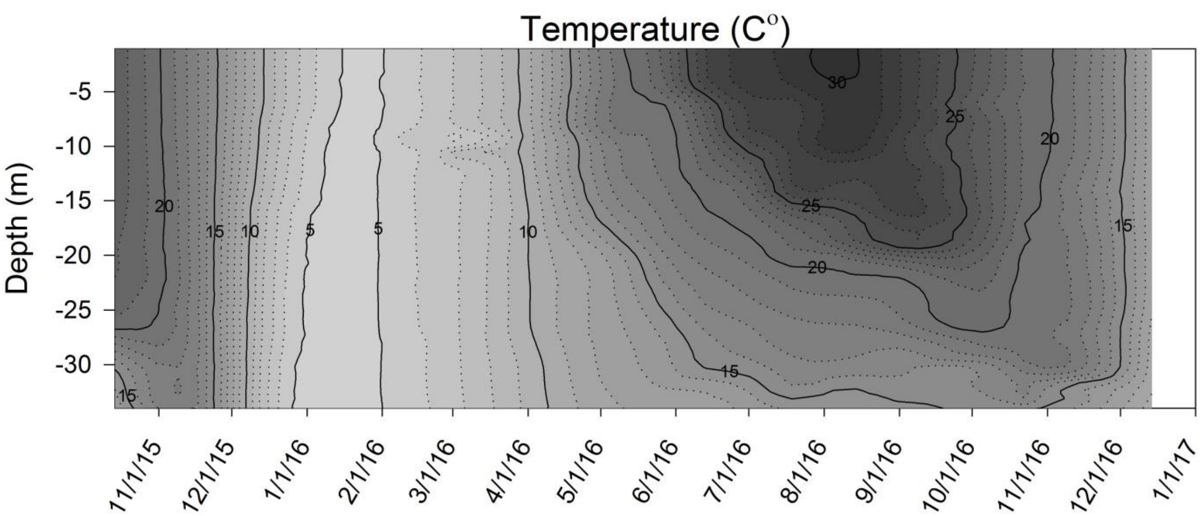


Figure 6.2-3. Temperature isopleth of Pensacola Dam sample site. Data range November 2015 – January 2017.

[10] The upper and lower, respectively, layers of water in a stratified lake.

Table 6.2-9. Mean surface temperature, thermocline, and anoxic depth for Grand Lake from June to October 2011.

Date	Mean Surface Temperature (°C)	Thermocline Depth (m)	Anoxic Depth (m)	Secchi disk depth (m)
6/6	29.9	2.20	27.0	-
6/21	25.4	9.80	15.3	-
7/5	29.6	12.4	11.2	1.2
7/19	31.9	10.8	7.3	1.1
8/1	32.5	10.0	6.9	1.3
8/17	28.3	12.2	11.3	-
9/7	26.8	15.4	15.2	1.7
9/23	22.8	19.5	17.9	-
10/14	21.6	23.0	19.3	2.0
10/28	18.5	-	27.6	1.3

Source: Nikolai and Dzialowski 2014.

The variability of solar radiation and heat directly influences the DO dynamics of Grand Lake. As with temperature, DO varies temporally over the course of a year. In the winter, DO is generally at or near saturation in a fully mixed water column as heat is evenly distributed. Due to the lack of light and heat, photosynthesis rates and biomass of algae is low while respiration rates and oxygen consumption by bacteria is reduced. As the amount of solar radiation increases from winter to spring, production by algae and respiration rates increase. The byproduct of photosynthesis, DO, reaches levels exceeding the saturation point of the water in the epilimnion. In the denser, cooler, and isolated water the hypolimnion, microbial detritivores continue to break down the abundance of allochthonous[11] material derived from the large, agricultural watershed upstream of the lake, which deletes oxygen in this water layer until the lake mixes in October and November (Wetzel 2001). An isopleth of DO levels at the Pensacola dam monitoring site is provided in Figure 6.2-4.

[11] Sediment or rock that originated at a distance from its present position.

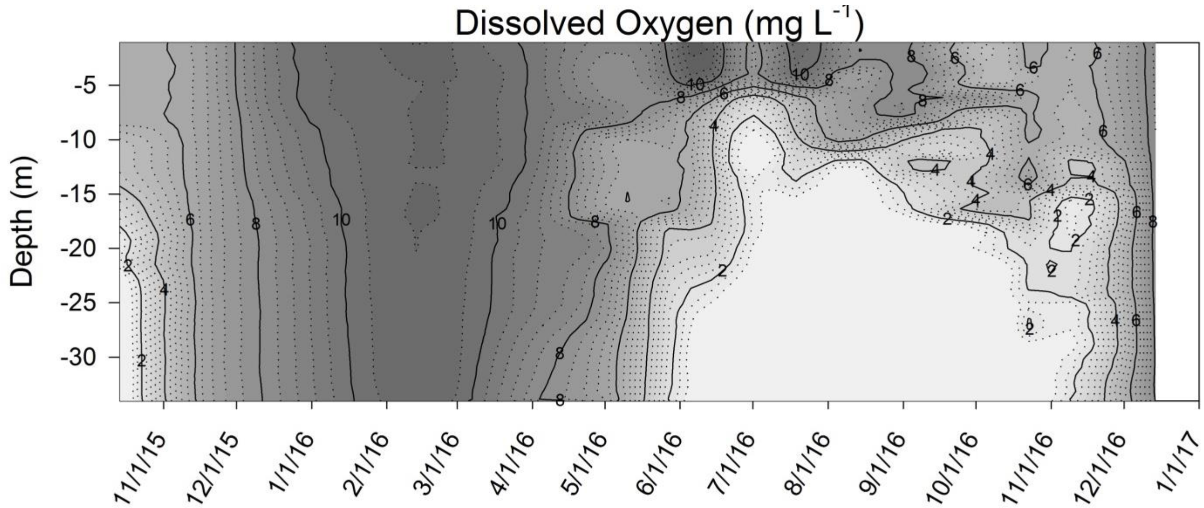


Figure 6.2-4. DO concentration (mg/L) isopleth of Pensacola Dam sample site. Data range November 2015 – January 2017.

DO is an important consideration for lake management in the lake and in the tailrace. The lower section of Grand Lake is listed on the 303d list for DO as often greater than 70 percent of the water column is below 2.0 mg/L during the summer stratification period. Possible management strategies to completely eliminate anoxia are limited by the size of the watershed, water temperature, and the amount of allochthonous material which will likely always result in high rates of respiration by microbes in the hypolimnion leading to anoxia. However, it has been suggested that reductions in chlorophyll, and perhaps nutrients, may delay the onset of anoxia (Jones et. al. 2011). Therefore, efforts to develop management strategies by Oklahoma state agencies and neighboring states to work together to reduce nutrient inputs may reduce occurrences of anoxia.

In the tailrace, GRDA and OWRB have already successfully worked together to create a management strategy to improve DO downstream. DO in the Pensacola Dam tailrace has been successfully mitigated by GRDA. As discussed previously, summertime anoxia on Grand Lake encompasses the hypolimnion. The water intakes on the Pensacola dam are at 682 feet or 18.5 meters below the summer elevation of 744 feet. The use of the turbines at the dam would ultimately send anoxic water into the tailrace and river below the dam. By installing air baffles and vacuum breaker bypass vales on the turbines, GRDA is able to move water at both low and high wicket gates and successfully oxygenate the tailrace. Currently GRDA has an automated system of water quality sondes that sends email alarms to dam operators when DO is getting low in the tailrace (Figure 6.2-2). Operators then turn on the generators until DO levels are at or above state standards. In 2014, with implementation of the mitigation protocol, DO values were below criterion in only 1.6 percent of the samples from June through October. Results indicated that when DO values dropped to a level to trigger the mitigation protocols, the DO concentrations were brought back above criterion within the hour (OWRB 2015). Since the implementation of this program, GRDA has almost eliminated instances of acute DO occurrences below the dam.

pH, Alkalinity, and Hardness

The underlying geology of the area influences the pH in Grand Lake and the Grand River. Hydrogen ion activity, measured as pH, is decreased from neutrality in Grand Lake as the result of the dissolution of carbonate rich minerals within the watershed (limestone [$CaCO_3$] and dolomite [$CaMg(CO_3)_2$] previously discussed in Section 6.1.3 (Figure 6.1-5) of this PAD. Grand Lake is a bicarbonate-type lake with moderately hard to hard water as a result of the dissociation equilibrium of carbonate minerals within the watershed. The total alkalinity, or acid neutralizing ability, of Grand Lake water is in a desirable range of 80-125 mg/L $CaCO_3$. Total hardness on Grand Lake ranges from moderately hard to hard; indicating an abundance of cations (e.g. Ca^+, Mg^{2+}).

The acidity as measured by pH in Grand Lake ranges from neutral to alkaline (Table 6.2-8). During summer stratification, pH in the epilimnion may temporarily deviate from the state standard of 9.0 during periods of intense photosynthetic activity caused by seasonal algal blooms typical of large, eutrophic, warm-water reservoirs. The pH in the hypolimnion is consistently near a neutral pH 7.

Nutrients

The overall driver of nutrient input into Grand Lake is the Neosho River, followed by the Spring and Elk rivers. Internal phosphorus loading generally occurs from July through September and causes a notable late-summer boost to phosphorus concentrations within the reservoir upon late summer thermocline erosion. Based on current nutrient levels, Grand Lake is classified as eutrophic.

Nitrogen and phosphorus are important in driving the productivity of the system (Nikolai and Dzialowski 2014). However, an excess of nutrients can lead to negative externalities such as to unsightly and/or toxic algae blooms, taste and odor issues for municipal drinking water customers, and general stress to aquatic communities. Anthropogenic nutrient sources are derived from runoff and discharge from agriculture (e.g. fertilizer, feces), municipal (e.g. waste water treatment), and industrial activities (e.g., poultry rendering).

Phosphorus is measured in the form of total phosphorus (TP) and orthophosphorus (PO_4^{-3}-P). In Grand Lake, TP and orthophosphorus vary spatially and temporally (Table 6.2-8). Phosphorus concentrations decrease longitudinally along the river/reservoir gradient as the result of precipitation with clay particles and uptake of phosphorus by algae.

Nitrogen as an element has a far more complex biogeochemical cycle than phosphorus and is available as dissolved gas (N_2), nitrate (NO_3^-), nitrite (NO_2^-), and ammonia (NH_3). In Grand Lake, total nitrogen ranges from 0.5-2.25 mg/L with the highest concentrations occurring in the spring and in the upper portions of the lake. This situation is similar to nitrate-nitrite and NH_3 concentrations as they both show the same spatial and temporal variability.

Heat and DO levels also play a role in the biochemical cycling of nutrients in Grand Lake. Specific processes including internal phosphorus loading, denitrification, and nitrification all contribute to available nutrients for algal growth and production. Following the consumption of nitrate+nitite, internal release of phosphorus occurs as well as deamination of organic detritus. Figure 6.2-5 illustrates orthophosphorus, nitrate+nitrite, and ammonia isopleths at the Pensacola Dam sample site. In cold months, Grand Lake is mixing; both nitrogen and phosphorus are evenly distributed in the water column in the same way as DO. Under stratified conditions, oxygen depletion from aerobic respiration leads to anaerobic respiration in the hypolimnion. Denitrification, the process of microbial-mediated nitrate reduction, forms nitrogen gas and, as a result, nitrate-nitrite in the hypolimnion is depleted. As redox conditions continue to fall and following the extirpation of nitrate, anaerobic bacteria begin to use iron as in their respiration chain; causing the release of iron-bound phosphate back into the water column. Furthermore, the breakdown of organic nitrogen in sediment detritus causes the increase in ammonia through deamination. Upon thermocline erosion and mixing in the fall, these nutrients upwell from the hypolimnion; giving a late-season pulse of nutrients to an otherwise nutrient-deficient water column following the summer algal peak.

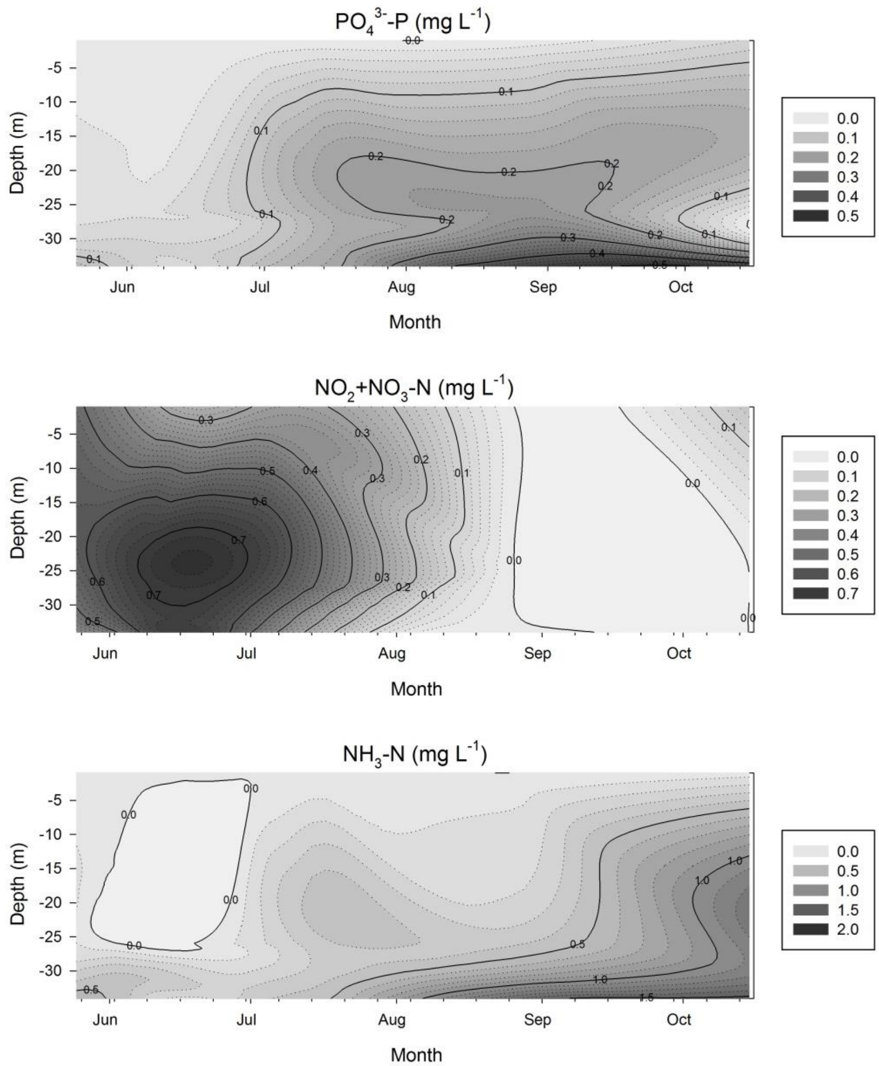


Figure 6.2-5. Orthophosphorus (top), nitrate+nitrite (mid) and ammonia (bottom) isopleths of the Pensacola Dam sample site. Following the consumption of nitrate+nitite, internal release of phosphorus occurs as well and deamination of organic detritus. Date range June – October 2016.

Nikolai and Dzialowski (2014) suggest that reducing sources of both nitrogen and phosphorus simultaneously could be the most effective approach to nutrient reduction to improve water quality in Grand Lake. Operation of the Pensacola Project does not affect the current state of nutrient dynamics in Grand Lake or nutrient-related algal growth; water quality within Grand

Lake is largely a function of land use within the watershed. Nonetheless, GRDA is partnering with state agencies and other interested parties to develop management strategies for nitrogen and phosphorus reduction and to address point and non-point source nutrient inputs into the Grand Lake watershed.

Bacteria

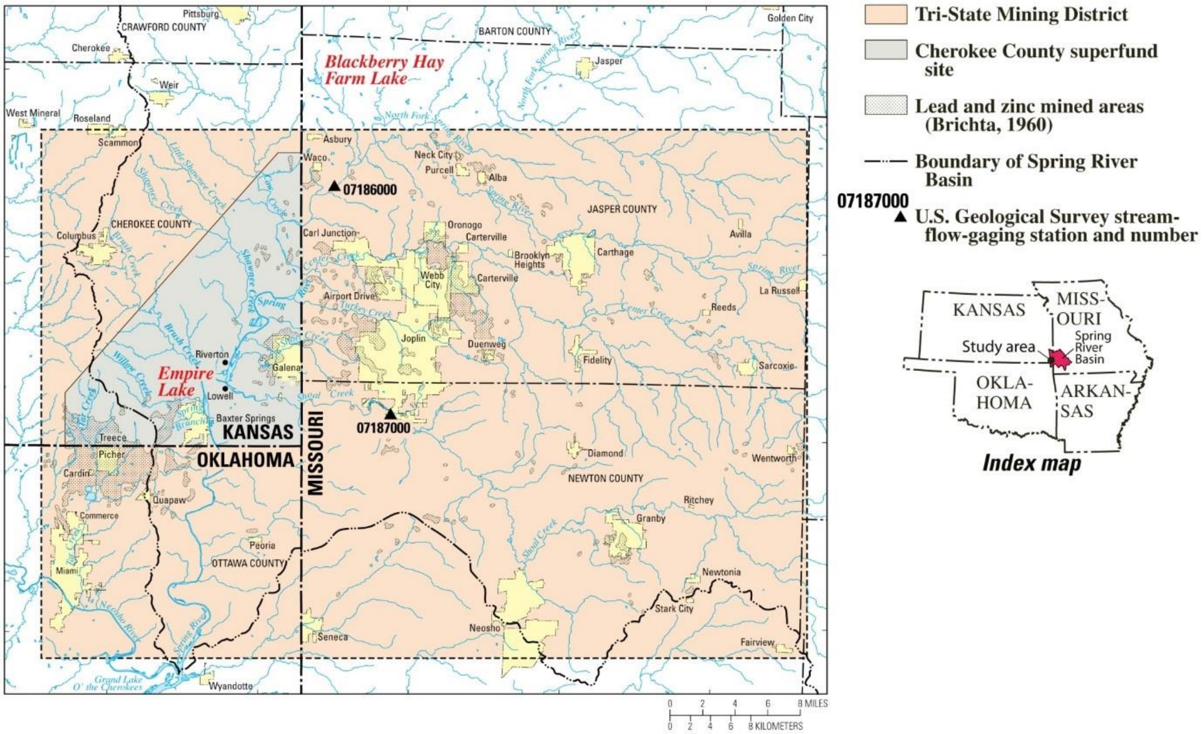
Fecal indicator bacteria (FIB) are used to monitor water quality and protect recreational uses of water. Table 6.2-8 summarizes seasonal data on bacteria levels collected during routine sampling around Grand Lake. GRDA collects *E. coli* and enterococci samples during the recreation season; following an instance of illness and high Enterococci values in summer 2014 there was a summer beach closure, GRDA increased sampling efforts, though the source of contamination was inconclusive.

GRDA currently voluntarily implements guidelines in its "*Bacteria Management Plan for Designated Swimming Areas in the Grand River Watershed*" for body contact in the designated swimming areas and parks in cases where bacteria sources can be ascertained to further protect and assess risk to health and public safety (GRDA 2015). The guidelines specify that GRDA will actively investigate any reported illnesses associated with designated swimming areas in the waters and continue to monitor heavily-used coves. In the event of contamination, GRDA has developed steps in collaboration with other relevant state agencies to better assess risk to health and public safety and to determine and manage the sources of fecal contamination, which were based on the EPA's recreational water quality criteria, Oklahoma's WQSs, and recommendations developed by interagency working groups (GRDA 2015).

Metals

Tri-State Mining District

The Tri-State Mining District (TSMD) encompasses an approximate 2,500 square mile area that was extensively mined for lead and zinc from 1850-1950 (Figure 6.2-6). Ellis (1939) and Mitchell (1942) both raised the potential for water quality impacts due to the past pumping contaminated mine water into the Neosho and Spring rivers. Cessation of mining operations in the mid-20th century left behind tailing piles and cavernous subterranean mines which have leached cadmium (Cd), lead (Pb), zinc (Zn), and other metals into nearby groundwater, streams and rivers. The TSMD has a total of four superfund sites spanning Kansas, Missouri, and Oklahoma. In particular, Tar Creek and the Tar Creek Superfund site are located in the towns of Pitcher and Cardin, Oklahoma, and is a tributary to the Neosho River at RM 142. Tribal, state and federal agencies continue to conduct cleanup and research efforts throughout the TSMD. Extensive data are available from the 1970s to the present day, which indicate the relative impact of the TSMD on Grand Lake water, sediment, and wildlife is limited.



Source: Retrieved from http://ks.water.usgs.gov/tri-state-mining.

Figure 6.2-6. Map of the Tri-State Mining District.

Water and Sediment

Contaminated sediments (elevated lead and zinc) from historic mining have been documented in the Spring, Neosho River system, and Grand Lake (MacDonald et al, 2010; Pita and Hyne 1975; McCormick 1985; OWRB and OSU 1995; ODEQ 2014); the Neosho and Spring Rivers upstream of the Project area, as well as Grand Lake are on the ODEQ impaired water list for total recoverable lead.

Observed metals are concentrated in sediments at the upper end of the Grand Lake (McCormick 1985; OWRB and OSU 1995; Jones and Donlan 2009; Juracek and Becker 2009). Sediments also showed a longitudinal decrease in cadmium, lead, and zinc concentrations from the Neosho-Spring confluence to the dam (OWRB and OSU 1995).

Toxicity Investigations

The effect that TSMD metals contamination has had on organisms is well documented, though primary impacts have been observed upstream of the Pensacola Project. In areas near abandoned mines and chat plies within the TSMD, cases of acute and chronic toxicity to both terrestrial and aquatic wildlife are found. For example, Canada Geese (*Branta Canadensis)* collected from chat ponds affected by mine waste were found to have elevated lead concentrations in tissues and pancreas tissue damage from zinc (Merwe et. al. 2011). Allert et al. 2011 found decreased crayfish densities at affected mining sites along with elevated crayfish metals concentrations.

Many investigations into the effects of mine waste and runoff on organisms Grand Lake have been completed over the past 30 years. McCormick (1985) extracted Grand Lake sediments at pH of 6 for use in *Daphnia* bioassays and found no acute toxicity.

An EPA Phase 1 study which evaluated overall toxicity in the area of the superfund site concluded that there were no significant toxic effects upon sensitive species of small fish or micro-crustaceans exposed to water samples collected from Grand Lake (OWRB and OSU 1995). Furthermore, the study concluded that the contaminants of concern appear to be chemically bound to sediments since toxic concentrations of metals could not be extracted under conditions that occur naturally in the lake (OWRB and OSU 1995).

This study provided additional analysis on organisms' chronic exposure to cadmium, zinc, and lead by evaluation of 40 sediment samples from Grand Lake. The researchers concluded that lake sediments were likely not causing or substantially contributing to toxicity to sediment-dwelling organisms (Ingersoll et al. 2009).

Finally, in 2013, OSU and GRDA investigated toxicity of amphipods (*Hyalella azteca)* and pond snails (*Heilisoma trivolvis*) in near shore sediment under conditions that would simulate sediment disturbance (e.g. wave action and dredging). In the EPA Phase 1 Study it was postulated that sediment disturbance could cause the release of toxic concentrations of metals (OWRB and OSU 1995). Researchers found that under both disturbed and undisturbed conditions that survival and biomass did not exhibit any significant differences between contaminated (Neosho, Spring, and Grand rivers) and uncontaminated reference sites (Elk River)(Morrison et.al. 2014). In summary, past research spanning decades indicate no acute or chronic toxicity as a result of metals contamination within Grand Lake. The result of these studies is consistent with expectations based on Grand Lake water chemistry including pH, hardness, and the presence of anoxic sediments, bioavailability of metals would be expected to be low (Atkinson et al. 2007).

Ecological risk assessment completed for the superfund program upstream (MacDonald et al. 2010) states that the Neosho River draining into Grand Lake poses low risk to sediment-dwelling organisms; diluting out the influences from Tar Creek which is listed as a high risk stream. These findings are consistent with previous toxicity investigations on Grand Lake which suggest that rapid dilution, precipitation, and sequestration of metals occurs upon the formation of the Grand River (OWRB and OSU 1995; Juracek and Becker 2009).

Fish and Fish Consumption Advisories

The impact of the TSMD on fish in Grand Lake is important for both recreational users and subsistence fishermen. Concerns over the impact of metals from Tar Creek and the TSMD resulted in investigations into the effect of contamination on fish and benthic communities (Aggus et al. 1987). Aggus (1987) found fish communities and standing biomass show no effect of heavy metals contamination in Grand Lake, the Neosho River, or Spring River. In 1982, fish biomass in Grand Lake yielded an average total standing fish crop of 465.3 pounds (lb) per acre which was near the 444.8 pound per acre average as monitored since 1949 (Aggus et al. 1987).

The EPA Phase 1 study collected Gizzard Shad for analysis of trace metals. Liver and kidney tissues were used as indicators of potential bioaccumulation of metal contaminants. Researchers found no significant differences between cadmium and lead between the upper and lower reservoir sites. However, zinc concentrations were significantly higher in Gizzard Shad in the upper reaches of Grand Lake (OWRB and OSU 1995).

In 2007, ODEQ issued a fish consumption advisory for waters affected by runoff from the TSMD, including Grand Lake due to lead levels. Carcass preparations (skin on, headless, eviscerated fish, with bones) of non-game fish (Carp, Freshwater Drum, Redhorse Sucker, and Smallmouth Buffalo) from the Neosho River and Grand Lake; catfish, non-game fish, and sunfish in the Spring River have led to concentrations high enough to warrant consumption restriction recommendations (ODEQ 2007). Skinless fish fillets, the most common preparation type, are safe to eat from the Neosho River and Grand Lake. However skinless fillets from non-game fish from the Spring River should be limited.

Mercury

Mercury (Hg) contamination in fish is observed worldwide. Mercury is released through man-made processes (mining, coal fired utilities, industry, etc.) and natural processes (volcanoes). Upon deposition from the atmosphere, mercury runs off into lakes, rivers, streams, and oceans. Chemical changes alter the bioavailability of the deposited mercury to methyl-mercury (MeHg) and it is taken up into the food chain where it biomagnifies in predators and top predators. As it relates to the Grand Lake, mercury has been well studied.

In 2011, seasonal mercury and methyl-mercury dynamics were studied in Grand Lake. Researchers found that mercury concentration were driven by inflow hydrology when inflows were high. During low flow conditions, biogeochemistry of the system controlled the methyl-mercury enrichment; sequestering both mercury and methyl-mercury (Wildman 2016). This suggests that Grand Lake sequesters watershed derived mercury pollution for reservoirs downstream. Furthermore, this research suggests mercury exposure to organisms is greatest during floods and in the upper reaches of the reservoir as most mercury enrichment occurs in deep anoxic waters that are not conducive to supporting life (Wildman 2016).

Mercury concentrations in fish were also recently evaluated. Between April 2010 and February 2013, 1,300 fish representing 30 species were collected from Grand Lake, Lake Hudson and nearby farm ponds. Researchers found that with the exception of Gar (*Lepisostedae)* mean mercury levels for all species was below EPA's fish tissue residue criterion and the EPA wildlife criterion values (Dong et al. 2016). Grand Lake was also compared to other Oklahoma lakes and found that for all species of fish, mercury tissue concentrations were far below the Oklahoma average (Dong et al. 2015).

6.3 Fish and Aquatic Resources

6.3.1 Grand Lake Aquatic Habitat

Shoreline habitat in Grand Lake is primarily comprised of rock and gravel substrate and has an average depth of 36.3 feet and maximum of 133 feet, as determined in a hydrographic survey of the reservoir in 2009 (OWRB 2009). The lake is deeper toward the southern portions closest to the dam, while the northern portions of the reservoir and tributaries provide shallower littoral habitat important for the spawning and rearing of several fish species and other aquatic organisms. Additional habitat includes man-made structures such as rip-rap, brush piles, and boat docks. There is little aquatic vegetation or standing timber within the reservoir (ODWC 2008).

Under its current license, GRDA initiated an experimental millet seeding program to increase aquatic vegetation for fish nursery habitat and waterfowl food supply; however, the program did not achieve the desired results and was discontinued in 2011 (GRDA 2016a). Similarly, from

2004 to 2009, GRDA has been working in collaboration with other agencies to establish native aquatic vegetation in Grand Lake (OWRB 2007). Since these efforts were initiated, a total of ten founder colonies and 13-14 acres of aquatic plants have been established and maintained in Grand Lake (GRDA 2007, 2015). However, two years of drought and two years of flood waters, out of the six-year effort, curtailed the spread from the founder colonies in Grand Lake. Thus, despite significant labor inputs to maintain and replant these sites, it was determined that establishment of self-sustaining founder colonies necessary to provide meaningful wildlife and fishery habitat or expansion outside of protective areas was not feasible (GRDA 2015). In 2009, the OWRB recommended utilizing a new concept known as "floating wetlands" as an alternative to aquatic plantings (Attachment C of the April 2015 Request for Extension of Time; GRDA 2015). Subsequently GRDA experimented with floating wetlands in 2010 and 2011 and reached similar conclusions that the floating wetland concept was not self-sustaining. Alternatively, artificial structures have been deployed in Grand Lake to enhance the fishery and protect shoreline habitat as part of GRDA's annual Rush-4-Brush program (established in 2007). The artificial structures simulate natural brush piles and provide critical rearing habitat for fry and fingerlings, as well as young-of-the-year fish. The program is designed to promote habitat conservation by discouraging the once common practice of removing trees and shrubs along the shoreline to construct brush piles that are ultimately submerged by fisherman as attractants for popular game species. By engaging the public as volunteers, the program also serves as a critical outreach opportunity. Over the last 10 years GRDA has provided more than 14,000 artificial structures for creating habitat along the shorelines of GRDA's project lakes with approximately 59 percent being deployed in Grand Lake (GRDA 2015, 2016a).

6.3.2 Pensacola Dam Tailwater

A hydrographic survey of the Pensacola Dam tailwater was conducted in 2011 that included the area 1,000 feet downstream of the dam. The deepest part of the tailrace directly downstream of the dam is approximately 12 feet deep; however, the majority of the tailrace is approximately 6 feet deep according to bathymetric maps created as a result of this survey (OWRB 2011).

Three primary spillway channels exist to the east of the powerhouse tailrace. Each of these channels joins a small tributary, Summerfield Creek, before connecting with the tailrace channel and forming the mainstem of the Grand River. All together the spillway channel is approximately 1.5 miles long. The substrate of these channels is dominated by bedrock, with some boulders and cobble, and several sand bar islands.

Because of the elevation of the intake, during summer stratification water low in DO from the hypolimnion is released downstream into the tailrace during generation. Through collaboration with resource agencies, especially OWRB, GRDA has successfully mitigated for this issue through an alert system that allows GRDA to respond in real-time to quickly improve the DO conditions in the tailrace downstream of the Pensacola Dam. See Section 6.2 Water Resources of this PAD for additional information on water quality in the Project tailwaters.

The ODWC has collected a variety of fishery data for Lake Hudson, which is directly downstream of Grand Lake, for over twenty years. Although not specific to the tailrace these data indicate that fish populations in the lake downstream of Grand Lake are stable (GRDA 2016b).

6.3.3 Fish Community

Grand Lake supports a warm water fishery and is similar to other reservoirs within the region. Table 6.3-1 includes a list of fish species known to occur in the Project vicinity. The primary sport fish in Grand Lake and its tailwaters is the Largemouth Bass (*Micropterus salmoides*), but other important sport fish include, Spotted Bass (*M. punctulatus*), White Bass (*Morone chrysops*), Hybrid Striped Bass (*M. chrysops* x *M. saxatilis*), White Crappie (*Pomoxis annularis*), Black Crappie (*P. nigromaculatus*), Blue Catfish (*Ictalurus furcatus*), Channel Catfish (*I. punctatus*), Flathead Catfish (*Pylodictis olivaris*), and Paddlefish (*Polyodon spathula*)(ODWC 2008). Although not abundant in Grand Lake, Smallmouth Bass (*Micropterus dolomieu*) is also a sport fish of interest and is native to the Grand Lake watershed. Specifically, the Neosho Smallmouth Bass (*Micropterus dolomieu velox*) is endemic to the watershed and represents one of the most divergent genetic lineages of Smallmouth Bass. The ODWC has regularly stocked Hybrid Striped Bass and Paddlefish in Grand Lake (Table 6.3-2). Primary forage species include Gizzard Shad (*Dorosoma cepedianum*) and Threadfin Shad (*D. petenense*)(ODWC 2008).

Table 6.3-1. Fish species known to occur in the Project vicinity.

Common Name	Scientific Name	Common Name	Scientific Name
Ozark Cavefish[1]	*Amblyopsis rosea*	Spotted Bass	*Micropterus punctulatus*
Freshwater Drum	*Aplodinotus grunniens*	Largemouth Bass	*Micropterus salmoides*
Carpsucker	*Carpiodes carpio*	White Bass	*Morone chrysops*
Blue Sucker	*Cycleptus elongatus*	Hybrid Striped Bass	*Morone chrysops* x *M. saxatilis*
Red Shiner	*Cyprinella lutrensis*	River Redhorse	*Moxostoma carinatum*
Common Carp	*Cyprinus carpio*	Emerald Shiner	*Notropis atherinoides*
Gizzard Shad	*Dorosoma cepedianum*	River Shiner	*Notropis blennius*
Threadfin Shad	*Dorosoma petenense*	Ghost Shiner	*Notropis buchanani*
Blue Catfish	*Ictalurus furcatus*	Silverband Shiner	*Notropis shumardi*
Channel Catfish	*Ictalurus punctatus*	Neosho Madtom[1]	*Noturus placidus*
Smallmouth Buffalo	*Ictiobus bubalus*	Logperch	*Percina caprodes*
Brook Silverside	*Labidesthes sicculus*	River Darter	*Percina shumardi*
Longnose Gar	*Lepisosteus osseus*	Bullhead Minnow	*Pimephales vigilax*
Green Sunfish	*Lepomis cyanellus*	Paddlefish	*Polyodon spathula*
Warmouth	*Lepomis gulosus*	White Crappie	*Pomoxis annularis*
Bluegill	*Lepomis macrochirus*	Black Crappie	*Pomoxis nigromaculatus*
Longear Sunfish	*Lepomis megalotis*	Flathead Catfish	*Pylodictis olivaris*
Smallmouth Bass	*Micropterus dolomieu*		

Notes:
1 See Section 6.6, Rare, Threatened, and Endangered Species of this PAD for details.

Table 6.3-2. ODWC stocking reports in Grand Lake, 2007 - 2014.

Year	Species	Number	Size (inch)
2014	Hybrid Striped Bass	42,000	1.5
	Hybrid Striped Bass	56,500	1.7
	Paddlefish	2,005	11.6
2013	Paddlefish	2,052	11.0
2012	Hybrid Striped Bass	10,500	1.5
	Paddlefish	900	15.0
	Paddlefish	2,003	17.0
2011	Paddlefish	505	-
2010	Paddlefish	1,998	12
2008	Paddlefish	2,000	12
2007	Hybrid Striped Bass	104,960	2

Source: ODWC 2012, 2013, 2014, 2016h.

The ODWC has collected a variety of fishery data in Grand Lake annually for over twenty years. In 2013 gill net sampling conducted in Grand Lake, the most common species included Gizzard Shad, White Crappie, White Bass, Blue Catfish, Channel Catfish, Threadfin Shad, and Hybrid Striped Bass, respectively (ODWC 2014), which is a common trend apparent in the available data when all species are reported. Periodically, ODWC conducted spring electrofishing surveys in Grand Lake from 1994 to 2010. Results for Largemouth and Spotted Bass combined (abundance, size, and heaviest fish) were available from these electrofishing survey efforts and are provided in Table 6.3-3. From 1994 to 2013, the ODWC also conducted gill netting in Grand Lake. Results for White Crappie, White Bass, Channel Catfish, and Blue Catfish were available and are summarized in Table 6.3-4. The most recent available survey data of Gizzard Shad gill netting and Bass electrofishing (Largemouth and Spotted Bass) was collected in 2015. The catch per unit effort (CPUE) for Gizzard Shad less than six-inches was 42.32, while CPUE for Gizzard Shad over six-inches was only 1.78. CPUE for Largemouth Bass was 55.25, and CPUE for Spotted Bass was 9.0 in 2015 (ODWC 2015).

Table 6.3-3. ODWC spring Largemouth and Spotted Bass electrofishing results in Grand Lake, 1994 - 2015.

Year	Bass Abundance (# per hour)	Bass Size (# over 14 inches per hour)	Heaviest fish (lbs)
2015	55.25	32.0	6.7
2012	80.9	28.7	5.5
2010	70.7	38.2	4.9
2008	83.3	29.8	6.2
2005	121.8	37.5	6.5
2003	168.8	45.8	6
2002	114	49	7.2
2001	223	42	5
2000	145	55.5	6.6
1999	95.3	43.3	7
1998	95.3	43.3	7
1996	100	41	7.1
1994	68	35	8.9

Source: ODWC 2016i and data from ODWC for 2012 and 2015.

Table 6.3-4. 2011 and 2013 ODWC gill netting survey results for White Crappie, White Bass, Channel Catfish, and Blue Catfish in Grand Lake.

Species	Scientific Name	Year	Catch Rate	Prefer %[1]	Weight of largest fish (lbs)	# Fish	Rating
White Crappie	*Pomoxis annularis*	2013	10.494	33	1.3	134	N/A
White Bass	*Morone chrysops*	2013	8.879	59	2.2	115	N/A
Channel Catfish	*Ictalurus punctatus*	2013	5.472	4	5.6	70	N/A
Blue Catfish	*Ictalurus furcatus*	2013	6.324	6	35.5	81	N/A
White Crappie	*Pomoxis annularis*	2010	4.929	19	1.5	68	Above average
White Bass	*Morone chrysops*	2010	9.318	57	2.2	125	Excellent
Channel Catfish	*Ictalurus punctatus*	2010	8.75	7	4.8	119	Above Average
Blue Catfish	*Ictalurus furcatus*	2010	7.905	1	6.1	107	Above Average

Source: ODWC 2016j and data from ODWC for 2013.

Notes:

1 Prefer % is considered what anglers considered percentage of fish ≥ preferred size of fish for each species as follows; White Crappie = 10 inches, White Bass = 12 inches, Channel Catfish = 22 inches, Blue Catfish = 26 inches.

6.3.3.1 Grand Lake Fishery Management Plan

The Grand Lake Fishery Management Plan (ODWC 2008) was created to manage and improve the reservoir's fishery resources. The goals and objectives of the plan are as follows:

- Collect Standardized Sampling Protocol (SSP) trend data on the major sport fish and forage species.
- Conduct creel survey to determine angling pressure, success, harvest, satisfaction, and regional economic impact of the fishery.
- Protect and enhance aquatic habitat.
- Work with GRDA and other appropriate agencies to improve water quality in the tailrace.
- Work with GRDA and other appropriate entities to enhance boating and/or fishing access.
- Conduct public outreach and solicit feedback regarding fisheries management issues.
- Coordinate and assist with the documentation and monitoring of aquatic nuisance species.
- Coordinate and assist with the monitoring and evaluation of heavy metal contamination.

The plan outlines sampling goals for the major sport fish and forage species, including Largemouth Bass, Spotted Bass, Smallmouth Bass, White Bass, Hybrid Striped Bass, White Crappie, Black Crappie, Blue Catfish, Channel Catfish, Flathead Catfish, Paddlefish, Gizzard Shad and Threadfin Shad. Creel surveys for these species were also recommended. The ODWC plan also establishes aquatic habitat management goals, including protection of habitat consistent with GRDA's SMP, establish vegetation founder colonies, and construct and maintain brush piles. The plan includes goals to monitor and assess water quality in the forebay and the tailrace of Pensacola Dam during the summer period annually, develop and maintain fishing access, track aquatic nuisance species, and coordinate with other agencies regarding monitoring and evaluation of heavy metal contamination.

6.3.3.2 Key Species of Management Interest

Black Bass

There are three species of Black Bass in Grand Lake, including the Largemouth Bass, Spotted Bass, and Smallmouth Bass. Grand Lake is considered a premier recreational fishery for Black Bass, especially Largemouth Bass, and popular Bass tournaments are held on this reservoir annually. In 2013, Grand Lake was ranked third in the top Bass tournament lakes in Oklahoma. In 2015, Bassmaster Magazine ranked Grand Lake as the 13th best Bass fishing lake in the country (Bassmaster 2015).

Largemouth Bass

The Largemouth Bass is found throughout much of the United States and is found throughout Oklahoma in ponds, lakes, rivers, and streams (ODWC 2016a). State and federal hatcheries stock most waters in the State with Largemouth Bass, which is the dominant Black Bass species in Grand Lake (ODWC 2008). Grand Lake has not been stocked with Largemouth Bass in recent years and its abundance in the reservoir suggests natural reproduction and recruitment is sufficient to maintain a high-quality fishery.

During the spring, Largemouth Bass are found in shallow water where food and cover are available. During the summer and winter, they move into deeper water. Spawning begins as water temperatures reach 62 to 65°F, which typically occurs in April and May in Oklahoma. Nests are usually located within 10 feet of the shoreline in several feet of water with adequate cover and smaller substrates (e.g., silt, sand, and gravel), where females typically deposit 2,000 to 7,000 eggs per lb of body weight. After fertilization occurs, the male guards the nest until the eggs hatch and the fry leave. Fry occur in schools until reaching a length of approximately 1 inch (ODWC 2016a).

Spotted Bass

Spotted Bass make up a small portion of the Black Bass population at Grand Lake (ODWC 2008). They are found in lakes, creeks, and rivers in run and pool habitat. Spotted Bass also build nests and spawn in rock and gravel substrate at water temperatures of 56 to 74°F (Texas Parks and Wildlife 2016). Spotted Bass tend to be found in areas with more current than Largemouth Bass and in warmer, more-turbid waters than Smallmouth Bass.

Smallmouth Bass

Smallmouth Bass are native to the Great Lakes, Ohio, Tennessee, Mississippi, and Arkansas River watersheds including the Neosho River and Grand Lake (Brewer and Orth 2015). Specifically, the Neosho subspecies (*M. dolomieu velox*) is endemic to streams of the western Ozark Highlands and Boston Mountains in the Arkansas River watershed, which includes tributaries of Grand Lake like the Elk River (Hubbs and Bailey 1940; Stark and Echelle 1998). The presence of the Neosho form was confirmed genetically in the late 1990s (Stark and Echelle 1998), which caused the ODWC to place a moratorium on the stocking of Northern Smallmouth Bass into watersheds where the Neosho subspecies was an endemic form (Taylor et al. 2016). However, Northern Smallmouth Bass (aka Tennessee 'lake strain') were stocked in Lake Tenkiller of the Illinois River, which meets the Arkansas River below Fort Gibson Lake and genetic introgressions of some northern genes have been found in Grand Lake tributaries and Lake Hudson (Taylor et al. 2016). Although another genetically distinct prospective form (i.e., Ouachita Smallmouth Bass) has been found in streams of the Ouachita Mountains, its range is not known to overlap with the Neosho form (Brewer and Long 2015) and has not been reported for tributaries of Grand Lake. The abundance of Smallmouth Bass in Grand Lake is largely unknown. Few Smallmouth Bass are reported to have been caught in the reservoir, with most reported catches occurring in the upper reaches of the tributaries. In general, Neosho Smallmouth Bass have relatively shorter lifespans and smaller body sizes although fish from the Ozark Highlands appear to grow faster and to be longer lived (specifically in the Elk River) than those in the Boston Mountains (Brewer and Long 2015).

In riverine environments, Smallmouth Bass typically inhabit clear streams with coarse-textured soils, although Neosho Smallmouth Bass do persist in some streams that carry relatively high sediment loads (Brewer and Long 2015; ODWC 2016a). Neosho Smallmouth are also usually found in pool habitats, but increased stream size and a variety of runs and riffles are also important determinants of population sizes (Brewer and Long 2015). Temperature may be important to habitat use and appears to be associated with ontogeny with older fish selecting colder temperature waters (Brewer and Long 2015). In reservoirs, Smallmouth Bass prefer clear, clean water usually with rock substrate. They can often be found along weedy shorelines, flats of channels, and shelves. During the day, Smallmouth Bass seek refuge in deeper waters, but in the morning and evening they are often found along the shoreline (ODWC 2016a).

Spawning takes place in the spring when water temperatures reach 60 to 75°F. Nests are built on gravel bars in three to 20 feet of water. The male drives a ripe female to the nest and once she lays her eggs, the male will find another female, and frequently a third female for spawning. Each female will produce from 2,000 to 7,000 eggs per lb of body weight. There is little or no parental care provided after hatching (ODWC 2016a).

Temperate Bass

White Bass

Although White Bass are native to Oklahoma, White Bass were not found in great numbers until large reservoirs were constructed and are now found statewide (ODWC 2016b). White Bass are abundant in Grand Lake (ODWC 2008). Adult fish usually travel in large schools and prefer open water over sandy shoals during the day and shallows at night (ODWC 2016b). White Bass are very prolific and a single female can produce up to one million eggs. Spawning occurs in several feet of water over weeds, debris, and rocks when water temperatures are between 50 to 55°F. If tributary streams are accessible, White Bass prefers to migrate upstream. No parental care is provided to eggs or young.

Hybrid Striped Bass

The Hybrid Striped Bass is a sterile cross between the White Bass and the Striped Bass (ODWC 2016c). These fish are produced in a hatchery by crossing female Striped Bass with male White Bass. Although both male and female hybrids attain sexual maturity, natural reproduction has not been observed (ODWC 2016c). The first stocking of Striped Bass in Oklahoma occurred in 1977. Subsequently, these fish have been stocked in lakes statewide (ODWC 2016c). Hybrid Striped Bass were first stocked in Grand Lake in 1981. Historically, stocking rates and frequency have not been at the desired levels to produce a quality Hybrid Striped Bass fishery in Grand Lake, since they do not reproduce naturally. However, recent increased stocking efforts have resulted in increased fishing success. The most recent available stocking reports state 42,000 (1.5-inch) and 56,500 (1.7-inch) Hybrid Striped Bass were stocked in Grand Lake in 2014 (ODWC 2014)(Table 6.3-2).

Hybrid Striped Bass can reach large sizes. For example, a 19.2-lb and 22.2-lb Hybrid Striped Bass have been caught in the Project's tailrace and in Grand Lake (ODWC 2008). Hybrid Striped Bass tend to prefer areas within lakes and streams similar to Striped Bass and White Bass, typically traveling in large schools in open water.

Crappie

Originally, Crappie were considered stream fish in Oklahoma, but are now found statewide in many lakes and rivers (ODWC 2016d). Grand Lake contains both White and Black Crappie. White Crappie is the more prevalent of the two species and accounts for approximately 95 percent of the Crappie population (ODWC 2008). Crappie are often found in standing timber and brush cover in lakes. In the spring they tend to inhabit shallow coves, but are found in depths at 15 feet or greater other times of the year. Spawning habits of White Crappie are similar to other sunfishes, where nests are built in several feet of water over small substrates near cover such as rocks, brush, and logs. Black Crappie construct their nests at even greater depths than White Crappie. Females of both species deposit from 3,000 to 15,000 eggs. Spawning occurs shortly after springtime water temperatures reach 55 to 65°F. After spawning, males guard the eggs and fry (ODWC 2016d).

Catfish

There are three species of catfish that are known to occur in Grand Lake, including the Blue Catfish, Channel Catfish, and Flathead Catfish. Originally, distribution of the Blue Catfish was limited in Oklahoma, but now they are found in most sections of the state due to transplanting. Blue Catfish prefer large rivers as well as reservoirs with sand, gravel, or rocky substrate (ODWC 2016e). Channel Catfish are common statewide in streams, ponds, and lakes often near cover in larger pools. Immature Channel Catfish are more tolerant of faster current and shallow water (ODWC 2016f). Flathead Catfish are common in most large impoundments and streams (ODWC 2016g).

Spawning for all three species of catfish usually takes place in late May or early June when the water temperatures reach 75°F. Catfish typically nest in hollow logs, overhanging underwater ledges, or holes under mud banks. Typically, a female will lay about 10,000 eggs. Males guard the eggs against intruders, including the female. Fry are attended for a short time by the male as they feed in a dense school (ODWC 2016e; ODWC 2016f; ODWC 2016g).

Paddlefish

Paddlefish are a pelagic, filter-feeding, planktivore that make spawning migrations upriver to find gravel bars to deposit eggs (Scarnecchia et al. 2013). The spawning migration into Grand Lake’s tributaries congregates a large number of fish each year from March through April, although recruitment is highly dependent on springtime river discharge and duration. Paddlefish in Grand Lake have an expected lifespan of approximately 20 years with males maturing at 6-7 years and females maturing at 8-9 years and prime reproduction occurring by age 12. Similarly, they show a sexual size dimorphism as females usually have greater lengths and weights at ages 8 and older (Scarnecchia et al. 2013). Harvest and seasonal movement data indicate that female paddlefish in the Grand Lake stock are capable of annual spawning, given appropriate ecological conditions (Schooley and Johnston 2015).

In the past, Paddlefish were harvested by commercial and recreational fishermen (Scarnecchia et al. 2013). From 1975-1992 commercial fisheries existed on Grand Lake, but these were closed indefinitely in 1992, due to increasing harvests and public hearings. Currently the recreational snag fishery is open year-round. Since the establishment of the Paddlefish Research Center (PRC) in 2008, the Paddlefish fishery has been under intense management from the ODWC to support their research efforts. The research has resulted in the publication of the Comprehensive Management Plan for the Management of Paddlefish in Oklahoma in 2013 (Scarnecchia et al. 2013), which includes the current regulations as of 2013. In this plan, ODWC also lists their current hypotheses and goals, which include the extensive research conducted on Paddlefish (e.g., Goals 2, 4, and 5 in Scarnecchia et al. 2013), most of the suggested research projects are completed or projects are currently underway with the goal of completion by 2017 (Table 6.3-5, and Scarnecchia et al. 2013).

Table 6.3-5. Examples of available data and reports for Grand Lake Paddlefish.

Year	Study/Project Title
2011	Southern and Northern Great Plains (United States) Paddlefish Stocks Within Frameworks of Acipenseriform Life History and the Metabolic Theory of Ecology
2013	A Comprehensive Plan for the Management of Paddlefish in Oklahoma. (Includes a report of all PRC data up through 2012 on age, length-weight at age and growth, maturation and energy storage (gonadal somatic index), and life history stages and summary)
2014	Harvest Management Regulation Options for Oklahoma's Grand Lake Stock of Paddlefish
2014	Grand Reservoir Paddlefish Telemetry and Spawning Frequency. Grant Report. Project Number: F11AF00318.
2008-15	Oklahoma Department of Wildlife Conservation (2008-2012, 2014-2015) Post-season Survey of Paddlefish Permit Holders
2014	Development of diploid microsatellite markers for the North American paddlefish (*Polyodon spathula*).
2014	Genetic analysis of demographic dynamics of Paddlefish in Grand Lake O' the Cherokees. Grant Report. Project Number: F12AF00948
2015	Fine-scale Genetic Structuring of American Paddlefish Populations in Oklahoma. Grant Report. Project Number: F14AF00156.
2015	Costs and Consequences of Dam Passage for Paddlefish in Northeast Oklahoma – Rostrum Amputation and the Hydropower Diet Plan.
2016	Benthic Habitat Mapping of Grand Lake Tributaries as it Relates to Paddlefish Recruitment. Grant Report. Project Number: F15AF00540

Source: These projects are in fulfillment of or in addition to the goals and objectives of ODWC's management plan for Paddlefish in Oklahoma (i.e., Goals and Objectives 2, 4, and 5 from Scarnecchia et al. 2013).

Since 2008, there has been a declining trend in the estimated number of adult Paddlefish in Grand Lake (Table 6.3-6; Schooley et al. 2014). The 1999 cohort has dominated the harvest of Paddlefish on Grand Lake since 2008. Estimated numbers and harvest of adult Paddlefish were expected to drop due to increased natural mortality of this cohort as these fish passed their prime years for reproduction and entered into senescence. What caused the strength of this cohort is unknown, but it was associated with high river discharges and lake levels, enhancing gravel habitat availability for spawning and recruitment (Schooley and O'Donnell 2016). However, great fluctuations in year class strength and population abundances have occurred in the past, with reports of as low as 25,118 individuals in 1982 (Schooley et al. 2014; Combs 1982). Modern regulation changes by ODWC since 2010 have aimed to moderate individual harvest while retaining recreational opportunities (Schooley, et al. 2014). The closure of the Spring River to snagging, prohibition of harvest on Mondays and Fridays, and the development of the two-fish individual annual harvest limit have collectively reduced harvest pressure while maintaining a vibrant destination fishery in Northeast Oklahoma (Jason Schooley, ODWC, personal communication, 2016). Additional regulations such as mandatory harvest reporting have enhanced knowledge of off-peak harvest at Grand Lake and statewide. Initial estimates from 2015 appear to be showing an increase in stock (although there are still data quality assurance checks to be completed before a firm number can be reported) and reports from spring 2016 that yearling Paddlefish were extremely common appear to indicate good recruitment in 2015 (Jason Schooley, ODWC, personal communication, 2016). ODWC stocks tagged (coded wire tags), hatchery-reared Paddlefish in Grand Lake regularly (GRDA 2016), Table 6.3-2. However, the purpose of these efforts is not to supplement natural recruitment, but for known-age verification. Later recovery of these tags via angler harvest allows verification of age estimation from dentary bones. In 2016, 2,112 (14.8 inch) Paddlefish were stocked in Grand Lake.

Table 6.3-6. Estimated numbers of adult paddlefish (single-census adjusted Peterson/Chapman population estimates)(N) and 95 percent confidence intervals (CI) in Grand Lake

Year (winter)	N	95% CI
2008	215,669	139,378 – 350,232
2009	144,744	86,971 – 256,508
2010	154,575	109,920 – 224,836
2011	87,573	66,426 – 118,212
2012	66,624	47,692 – 96,430
2013	68,288	39,587 – 128,039
2014	69,234	50,594 – 97,441

Source: (unpublished data refined and updated from Schooley et al. 2014).

Since 2008, ODWC has conducted surveys of permitted paddlefish anglers nearly every year. Usually, more than 50 percent of permitted Paddlefish anglers and over 85 percent of non-resident permitted Paddlefish anglers fish in the Grand Lake Region (Table 6.3-7; Jager and Schooley 2016). From 2008-2015 declines have been observed in number of days fished, catch, and harvest, however the total number of estimated anglers has increased by 75 percent and catch-per-day has been relatively stable (Jager and Schooley 2016). Overall, most Paddlefish anglers use boats, but resident anglers are more likely to use bank fishing. Additionally, most Grand Lake Paddlefish anglers donate their catch to the PRC, which aides in ODWC's funding and research efforts for Paddlefish (Jager and Schooley 2016).

Table 6.3-7. Paddlefish angler participation at Grand Lake.

Year	Overall	Residents	Non-residents
2008	50%	24%	84%
2009	65%	47%	90%
2010	58%	43%	89%
2011	61%	38%	93%
2012	56%	35%	88%
2014	54%	33%	87%
2015	42%	25%	73%

Source: Jager and Schooley 2016.

Shad

Gizzard Shad

The Gizzard Shad are an important forage fish when young and are found in both streams and lake habitats in Oklahoma (Miller and Robison 2004; ODWC 2008). Gizzard Shad are filter feeders and feed on plankton and detritus from the water column (Miller and Robison 2004).

They generally spawn pelagically in schools at night in late April to May (Miller and Robison 2004).

Threadfin Shad

Historically, Threadfin Shad naturally occurred in only parts of the Arkansas drainage in Mayes and Wagoner counties. However, it has been introduced as a forage species in various lakes around the state (Miller and Robison 2004), including Grand Lake (ODWC 2008). Threadfin Shad inhabit open water areas of lakes, reservoirs, and rivers (Thomas et al. 2007). As opposed to the Gizzard Shad, the Threadfin Shad is a pelagic, planktivorous fish (Miller and Robison 2004). Adults are also considerably smaller than Gizzard Shad adults and rarely exceed 6 inches in length, making them an ideal forage species throughout their life. Spawning takes place in spring near shore when water temperatures reach 70°F and continues for several months. Adhesive eggs are scattered over submerged plants and other objects and hatch in about three days (Miller and Robison 2004).

6.3.3.3 Essential Fish Habitat

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act, Congress mandated that habitats essential to federally managed commercial fish species be identified and that measures be taken to conserve and enhance habitat. In the amended Act, Congress defined essential fish habitat (EFH) for federally managed fish species as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. §§1801 – 1884). The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) works with the regional fishery management councils to identify the EFH for each federally managed species and develop conservation to protect and enhance these habitats. No EFH has been identified in the Project Boundary or the Grand River (NOAA and NMFS 2016).

6.3.3.4 Invasive Species

Bighead Carp

The Bighead Carp (*Hypophthalmichthys nobilis*) is an invasive species native to southern and central China (Li and Fang 1990, Robins et al. 1991, as cited in Nico et al. 2016). They were first imported into the United States in 1973 by a private fish farmer in Arkansas as a biological control to improve water quality and increase fish production in culture ponds (Conover et al. 2007, as cited in Nico et al. 2016). Adult Bighead Carp have been confirmed at several sites in the Grand River drainage, including the Neosho River in Ottawa County, Grand River in Mayes County, upper Grand Lake, and Lake Hudson (Pigg et al. 1993, 1997, Rasmussen 1998, as cited in Nico et al. 2016; ODWC 2008). The most recent confirmed Bighead Carp was snagged at Miami Park in the Neosho River in May of 2008 (ODWC 2008).

The Bighead Carp prefer large rivers, but have been able to establish themselves in a wide range of environments. Bighead Carps are filter feeders that grow and reproduce quickly (Xie and Chen 2001, as cited in Nico et al. 2016). They out-compete native larval fishes and mussels for food (Laird and Page 1996, as cited in Nico et al. 2016). Bighead Carp need large, turbulent rivers and higher temperatures to spawn. They produce eggs that are semi-buoyant and require current to keep them from sinking to the bottom (Soin and Sukhanova 1972, Pflieger 1997, as cited in Nico et al. 2016). The eggs float for 40-60 hours before hatching (Nico et al. 2016).

Pacu

Pacu are a fish native to South America and mainly herbivores, but will also eat small fish and insects. They have been sighted in Grand Lake, although rare. They are sold in pet stores and are likely released into Grand Lake once they have outgrown their aquaria, but they are not believed to be able to survive winter temperatures in Grand Lake. There are a number of genera, but the most common species found in pet stores include the Black Pacu (*Colossoma macropomumand*) and the Red-bellied Pacu (*C. brachypomum*).

6.3.4 Mussels

Data on mussels in the vicinity of the Project are limited. Branson (1982) reported 11 species of mussels from the Spring-Neosho drainage in 1966; however, a list of these species was not available. In 1969, Branson indicated the pearlshell (*Glebula rotunda*) mussel was found in Grand Lake and later indicated the distribution of nine species of mussels included the Neosho River (Branson 1982)(Table 6.3-8).

Additionally, a review of federal and state databases indicated that the Neosho mucket (*Lampsilis rafinesqueana*) may occur in the Project vicinity. It was listed as endangered by the USFWS in 2013, and critical habitat was designated on April 29, 2015. It is a freshwater mussel native to streams and rivers in four states including Oklahoma (USFWS 2015d, as cited in GRDA 2016a). This species is discussed in greater detail in Section 6.6 Rare, Threatened, and Endangered Species of this PAD.

Table 6.3-8. Mussels in the Neosho River.

Common Name	Scientific Name
Threeridge	*Amblema plicata*
Wabash pigtoe	*Fusconaia flava*
Rabbitsfoot	*Quadrula cylindrica*
Monkeyface	*Quadrula metanevra*
Pimpleback	*Quadrula pustulosa*
Mapleleaf	*Quadrula quadrula*
Pistolgrip	*Tritogonia verrucosa*
Washboard	*Megalonaias gigantean*

Source: Branson 1982.

6.3.4.1 Invasive Species

Zebra Mussels

Zebra mussels (*Driessena polymorpha*) were first reported in Grand Lake in February 2005 at the Disney State Park boat ramp, located on the southern portion of the lake along the eastern bank. An additional zebra mussel was found in Ketchum Cove in July 2006. Since then, there were no extensive reports until 2014. Currently, zebra mussels have been confirmed by GRDA and there are ongoing research projects with Oklahoma State University monitoring larval presence in the reservoir. A finalized report is expected no later than 2018.

GRDA has participated in a state-wide task force since the 1990s to monitor Grand Lake for the presence of zebra mussels. In 2008, GRDA installed a permanent display at the Oklahoma

Aquarium to inform visitors about the species and has been involved in informing lake users to help slow their spread (GRDA 2014).

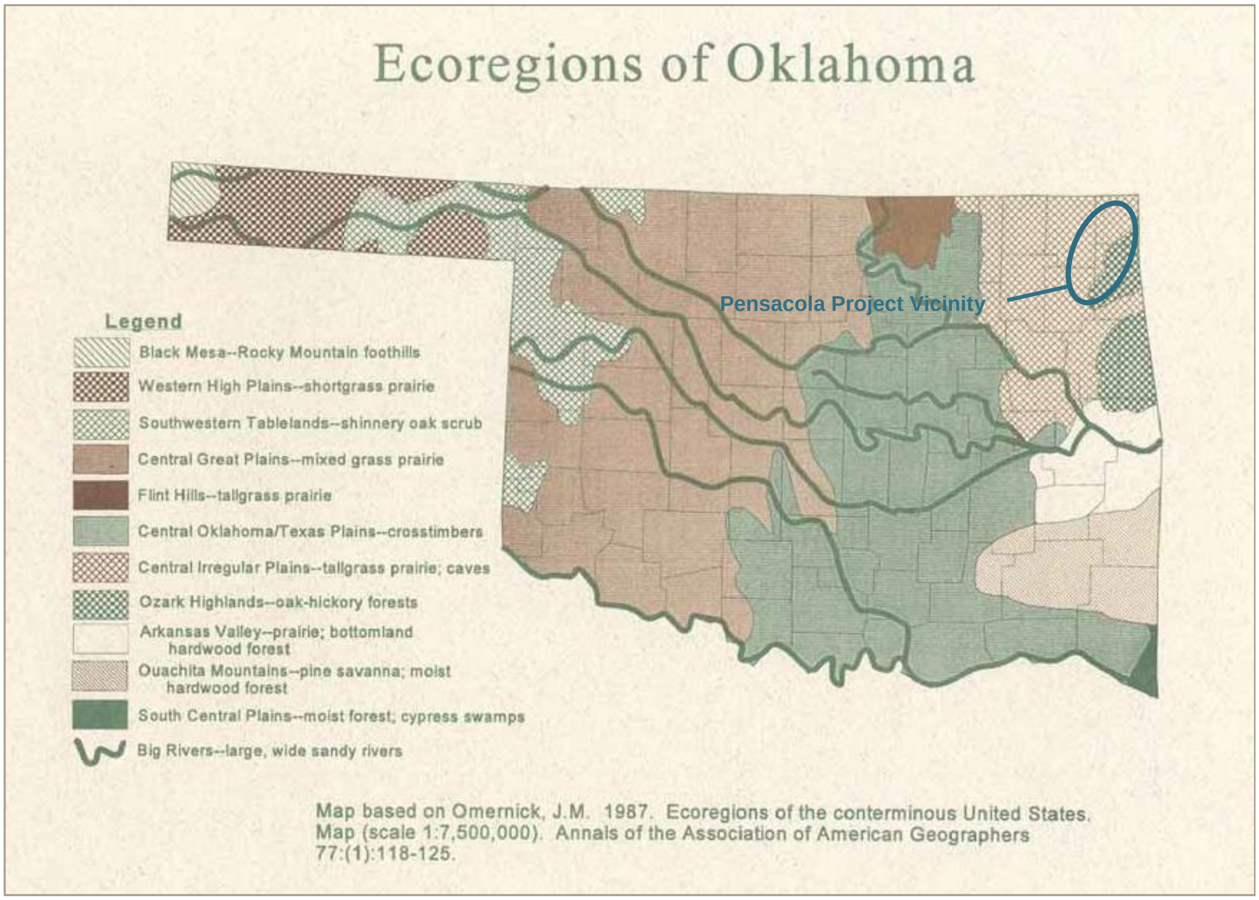
Asian Clam

The Asian clam (*Corbicula fluminea*) invaded Oklahoma in the early 1970s (ODWC 2005) and was collected from Grand Lake in the late 1970s (USGS 2016). It is a filter feeder that removes particles from the water column and can be found at the sediment surface or slightly buried (USGS 2016). Impacts associated with the Asian clam include biofouling municipal and industrial systems including pipes and canals. It also alters benthic substrates and competes with native species for limited resources (USGS 2016).

6.4 Wildlife and Botanical Resources

Grand Lake and the Project vicinity are located within a transitional zone between the Ozark Highlands and Central Irregular Plains ecoregions that span northeastern Oklahoma (GRDA 2008). A significant portion of the Project's vicinity is characterized by the Ozark Highlands—an area of considerable species richness and biodiversity (Figure 6.4-1). The Oklahoma Biodiversity Task Force has documented 311 native vertebrate species in the region (Oklahoma Biodiversity Task Force [OBTF] 2005).

The Ozark Highlands ecoregion has also been identified as the most significant highland region within central North America (USGS 2009). The second ecoregion within the Project vicinity, the Central Irregular Plains, is predominantly represented by a grassland/forest mosaic of mixed land use (Oklahoma Forestry Services [OFS] 2011). The Central Irregular Plains ecoregion is also characterized by high species diversity; the Oklahoma Biodiversity Task Force has documented 327 native vertebrate species in the region (OBTF 2005).



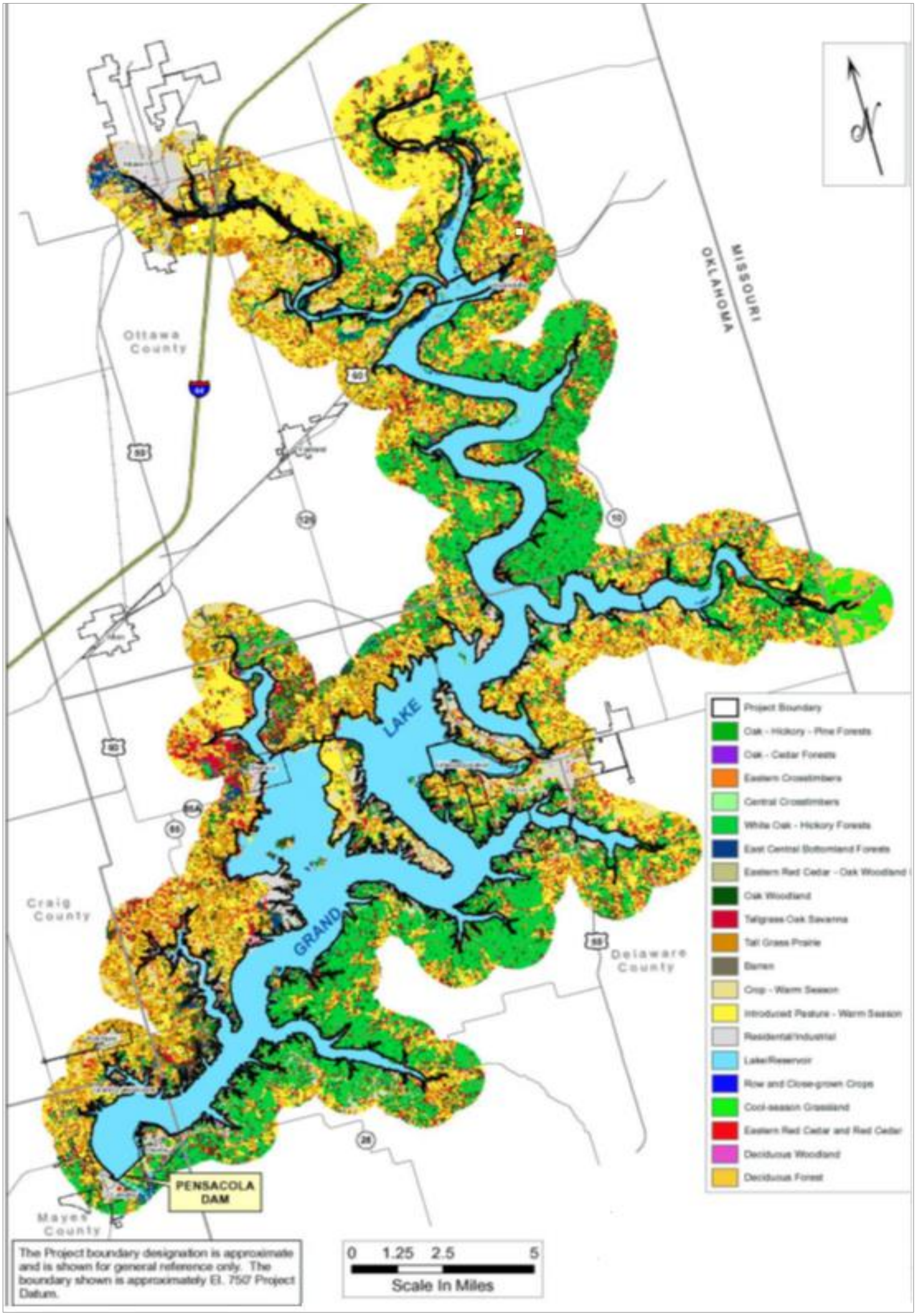
Source: OBTF 2005.

Figure 6.4-1. Ecoregions of Oklahoma.

6.4.1. Botanical Resources

The Oklahoma Biological Survey (OBS) lists approximately 1,380 species of vascular plants in its specimen collections for the four counties within which the Project lies: Craig, Delaware, Mayes, and Ottawa counties (see Attachment F for full OBS list, accessed May 2016). In general, forested cover within the Ozark Highlands ecoregion of the Grand Lake is primarily comprised of oak-hickory (*Quercus-Carya*) and oak-hickory-pine (*Quercus-Carya-Pinus*)(Woods et al. 2005). Species characteristic of the canopy on dry uplands and ridge tops include black oak (*Quercus velutina*), white oak (*Q. alba*), blackjack oak (*Q. marilandica*), post oak (*Q. stellate*), coralberry (*Symphoricarpos orbiculatus*), black huckleberry (*Gaylussacia baccata*), sassafras (*Sassafras albi*dum), and winged elm (*Ulmus alata*), in addition to numerous hickories (*Carya* spp.)(GRDA 2008). Shortleaf pine (*Pinus echinata*) also occurs in oak-hickory-pine stands. Mesic forests, characteristic of north-facing slopes and ravines of generally precipitous terrain, consist of sugar maple (*Acer saccharum*), white oak, and northern red oak (*Q. rubra*)(GRDA 2008). Trees common on low terraces and along floodplains include: willows (*Salix* spp.), bottomland oaks (*Quercus* spp.), maples (*Acer* spp.), hickories, birch (*Betula* spp.), American elm (*Ulmus americana*), and sycamore (*Platanus occidentalis*). The forest floor in this ecoregion is characterized by shade-tolerant shrubs, such as flowering dogwood (*Cornus florida*); pawpaw (*Asimina triloba*); spicebush (*Lindera benzoin*); and bladdernut (*Staphylea* *trifolia*) and herbaceous plants including American mayapple (*Podophyllum peltatum*); dogtooth violet (*Erythronium americanum*); and bloodroot (*Sanguinaria Canadensis*), as well as mosses; ferns; and liverworts (Oklahoma Cooperative Extension Service [OCES] 1998). Ridgetops and south-facing slopes support grassland communities; some of which are sparsely vegetated glades and rock outcrops. Level sites within the Ozark Highlands often have been converted to pasturelands or haylands (Woods et al. 2005).

Within the Neosho River arm of Grand Lake, the oak-hickory forests of the Ozark Highlands transition into the grassland/forest mosaic of the Central Irregular Plains (GRDA 2008). Typical dominants of tall grass prairie sites within the Central Irregular Plains include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), and indiangrass (*Sorghastrum nutans*)(GRDA 2008). Similar to the oak-hickory forests of the Ozark Highlands to the south and east, dry upland forests are prevalent along low, rocky hills (GRDA 2008). The canopies of riparian corridors are typically dominated by American elm, oaks, hackberry (*Celtis occidentalis*), eastern black walnut (*Juglans nigra*), sycamore, and pecan (*Carya illinoinensis*). A large proportion of this ecoregion has been converted for agricultural use; rangeland occupies steeper slopes, while plains are utilized as croplands (GRDA 2008). Common crops of the region include grain and sweet sorghum, (*Sorghum bicolor)*, alfalfa (*Medicago sativa*), wheat (*Triticum aestivum*), and soybeans (*Glycine max*)(Woods et al. 2005). An illustration of the vegetation communities surrounding Grand Lake is provided in Figure 6.4-2.



Source: GRDA 2008.

Figure 6.4-2. Vegetation patterns around Grand Lake.

6.4.1.1 Invasive Plant Species

Oklahoma has three state-listed noxious weeds: musk thistle (*Carduus nutans*), Canada thistle (*Cirsium arvense*), and Scotch cottonthistle (*Onopordum acanthium*)(Oklahoma House of Representatives [OHR] 1998). In addition, the presence of invasive plants in each region of Oklahoma, as defined by the Oklahoma Department of Recreation and Tourism, indicates that 15 non-native plant species have been identified in the northeast region of Oklahoma (Oklahoma Invasive Plant Council [OIPC] 2014), Table 6.4-1.

Table 6.4-1. Invasive plant species listed in the northeast region of Oklahoma.

Scientific Name	Common Name
Ailanthus altissima	Tree of heaven
Albizia julibrissin Durazz.	Mimosa, silk tree
Alliaria petiolata	Garlic mustard, garlic root, jack-in-the-bush
Alternanthera philoxeroides	Alligator weed
Broussonetia papyrifera	Paper mulberry
Cyperus rotundus.	Nutgrass, purple nutsedge
Dipsacus fullonum	Common teasel, Fuller's teasel
Eichhornia crassipes	Water hyacinth, common water hyacinth
Lonicera maackii	Bush honeysuckle, amur honeysuckle
Lythrum salicaria	Purple loosestrife
Paulownia tomentosa	Princess tree, empress tree, foxglove tree
Perilla frutescens	Beefsteak plant
Potentilla recta	Sulfur cinquefoil
Pueraria montana	Kudzu
Pyrus calleryana	Callery pear

Source: OIPC 2014.

6.4.2. Wildlife

The Oklahoma State Biodiversity Plan lists 38 mammals that occur within the Project vicinity (Table 6.4-2). Upland deciduous forests within the Project vicinity are inhabited by white-tailed deer (*Odocoileus virginianus*), striped skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), fox squirrels (*Sciurus niger*), Virginia opossums (*Didelphis virginiana*), eastern cottontails (*Sylvilagus floridanus*), nine-banded armadillos (*Dasypus novemcinctus*), red foxes (*Vulpes vulpes*), and an array of rodents (GRDA 2008).

Table 6.4-2. Mammals occurring in the Pensacola Project vicinity.

Scientific Name	Common name
Blarina hylophaga	Elliot's short-tailed shrew
Canis latrans	Coyote
Castor canadensis	Beaver
Dasypus novemcinctus	Nine-banded armadillo
Didelphisvirginiana	Virginia opossum
Eptesicus fuscus	Big brown bat
Glaucomys volans	Southern flying squirrel
Lasiurus borealis	Red bat
Lepus californicus	Black-tailed jack rabbit
Marmota monax	Woodchuck
Mephitis mephitis	Striped skunk
Mus musculus	House mouse
Mustela vison	Mink
Myotis grisescens	Gray myotis
Myotis keenii	Keen’s myotis
Myotis lucifugus	Little brown myotis
Neotoma floridana	Eastern woodrat
Nycticeius humeralis	Evening bat
Odocoileus virginianus	White-tailed deer
Ondatra zibethicus	Muskrat
Perognathus hispidus	Hispid mouse
Peromyscus attwateri	Texas mouse
Peromyscus leucopus	White-footed mouse
Peromyscus maniculatus	Deer mouse
Pipistrellus subflavus	Eastern pipistrel
Procyon lotor	Raccoon
Rattus norvegicus	Norway rat
Reithrodontomys megalotis	Western harvest mouse
Reithrodontomys fulvescens	Fulvous harvest mouse
Reithrodontomys montanus	Plains harvest mouse
Scalopus aquaticus	Eastern mole
Sciurus carolinensis	Gray squirrel
Sciurus niger	Fox squirrel
Sigmodon hispidus	Hispid cotton rat
Sylvilagus floridanus	Eastern cottontail
Tamias striatus	Eastern chipmunk
Taxidea taxus	American badger
Vulpes vulpes	Red fox

Source: GRDA 2008, 2010; OBS 2016.

Bottomland forests within the Project's vicinity provide habitat for all of the species described above, as well as muskrats (*Ondatra zibethicus*) and beavers (*Castor canadensis*). Common mammals associated with grasslands in the region are the least shrew (*Cryptotis parva*), deer mouse (*Peromyscus maniculatus*), black-tailed jack rabbit (*Lepus californicus*), and American badger (*Taxidea taxus*)(GRDA 2008). Additionally, bats are of ecological concern in the Grand Lake area, and in particular, the federally endangered gray bat (*Myotis grisescens*), which is discussed in greater detail in Section 6.6 Rare, Threatened, and Endangered Species of this PAD.

The Project vicinity supports populations of both resident and migratory birds. The Oklahoma Ornithological Society maintains a checklist of Oklahoma birds; as of 2011, 473 species have been recorded (see Attachment G)(Oklahoma Bird Records Committee [OBRC] 2011). ODWC also conducts annual waterfowl survey and harvest estimates. Grand Lake represents an important migratory stop and overwintering location for shorebirds and waterfowl.

Under its current license, GRDA initiated an experimental millet seeding program to increase aquatic vegetation for waterfowl food supply; however, the program did not achieve the desired results and was discontinued in 2011 (GRDA 2016b). Alternatively, artificial structures have been deployed in Grand Lake to protect shoreline habitat as part of GRDA's annual Rush-4-Brush program (established in 2007). These efforts are discussed in greater detail in Section 6.3 Fish and Aquatic Resources of this PAD.

As part of Article 406, GRDA manages 1,630 acres of Project lands as four WMAs located either adjacent to streams entering the reservoir or as islands within the reservoir (GRDA 2015), Figure 6.4-3. Also, since 2007, GRDA has spent $1.1 million to acquired 540 acres, known as the Coal Creek Unit, for wildlife purposes with the focus on conservation and restoration of grasslands, bottomland hardwoods (BLH), wetlands, and riparian areas (GRDA 2016a; ODWC 2016). In January 2016, GRDA and ODWC developed an Interagency Agreement for the Coal Creek Unit to be utilized as adjacent-site mitigation. The restored habitat will negate the need to perform millet seeding and is expected to directly benefit waterfowl in the Grand Lake/Neosho River Basin (ODWC 2016, as cited in GRDA 2016b). Per the Interagency Agreement, a comprehensive restoration and management plan necessary to complete mitigation on Coal Creek will be developed, as well as to coordinate the development and implementation of a management plan for the 1,630 acres of WMAs (ODWC 2016).

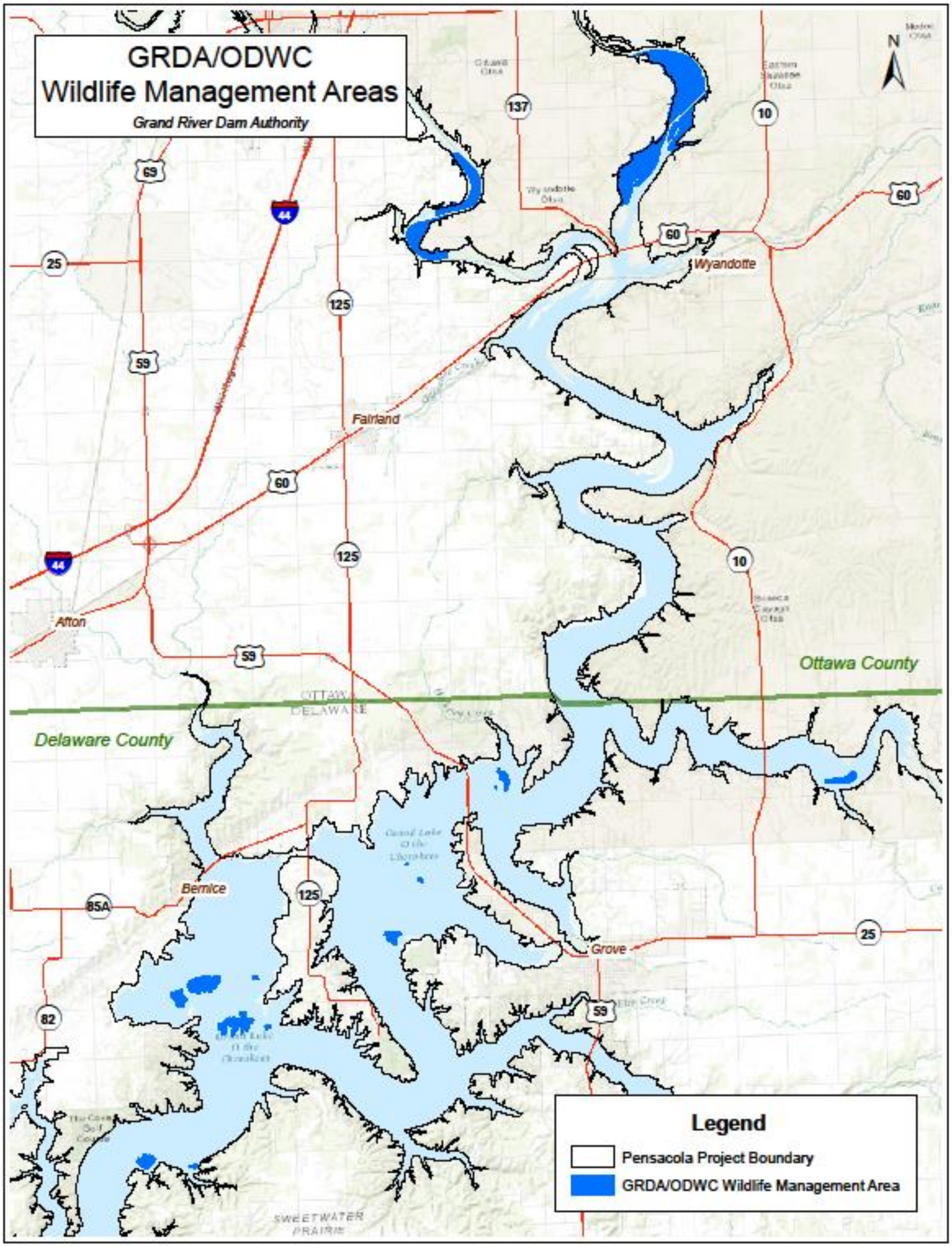


Figure 6.4-3. GRDA WMAs.

Cormorants (*Phalacrocorax* spp.), pelicans (*Pelecanus* spp.), egrets, and herons are some of the non-game avian species known to visit the reservoir annually (GRDA 2008). Additionally, a vast array of waterfowl, including geese and numerous species of ducks, occur on Grand Lake during migration (Stancill et al. 1988). The most abundant duck on the reservoir are mallards (*Anas platyrhynchos*), and they are the only dabbling duck to overwinter (GRDA 2008). Canada geese (*Branta canadensis*) and wood ducks (*Aix sponsa*) are year-round residents.

Wooded lots within the Project vicinity include song birds such as tanagers, nuthatches, and warblers, as well as woodpeckers typical of eastern deciduous forests (GRDA 2008). Barred owls (*Strix varia*), red-tailed hawks (*Buteo jamaicensis*), and red-shouldered hawks (*B. lineatus*) are some of the raptors that are known to occur in both upland and bottomland forests encompassing Grand Lake (GRDA 2008). Raptors found in the surrounding grasslands include short-eared owls (*Asio flammeus*), northern harriers (*Circus cyaneus*), and rough-legged hawks (*Buteo lagopus*). Bald eagles breed and overwinter on Grand Lake. GRDA conducts a winter and spring count and nest status survey around the Grand Lake shoreline, documenting an average of 86 adult and juvenile bald eagles between 2013 and 2016. Active nest numbers and status vary from year to year; the most recent survey found 14 active nests within or near the Project Boundary. Although the bald eagle was delisted in 2007 (USFWS 2007), it is still protected under the Bald and Golden Eagle Protection Act of 1940 as amended in 1978 and is discussed in more detail in Section 6.6 Rare, Threatened, and Endangered Species of this PAD. Songbirds present in the prairie habitat include horned larks (*Eremophila alpestris*), grasshopper sparrows (*Ammodramus savannarum*), meadowlarks (*Sturnella* spp.), dickcissels (*Spiza Americana*), and bobolinks (*Dolichonyx oryzivorus*). Game birds found at Grand Lake include northern bobwhite quails (*Colinus virginianus*), wild turkeys (*Meleagris gallopavo*), mourning doves (*Zenaida macroura*), and various species of waterfowl (GRDA 2008).

6.4.3. Reptiles and Amphibians

Herpetofauna within the Project vicinity includes a variety of frogs, toads, salamanders, lizards, turtles, and snakes. A review of the OBS Distribution of Oklahoma Amphibians and Reptiles by Recorded Sightings database (DOKARRS) found 90 species located in the four counties, Mayes, Delaware, Craig, and Ottawa that surround the Project (Table 6.4-3). Amphibious species such as American toads (*Anaxyrus americanus*), spadefoot toads (*Scaphiopus* spp.), gray tree frogs (*Hyla versicolor*), and narrow-mouthed toads (*Gastrophryne* spp.) have been noted within the region. Turtles known to occur within the area include snapping turtles, mud turtles, and softshell turtles, as well as a variety of slider, map, and box turtles (GRDA 2008). With the exception of the land-dwelling box turtles, all of these turtles are aquatic. Lizards that occur in the Project vicinity include western slender glass lizards (*Ophisaurus attenuatus*), eastern collard lizards (*Crotaphytus collaris*), Texas horned lizards (*Phrynosoma cornutum*), and a diverse group of skinks. Common snake species include black rat snakes (*Pantherophis obsoletus*), various water snakes, and bullsnakes (*Pituophis catenifer sayi*) in addition to venomous snakes such as copperheads (*Agkistrodon contortrix*), western cottonmouths (*Agkistrodon piscivorus leucostoma*), timber rattlesnakes (*Crotalus horridus*), and western pygmy rattlesnakes (*Sistrurus miliarius streckeri*)(Erickson and Leslie 1988, as cited in GRDA 2008). Many snakes are semi-aquatic; copperheads and cottonmouths are both known to feed in lakes, ponds, and streams (Cline and Anderson 2013).

Table 6.4-3. Amphibians and reptiles occurring in the Pensacola Project vicinity.

Scientific Name	Common Name
Acris crepitans	Cricket frog
Agkistrodon contortrix	Copperhead
Agkistrodon piscivorus	Cottonmouth
Ambystoma maculatum	Spotted salamander
Ambystoma texanum	Narrow mouth salamander
Bufo woodhousei	Fowler’s toad
Anaxyrus americanus	American toad
Carphophis amoenus vermis	Worm snake
Cemophora coccinea	Scarlet snake
Chelydra serpentine	Snapping turtle
Cnemidophorus sexlineatus	Six-lined racerunner
Coluber constrictor	Racer
Crotalus horridus	Timber rattlesnake
Crotaphytus collaris	Collared lizard
Deirochelys reticularia miaria	Chicken turtle
Desmognathus fuscus	Dusky salamander
Desmognathus brimleyorum	Ouachita dusky salamander
Diadophis punctatus	Ring-necked snake
Elaphe obsoleta	Black rat snake
Elaphe guttata emoryi	Corn snake
Eumeces fasciatus	Five-lined skink
Eumeces obsoletus	Great plains skink
Eumeces anthracinus	Coal skink
Eumeces septentrionalis	Prairie skink
Eurycea tynerensis	Oklahoma salamander
Eurycea lucifuga	Cave salamander
Eurycea multiplicata	Many-ribbed salamander
Eurycea longicauda	Long-tailed salamander
Gastrophryne carolinensis	Eastern narrow-mouthed toad
Graptemys pseudogeographica	Ouachita map turtle
Graptemys geographica	Map turtle
Hemidactylus turcicus	Mediterranean house gecko
Heterodon platyrhinos	Eastern hog-nosed snake
Hyla crucifer	Spring peeper
Hyla versicolor	Grey treefrog
Hyla chrysoscelis	Grey treefrog
Kinosternon subrubrum	Mississippi mud turtle
Kinosternon flavescens flavescens	Yellow mud turtle
Lampropeltis calligaster	Prairie kingsnake
Lampropeltis triangulum	Milk snake
Lampropeltis getulus	Speckled kingsnake

Scientific Name	Common Name
Leptotyphlops dulcis	Blind snake
Macroclemys temmincki	Alligator snapping turtle
Masticophis flagellum	Coachwhip
Necturus maculosus	Mudpuppy
Nerodia sipedon pleuralis	Northern banded water snake
Nerodia erythrogaster	Plain-bellied water snake
Nerodia rhombifera	Diamondback water snake
Nerodia sipedon	Northern banded water snake
Notophthalmus viridescens louisianensis	Central newt
Opheodrys aestivus	Rough green snake
Phrynosoma cornutum	Texas horned lizard
Pituophis melanoleucus sayi	Bull snake
Plethodon glutinosus	Northern slimy salamander
Plethodon dorsalis angusticlavius	Ozark zigzag salamander
Plethodon serratus	Southern red-backed salamander
Pseudacris triseriata	Striped chorus frog
Pseudacris streckeri	Strecker's chorus frog
Pseudemys concinna	Missouri river cooter
Pseudemys scripta elegans	Common slider
Pseudemys concinna hieroglyphica	Missouri river cooter
Rana utricularia	Southern leopard frog
Rana pipiens	Northern leopard frog
Rana catesbeiana	Bullfrog
Rana clamitans	Northern Green frog
Rana areolata	Crawfish frog
Rana blairi	Plains leopard frog
Regina grahamii	Graham's crayfish snake
Scaphiopus bombifrons	Plains spadefoot
Scaphiopus hurteri	Hurter’s spadefoot
Sceloporus undulatus hyacinthinus	Fence lizard
Scincella lateralis	Ground skink
Sistrurus miliarius	Western pygmy rattlesnake
Sonora semiannulata	Ground snake
Sternotherus odoratus	Common musk turtle
Storeria dekayi	Brown snake
Storeria occipitomaculata	Red-bellied snake
Storeria dekayi	Brown snake
Tantilla gracilis	Flat-headed snake
Terrapene carolina triunguis	Eastern box turtle
Terrapene ornata	Ornate box turtle
Terrapene carolina	Eastern box turtle
Thamnophis sirtalis parietalis	Common garter snake

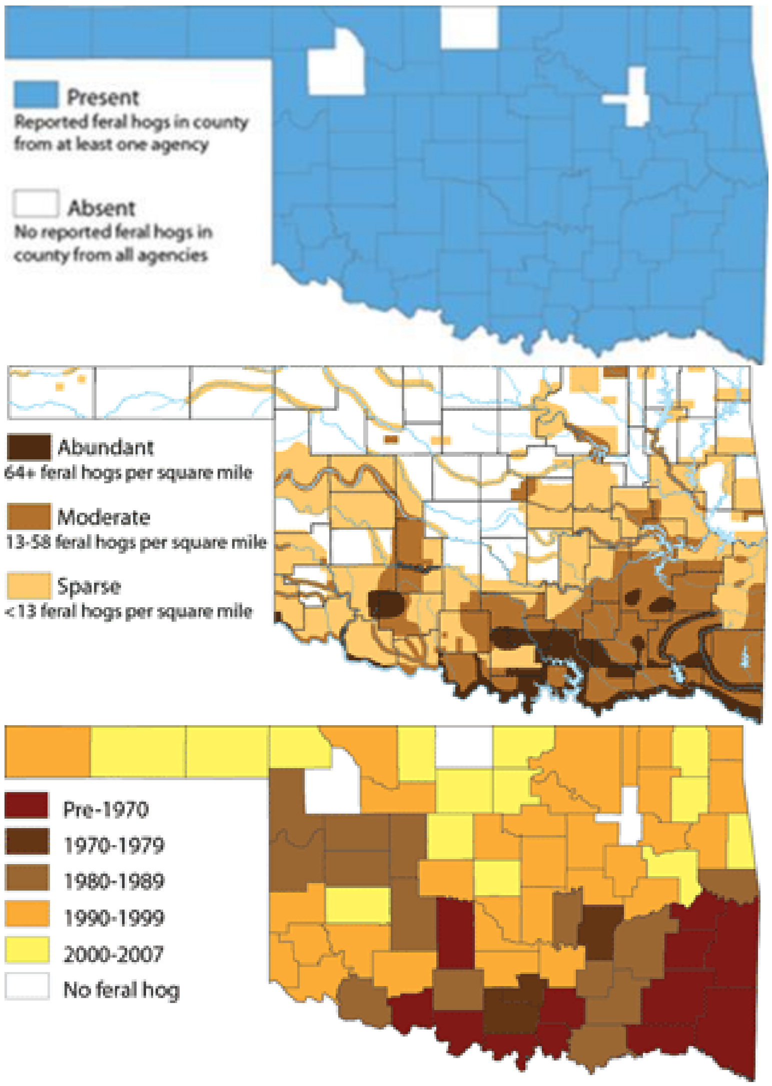
Scientific Name	Common Name
Thamnophis proximus	Western ribbon snake
Thamnophis sirtalis	Common garter snake
Trachemys scripta	Common slider
Trionyx spiniferus	Spiny softshell turtle
Tropidoclonion lineatum	Lined snake
Typhlotriton (eurycea) spelaeus	Grotto salamander
Virginia striatula	Rough earth snake

Source: OBS, DOKARRS, Accessed May 13, 2016.

6.4.4. Invasive Wildlife Species

The density of Oklahoma's feral swine (*Sus scrofa*) population continues to increase throughout the state as result of natural range expansion, illegal trapping and movement, and accidental releases from domestic swine operations (Oklahoma Department of Agriculture, Food, and Forestry Oklahoma Forestry Service [ODAFF] 2016). Accordingly, feral swine populations include former domestic pigs, hybrids, and free-roaming European wild boars. Feral swine have been noted in the counties comprising the Project vicinity (Figure 6.4-4). Although able to adapt to a variety of habitats, the preferred habitats of feral swine are bottomlands and riparian areas; habitats that occur within and near the Project Boundary (Noble Foundation 2016). Swine rooting for food can cause large areas of disturbance that may lead to soil erosion, water quality degradation, and property damage (ODAFF 2016). Additionally, feral swine are known to consume prey such as ground-nesting birds. Pursuant to 2 O.S. §6-2 (2011), an emergency order banning the import of feral swine into Oklahoma was issued on July 2, 2015.

Invasive insects are also a growing concern in Oklahoma; examples include the gypsy moth, emerald ash borer, and introduced wood wasp (OFS 2007).



Source: Nobel Foundation 2016.

Figure 6.4-4. Feral swine distribution and abundance in Oklahoma.

6.4.5. Commercially, Recreationally, or Culturally Important Species

Commercially important species include timber harvested from trees found within the Oak-hickory forests of northeastern Oklahoma (ODAFF 2010). Native plants used as hay and feed for livestock are among the most widely used natural resources (OBTF 2005). Important game species in the region include small game such as doves, quails, rabbits, turkeys, ducks, and squirrels and large game such as deer. Nighttime raccoon hunting and trapping are also common pastimes and are deeply rooted in Oklahoma tradition (ODWC 2011). Additional information on these species is provided in Section 6.4.2 Wildlife of this PAD.

Wildlife and botanical resources in the area used by Indian tribes include hundreds of species of plants, freshwater mussels, crayfish, fishes, large game, and numerous species of small game (U.S. Department of Interior [USDI] 2014). Some of these resources provide sources of sustenance and contribute a component to both ceremony and cultural ideology (USDI 2014).

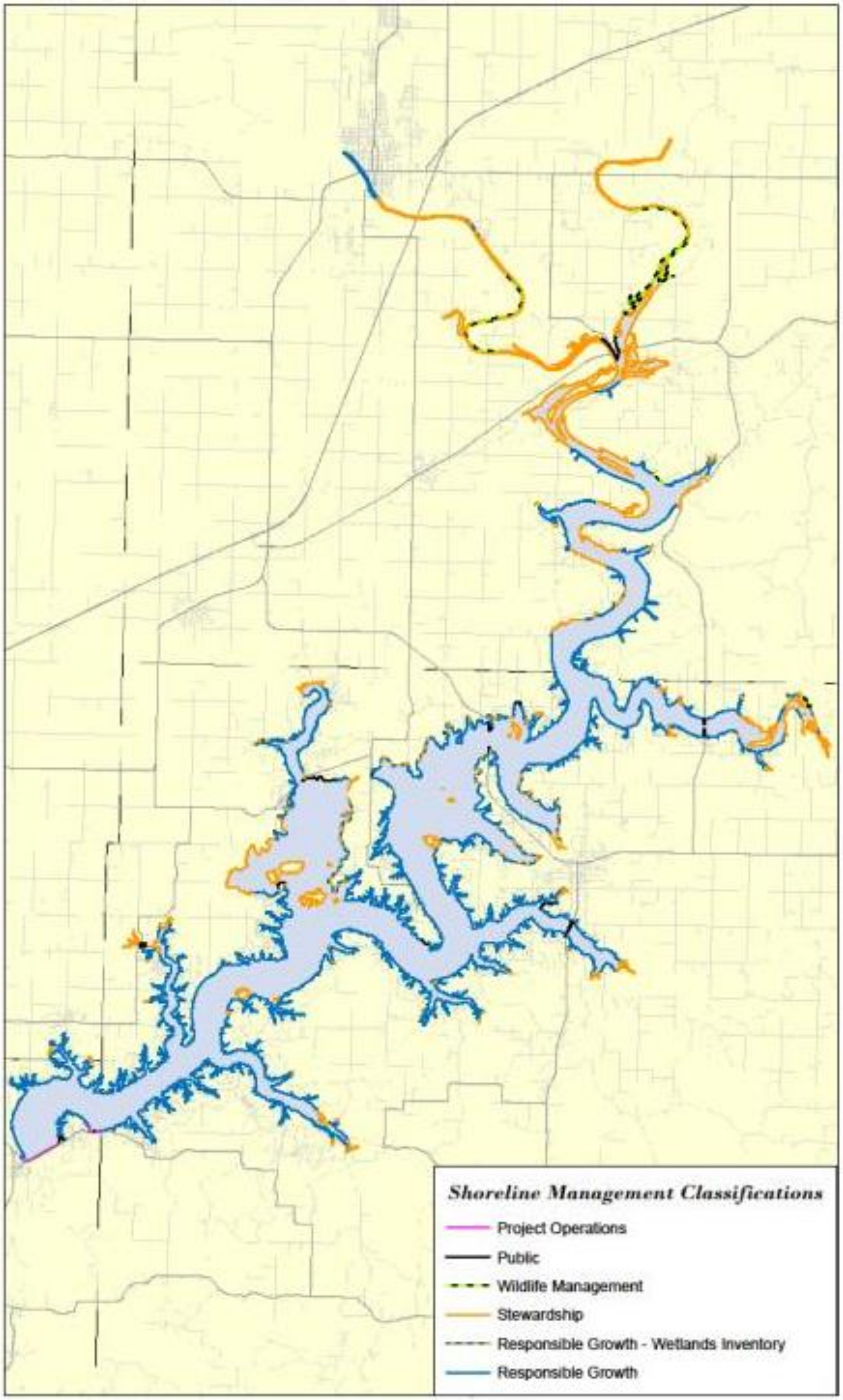
6.5 Floodplains, Wetlands, Riparian, and Littoral Habitat

6.5.1. Overview

The Pensacola Project reservoir, Grand Lake, has a surface area of approximately 45,200 acres, with about 667 miles of shoreline extending nearly 66 miles upstream from the Project Dam. The reservoir's normal maximum water surface elevation is 745 feet with a storage capacity of 1,680,000 acre-feet. The Project includes a shoreline buffer zone up to elevation 750 feet (generally the elevation of the Project Boundary). Pursuant to Article 401 of the Pensacola FERC license, as amended in 1996, GRDA was granted the authority to operate the Project to a target rule curve to control fluctuations of the reservoir surface elevation for the protection of fish, wildlife, and recreational resources associated with the Grand Lake reservoir (FERC 1996). Water storage and release operations are shared between GRDA and USACE as part of a basin-wide system of flood control and navigation projects (GRDA 2008) pursuant to USACE's exclusive responsibilities for flood control operations under the Flood Control Act of 1944.

GRDA, in coordination with interested parties, developed a SMP in 2008 that was approved by FERC in 2013 (GRDA 2008; FERC 2013). Land use along Grand Lake's shoreline is managed through a permitting system described in the SMP. Management regulations preclude construction below elevation 750 feet without prior authorization from GRDA. Figure 6.5-1 shows the SMP's six Shoreline Management Classifications (SMC): Project Operations Areas, Municipal/Public Use Areas, Stewardship Areas, WMAs, Responsible Growth Areas, and Responsible Growth-Wetlands Areas. The SMP helps define management responsibilities of both GRDA and FERC under the Project's license and the FPA, respectively (GRDA 2008), and is further described in Section 6.7 Recreation and Land Use of this PAD.

Areas adjacent to Grand Lake's shoreline, including floodplain, wetland, and riparian areas, provide habitat for many species of wildlife and plants (see Section 6.4 Wildlife and Botanical Resources of this PAD). In addition to resident species, a number of species of migratory land birds and waterfowl use the shoreline and wetland areas at Grand Lake for breeding and rearing young in the summer or for forage and shelter while overwintering.



Source: GRDA 2016c.

Figure 6.5-1. Shoreline management classifications, Pensacola Project.

6.5.2. Floodplains

Grand Lake water surface elevation within the conservation pool (up to elevation 745 feet) is managed for power generation and other public uses, and is governed by the Article 401 rule curve that varies seasonally between 741 and 744 feet. The Project Boundary generally follows elevation 750 feet, and USACE manages a flood control pool up to elevation 755 feet for purposes of discharging its responsibilities under the Flood Control Act of 1944. Flood studies have been conducted near the community of Miami at the confluence of the Neosho River and Tar Creek at the northern extent of the reservoir. The latest analysis was included as an appendix to GRDA's recent application for an amendment to the rule curve (GRDA 2016b). Using data from flood events over the last 30 years, City of Miami, FERC and GRDA conducted modeling of potential flood water levels upstream at Miami and downstream below the Pensacola Dam (GRDA 2016b; Tetra Tech 2015, 2016).

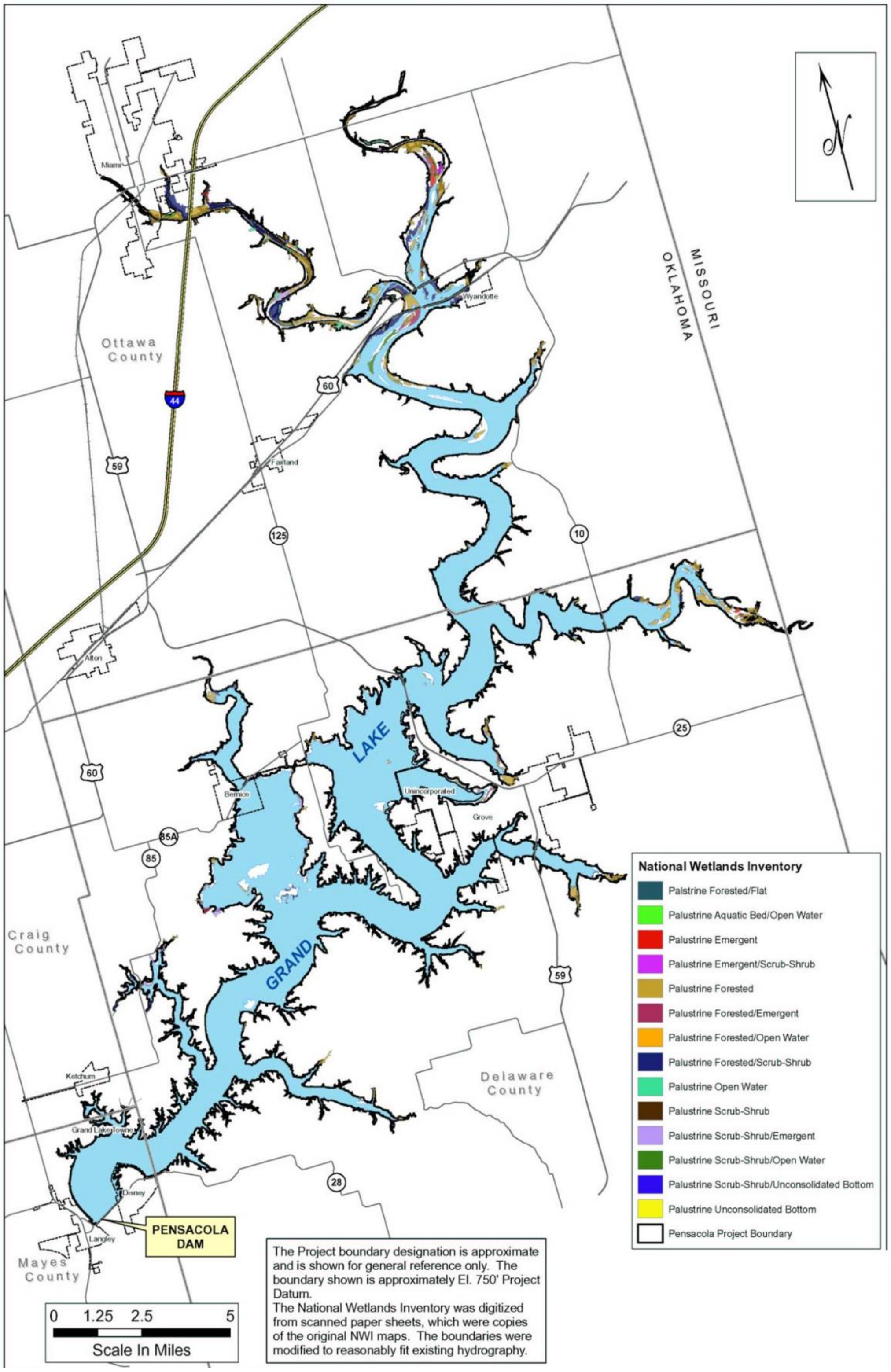
Riparian and wetland habitats within the floodplains are described below. Mapped wetlands are shown in Figure 6.5-2 and nearshore vegetation types in Figure 6.4-2 (see Section 6.4 Wildlife and Botanical Resources of this PAD).

6.5.3. Wetlands

Wetlands are areas that are temporarily, intermittently, or permanently inundated by surface water, or are permanently saturated by groundwater. USACE regulates certain activities within wetlands under Section 404 of the Clean Water Act. USACE criteria for jurisdictional wetlands require that the following three-parameter criteria are met, including: the presence of hydrophytic vegetation, hydrology, and hydric soils (USACE 1987). The beneficial functions of wetlands include providing breeding and foraging habitat for wildlife, habitat for wetland adapted plants, floodwater retention, and water quality maintenance.

Wetlands in the Project vicinity are confined to inlets and coves along the numerous small tributaries that enter the reservoir and are more abundant along the upper, shallower reaches of the northern and western shores of the reservoir where silty soils and gently sloping banks provide favorable conditions for wetland vegetation (GRDA 2008). Shoreline areas within the reservoir's lower reaches primarily consist of limestone bluffs, with wetlands restricted to coves and backwaters of inundated tributaries. Some of the limestone formations along the reservoir contain extensive cave systems and are further described in Section 6.5.5 of this PAD (FERC 1992; GRDA 2004). Figure 6.5-2 shows locations of mapped wetlands within the Project Boundary. Acreages of the various wetland types occurring in the Project vicinity are summarized in Table 6.5-1.

Project vicinity wetlands support a wide variety of wildlife, including large and small mammals, birds, amphibians, and migratory birds (FERC 1996). Emergent vegetation within wetlands of the northern and western shores primarily consists of herbaceous plants such as smartweeds (*Polygonum* spp.), sedges (*Carex* spp.), and reed canary grass (*Phalaris arundinacea*). Bottomland woody species such as black willow (*Salix nigra*), eastern cottonwood (*Populus deltoids*), and silver maple (*Acer saccharinum*) are also present (FERC 2015). Under its current license, GRDA initiated an experimental millet seeding program to increase aquatic vegetation for fish nursery habitat and waterfowl food supply; however, the program did not achieve the desired results and was discontinued in 2011. As an alternative mitigation to the millet seeding program, since 2007, GRDA in coordination with other resource agencies has acquired 540 acres that includes wetlands providing important wildlife habitat (GRDA 2016a; ODWC 2016).



Source: GRDA 2008.

Figure 6.5-2. Wetlands mapped within the Project Boundary along Grand Lake.

Table 6.5-1. Wetland cover types by elevation zone at Grand Lake.

Wetland Cover Types	Elevation Zones (values in acres)			
	735-742 feet[1]	742-755 feet	755+ feet[2]	Totals
Palustrine Forested Wetlands[3]	1,720	5,555	4,374	11,649
Emergent Wetlands	34	145	55	234
Scrub/Shrub Wetlands	194	268	64	526
Mudflats	4,994	645	23	5,662
Ponded Water	89	70	88	247
Totals	7,031	6,683	4,604	18,318

Source: GRDA 2008, as adapted from Erickson and Leslie 1988.

Notes:

1 Elevations 735 to 742 feet are included since the study was conducted under the pre-1992 rule curve when these elevations were occasionally exposed. Since that time, many of the included areas have become permanently inundated.

2 To 0.25 mile from 755-foot elevation.

3 Referred to as Bottomland or Floodplain Forests (Erickson and Leslie 1988).

6.5.4. Riparian

Lands adjacent to bodies of water are known as riparian areas which provide benefits to both terrestrial and aquatic ecosystems (GRDA 2010). Healthy riparian areas provide numerous benefits by playing an important role in improving water quality, protecting adjacent aquatic habitats, and preserving biodiversity. Riparian areas serve as an important source of food and shelter for terrestrial species and as effective corridors for wildlife movement between fragmented habitats. GRDA has in place a SMP and VMP to provide for stewardship of riparian habitats surrounding Grand Lake (GRDA 2004, 2011).

Vegetation in the vicinity of the reservoir varies from tall grass prairie and pasturelands, to forests, to introduced landscaping in developed areas (Figure 6.4-2 in Section 6.4 Wildlife and Botanical Resources of this PAD). Forested riparian corridors on the shoreline of Grand Lake are typically dominated by canopies of American elms (*Ulmus americana*), oaks (*Quercus* spp.), hackberry (*Celtis* spp.), black walnuts (*Juglans nigra*), sycamores (*Platanus occidentalis*), and pecans (*Carya illinoinensis*)(Woods et al. 2005). Lowland areas and stream corridors in the Project vicinity are typically dominated by canopies of eastern cottonwoods (*Populus deltoides*), willows, green ash (*Fraxinus pennsylvanica*), elms (*Ulmus* spp.), and maples (*Acer* spp.)(FERC 2004). All large woody vegetation below elevation 746 feet is regrowth following clearing at the time of Project construction (FERC 2004). Understory shrubs and vines found in upland riparian areas of the Project vicinity include poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), trumpet creeper (*Campsis radicans*), greenbriars (*Smilax* spp.), coral berry (*Symphoricarpos orbiculatus*), and rough leaf dogwood (*Cornus drummondii*)(Barbander et al. 1985).

6.5.5. Littoral

Most of the land surrounding Grand Lake is privately owned, and developed with private homes, condominiums, docks, municipal and state parks, and commercial resorts and marinas. Current uses of the shoreline also include agriculture and WMAs. As of 2016, an estimated 6,000 private residences exist along the shoreline of Grand Lake. Overall, the character of Grand

Lake's shorelines varies widely; ranging from forested areas with numerous vegetative cover types, to residential housing, commercial development, and contiguous manicured lawns. Deciduous forests dominate the river basin in the Project vicinity. GRDA has in place a SMP and a VMP to manage activities within the Project Boundary for protection and maintenance of shoreline conditions (GRDA 2008, 2011).

The shorelines of upper Grand Lake along the northern and western borders are generally typified by gentler slopes, while along the southern and eastern borders, shorelines are characterized primarily by steep rocky beaches and bluffs (GRDA 2008). Upper Grand Lake is primarily continuous sections of undeveloped shoreline (GRDA 2008). In the reservoir's lower reaches, shoreline areas primarily consist of limestone bluffs that are mainly developed. Generally, Grand Lake's shores consist of stony, silt-loam soils on slopes with a gradient of 5 to 20 percent. Maintaining vegetated shorelines is an integral component of both the SMP and VMP to help stabilize and control the potential effects of erosion (GRDA 2008, 2011). Guidelines outlined in the SMP and VMP are intended to mitigate ground-disturbing activities and to monitor the shoreline to ensure that erosion of Project lands that result from permitted uses is addressed (FERC 2009). Restrictions on boat traffic, shoreline construction, tree removal, and landscaping are among the regulations in the SMP and VMP (FERC 2009; GRDA 2008, 2011). In addition, habitat enhancement strategies that reintroduce native vegetation in the littoral zone also provide forage and shelter to migrating waterfowl and aquatic species, such as fish and turtles (OWRB 2005; GRDA 2008).

6.6 Rare, Threatened, and Endangered Species

6.6.1. Overview

A search of federal and state databases – the USFWS Ecological Conservation System (ECOS), the Information Planning and Conservation System (IPaC), the ODWC, and the Oklahoma Natural Heritage Inventory (ONHI) – indicated five species listed under the Endangered Species Act of 1973 (ESA) as endangered may occur in the Project vicinity: the gray bat (*Myotis grisescens*), the Indiana Bat (*Myotis sodali*), the Ozark big-eared bat (*Corynorhinus townsendii ingens*), the Neosho mucket (*Lampsilis rafinesqueana*), and the American burying beetle (*Nicrophorus americanus*)(Table 6.6-1).

Seven species listed as threatened under the ESA potentially occur in the Project vicinity and include the northern long eared bat (*Myotis septentrionalis*), the piping plover (*Charadrius melodus*), the rufa red knot (*Calidris canutus rufa*), the Ozark cavefish (*Amblyopsis rosae*), the Neosho madtom (*Noturus placidus*), the rabbitsfoot mussel (*Quadrula cylindrical cylindrical*), and the Western prairie-fringed orchid (*Planthera praeclara*). One candidate species, the Arkansas darter (*Etheostoma cragini*), has a range that includes portions of the Project vicinity.

Two endemic crayfish, the Delaware County cave crayfish (*Cambarus subterraneus)* and the Oklahoma cave crayfish (*Cambarus tartarus*), both state-listed endangered species, are known to occur solely within a few caves in Delaware County (Graening et al. 2006; ODWC 2015a). Two other species, the blackside darter (*Percina maculata* – threatened) and the longnose darter (*Percina nasuta* – endangered) are listed by the state for the Ozarks Region, but are not known to occur in the counties surrounding the Pensacola Project (ODWC 2015b, 2015c).

Tables in Attachment H compile all state-designated Species of Greatest Conservation Need and rare and vulnerable plants potentially in the Project vicinity. There are currently 144 Species of Greatest Conservation Need (also includes threatened and endangered species) potentially found near the Project – among them are mammals, birds, reptiles, amphibians, invertebrates, and plants (ODWC 2015a, 2015b; ONHI 2016). In addition, the ONHI, which tracks biodiversity world-wide, lists four rare and/or vulnerable plants in the Project vicinity (ODWC 2015a; ONHI 2016).

Table 6.6-1. Animal and plant species potentially occurring in the Pensacola Project vicinity that appear on federal endangered (E), threatened (T), and candidate (C) lists.

Scientific Name	Common Name	Federal Listing
Mammals		
Myotis grisescens	Gray bat	E
Myotis sodalis	Indiana bat	E
Myotis septentrionalis	Northern long-eared bat	T
Corynorhinus townsendii ingens	Ozark big-eared bat	E
Birds		
Charadrius melodus	Piping plover	T
Calidris canutus rufa	Rufa red knot	T
Fish		
Etheostoma cragini	Arkansas darter	C
Noturus placidus	Neosho madtom	T
Amblyopsis rosae	Ozark cavefish	T
Invertebrates		
Lampsilis rafinesqueana	Neosho mucket	E
Quadrula cylindrical cylindrical	Rabbitsfoot mussel	T
Nicrophorus americanus	American burying beetle	E
Plants		
Planthera praeclara	Western prairie-fringed orchid	T

6.6.1.1 Mammals

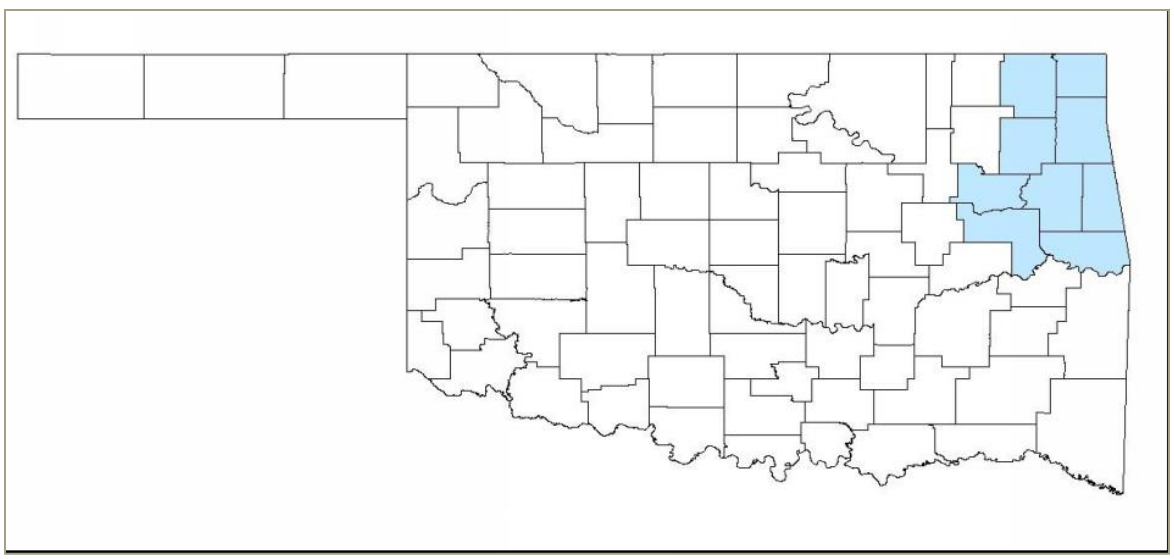
Gray Bat

The gray bat was federally listed as an endangered species on April 29, 1976 (41 FR 17736-17740, amending 50 CFR §17.11). The gray bat is classified as endangered wherever found, although at this time no critical habitat has been designated (USFWS 2011b). The current recovery plan for the gray bat was finalized on July 8, 1982 (USFWS 1982) and there is no conservation plan for the species.

The federally endangered gray bat is found in limestone karst areas of the southeastern United States. Figure 6.6-1 shows their range in Oklahoma. Flying aquatic and terrestrial insects along rivers and lakes are primary sources of food. Under requirements for the SMP for the Project, GRDA conducted surveys in summer 2015 to determine gray bat foraging areas along the Grand Lake shoreline (GRDA 2016b). Of 100 bat detections, 15 were identified as gray bats; however, no distinct foraging areas were found.

Female gray bats give birth to a single young in late May or early June. Gray bats live in caves year-round, although they migrate from caves along rivers in the summer to deep vertical caves in the winter (USFWS 1997a). The primary cause of declining populations of gray bats is their vulnerability to human disturbance due to reliance on a small number of caves for hibernation and propagation. Over time, these bats have suffered habitat loss and population declines as a result of human disturbances during critical life stages.

Gray bats rely on two caves near the Grand Lake reservoir: Beaver Dam Cave and Twin Cave. Beaver Dam Cave is located at an elevation somewhat less than 745 feet adjacent to Drowning Creek, a tributary of Grand Lake. Twin Cave is located approximately one kilometer (km) from Grand Lake at an elevation of 840 feet (GRDA 2015, 2016b). Both caves are south and east of Grand Lake in the Ozark Plateau karst topography. Annual surveys of gray bats have been conducted at caves within the Project vicinity since 2007. The averages of estimated populations – when bats were present – from 2007 through 2015 were 12,226 and 15,659 individuals at Beaver Dam Cave and Twin Cave, respectively. Based on those surveys, gray bats have not been found at Beaver Dam Cave when the water elevation reaches 752 feet. Beaver Dam Cave is a maternity roost and most bats vacate the cave by late summer when the young can fly (GRDA 2015, 2016b). The size and status of the colony has remained relatively constant for the last 25 years according to recent exit and capture surveys (GRDA 2015, 2016b). Modifications to the cave were done in coordination with USFWS and Roger State University to provide a secondary exit which the maternity colony used in 2015 when otherwise the main entrance to the cave would have been inundated. Shoreline acoustic bat surveys in 2015 and 2016 found this species to be the second most a commonly detected bat on Grand Lake (Martin and Zimmerman unpublished).



Source: ODWC 2015a.

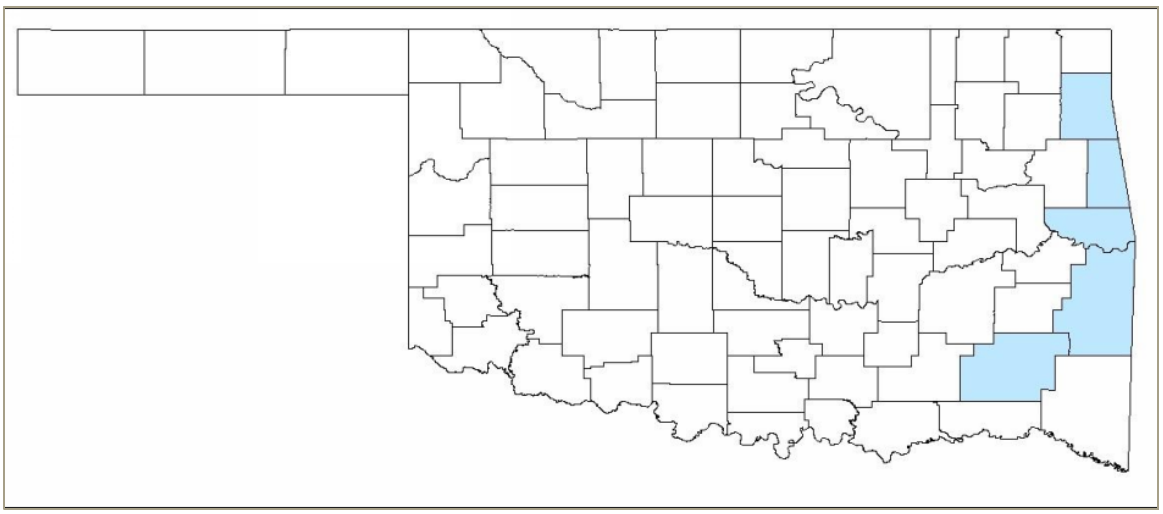
Figure 6.6-1. Gray bat range.

Indiana Bat

The Indiana bat is listed as federally endangered. Indiana bats use only a few caves for hibernating but congregate in large numbers. Hibernation caves can house 20,000 to 50,000 bats. The effects of disturbance during hibernation has resulted in the Indiana bat being listed as endangered as early as 1967 (USFWS 2006). Loss of caves and summer habitat, the effects of pesticides and other contaminants, and white-nose syndrome

(WNS)(*Pseudogymnoascus destructans*) have all contributed to the bat's decline. A recovery plan was developed in 1983 and is currently being revised (USFWS 2006). Critical habitat has been designated in several states, but not in Oklahoma or the Project vicinity (USFWS 2007a).

The Indiana bat has a wingspan of 9 to 11 inches and weighs about a quarter of an ounce. During hibernation the bats roost in caves, but in summer months crawl under the loose bark of dead or dying trees. Maternity colonies under tree bark can contain groups of up to 100 bats. The bats mate in fall before hibernating but do not become pregnant until they emerge in the spring. They eat a variety of insects found flying near rivers, lakes, and uplands. The current range of the Indiana bat extends into Oklahoma (ODWC 2015a) in the vicinity of the Project (Figure 6.6-2). No Indiana bats were detected during shoreline acoustic surveys in 2015 or 2016 along the shoreline of Grand Lake (GRDA 2016b; Martin and Zimmerman unpublished).



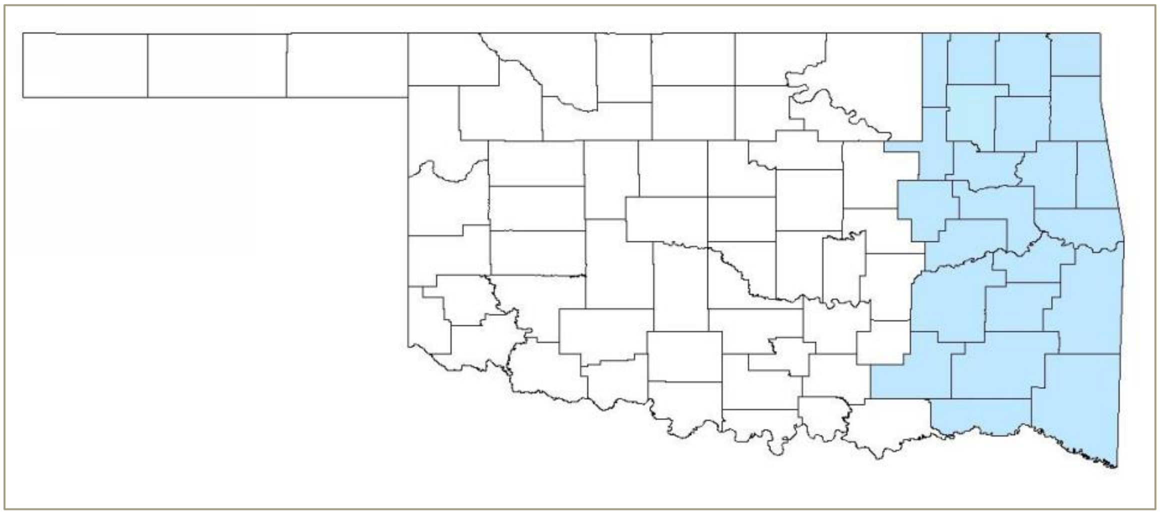
Source: ODWC 2015a.

Figure 6.6-2. Indiana bat range.

Northern Long-Eared Bat

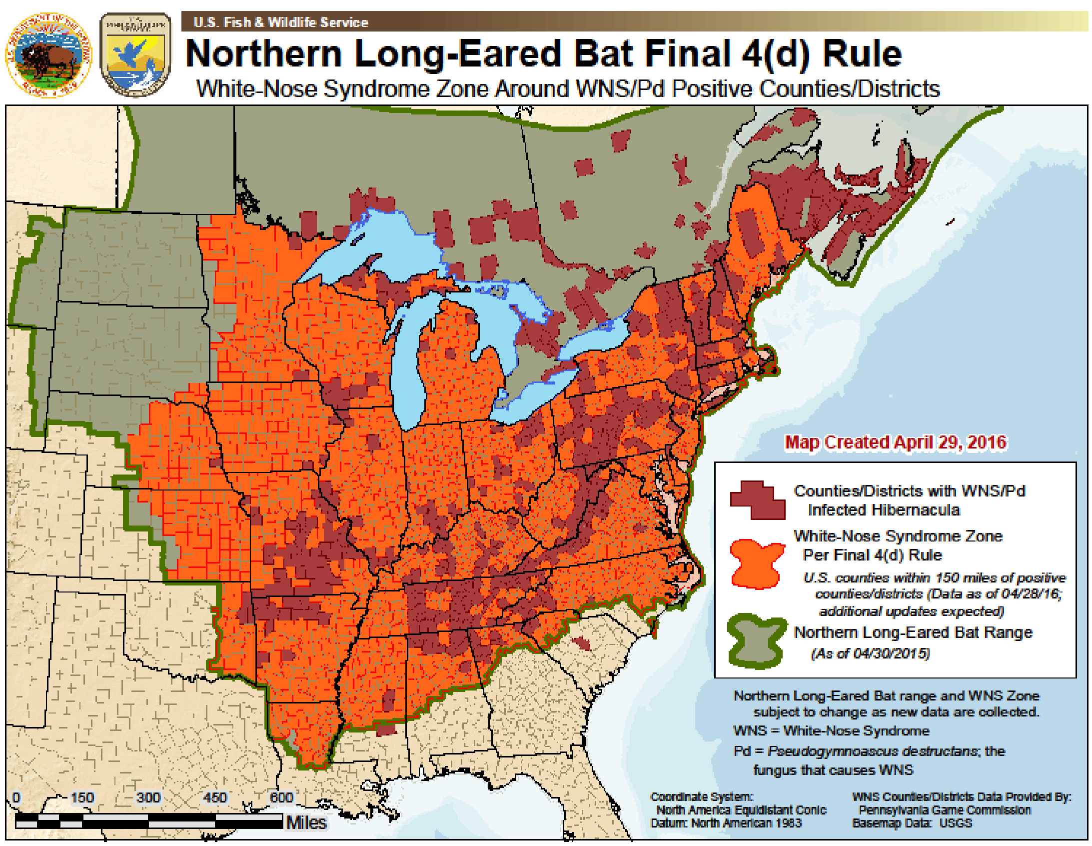
The northern-long eared bat is federally listed as threatened. The northern long-eared bat is a medium-sized bat with a body length of 3 to 3.7 inches and a wingspan of 9 to 10 inches (USFWS 2016d). The northern long-eared bat is one of the bat species most critically affected by the fungal (*Pseudogymnoascus destructans*) disease known as WNS. Due to continued spread of the disease resulting in significantly declining populations, the northern long-eared bat was federally listed as threatened in April 2015 (80 FR 17974, amending 50 CFR §17.11). In January 2016, USFWS also developed a Final 4(d) Rule that rule specifically defines the "take" prohibitions for the northern long-eared bat. This species is found throughout much of the eastern and north central United States, as well a large portion of Canada. Northern long-eared bats hibernate in caves and mines during the winter, and during the spring and summer, they roost singly or in colonies on both live and dead trees in upland forests (USFWS 2016c). During autumn, northern long-eared bats typically swarm the wooded areas surrounding caves and mines prior to hibernation. The Pensacola Project is located within the range of northern long-eared bats (Figure 6.6-3), and were detected during bat surveys conducted by GRDA in summers of 2015 and 2016 under requirements of the SMP (GRDA 2016b; Martin and Zimmerman unpublished). The Project vicinity has been designated a WNS Zone per USFWS'

Final 4(d) Rule (Figure 6.6-4). On April 27, 2016, the USFWS announced their decision that determination of critical habitat for the northern long-eared bat is not prudent at this time.



Source: ODWC 2015a.

Figure 6.6-3. Northern long-eared bat range.



Source: USFWS 2016e.

Figure 6.6-4. Map of classified WNS zone areas subject to the Final 4(d) Rule.

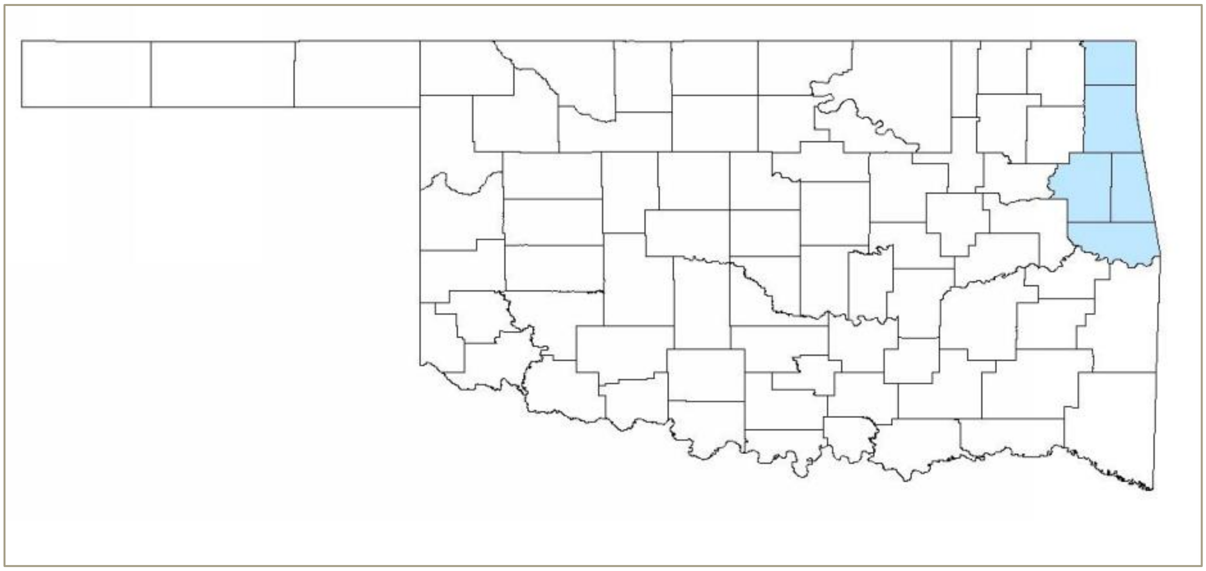
Ozark Big-Eared Bat

The Ozark big-eared bat was federally listed as endangered on November 30, 1979 (44 FR 69206 69208, amending 50 CFR §17.11). At this time, critical habitat has not been conclusively designated for Ozark big-eared bats. On March 28, 1995, the Ozark Big-Eared Bat Revised Recovery Plan final revision was published (USFWS 1995).

The Ozark big-eared bat is a medium-sized bat (about 3.5 to 4.5 inches long) with distinctively large ears (1.2 to 1.5-inches long) and prominent lumps on either side of the face. Ozark big-eared bats have a wingspan of 12 to 13 inches and weigh between 5 to 13 grams. The bats' long fur is light to dark brown on the back and lighter tan underneath. The Ozark big-eared bat has been federally listed as endangered since 1979. Presently, the range of Ozark big-eared bats includes the Ozark Highlands and the Boston Mountains ecoregions of northeastern Oklahoma and northwestern and north-central Arkansas (Figure 6.6-5). The Ozark big-eared bat is endemic to those ecoregions (USFWS 2008) and occurs in oak-hickory hardwood forests (USFWS 1995). Although their range and suitable habitat extends into the Project vicinity, no Ozark big-eared bats were identified during surveys conducted in 2015 under requirements of the SMP (GRDA 2016b). Current population estimates have reported about 1,800 total individuals (USFWS 2011d). Limestone and sandstone talus caves are the bats' typical habitat preference and are used year-round (USFWS 2008). Mating occurs during fall and winter.

Typically, colonies begin to form at hibernaculum, which occurs during October and November. Hibernation occurs with both sexes in clusters ranging anywhere from 2 to 135 individuals. Colonies hibernating in clusters slowly begin to disperse from April through May. During this time, females also become pregnant and slowly begin to congregate at warm maternity caves to give birth and rear their young over the summer. The formation of maternity colonies typically occurs between late April and early June. Disturbance during the sensitive maternity period can result in cave abandonment; thus, mortality of their young. Ozark big-eared bats generally return to the same maternity caves each year (Clark et al. 1996). Females give birth to a single offspring in May or June after a two-three month gestation period. Generally, young bats mature rapidly; they are capable of flight at just three weeks and weaned by six. During the summer maternity period, males are solitary.

Ozark big-eared bats tend to forage in edge and forested habitats. They primarily feed on moths, but also are known to feed on other flying insects and beetles. Conservation and recovery efforts include locating and protecting caves used by Ozark big-eared bats and foraging habitat around the caves and educating the public about the bats' ecological importance and the dangers associated with disturbance of the bats' habitat (USFWS 2008). No Ozark Big Eared bats were detected during the 2015 and 2016 shoreline acoustic surveys (GRDA 2016b; Martin and Zimmerman unpublished).



Source: ODWC 2015a.

Figure 6.6-5. Ozark big-eared bat range.

6.6.1.2 Birds

Piping Plover

The Great Plains population of piping plovers was federally listed as threatened on December 11, 1985 (50 FR 50726–50734, amending 50 CFR §17.11). At this time, critical habitat has not been designated for piping plovers in Oklahoma (USFWS 2011g). Focused on breeding and wintering areas, the current recovery plan has no specific guidelines for Oklahoma. However, the current recovery plan has been revised and is under review (USFWS 2016d). There are only two nesting records for the piping plover in Oklahoma, both in the panhandle and there are no recent migration records for the Project vicinity (ODWC 2011b). The piping plover is a small (17-18 centimeters [cm] long, weighing 43-63 grams) shorebird with pale grayish-brown feathers and a white breast. The plover's bill is dull orange with a black tip, and its legs and feet are orange. Breeding plumage is typical of piping plovers arriving on wintering grounds and consists of a single black breastband and a black bar across the forehead (Haig 1992). The piping plover is a biannual migrant in Oklahoma, its range covering the entire state. It travels between nesting habitat to the north of the State - the Great Plains population nests from Kansas to southern Canada - and overwintering habitat on the gulf coast. The piping plovers' migrations through Oklahoma generally occur from March to May and from July to September. Typically, piping plovers migrate as individuals or small groups and may be seen along sandbars of major rivers, salt flats, and mudflats of reservoirs. They use bare or sparsely vegetated shoreline habitats to forage for small invertebrates. Piping plovers could potentially occur in suitable foraging habitats in the Project vicinity during migration.

Rufa Red Knot

The rufa subspecies of red knot was federally listed as threatened wherever found on January 12, 2015 (79 FR 73705 73748, amending 50 CFR §17.11). Query of the USFWS IPaC tool indicated that all of Oklahoma falls within the range of rufa red knots. At this time, no critical habitat has been designated for this species. Current conservation plans for the red knot include the Red Knot Cooperative Agreement (USFWS 2012).

The red knot is a medium-sized (23 to 28 cm in length) shorebird known as one of the longest distance migrants in the animal kingdom; annual migrations are generally up to 30,000 km (18,641 miles)(USFWS 2014a). During the breeding season, the red knot is easily identified by its rufous plumage. In Oklahoma, the red knot is considered to be a rare and irregular migrant whose range includes the entire state (Central Flyway Council 2013; USFWS 2014a). From 1962 to 2012, 39 occurrences of red knots in Oklahoma have been recorded by the ODWC (2013). While evidence shows a population of red knots migrates through the Great Plains annually (Newstead et al. 2013; USFWS 2014a), observational data has indicated red knots make landfall in Oklahoma infrequently (ODWC 2013). There are no sites in Oklahoma that are known to be used annually, and there are only 3 locations with more than 2 documented occurrences: Hefner Reservoir (14 observations), Salt Plains National Wildlife Refuge (7 observations), and Oologah Reservoir (3 observations)(Central Flyway Council 2013). Generally, red knots migrate at high altitudes over inland areas and have not been recorded in the Project vicinity (USFWS 2014a; ODWC 2013).

Bald Eagle

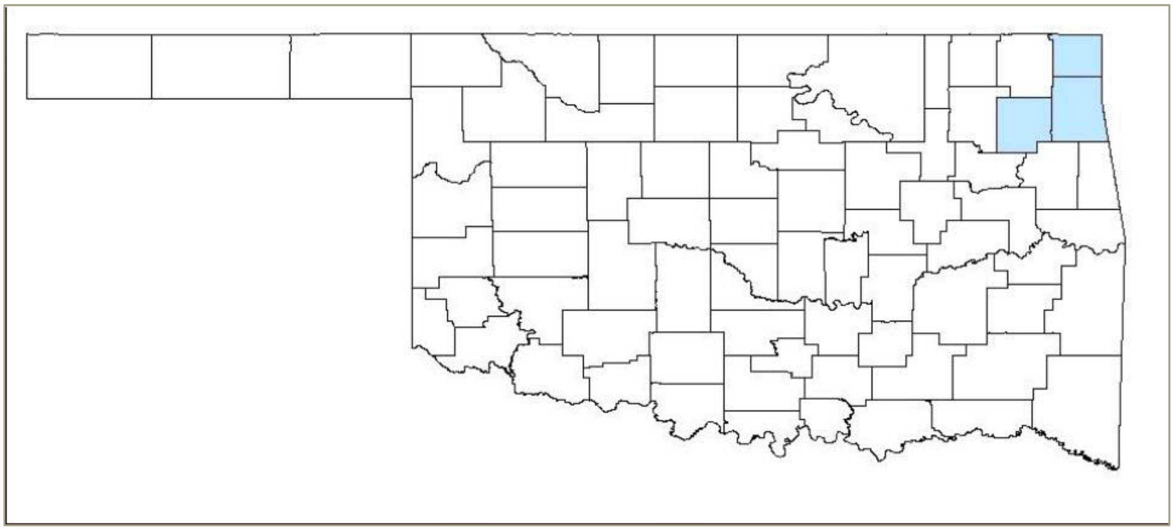
Once listed as endangered, the bald eagle was delisted in 2007 (USFWS 2007b). The bald eagle is still protected under the Bald and Golden Eagle Protection Act of 1940 as amended in 1978 and appears on Oklahoma's list of Species of Greatest Conservation Need (ODWC 2015c). In addition, the bald eagle is protected within the Project boundary under Article 407 of the current Project license, which "restrict(s) shoreline development in bald eagle high use areas" (GRDA 2008). Bald eagles both forage and nest in the vicinity of Grand Lake (GRDA 2016a). Bald eagles prey primarily on fish, but also consume waterfowl, small mammals, birds, and carrion. Grand Lake is an important wintering location with eagles frequenting; large trees and snags for roosting (GRDA 2008). A single day winter count of bald eagles for each of years 2013 through 2016 indicates an average of 86 (high of 156) adult and juvenile bald eagles at Grand Lake.

6.6.1.3 Fish

Ozark Cavefish

The Ozark cavefish was federally listed as a threatened species on November 1, 1984 (49 FR 43965 43969, amending 50 CFR §17.11). The Ozark cavefish is classified as threatened wherever found, although at this time, no critical habitat has been designated. The current recovery plan was finalized November 14, 1989, and no conservation plan has been created (USFWS 1997b; USFWS 2011e).

The Ozark cavefish is a small (up to 2.5 inches long) and sightless fish requiring clean-flowing, permanently dark cave streams, often with a rubble bottom (Masters 1993). This species occurs strictly in subterranean waters (Page and Burr 2011). Primary sources of food for the cavefish include plankton and bat guano (FERC 2009). A commensal association exists between this species and the federally endangered gray bat; there is some evidence that the Ozark cavefish feeds directly on the guano of gray bats (USFWS 1989). The shallow aquifer of the Springfield Plateau in the Ozark Highlands provides important habitat for this species (ODWC 2011a). The range of Ozark cavefish in Oklahoma is shown in Figure 6.6-6. While the Ozark cavefish is known to occupy 41 caves, only two caves contain approximately 80 percent of the countable population (USFWS 2011f). The Jailhouse and Twin Caves near Grand Lake are areas in which the Ozark cavefish is known to occur (GRDA 2016a). Jailhouse Cave is located on Summerfield Creek downstream of the dam and lies outside of the portion of the lake influenced by the rule curve. Located approximately 1 mile south of Grand Lake at 770 feet, Twin Cave is well above the flood control pool of 757 feet (GRDA 2016a).



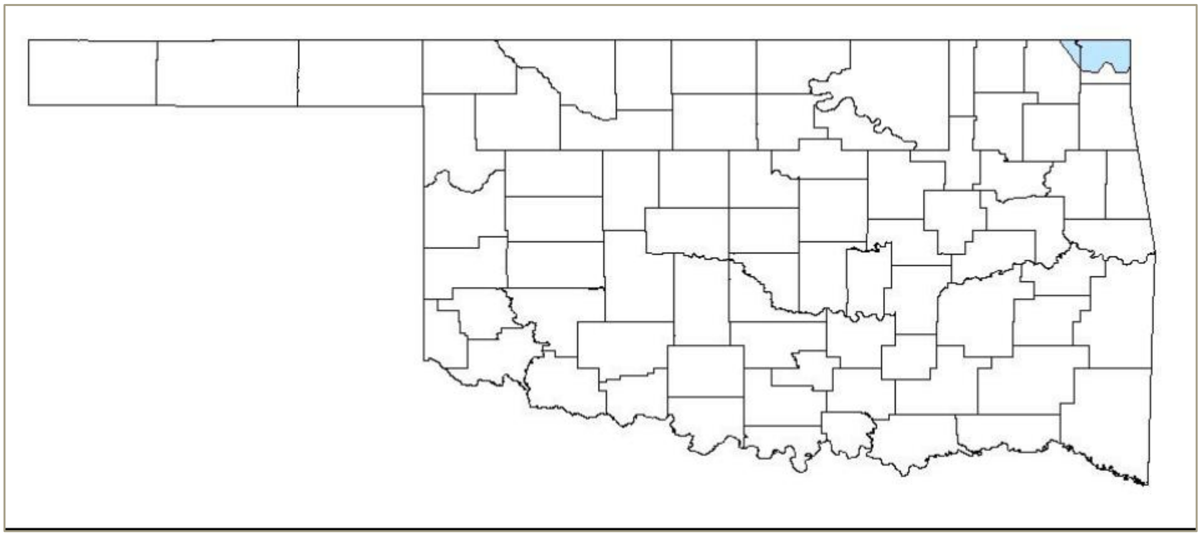
Source: ODWC 2015a.

Figure 6.6-6. Ozark cavefish range.

Neosho Madtom

The Neosho madtom was federally listed as a threatened species on May 22, 1990 (55 FR 21148 21153, amending 50 CFR §17.11). The Neosho madtom is classified as threatened wherever found, although at this time, no critical habitat has been designated. The current recovery plan was finalized September 31, 1991; there is no conservation plan for the species (USFWS 2011c).

The Neosho madtom is a small catfish (up to 3.25 inches in length), with only four known populations (USFWS 2011c). Figure 6.6-7 shows the range of the Neosho madtom in Oklahoma. This species feeds at night on the bottom of rivers and streams, and its habitat is primarily swift-flowing riffles and runs over gravel in small- to medium-sized rivers (Page and Burr 2011). The Neosho madtom occurs within the Project Boundary in the Neosho River upstream of Grand Lake at a site periodically inundated by the USACE flood control pool (GRDA 2004; FERC 2009). This species is not known to inhabit waters of lakes or reservoirs with any regularity.

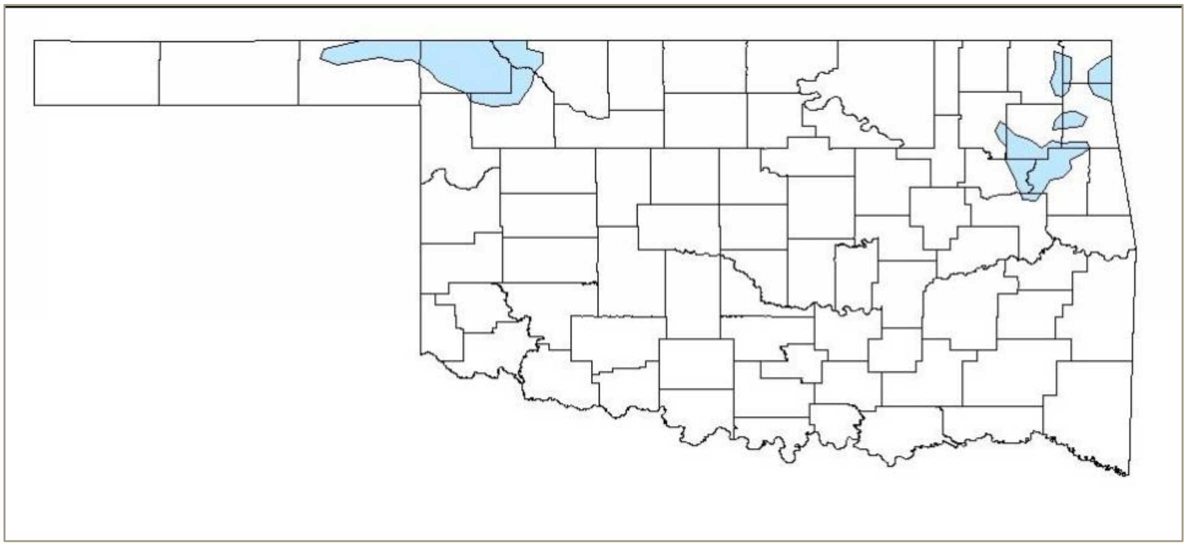


Source: ODWC 2015a.

Figure 6.6-7. Neosho madtom range.

Arkansas Darter

The Arkansas darter is a candidate species that has been proposed for federal classification under the ESA (50 CFR §17.11). The Arkansas darter is a small fish that favors habitat in spring-fed headwaters and creeks with cool, clear, shallow water, slow current, and herbaceous aquatic vegetation, such as growths of watercress or other aquatic plants; often occurring in pools with sand, fine gravel, or organic detritus substrate; and sometimes in turbid water away from springs (Lee et al. 1980; Cross and Collins 1995; Hargrave and Johnson 2003; Miller and Robison 2004; Page and Burr 2011, as cited in NatureServe 2014). Eggs are laid in gravel bottoms. The range of the Arkansas darter includes the Great Plains region of southeastern Colorado, southwestern and south-central Kansas, and northwestern Oklahoma, in addition to the Spring, Neosho (Grand), and Illinois River drainages of the Ozark Plateau region in southwestern Missouri, southeastern Kansas, northeastern Oklahoma, and northwestern Arkansas. The Arkansas darter population is geographically separated over its range due to habitat fragmentation. Development such as irrigation that affects groundwater inputs to streams and dams that inundate habitats and block migration has displaced and limited dispersal (USFWS 2011a, 2014b). Localized populations occurring in northern Oklahoma are found primarily within the Grand River system in the northeast and within the Cimarron River and its tributaries in the northwest (Pigg and Gibbs 1994; Miller and Robison 2004)(Figure 6.6-8). Tributaries of the Lower Neosho River in the vicinity of the Project, including streams that are tributaries to Grand Lake, are considered to contain populations of Arkansas darter (USFWS 2014b).



Source: ODWC 2015a.

Figure 6.6-8. Arkansas darter range.

6.6.1.4 Invertebrates

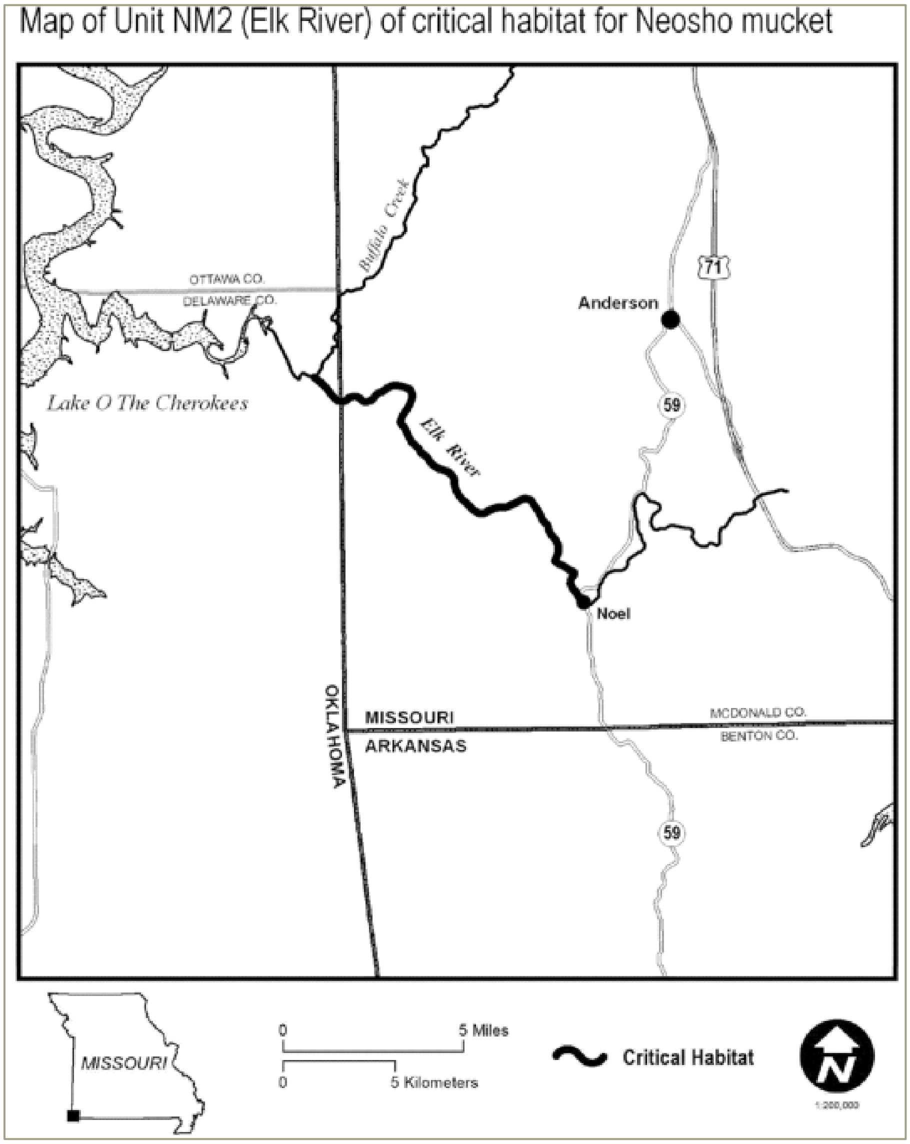
Neosho Mucket

The Neosho mucket, a freshwater mussel native to streams and rivers in four states including Oklahoma, is listed by state and federal governments as endangered (USFWS 2015a). The Neosho mucket generally inhabits gravel and sand in shoals and near shorelines in rivers (USFWS 2015a). Spawning occurs in May and is closely followed by brooding eggs and larvae from May to July (Shiver 2002). At a microscopic larval stage—the glochidia stage—the larva act as obligate parasites on fish gills.

The Neosho mucket was listed as federally endangered in 2013 and critical habitat was designated on April 29, 2015 (USFWS 2015a). The nearest critical habitat to the Project is in the Elk River above its confluence with Buffalo Creek (Figure 6.6-9). Designated critical habitat Unit NM2, the most downstream reach lies within the Project Boundary, which extends upstream in the Elk River as far as the state line (see Pensacola Project vicinity map Figure 1.0-1, Section 1 Introduction and Background of this PAD). However, the Final Rule states:

> "*When determining critical habitat boundaries within this final rule, we made every effort to avoid including developed areas such as dams, piers, and bridges, and other structures because such areas usually lack physical or biological features for the species. Areas designated as critical habitat for the Neosho mucket and rabbitsfoot include only stream channels within the ordinary high-water line and do not contain manmade structures (such as dams, piers and docks, bridges, or other similar structures), or areas inundated by lakes and reservoirs. The ordinary high-water line defines the stream channel and is the point on the stream bank where water is continuous and leaves some evidence, such as erosion or aquatic vegetation. The scale of the maps we prepared under the parameters for publication within the Code of Federal Regulations may not reflect the exclusion of structures or other developed areas. Any such areas*

inadvertently left inside critical habitat boundaries shown on the maps of this final rule have been excluded by text in the final rule and are not designated as critical habitat. Therefore, a Federal action involving these areas would not trigger section 7 consultation with respect to critical habitat and the requirement of no adverse modification unless the specific action would affect the physical or biological features in the adjacent critical habitat."



Source: USFWS 2015a.

Figure 6.6-9. Neosho mucket critical habitat designation.

Rabbitsfoot Mussel

Found in rivers and streams, the rabbitsfoot mussel was listed as federally threatened concurrent with the Neosho mucket on April 17, 2013. The rabbitsfoot mussel has been lost from an estimated 64 percent of its historical range (USFWS 2015a). Critical habitat was designated for both bivalve species on April 29, 2015. Critical habitat units RF1 (on the Spring River) and RF3 (on the Neosho River) are within the Neosho watershed. However, RF1 and RF3 are beyond the Project Boundary, in Missouri (approximately 18 miles) and Kansas (approximately 65 miles), respectively and unlikely to be affected by Project operations. Rabbitsfoot mussels prefer protected shallow-water habitat with sand and gravel substrate where they live as filter feeders, syphoning water through their gills. After fertilization the mussel's eggs are released into the water to develop into glochidia, a parasitic stage. As glochidia, the immature mussels parasitize shiner minnow for several weeks, when they drop off and transform into young mussels on the stream bottom (USFWS 2015a).

American Burying Beetle

The American burying beetle was federally listed as endangered in 1989 (54 FR 29652) by the USFWS in accordance with the ESA of 1973, as amended (16 U.S.C. 1531 et seq.). The American burying beetle is a habitat generalist and is associated with a wide range of soil types and vegetation communities (USFWS 2016a). Various habitat types where the beetle is known to occur include oak-pine woodlands, open fields, oak-hickory forest, open grasslands, and edge habitat. Generally, ecosystems supporting the beetles' populations are diverse. Suitable soils and vegetation layers are necessary for breeding; thus, habitat requirements are more selective for breeding as compared to feeding. Carrion provides a primary source of food; adults and larvae are dependent on carrion for food and reproduction (USFWS 2016a). The beetle's dependency on carrion results in competition with other invertebrates, as well as vertebrates.

As of 2015, the beetles known range in Oklahoma was 999,511 acres; of which, 11,875 acres occur in the counties of Craig, Delaware, and Mayes (USFWS 2016b). American burying beetles were recorded in Oklahoma as moving approximately 10 km in just 6 nights (Creighton and Schnell 1998, as cited in USFWS 2016b). USFWS has determined all areas within 30 km (18.6 miles) of all documented American burying beetle occurrences fall within the species' range (USFWS 2016a). Portions of counties on the eastern edge of Oklahoma that are not within 30 km of a documented occurrence have also been classified by USFWS as potential range (Figure 6.6-10). Recently, the USFWS identified Conservation Priority Areas for the American burying beetle in Oklahoma; one of those areas is located within the southwest portion of Mayes County, but outside the Project vicinity (USFWS 2016a)(Figure 6.6-10).

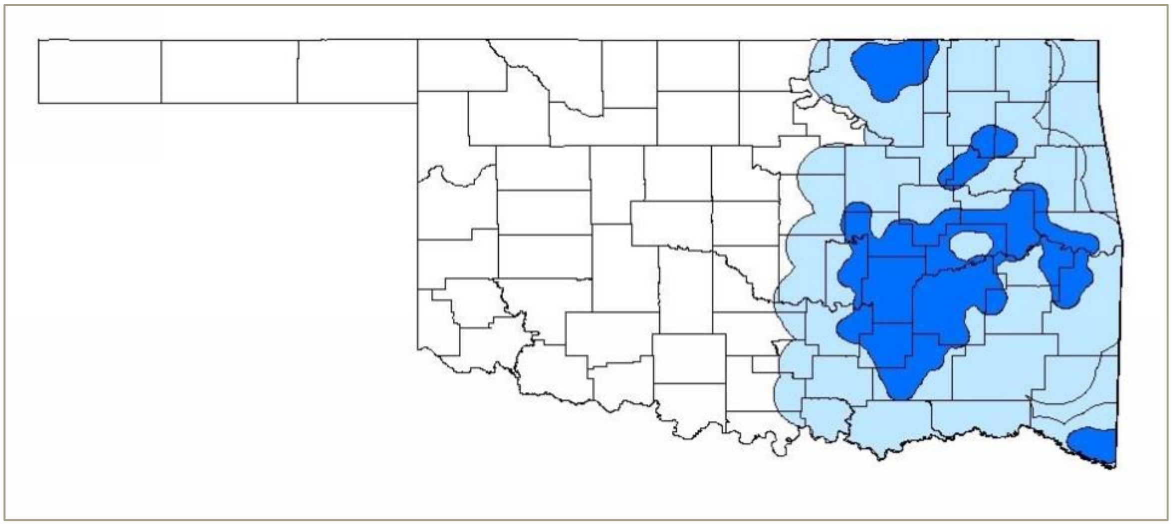
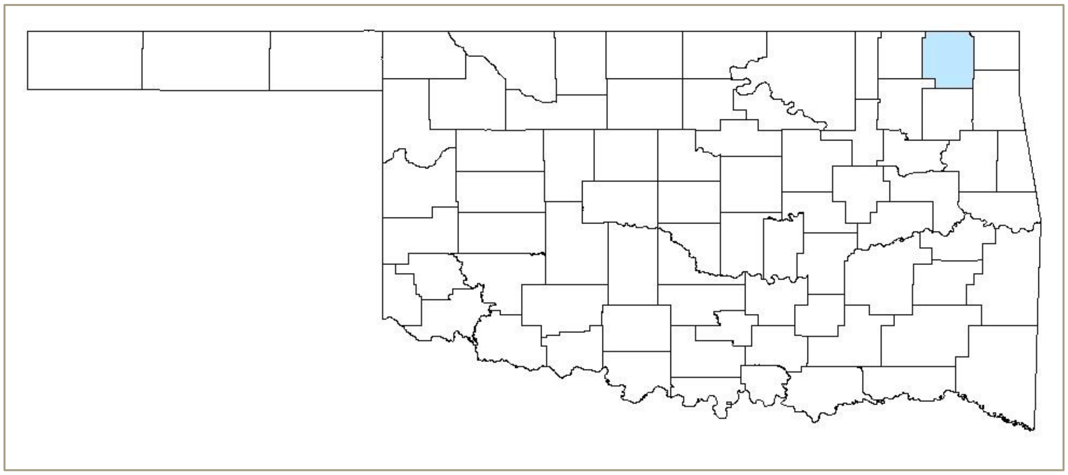


Figure 6.6-10. American burying beetle range (ODWC 2015a): dark blue shading indicates Conservation Priority Areas; light blue shading describes 30 km buffer zones around documented occurrences.

6.6.1.5 Plants

Western Prairie-Fringed Orchid

The western prairie-fringed orchid was added to the federal list of threatened species on September 28, 1989, and a recovery plan was issued in 1996 (USFWS 1996, 2015b). No critical habitat has been designated (USFWS 1996, 2009). The orchid produces a flower stalk up to 47 inches tall with as many as 40 white, one-inch-long flowers. Western prairie-fringed orchids prefer mesic to wet unplowed tallgrass prairies and meadows, but have been found growing in old fields and roadside ditches (USFWS 2015b). The flowers are fertilized by nocturnal hawkmoths. Seed germination and growth is dependent on a symbiotic relationship with soil fungus for proper water uptake and nutrition. Habitat loss is the greatest threat to these orchids and habitat protection is the primary recovery strategy for western prairie-fringed orchids (USFWS 1996). Figure 6.6-11 shows the orchid's range in Oklahoma, on the western side of the Project vicinity.



Source: ODWC 2015a.

Figure 6.6-11. Range of western prairie-fringed orchid.

6.6.2. Oklahoma State-Listed Endangered Species in the Project Vicinity

Delaware County Cave Crayfish and Oklahoma Cave Crayfish

The Delaware County cave crayfish and Oklahoma cave crayfish are listed as state endangered. These small, colorless crayfish both inhabit karst subterranean waters in northeastern Oklahoma. They are listed as endangered by the state because they are endemic to Delaware County in Oklahoma and restricted to limited habitat that is vulnerable to groundwater contamination. They feed on detritus in subterranean pools, streams, and caves associated with karst geology. The Delaware County cave crayfish is known from only three caves and the Oklahoma cave crayfish has been found in only two caves, but their entire range is possibly unknown (ODWC 2015a, b, and c). Attachment H presents the Federal and State Listed Species, State Designated Species of Greatest Conservation Need, and State Rare and/or Vulnerable Plant Species potentially occurring in the Project vicinity.

6.7 Recreation and Land Use

Grand Lake is the premier recreational lake in northeast Oklahoma (FERC 2014). Bass fishing is very popular and draws both local and out-of-state anglers to the area. Public recreation facilities at Grand Lake are available at five state parks around the shoreline and at more than a dozen privately operated facilities. There are also numerous boat launches, marinas, tailwater fishing facilities, and fishing piers available to the public, as well as several wildlife areas, two visitor centers, several public overlooks, and one golf course. In addition, there are many popular, unimproved sites that can be used to access Grand Lake to launch boats, fish, and swim. There are also many campgrounds on Grand Lake providing tent, trailer, and recreational vehicle (RV) sites.

Development along the shoreline of Grand Lake primarily consists of residential, light commercial and business, and limited agricultural lands. Grand Lake is a popular location for recreation and residential development, particularly summer homes, due in part to the scenic quality of the reservoir and surrounding landscape, recreational fishing, and proximity to major population centers in Oklahoma, Kansas, Missouri, and Arkansas (GRDA 2008).

The Project Boundary is defined by a combination of a metes and bounds description— around GRDA owned-lands—and generally following elevation 750 feet in other areas, and encompasses 53,965 acres, including the approximately 45,200 surface acres of the Project reservoir. The Project Boundary encompasses the lands necessary to operate the Project, including a shoreline buffer around the entire reservoir. These Project lands are managed per the Project's SMP (GRDA 2008).

Under the current license issued April 1992, GRDA has developed and continuously implements a RMP (GRDA 1997) and SMP for the Project. The management, monitoring, and reporting requirements of these two plans inform this section of the PAD. Other available information sources include the Oklahoma State Comprehensive Outdoor Recreation Plan (SCORP), Oklahoma's official travel and tourism website, and the Environmental Assessment (EA) prepared by FERC staff (FERC 2014) for the relicensing of the Salina Project (FERC No. 2524).

6.7.1 Important Recreation Areas in the Project Vicinity

The Pensacola Project is located in the Ozark Plateau's Grand River lake region, which provides a host of recreational activities, including fishing, hunting, boating, hiking, camping, biking, rock climbing, cave exploration, and off-highway vehicles (OHV) activities. Tourism is the stimulus for recreational developments in the region including resorts, campgrounds, lake marinas, vacation homes, and associated support services (USFWS 2002).

In addition to the Pensacola Project's Grand Lake, GRDA manages recreation sites at two other FERC-licensed projects in the vicinity of the Pensacola Project: Markham Ferry Hydroelectric Project and Salina Pumped Storage Hydroelectric Project, both located downstream of the Pensacola Project. Lake Hudson, formed by the Markham Ferry Dam, is a popular local reservoir for recreation; it is readily accessible from Tulsa and its surrounding communities (FERC 2014). Three major public parks are located along the shores of Lake Hudson. Other recreation facilities available to the public on Lake Hudson include several boat launch areas, a marina, tailwater fishing facilities, several fishing piers, a visitor center, and an overlook. In addition to these developed facilities, there are many unimproved access sites that can be used to launch boats, fish, or swim. There are also numerous campgrounds on Lake Hudson that provide opportunities for tent, trailer, and RV camping.

The Salina Project's W.R. Holway reservoir is high above the Grand River Valley in a remote location off the mainstem of the Grand River. Reservoir waters cover a bed of rocks carved from the Ozark foothills and have a reputation for being clear and pristine. GRDA owns, operates, and maintains eight recreation sites primarily used for fishing access at the W.R. Holway reservoir. The improved and unimproved recreation sites are commensurate with the reservoir's rural setting, remote location, and light amount of recreation use compared with that at Lake Hudson and Grand Lake (FERC 2014).

6.7.2 Existing Recreational Facilities within the Project Boundary

The FERC Form 80 Licensed Hydropower Development Recreation Report filed April 1, 2015, identified 90 boat launch areas, 58 marinas, 15 swim areas, 27 campgrounds with over 2,000 camp and cottage sites, 47 active recreation areas (e.g., playgrounds, golf course), 32 picnic areas, 7 overlooks, and 6 visitor centers around the Project reservoir (GRDA 2015b). GRDA maintains the 5 FERC-approved formal and informal public access sites in conformance with the Project's RMP and Article 407 of the current license. The State of Oklahoma and several municipalities and private operators also maintain publicly available recreation facilities around the reservoir. The FERC-approved recreation sites, state parks, and other public access points are shown in Figure 6.7-1.

6.7.2.1 FERC-Approved Recreation Sites

GRDA operates and maintains five FERC-approved recreation sites at the Project. These facilities are described in detail below.

Duck Creek Bridge Public Access

Duck Creek Bridge Public Access, also referred to as Ketchum Public Access, provides one boat launch. There is no user fee associated with this facility. This facility consists of an informal gravel/dirt parking area with one concrete boat ramp.

Seaplane Base Public Access

Seaplane Base Public Access, also referred to as GRDA Hanger, provides one boat launch with two boat lanes and informal reservoir fishing. There is no user fee associated with this facility. This facility consists of an informal gravel/dirt parking area with one concrete boat ramp.

Monkey Island Public Boat Ramp

Monkey Island has a concrete parking area and one boat launch. There is no user fee associated with this facility.

Big Hollow Public Access

Big Hollow Public Access provides one boat launch. There is no user fee associated with this facility.

Wolf Creek Public Access

Wolf Creek Public Access provides one boat launch area with six lanes, reservoir fishing via three courtesy docks, a mooring dock, a breakwater, and one restroom. There is no use fee associated with this facility. The facility also includes parking for 71 vehicles with trailers, 8 single vehicles, and 5 accessible parking spaces with sidewalks. Two pavilions, one for fish cleaning and one for event coordination are available as well.

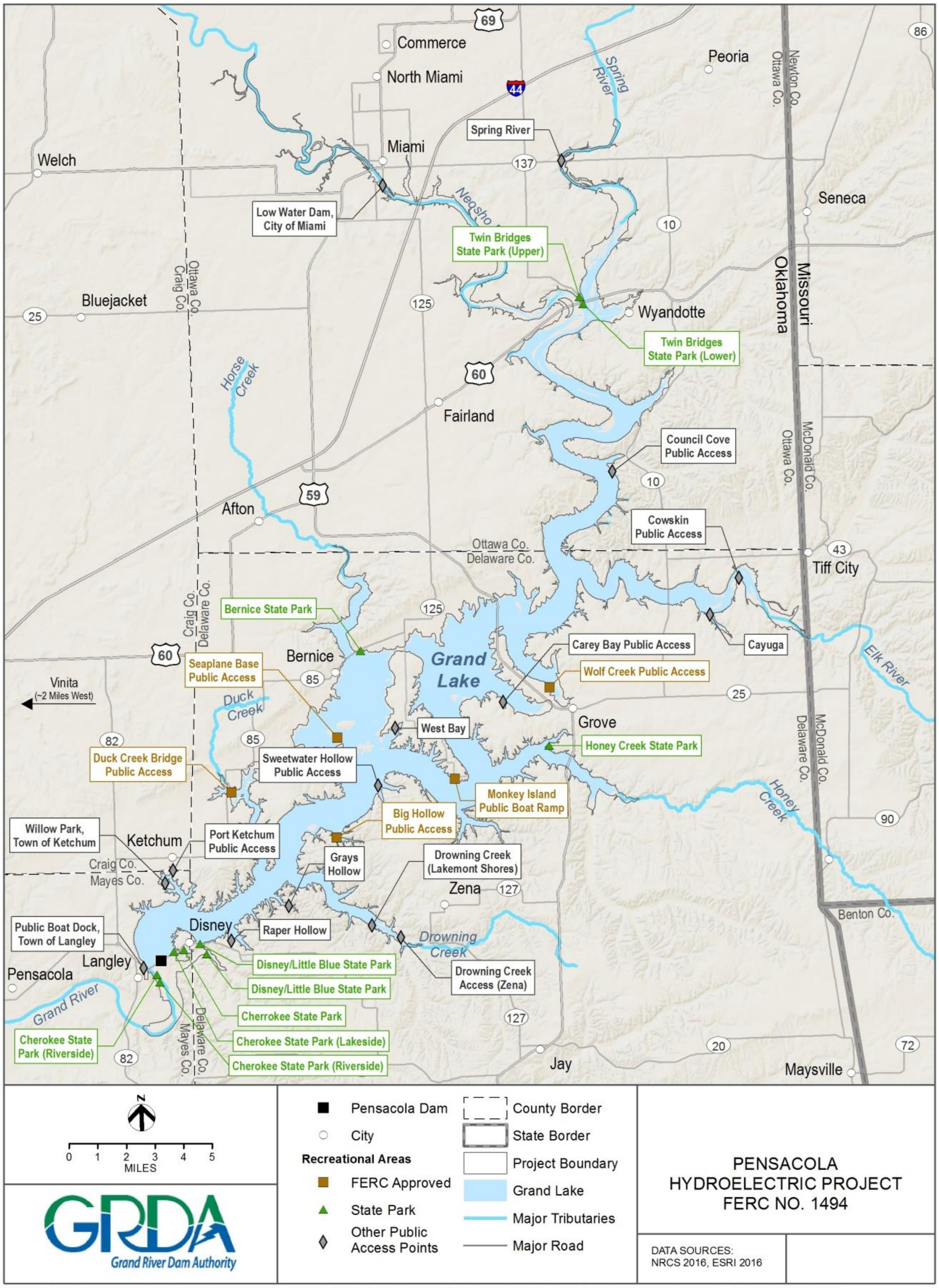


Figure 6.7-1. Recreation facilities and access sites in the Pensacola Project.

6.7.2.2 Oklahoma State Parks

Oklahoma Tourism and Recreation Department (OTRD) manages several state parks with access to the Project. While not part of GRDA's RMP, the recreation facilities described in further detail below provide public access to Project lands and waters.

Bernice State Park

Bernice State Park is located on the northwestern corner of Grand Lake in Bernice, Oklahoma. Amenities at Bernice State Park include RV sites, tent campsites, comfort stations with showers, boat ramp, picnic areas, a playground, a nature center, two wildlife watch towers, and a one-mile, paved, handicap-accessible walking and jogging path (State Park 2015a).

Cherokee State Park (Riverside Area, Lakeside Area, and Cherokee Area)

Cherokee State Park is located on the southwestern portion of Grand Lake in Disney, Oklahoma. Cherokee State Park offers three park areas: Riverside, Lakeside, and Cherokee. Amenities at Riverside area include picnic sites, a group shelter, campsites, comfort stations, lighted boat ramp, and a 9-hole golf course. Amenities at Lakeside area include a swimming beach, picnic sites, a group shelter, campsites, restroom with shower, playground, and lighted boat ramp. Amenities at the Cherokee area include a swimming beach, picnic sites, a group shelter, camp sites, and restroom with showers (State Park 2015b).

Disney/Little Blue State Park

Disney/Little Blue State Park is located in the southern portion of Grand Lake near the flood gates of the Project dam in Disney, Oklahoma. Amenities at Disney/Little Blue State Park include picnic areas, a lighted boat ramp, group picnic shelter, playground, and tent camping sites (State Park 2015c).

Honey Creek State Park

Honey Creek State Park is located in the northeastern portion of Grand Lake in Grove, Oklahoma. Amenities at Honey Creek State Park include 30/50 amp RV sites, 150 primitive sites, paved interior roads and RV sites, lighted boat ramp, picnic areas, two covered group shelters, outdoor grills, comfort stations with showers, a dump station, a playground, a swimming pool, a boat dock, fishing dock, and fish cleaning station (State Park 2015d).

Twin Bridges State Park

Twin Bridges State Park is located in the northern portion of Grand Lake in Fairland, Oklahoma. There are two separate areas of the park known as Upper and Lower. Amenities at Twin Bridges State Park include a fishing center, fishing dock, lighted boat ramps, picnic facilities, RV and tent campgrounds, lake huts, playgrounds, volleyball court, and horseshoe pits (State Park 2015e).

6.7.2.3 Other Public Access Points

Various municipalities and organizations[12] maintain or manage the following community parks, access areas, and ramps providing access to the Project reservoir:

- Willow Park, Town of Ketchum
- Port Ketchum Public Access
- Low Water Dam, City of Miami
- Council Cove Public Access
- Cowskin Public Access
- Carey Bay Public Access
- Sweetwater Hollow Public Access
- Public Boat Dock, Town of Langley
- Gray's Hollow (back of cove)
- Cayuga
- Lakemont Shores (Drowning Creek)
- Raper Hollow (back of cove)
- West Bay
- Spring River (Highway 10)
- Drowning Creek (Zena)

6.7.3 Recreational Use, Capacity, and Management

This section describes recreation opportunities present and activities that are known to occur at Grand Lake and presents available information on recreation use levels and reservoir capacity. This section concludes with a discussion of GRDA's recreation management policies and programs.

6.7.3.1 Recreation Opportunities and Activities

Grand Lake is a popular recreation spot for local residents and tourists. Although some recreational activities such as boating take place year-round on Grand Lake, the primary recreation season typically spans May 1 through September 30.

Sailing

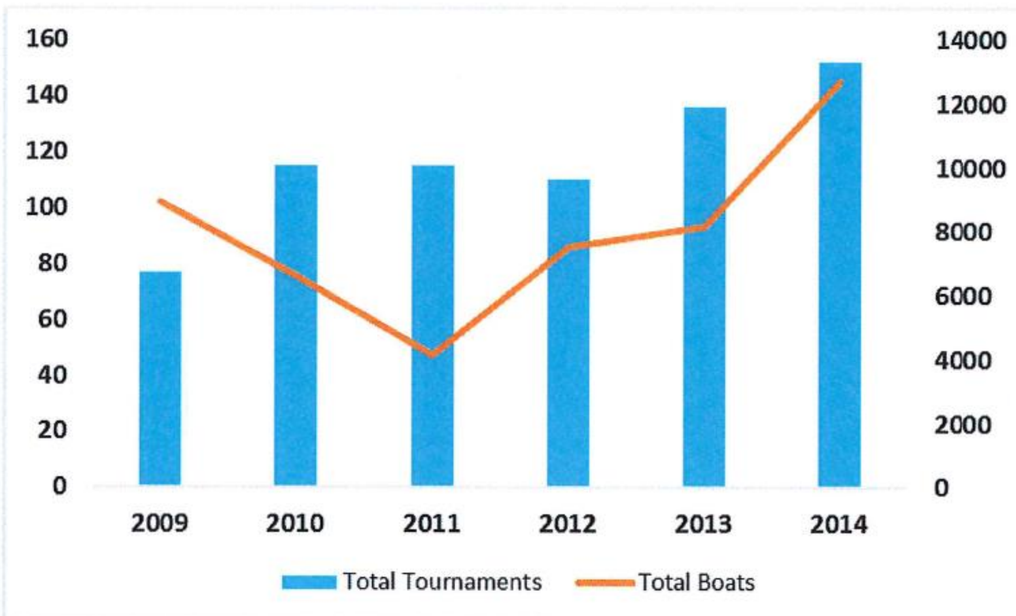
Grand Lake is home to several sailing clubs. Sailboat races and cruising events are held periodically through the year with approximately 10 to 40 boats participating in any one event (GRDA 2015b).

[12] Two previously identified public access points, Wyandotte Public Access, Town of Wyandotte and Drowning Creek Moonlight Cove, no longer provide public access.

Fishing

Fishing is a year-round activity on Grand Lake. Secluded coves, boat docks, fish shelters, and heated docks provide fishing opportunity to all segments of the reservoir. The reservoir supports a high-quality fishery for Largemouth Bass, Striped Bass, White Bass, Crappie, Catfish, and Paddlefish.

Fishing tournaments are popular at Grand Lake as it is considered one of the best bass fishing lakes in the U.S. In 2015, Bassmaster Magazine ranked Grand Lake as the 13th best Bass fishing lake in the country (Bassmaster 2015). Between 2009 and 2014, Grand Lake supported an average of 117 fishing tournaments annually as illustrated in Figure 6.7-2. On average, there are approximately 61 boats in each tournament, resulting in an average of 7,137 boats annually (GRDA 2015b).



Source: GRDA 2015b.

Figure 6.7-2. Fishing tournaments and participating boats on Grand Lake annually.

Rafting

At Grand Lake, “rafting” is the term used to describe the tying together of two or more anchored boats so that the boaters may visit with one another. Rafting is popular on Grand Lake in selected areas located away from the high-boat-traffic areas. Rafting is most popular over holiday weekends in the summer (GRDA 2015b).

Pleasure Boating

Pleasure boating on Grand Lake includes many different individual activities such as tubing, power boating, water-skiing, and house-boating. Pleasure boating typically intensifies in May with warmer temperatures and declines in September when cool temperatures arrive. Although there is no organized sport water-skiing on Grand Lake, there is one water-ski instruction school. Most water-skiing is done in calm water on the major creek arms of Grand Lake (GRDA 2015b).

Hunting

GRDA currently manages 1,630 acres of Project lands as WMAs and allows public hunting. These lands are located either adjacent to streams entering the reservoir or as islands within the reservoir. Wintering waterfowl use Grand Lake primarily from September through January. Waterfowl hunting occurs primarily in the riverine sections of the reservoir from October through January. Deer, turkey, squirrel, raccoon, bobwhite quail, and rabbit are the most commonly hunted animals. GRDA focuses on conservation and restoration of grasslands, BLHs, pecan orchards, and wetlands for the benefit of wildlife resources in northeast Oklahoma and to provide quality hunting opportunities to the general public (GRDA 2015b).

6.7.3.2 Recreation Use Levels and Lake Capacity

In support of Article 407 of the Pensacola Project license, GRDA conducted aerial boat counts from 2009-2016. Aerial boat counts identify the locations on the reservoir where people boat and the activities in which they participate. Flights occurred during times of the day when boating activity was expected to be at its peak. Figure 6.7-3 illustrates the average activity observed during flights for holiday and off-peak times of year for the period 2009-2016. Boating, rafting, use of personal watercraft, and fishing are the four primary activities observed throughout the year.

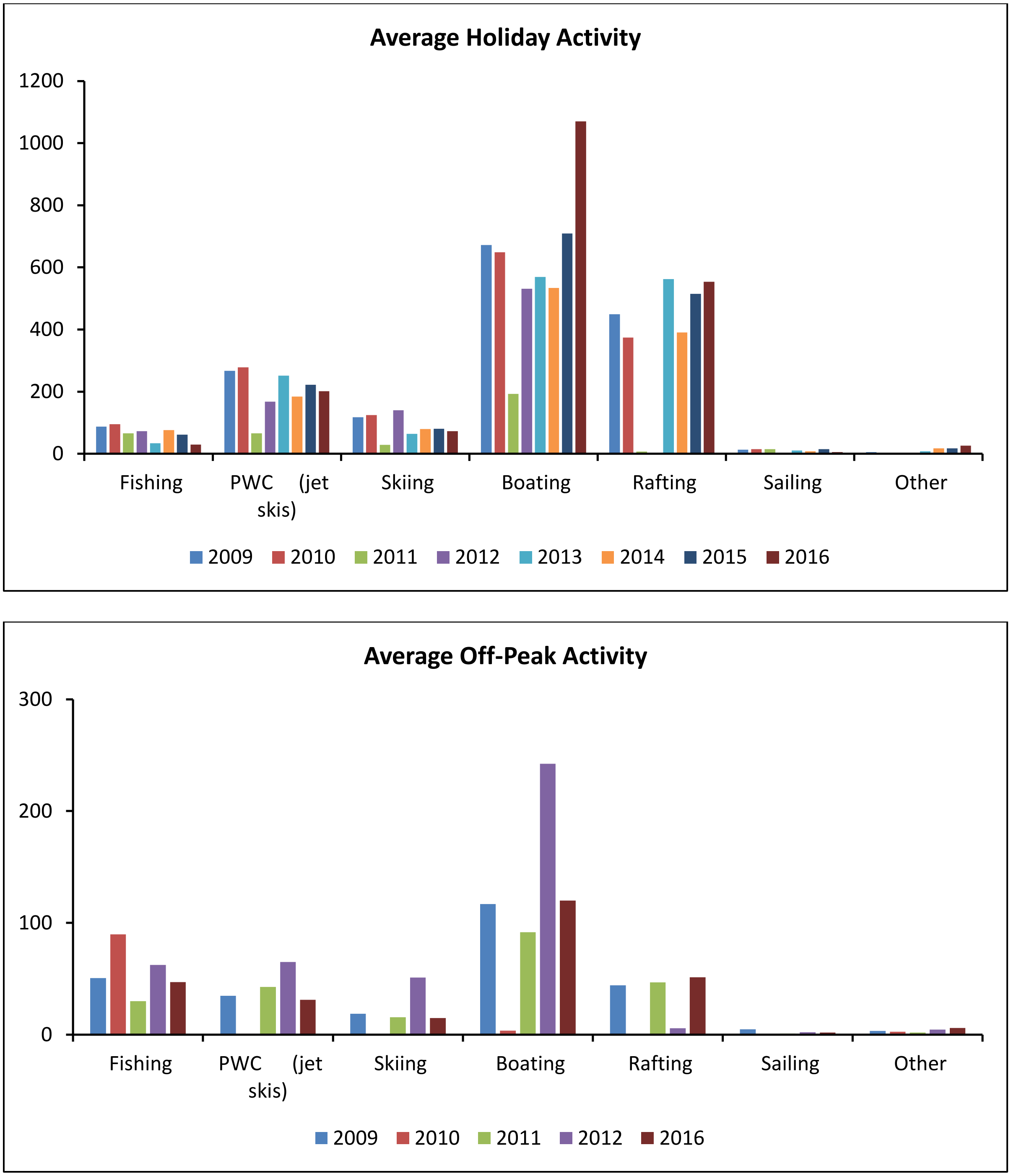


Figure 6.7-3. Average number of boats and their associated activity during holidays and off-peak times of year.

GRDA Planning and Management

GRDA is dedicated to recreation planning and recreation management. GRDA's Police and Compliance Officers closely manage recreation use and enforce the lake rules on all of GRDA's Project reservoirs, including Grand Lake (GRDA 2013). These officers are headquartered at the

GRDA Ecosystems and Education Center on Grand Lake, which also serves as central dispatch for enforcement operations. The officers are responsible for enforcing lake rules and regulations, conducting boat inspections, promoting water safety, and aiding boaters, when needed. They routinely patrol Grand Lake and Project recreation sites.

GRDA closely monitors recreation use and capacity at the Project. Recreation monitoring conducted from March 2014 through February 2015 in support of the FERC Form 80 requirements found low capacity utilization of FERC-approved Project recreation facilities and other publicly available recreation facilities at the Project. Utilization rates ranged from 0 to 23 percent for campsites. The boat launch areas, which include five FERC-approved Project recreation facilities, had a capacity utilization rate of approximately 11 percent (GRDA 2015a). Under the current license, recreation use is monitored and a report prepared every six years, with the next report due in 2021.

6.7.4 Current and Future Recreation Needs from Existing State or Regional Plans

Population Trends

Based on a linear trend of the four-county area surrounding Grand Lake, population projections through the year 2075 show an anticipated population increase in Delaware, Mayes, and Ottawa counties (three of the four-county area surrounding Grand Lake). While not the sole determining factor, an increase in population can be expected to contribute to an increase in regional recreation use over the term of the Project’s next license.

In addition to recreational visitors from the four counties surrounding Grand Lake, visitors originate from larger cities in the region; populations of large population centers within three to five hours drive of the Project have also increased (Table 6.7-1). Based on the current population trends through the four-county area, and in the region, it is expected these populations and associated recreation use, will continue to trend upward.

Table 6.7-1. Population trends of cities in the region within 3-5 hours drive of the Project.

Town	2010	2015[1]	Approximate Percent Change
Oklahoma City, Oklahoma	579,999	631,346	9%
Wichita, Kansas	382,368	389,965	2%
Kansas City, Kansas	145,786	151,306	4%
Joplin, Missouri	50,150	51,818	3%
Springfield, Missouri	159,498	166,810	5%
Fort Smith, Arkansas	86,209	88,194	2%
Fayetteville, Arkansas	73,580	82,830	13%

Source: GRDA 2015b; United States Census Bureau 2015.
Notes:
1 United States Census Bureau Population Estimate.

SCORP

Oklahoma's Great Outdoors: The Place, The People, The Providers, The Plan, also known as the SCORP, was published in 2012. The SCORP describes recreation resources available in Oklahoma; a description of analysis of recreation users; a description of agencies that manage the public recreation resources; and issues to be addressed and actions to be implemented during 2013-2017 to protect, preserve, and provide for the enjoyment of Oklahoma's great outdoors. GRDA adheres to the statewide plan's recommendation for 2013 to 2017 to provide "access to parks as a subsidized right of residence" (OTRD 2012) in its recreation initiatives at the Project. GRDA's ongoing recreation management goal for all of its hydroelectric projects is to provide open outdoor space (FERC 2014).

A national survey associated with outdoor recreation in support of the SCORP was conducted in 2000 and 2012 by categorizing outdoor recreation into five types of activities and investigated popularity of various outdoor recreation activities in the U.S. The trends highlighted in the study represent a national scope, but have direct application to outdoor recreation in Oklahoma. These survey results are discussed by type of activity below:

Natural-based land activities

According to survey results, approximately 32 percent of people 16 and older participated in day hiking in the past year, followed by visiting a wilderness/primitive area (approximately 30 percent), and visiting a farm or agricultural setting (approximately 30 percent)(OSU 2012).

Driving off-road vehicles is one of the fastest growing outdoor activities nationwide, with approximately 24 percent of Oklahomans participating in recreational OHV activity one or more times in the past year (OSU 2012).

Water-based activities

Visiting a beach (approximately 43 percent) and swimming in outdoor pool/lakes (approximately 42 percent) are consistently the most popular water-based outdoor activities. Boating (approximately 37 percent) and fishing (approximately 34 percent) are also common. Overall, swimming, boating, and fishing maintained their level of popularity throughout the past decade (OSU 2012).

Viewing/learning activities

National response levels showed consistent participation in viewing/photographing natural scenery (approximately 64 percent), visiting nature centers (approximately 57 percent), and visiting/photographing wildlife, trees, and flowers (approximately 52 percent). More than one-third of participants (approximately 34 percent) participated in bird watching yearly since 2000. Participation levels of viewing/learning activities in Oklahoma are similar to the national levels with the exception of visiting nature centers being less popular (OSU 2012).

Developed-setting land activities

Participation rates in developed-setting land activities are much higher than the other types of activities and people are most likely to use their local parks and recreation facilities. Approximately 84 percent of people 16 and older stated they walked for pleasure in the past year. Family gathering (approximately 71 percent), gardening for pleasure (approximately 67 percent), driving for pleasure (approximately 60 percent), and picnicking (approximately 50 percent) followed as the top popular developed-setting land outdoor activities (OSU 2012).

Outdoor sports

The most popular individual outdoor sport is running or jogging (approximately 29 percent), followed by golf (approximately 13 percent). Approximately 51 percent of people 16 and older attended team sports events at least once during the past year (OSU 2012).

In addition to the national data, the SCORP authors conducted a statewide survey and hosted two recreation rallies to seek public input pertinent to the recreation needs and issues of the people of Oklahoma. Survey respondents were provided a list of recreation facilities and asked to indicate the level of need within their communities related to each item. The “most needed” recreation facilities statewide were: (1) picnic areas; (2) splash pad or splash park; (3) running or walking track; (4) basketball courts; and (5) baseball fields (OSU 2012).

6.7.5 Land Use in the Project Vicinity

Approximately 53 percent of lands adjacent to the Project Boundary are undeveloped forestlands. In addition, approximately 31 percent of lands adjacent to the Pensacola Project shoreline are designated as agricultural/crop lands. The majority of the agricultural areas are found in Ottawa County, where over 35 percent of the total land area was used to plant field crops in 2001. In Delaware County, less than 3 percent of the total land area was used for field crops in 2001 (Figure 6.7-4).

6.7.6 Non-recreational Land Use within the Project Boundary

Grand Lake has a surface area of approximately 45,200 acres and 667 miles of shoreline and is characterized by narrow channels and many coves. The reservoir north of Sailboat Bridge is about 24 miles long, comparatively shallow, more narrow and riverine in nature, with limited shoreline access. The main channel of Grand Lake south of Sailboat Bridge is about 28 miles long and offers large areas of open, deep water. The coves off of the main channel can be deep with vast areas of open water, or they may be shallow and irregular. The lower portion of Grand Lake, south of the bridge, has broad expanses of deep water areas and is easily accessed by public roadways, with the exception of the area known as Horse Creek, which has a large expanse of shallow open water and several small, undeveloped islands (FERC 2009).

The shoreline of Grand Lake ranges from forested areas with a mixture of vegetative cover types to contiguous manicured lawns, residential housing, and commercial development. The lands adjacent to the northern and western shores of the Project consist primarily of rolling plains with occasional hills and ridges and gently sloping shoreline. The lands adjacent to the southern and eastern shores are characterized by deep ravines and narrow valleys separated by broad, gently rolling uplands, with shorelines consisting primarily of steep rocky beaches and bluffs. The upper section of Grand Lake is primarily undeveloped with a more natural aesthetic, while the majority of the shoreline of the lower section of Grand Lake is primarily highly developed (FERC 2009).

About 50 percent of land within the Project Boundary is deciduous forest lands, followed by cropland and pasture lands comprising about 35 percent of the Project lands. Residential, commercial, and other development accounts for about 11 percent of total land area within the Project Boundary (FERC 2009). Land uses within the Project Boundary are depicted in Figure 6.7-4 and Table 6.7-2.

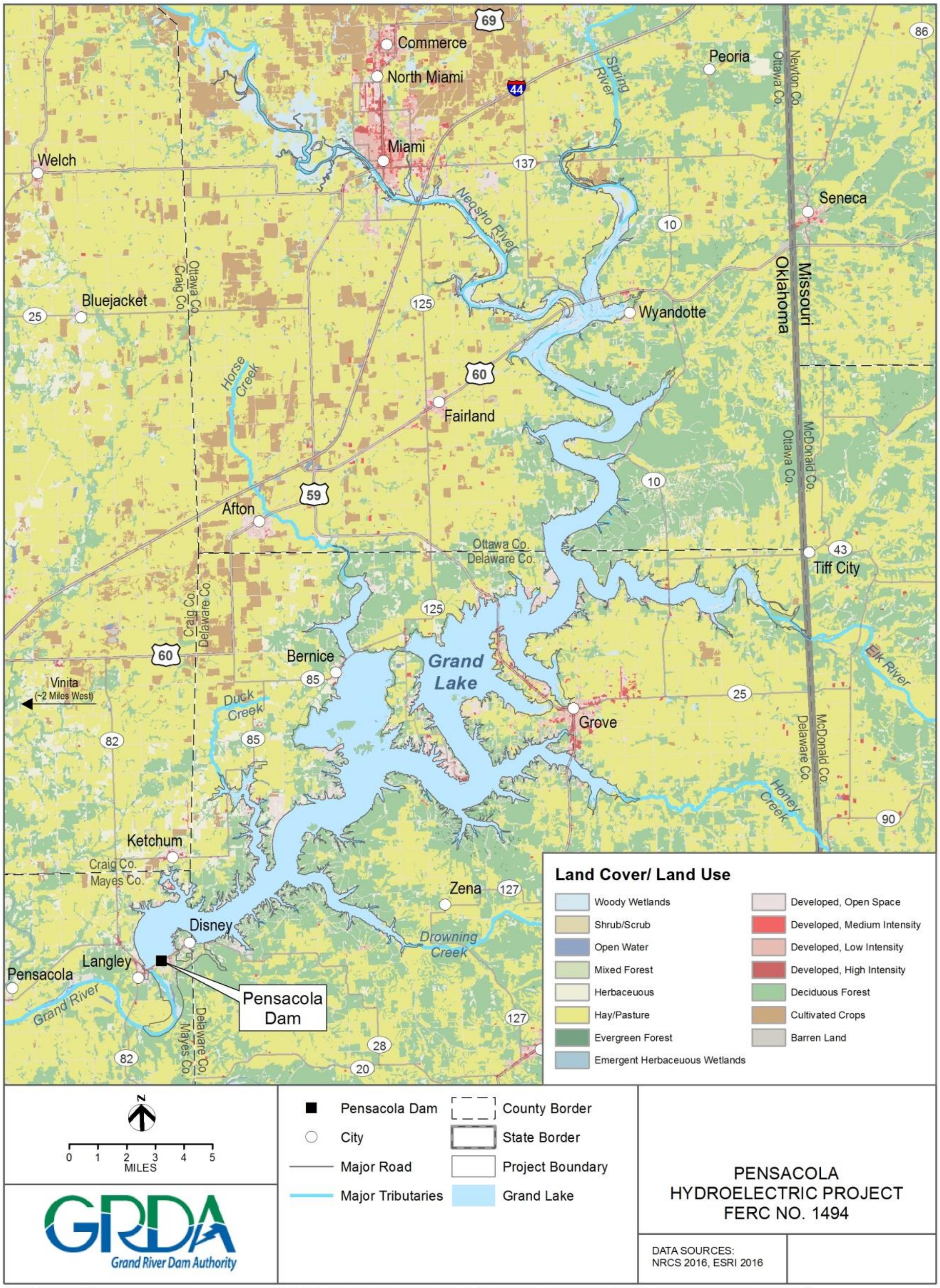


Figure 6.7-4. Land use in the Project Boundary and Project vicinity.

Table 6.7-2. Land uses within the Project Boundary.

Land Use	Percent of Total Land Use
Commercial and Services	0.3%
Cropland and Pasture	35.0%
Deciduous Forest Land	49.1%
Mixed Urban or Developed	0.7%
Non-forested Wetland	0.4%
Other Agricultural Land	0.0%
Other Urban or Developed	0.1%
Residential	9.3%
Streams and Canals	4.4%
Transportation, Commercial, and Utilities	0.2%
Transitional Areas	0.5%

Source: GRDA 2008.

Grand Lake is a popular location for recreation and residential development, particularly summer homes. In addition, leisure and retirement community development has expanded on Grand Lake. As of 2016, an estimated 6,000 private residences exist along the shoreline of Grand Lake.

6.7.7 Shoreline Management Policies and SMP Implementation

GRDA voluntarily submitted an SMP to guide management of the Grand Lake shoreline. It is a comprehensive plan for Grand Lake that considers GRDA's enabling legislation, the FERC license, historical and current public use, and the need to accommodate future growth and changing use patterns; all while maintaining stewardship for the environmental and socioeconomic resources entrusted to GRDA. The SMP is the product of extensive consultation with interested parties, including the public and resource agencies over the period 2005 to 2008. No less than twenty-seven public meetings were held during the SMP's development and thousands of written comments were received. Additionally, resource agencies had the opportunity to be actively involved during all stages of the plan's development. The SMP serves as a planning tool to guide GRDA in the protection and enhancement of the Project's environmental, recreational, and other values. It also provides the background to support permitting decisions and other activities undertaken by GRDA within the Project. In August 2009, FERC issued an EA of the SMP (FERC 2009) and on October 17, 2013, FERC issued an Order Modifying and Approving the SMP. GRDA currently manages Project lands per the 2013 Order.

Under the SMP permitting program, GRDA either renewed or issued approximately 6,500 permits in 2015. GRDA is responsible for supervision and control of the uses and occupancies for which it grants permission and the SMP provides clear guidance for determining whether a proposed use is appropriate in an area. Additionally, FERC requires GRDA to monitor compliance with any permits or conveyances they issue. Shoreline management is defined by the SMP's SMC and Allowable Use Categories (AUC). The SMC system includes Project Operations Areas, Municipal/Public Use Areas, Stewardship Areas, WMAs, Responsible Growth Areas, and Responsible Growth-Wetlands Areas and identifies clear management objectives for Project land. The AUC define the use types that will be permitted in those areas.

Shoreline management classifications consist of the following:

- Project Operations Areas – reserved for current and potential future Project operation and related functions;
- Municipal/Public Use Areas – uses that serve a public purpose or governmental function such as state parks, public beaches, municipal water intake/outflow, transmission/utility line crossing, roads, bridges, and gas/oil pipelines;
- Stewardship Areas – areas that contain important or sensitive resources that require special attention, consideration, and protection in order that their significant environmental, cultural, or aesthetic contributions not be threatened, diminished, or lost;
- WMAs – lands are managed exclusively for the preservation and enhancement of aquatic and terrestrial habitat; and
- Responsible Growth Areas – lands GRDA intends to manage to accommodate the reasonable demands for public and private uses that are conducive to the protection and enhancement of Grand Lake's environmental, recreational, and socioeconomic resources.
- Responsible Growth-Wetlands Areas – lands containing palustrine wetlands not included in Stewardship Areas due to diminished resource management potential.

AUCs consist of the following:

- Commercial Uses – these uses are best located in areas with adequate shoreline and water depth to allow construction and operation with minimal effect on environmental resources;
- Residential Uses – permit uses associated with private residential or residential associations' uses will continue to be permitted. For new developments, emphasis on consolidating uses to minimize shoreline effects for both single and multi-family shoreline uses; and
- Municipal/Public Uses – these uses must demonstrate that the use is in the public interest.

The shoreline management classification maps are included as an Appendix to the SMP. Classifications and categories are contained in a GRDA database and updated periodically, with a lake-wide review of all classifications scheduled every 6 years. Updates are scheduled to occur in 2019, 6 years after the SMP Order issuance in 2013.

The SMP policies and regulations are enforced by GRDA Police and Compliance Office staff. Enforcement duties include periodic inspection of permitted structures, general patrol of Grand Lake to identify new construction, review upon demand of permits approving repairs or new construction of facilities, water quality sampling, buoy review and relocation, and issuance of violation notices to adjacent property owners who are in violation of permit standards and conditions. GRDA also conducts periodic fly-overs by patrol officers and other GRDA Ecosystem Management staff to assess permitted development and identify new potentially unauthorized uses within the Project Boundary or potential violations of existing permits. All GRDA Police and Compliance Office staff are trained and familiar with the existing standards, rules, regulations, and policies in the SMP and are charged not only with their enforcement, but also public outreach regarding them (GRDA 2008).

6.7.8 Shoreline Buffer Zones

GRDA manages the shoreline of the Pensacola Project in accordance with the SMP. GRDA believes the proper stewardship of shoreline vegetation is critical to the protection and enhancement of Grand Lake's environmental resources and socioeconomic value. Shoreline vegetation acts as a buffer to stabilize shorelines, prevents erosion, and protects water quality by filtering and trapping organic and chemical pollutants and can provide valuable habitat for fish and wildlife. Additionally, shoreline vegetation can have significant recreational and aesthetic value. GRDA's vegetation management practices are included in GRDA's VMP contained in GRDA's Lake Rules (GRDA 2013) and recommends the following practices to owners outside the Project Boundary as well.

1. Plant native trees, shrubs, and flowers for landscaping and gardens to reduce watering as well as chemical and pesticide use.
2. Preserve or establish an unmanaged filter strip of natural vegetation along the shoreline and keep clearing of native trees and vegetation to a minimum.
3. Plant a low-maintenance, slow-growing grass recommended for local soil conditions and climate.
4. Maintain the grass as high as possible to shade out weeds and improve rooting so less fertilizing and watering are required.
5. Avoid dumping leaves or yard debris on or near the shoreline.

The SMP describes GRDA's support and rationale for permitting non-Project uses of Project lands and includes specific protocols that must be followed before conducting any vegetation management activities, including trimming trees and removing brush on Project lands designated as a Stewardship Area or a Responsible Growth-Wetlands Area (discussed in Section 6.7.7 Shoreline Management Policies and SMP Implementation of this PAD). Before any vegetation removal, a site-specific VMP must be submitted to and approved by GRDA and the proper permits must be obtained.

Generally, no vegetation management activity is permitted in a Stewardship Area, and GRDA will not permit the removal of vegetation in wetlands located in Stewardship Areas. Vegetation management activities are permissible in Responsible Growth-Wetlands Areas. However, such VMPs may be subject to greater scrutiny and may result in a requirement for on- or off-site mitigation and/or alternative VMPs.

6.7.9 Specially Designated Lands

There are no river segments in Oklahoma designated as part of the National Wild and Scenic Rivers System. There are no known river segments under study in the Project vicinity for inclusion in the National Wild and Scenic Rivers System (NPS 2016c). There are no American Heritage Rivers designated in Oklahoma (EPA 2016).

There are no state-protected river segments in the Project vicinity that have been designated for preservation under the Oklahoma Scenic Rivers Act (Oklahoma Scenic Rivers Commission 2016).

No Project lands or lands within the vicinity of the Project are under study for inclusion in the National Trails System (NPS 2016b).

There are no National Park Service (NPS) lands located in the vicinity of the Project (NPS 2016a). No Project lands are designated as a Wilderness Area (Wilderness.net 2016), and there are no Project lands under study for inclusion as a Wilderness Area (Wilderness Society 2016).

6.8 Aesthetic Resources

6.8.1 Visual Character of Project Facilities, Lands, and Waters

Grand Lake provides recreational opportunities and there are a number of recreational access points to Grand Lake to enjoy the scenery. Route 59 and Route 60 cross Grand Lake providing views of the impoundment.

Figure 6.8-1 to Figure 6.8-8 provide photos of Grand Lake and Project facilities. The lands adjacent to the northern and western shores of the Project are characterized by rolling plains with occasional hills and ridges. The shoreline of Grand Lake in these areas has generally gentle slopes. The lands adjacent to the southern and eastern shores are characterized by deep ravines and narrow valleys separated by broad, gently rolling uplands. Shorelines in these areas are primarily steep rocky beaches and bluffs. The shoreline of Grand Lake ranges from forested areas (with a mixture of vegetative cover types) to contiguous manicured lawns, residential housing, and commercial development. The river basin in the Project vicinity is dominated by deciduous forests (GRDA 2008).

The extent of development along the shoreline between the upper and lower sections of the lake varies considerably. The majority of the shoreline of the lower section of the reservoir is highly developed. The upper section of Grand Lake presents some continuous sections of undeveloped shoreline, exhibiting a relatively natural aesthetic (GRDA 2008).

Figure 6.8-1. Boats, participating in the 2013 Bassmaster Classic, make their way under Sailboat Bridge (north of Grove), headed west to the main lake channel in late February.

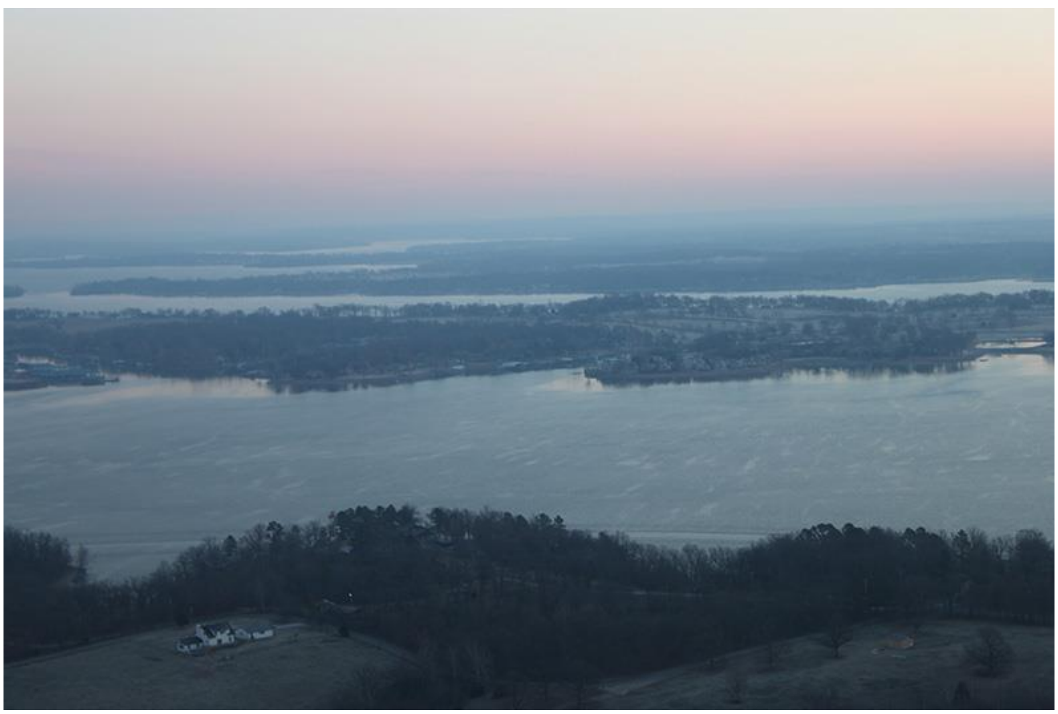


Figure 6.8-2. Sunrise over Grand Lake during the 2013 Bassmaster Classic. This view is near Grove.

Figure 6.8-3. Monkey Island can be seen in the background of this photo, looking southwest near Grove during the 2013 Bassmaster Classic.

Figure 6.8-4. Boats and boat docks fill one of the many scenic coves along Grand Lake's shoreline.

Figure 6.8-5. This picture is characteristic of many of the scenic bluffs that can be found along Grand Lake's shoreline.

Figure 6.8-6. The Pensacola Dam and spillways.

Figure 6.8-7. The multiple-arch section of the Pensacola Dam.

Figure 6.8-8. The highway bridge (State Highway 28) built across the length of the Pensacola Dam and the Project's east spillways, which provides two 10-foot-wide vehicle lanes and a 4-foot-wide sidewalk for pedestrians.

6.9 Cultural and Tribal Resources

In considering a new license for the Project, FERC has the lead responsibility for compliance with applicable federal laws, regulations, and policies pertaining to historic properties, including the National Historic Preservation Act of 1966, as amended (NHPA). Section 106 of the NHPA (Section 106)[13] directs federal agencies to take into account the effects of their undertakings on historic properties and to afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment.

The regulations implementing Section 106 (36 CFR Part 800) define “historic properties” as any pre-contact or historic period district, site, building, structure, or individual object included in or eligible for inclusion in the National Register of Historical Places (NRHP or National Register). This term includes artifacts, records, and remains that are related to and located within historic properties, as well as properties of traditional religious and cultural importance (often referred to as “traditional cultural properties” [TCP]) that meet the National Register Criteria.

The Secretary of the Interior has established the criteria for evaluating properties for inclusion in the NRHP (36 CFR Part 60). In accordance with the criteria, properties are eligible if they are significant in American history, architecture, archaeology, engineering, or culture. The quality of significance is present in historic properties that possess integrity of location, design, setting, materials, workmanship, feeling, or association and meet one or more of the National Register Criteria:

- Criterion A: Are associated with events that have made a significant contribution to the broad patterns of our history; or
- Criterion B: Are associated with the lives of persons of significance in our past; or
- Criterion C: That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components could lack individual distinction; or
- Criterion D: That have yielded, or could be likely to yield, information important in prehistory or history.

Normally, NRHP eligibility requires a property to be at least 50 years of age. Resources less than 50 years of age that are highly significant and meet the “special criteria considerations” as outlined in the regulations (36 CFR 60.4) also may be eligible for the NRHP.

The implementing regulations of Section 106 are intended to accommodate historic preservation concerns with the needs of federal undertakings through a process of consultation among agency officials, federally recognized Indian tribes, SHPO, Tribal Historic Preservation Officers (THPO), and other parties, including the public, as appropriate.

The archaeological record of Oklahoma begins over 10,000 years Before Present (B.P.). Section 6.9.1 below provides a brief overview of the cultural setting of the Project and is intended to provide contextual information regarding the nature and character of cultural resources within the Project’s vicinity. Section 6.9.2 provides an overview of existing discovery

[13] 54 U.S.C. §306108

measures, including previous archaeological and architectural surveys, and Section 6.9.3 describes the previously reported archaeological and historic resources within the Project's vicinity.

6.9.1 Cultural Context

The history and chronology of the region assists in the assessment of archaeological potential and provides a context for archaeological and historic resources in the Project vicinity. Knowledge of local prehistory and history helps to place cultural resources within their historic contexts (USACE 2005). This section of the PAD provides a brief summary of the cultural history and chronology of the region following major cultural traditions for eastern Oklahoma.

The earliest well-documented human occupation in North America is the Paleoindian period (10,000 – 8,000 B.C.). The Paleoindian period is characterized as the colonization of North America by nomadic bands of hunter-gatherers that likely crossed the Bering Land Bridge approximately 12,000 years B.P. (USACE 2005). Paleoindian populations in the area occupied a mosaic of rapidly changing environments that included open spruce parkland, other conifers, and deciduous forests (USACE 2005; Adovasio and Carr 2002). Paleoindian hunter-gatherers adapted to these environmental conditions by developing resource procurement strategies that relied on extensive seasonal mobility and a unique toolkit that included diagnostic fluted projectile points, gravers, utilized debitage, and tools crafted using bipolar percussion (Bureau of Land Management [BLM] 1993).

The Archaic period (8,000 – 500 B.C.) was marked by environmental, cultural, and technological changes including the expansion of grasslands, increased sedentism, and the advent of horticulture in the region (USACE 2005). While Paleoindian toolkits were generally designed for hunting charismatic megafauna, the Archaic toolkit suggests technological adaptations to locally available resources. Smaller, notched, and bifurcated projectile points better-suited for hunting locally available game animals appear during the Archaic, and notched pebble netsinkers reflect an increased focus on riverine resources (BLM 1993; USACE 2005). Large midden features at occupation sites indicate the near-continuous use of semi-permanent base camps, while specialized resource procurement sites indicate that Archaic peoples also focused seasonal hunting and gathering in prime locations (USACE 2005). The Archaic period is also characterized by the appearance of mortuary rituals in the archaeological record.

An essentially modern environment had emerged by the beginning of the Woodland period (500 B.C. – A.D. 900). USACE (2005) summarizes the Woodland period in eastern Oklahoma as "traditionally defined by the rise of and widespread use of ceramic vessels, increased sedentism, increasing social complexity, and improved agricultural techniques." In eastern Oklahoma, the presence of ceremonial and burial mound centers, of significant midden accumulations along river terraces, and the internment of exotic materials with the dead all suggest that socially complex groups were occupying large, semi-permanent villages (USACE 2005). By the end of the Woodland period, small and dispersed farmsteads become more common and the artifact assemblage from sites in eastern Oklahoma include smaller projectile points, farming implements, and groundstone tools (USACE 2005).

By the Mississippian period (A.D. 900 – 1500), archaeological evidence indicates that a distinctive Caddoan culture was present in the Trans-Mississippi South, a region lying south of the Arkansas Valley in western Arkansas, eastern Oklahoma, northwest Louisiana, and northeast Texas. Perttula (1992) summarizes the features of this Caddoan culture emerging from "(a) the development of more complex social and political systems of authority, ritual, and ceremony; (b) the rise, elaboration, and maintenance of social ranking and status within the Caddoan communities and larger social and political spheres; and (c) the intensification of maize agriculture and a reliance on tropical cultigens over time in local economic systems." Caddoan people lived in dispersed communities of isolated homesteads, small hamlets, a few larger villages, and civic-ceremonial centers (Perttula 1992).

The Protohistoric period (A.D. 1500 – 1700) was a time of enormous upheaval for native societies, although the specific effects of these early encounters between Europeans and Caddoan populations are poorly understood. The ramifications of European incursions in North America had undoubtedly begun to percolate into the heartland of the Caddoan community in the early sixteenth century. Native populations on the eastern seaboard and Gulf Coast encountered European traders, missionaries, explorers, pirates, and fisherman in the early 1500s, and archaeological evidence suggests that trade goods made their way inland from the coast to the Caddoan communities. Survivors of the ill-fated Narváez Florida expedition may have encountered Caddoan peoples in Texas between 1528 and 1534, though conclusive evidence of these encounters is lacking (Perttula 1992). In 1541, the de Soto *entrada* led by Luis de Moscoso (following the death of Hernando de Soto) made direct contact with the Caddoan people and spent several months living in Caddoan communities (Perttula 1992). The immediate aftermath of these encounters in unknown, but it is likely that the spread of diseases like smallpox had a tremendous, ravaging, and destabilizing effect on Caddoan communities in the wake of historic contact (Perttula 1992; USACE 2005). As described in USACE (2005), the period following this initial European contact saw dramatic changes in Caddoan society:

> *Historic Caddoan (after A.D. 1680) is the period when the historic Caddo Indians coalesced politically and culturally in the face of Euro-American expansionism, missionization, warfare, and trade. The dramatic cultural changes brought about by the advent of European colonies, as well as the new trade goods and European diseases, resulted in drastic and permanent changes to Native cultures. Throughout the interior of North America, the impact of disease and new trading patterns often long preceded the arrival of European explorers. Old World diseases, such as smallpox, are believed to have killed as much as 90 percent of the Native American population. Introduction of European items and European demand for particular resources, such as beaver pelts and deer skins transformed Native trading systems.*

Following the Louisiana Purchase of 1803, American settlers pushed into the Trans-Mississippi South in increasing numbers causing conflicts with local Indian tribes like the Osage and those that had been displaced from the east and promised lands west of the Mississippi River. In 1830, the Indian Removal Act was signed and the U.S. government forced resident tribes from the eastern states to resettle to the Indian Territory (present-day Oklahoma). Thousands of Choctaw, Creek, Chickasaw, Cherokee, and Seminole traveled the Trail of Tears from the east toward reservation lands in Oklahoma between 1830 and 1839 (USACE 2005). Other Indian tribes from the northeast, including some Seneca and Cayuga, were also relocated to northeastern Oklahoma. Relocated tribes began to rebuild their lives following this traumatic displacement, establishing schools, businesses, and new communities in the territory.

The Civil War caused disruption across northeastern Oklahoma, but by 1870, railroads had pushed into the territory. The discovery of oil in northeastern Oklahoma brought boom times in the 1880s and created new interest in transporting oil and goods along the region's waterways (USACE 2005). In 1939, the Tulsa District of the Little Rock Office of USACE began work on eight flood control dams in the Arkansas River Basin. The authorization of the McClellan–Kerr

Arkansas River Navigation System (MKARNS) through the Rivers and Harbors Act in 1946, formalized a plan for navigation, flood control, hydroelectric power, and recreation improvements on Arkansas River. MKARNS was officially dedicated by President Richard M. Nixon in 1971 (USACE 2005). Navigation on the lower Arkansas River and the other components of the MKARNS is controlled by a series of 18 locks and dams (USACE 2005).

Considered the "father" of the GRDA, Cherokee tribal member Henry Holderman advocated for construction of the Pensacola Dam prior to Oklahoma statehood in 1907. GRDA was created in 1935 by the Oklahoma State Legislature as a conservation and reclamation district with the authority to exercise the control, preservation, storage, and distribution of the waters of the Grand River and its tributaries. Construction of the Project was initiated in 1938 and completed in 1941 (Oklahoma Historical Society [OHS] 2009). The Pensacola Dam was the first hydroelectric Project in the State of Oklahoma and was listed on the NRHP in 2003.

6.9.2 Existing Discovery Measures

Archaeological investigations in the area began prior to the creation of Grand Lake. Between 1937 and 1940, the Works Progress Administration (WPA) conducted several archaeological investigations in conjunction with the University of Oklahoma (USACE 2005). These studies were continued after creation of Grand Lake. The Stovall Museum at the University of Oklahoma (now called the Sam Noble Oklahoma Museum of Natural History) also sponsored excavations in the Grand Lake area (USACE 2005). Detailed records of, or reports on, these investigations are not currently available.

In the prior 1992 relicensing of the Project, the Commission included a new license Article 409, which includes measures to protect and manage historic properties:

> *The Licensee, before starting any land-clearing or ground-disturbing activities within the project boundaries, other than those specifically authorized in this license, including recreation developments at the project, shall consult with the State Historic Preservation Officer (SHPO). If the Licensee discovers previously unidentified archeological or historic properties during the course of constructing or developing project works or other facilities (including recreation developments) at the project, the Licensee shall stop all land-clearing and land-disturbing activities in the vicinity of the properties and consult with the SHPO. In either instance, the Licensee shall file for Commission approval a cultural resource management plan prepared by a qualified cultural resource specialist after having consulted with the SHPO. The management plan shall include the following items: (1) a description of each discovered property indicating whether it is listed on or eligible to be listed on the National Register of Historic Places; (2) a description of the potential effect on each discovered property; (3) proposed measures for avoiding or mitigating effects; (4) documentation of the nature and extent of consultation; and (5) a schedule for mitigating effects and conducting additional studies. The Commission may require changes to the plan. The Licensee shall not begin land-clearing or ground-disturbing activities, other than those specifically authorized in this license, or resume such activities in the vicinity of a property, discovered during construction or operation, until informed that the requirements of this article have been fulfilled.*

During the existing license term, which began in 1992, no previously unidentified archeological or historic properties has been discovered during the course of constructing or developing

Project works or other facilities at the Project; therefore, there is no cultural resources management plan for the Project.

6.9.3 Reported Archaeological and Historical Resources

Archaeological and historic resources within the Project's vicinity have been inventoried by avocational archaeologists and historians as a result of cultural resources studies conducted in compliance with federal and state statutes. In preparing this PAD, GRDA conducted a search of publicly available literature, as well as records housed at the OAS to summarize the cultural context of the Project and to identify known archaeological resources within the one mile of the Project Boundary, including those properties listed in or eligible for the NRHP.

In total, 195 archaeological sites were identified within, and within one mile of, the Project Boundary. The sites are listed in Attachment I, Table I-1. One of the archaeological sites (34DL285) within the search radius is considered eligible for inclusion in the NRHP. A total of 50 of the sites are considered not eligible for inclusion in the NRHP, 125 have unknown NRHP eligibility statuses, and the remaining 19 sites have unassessed NRHP eligibility status. A total of 76 of the 195 sites are located within the Project Boundary. Sites within the Project Boundary are either considered not eligible for the NRHP or have not been evaluated for inclusion on the NRHP.

The Oklahoma State Historic Preservation Office website for the NRHP in Oklahoma was also consulted to identify any NRHP-listed or eligible historic architectural properties or districts within, or within one mile of, the Project Boundary. A total of eight NRHP historic architectural properties/districts are located within, or within one mile of, the Project Boundary. The sites are listed in Attachment I, Table I-2. One of the eight properties/districts (Pensacola Dam) is located within the Project Boundary.

Additionally, the Oklahoma Landmarks Inventory Database found 150 other historical sites within, and within one mile of, the Project Boundary. The details of these properties are presented in Attachment I, Table I-3.

Affected Indian Tribes

The Project Boundary does not encompass any federal lands or interests in lands that are held in trust for any Indian tribe (FERC 2017).

The following Indian tribes have been identified by GRDA as having historic and prehistoric interests in the area: Caddo Nation of Oklahoma; Eastern Shawnee Tribe of Oklahoma; Shawnee Tribe of Oklahoma; Apache Tribe of Oklahoma; Osage Nation; Cheyenne and Arapaho Tribes, Oklahoma; Cherokee Nation; Delaware Tribe of Indians; Wichita and Affiliated Tribes (Wichita, Keechi, Waco, and Tawakonie), Oklahoma; Muscogee (Creek) Nation; Alabama-Quassarte Tribal Town; Seneca-Cayuga Nation; Modoc Tribe of Oklahoma; Quapaw Tribe of Indians; Miami Tribe of Oklahoma; Ottawa Tribe of Oklahoma; United Keetoowah of Cherokees; Peoria Tribe of Oklahoma; Wyandotte Tribe of Oklahoma; and Little Traverse Bay Bands of Odawa Indians, Michigan.

6.9.4 Area of Potential Effects (APE)

GRDA has preliminarily identified the APE for the Pensacola Project to include all lands within the FERC Project Boundary and any lands outside the FERC Project Boundary that may be affected by Project-related activities conducted under the new license. The current Project Boundary generally follows the 750-foot contour around Grand Lake. A final determination of the Pensacola Project APE will be made in consultation with the Oklahoma SHPO, tribes, and FERC staff as part of the study planning phase.

6.10 Socioeconomic Resources

The Pensacola Project dam and hydroelectric generating facility is located northeast of Tulsa on the Grand (Neosho) River (Grand River) in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma. The Pensacola Dam creates the Grand Lake O' The Cherokees, also known as Grand Lake. This section presents information on the socioeconomics, including land use patterns, population, and employment, of the Project and the State of Oklahoma.

6.10.1 General Land Use Patterns

Northeastern Oklahoma is commonly referred to as the "Green Country," denoting its mild climate, beautiful scenery, tumbling rivers, expansive lakes, and tallgrass prairies. The entirety of the Project vicinity, including Craig, Delaware, Mayes, and Ottawa counties, lie within the boundaries of the Green Country. Approximately 53 percent of land within the Project Boundary is deciduous forestlands. Residential, commercial, and other development accounts for approximately 11 percent of total land area within the Project Boundary. Approximately 53 percent of lands adjacent to the Project boundary are undeveloped forestlands. In addition, 31 percent of lands adjacent to the Pensacola Project are designated as agricultural/crop lands. The majority of these agricultural areas are in Ottawa County (GRDA 2008).

Current uses around Grand Lake include residential and commercial development, agriculture, and WMAs. Lands surrounding the Project vicinity are generally rural and undeveloped, but historically, mining for lead and zinc was prevalent in Ottawa County, Oklahoma, and mining for coal was prevalent in Craig County, Oklahoma (Oklahoma Historical Society 2009). The popularity of water-based recreation at Grand Lake has resulted in significant economic development, particularly in real estate, goods, and services. Grand Lake is host to many marinas, resorts, and other commercial operations such as campgrounds and restaurants (GRDA 2008).

6.10.2 Population Patterns

The state population of Oklahoma has increased approximately 4.3 percent between 2010 and 2015, with a total estimated population of 3,911,338 people (U.S. Census Bureau 2015).

The area surrounding the Pensacola Project is sparsely populated, with populations centered in local cities. The cities of Miami (population: 13,611; distance from Project approximately 0.4 miles), Vinita (population: 5,643; distance from Project 10.2 miles), and Grove (population: 6,751; distance from Project approximately .2 miles) are the principal municipalities in the vicinity of the Project (U.S. Census Bureau 2015).

Craig, Delaware, Mayes, and Ottawa counties are located along the northeastern border of the state of Oklahoma. Ottawa County, the northernmost of the four counties occupied by the Pensacola Project, has two incorporated cities, six incorporated towns, one unincorporated community, and three ghost towns with a total estimated population of 31,981 as of the 2015 census. Mayes County, located to the southwest of Ottawa County, has one incorporated city, twelve incorporated towns, and five unincorporated communities with a total estimated population of 40,887 in 2015. Delaware County, located to the east of Mayes County, has two incorporated cities, five incorporated towns, and two unincorporated communities with a total estimated population of 41,459 in 2015. Craig County, located to the northwest of Delaware County, has one incorporated city, four incorporated towns, and one unincorporated community with a total estimated population of 14,818 in 2015 (U.S. Census Bureau 2016).

Grand Lake is a popular location for recreation and residential development, and in particular, the development of summer homes. As of 2016, an estimated 6,000 private residences exist along the shoreline of Grand Lake.

6.10.3 Project Vicinity Employment Sources

6.10.3.1 Economic Activity in the State of Oklahoma

Economic activity in the Project vicinity differs from economic activity throughout the State of Oklahoma. In the last quarter of 2015, the top five non-farm industries within Oklahoma were government (18.4 percent); trade, transportation, and utilities (17.2 percent); mining (13 percent); educational and health services (10.7 percent); and professional and business services (10.7 percent). Metropolitan areas contribute greatly to the State Real Gross Domestic Product (GDP); the cities of Tulsa, Lawton, and Oklahoma City contribute approximately 75 percent to the State GDP, whereas the Balance of the State contributes 25 percent (Oklahoma Employment Security Commission 2016).

6.10.3.2 Economic Activity within the Project Vicinity

The job opportunities, low electricity rates (approximately 45 percent lower than national average), and quality of life attract individuals to move to Oklahoma (Oklahoma Department of Commerce 2015). Manufacturing and health care are the dominant industries for Ottawa, Mayes, Delaware, and Craig Counties; retail trade, lodging, and food establishments contribute to the local employment base, particularly for Delaware and Ottawa Counties. Tourism, lodging, and recreational amenities also contribute to the local economy. GRDA also creates a multitude of jobs and careers within the Project vicinity.

6.10.3.3 GRDA as an Employer

The Oklahoma Department of Commerce published the Economic Impact of the Grand River Dam Authority in March 2015. This Economic Impact Study summarizes the economic benefits associated with operating, constructing, and positive externalities from GRDA.

Between 2015 and 2020, the estimated impact of operating GRDA represents an annual economic activity of $510 to $581 million (Oklahoma Department of Commerce 2015). These values result from the employment and payroll associated with operating the GRDA. In addition, the estimated economic impact resulting from construction and investment activities associated with the construction of the combined-cycle gas generation plant at the Grand River Energy Center, are projected to generate $210 million in additional economic activity within the first year of construction and another $214 million in the second year. The estimated economic impact resulting from tourism, quality of life, and relative power costs are expected to contribute approximately $240-$260 million (Oklahoma Department of Commerce 2015).

GRDA has supported over 7,100 jobs in Oklahoma's economy in the years 2015 and 2016. Of these 7,100 jobs, approximately 25 percent are directly related to construction of the Grand

River Energy Center, approximately 40 percent of these jobs are day-to-day operational positions, and approximately 35 percent of these jobs are derived from tourism, amenities, low power costs combined with high quality of life benefits associated with living in close proximity to GRDA (Oklahoma Department of Commerce 2015).

Disposable income, as a result from employment within GRDA, amounts to $310-$337 million between the years 2015 and 2016. Approximately 50 percent of disposable income is generated from day-to-day operational positions. GRDA operations provide a wide variety of occupations, ranging in an hourly rate of $11.39 through $38.41 (Oklahoma Department of Commerce 2015).

6.10.3.4 Socioeconomic Conditions in the Project Vicinity

Table 6.10-1 through Table 6.10-7 describe the general socioeconomic conditions in Craig, Delaware, Mayes, and Ottawa counties in Oklahoma. In comparison to the State of Oklahoma, populations in Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma, are growing at a comparable rate to the population in the state. Within the four counties, median household incomes have remained stable during the past six years. Unemployment rates have also remained relatively stable for all four counties that encompass the Project vicinity.

Table 6.10-1. Population in Oklahoma state by county.

Year	Oklahoma State	Craig County	Delaware County	Mayes County	Ottawa County
2010	3,751,351	15,029	41,487	41,259	31,848
2000	3,450,654	14,950	37,077	38,369	33,194
1990	3,145,585	14,104	28,070	33,366	30,561
1980	3,025,290	15,014	23,946	32,261	32,870
1970	2,559,229	14,722	17,767	23,302	29,800
1960	2,328,284	16,303	13,198	20,073	28,301

Source: Oklahoma Department of Commerce 2012.

Table 6.10-2. Population trends for cities in the Pensacola Project vicinity, Oklahoma.

Year	Craig County	Delaware County		Mayes County	Ottawa County	
	Vinita	Grove	Jay	Pryor Creek	Commerce	Miami
2015	5,643	6,751	2,483	2,483	2,483	13,611
2014	5,552	6,718	2,473	2,473	2,491	13,662
2013	5,585	6,674	2,475	2,475	2,501	13,738
2012	5,617	6,664	2,481	2,481	2,498	13,743
2011	5,701	6,643	2,485	2,485	2,472	13,618
2010	5,754	6,642	2,501	2,501	2,470	13,568

Source: U.S. Census Bureau Fact Finder 2016.

Table 6.10-3. Median household income estimates for Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma.

Year	Craig	Delaware	Mayes	Ottawa
2014	$38,273	$36,198	$42,076	$36,616
2013	$39,236	$36,588	$42,751	$36,473
2012	$40,496	$36,423	$41,475	$36,280
2011	$41,010	$35,552	$42,425	$36,931
2010	$39,836	$34,383	$41,228	$35,483
2009	$39,335	$35,937	$39,463	$34,160

Source: U.S. Census Bureau Fact Finder 2016.

Table 6.10-4. Craig County, Oklahoma, civilian labor force (annual average).

	2010	2011	2012	2013	2014
Civilian Labor Force	6,914	6,979	6,608	6,509	6,262
Total Employment	6,530	6,568	6,176	6,138	5,832
Total Unemployment	671	714	768	683	811
Unemployment as percent of labor force	5.7	5.9	6.4	5.7	6.8

Source: U.S. Census Bureau Fact Finder 2016.

Table 6.10-5. Delaware County, Oklahoma, civilian labor force (annual average).

	2010	2011	2012	2013	2014
Civilian Labor Force	17,130	17,387	17,642	17,765	17,487
Total Employment	15,815	15,966	16,183	16,195	15,678
Total Unemployment	1,282	1,421	1,459	1,603	1776
Unemployment as percent of labor force	3.9	4.3	4.4	4.8	5.3

Source: U.S. Census Bureau Fact Finder 2016.

Table 6.10-6. Mayes County, Oklahoma, civilian labor force (annual average).

	2010	2011	2012	2013	2014
Civilian Labor Force	18,887	18,908	18,562	18,318	18,177
Total Employment	17,271	17,354	16,907	16,656	16,635
Total Unemployment	1,584	1,555	1,624	1,598	1,509
Unemployment as percent of labor force	5.0	4.9	5.1	5.0	4.7

Source: U.S. Census Bureau Fact Finder 2016.

Table 6.10-7. Ottawa County, Oklahoma, civilian labor force (annual average).

	2010	2011	2012	2013	2014
Civilian Labor Force	14,821	15,024	14,726	14,527	14,478
Total Employment	13,480	13,494	13,273	13,096	13,073
Total Unemployment	1,315	1,505	1,453	1,430	1,430
Unemployment as percent of labor force	5.2	6.0	5.8	5.7	5.7

Source: U.S. Census Bureau Fact Finder 2016.

7.0 PRELIMINARY ISSUES, PROJECT EFFECTS, AND STUDIES LIST

This section summarizes potential effects of Project operations; existing protection, enhancement, and mitigation (PM&E) measures under the current license; and identifies proposed studies to supplement available resource information presented in Section 6.0 of this PAD. The list of issues was developed from GRDA's review of existing information gathered in support of this PAD and through the review of information provided by federal and state resource agencies, tribes, local governments, NGOs, and other interested parties in response to the PAD questionnaire. Studies are proposed only for those resource areas where additional information or analysis may be necessary to inform the evaluation of the potential impact of proposed operations on identified resources areas where there is a potential Project nexus.

The following narrative for each resource area discusses potential effects of proposed operations, summarizes available information and existing measures (if any), and identifies proposed studies GRDA is proposing three studies as identified in the following sections; (1) comprehensive hydraulic model; (2) recreation facilities inventory and use survey; and (3) phase I cultural resources background study. In addition to the three resource studies, GRDA will develop an operations model to describe and assess the extent of any water storage and generation changes considered during the relicensing process. Existing resource measures and associated license articles are also identified. There are no additional measures proposed at this time.

7.1 Geology and Soils

- Issue: Potential effects of Project operation and maintenance on soil erosion and shoreline erosion.

Operation of the Pensacola Project has the potential to cumulatively contribute to shoreline erosion. The existing SMP provides protection and mitigation measures for controlling erosion within the Project Boundary. Maintaining vegetated shorelines is an integral component of both the SMP and VMP to help stabilize and control the potential effects of erosion (GRDA 2008, 2011). Guidelines outlined in the SMP and VMP are intended to mitigate ground-disturbing activities and to monitor the shoreline to ensure that erosion of Project lands that result from permitted uses is addressed (FERC 2009). Restrictions on boat traffic, shoreline construction, tree removal, and landscaping are among the regulations in the SMP and VMP (FERC 2009; GRDA 2008, 2011). In addition, habitat enhancement strategies that reintroduce native vegetation in the littoral zone also provide forage and shelter to migrating waterfowl and aquatic species, such as fish and turtles (OWRB 2005; GRDA 2008). Available information is sufficient to evaluate any potential effects of operational changes. No study is proposed.

- Issue: Potential effects of Project operations on sedimentation in the Project Boundary.

Pensacola Project operations have the potential to cumulatively affect changes in sediment transport and sedimentation in the reservoir. There are existing studies that evaluate portions of the Project Boundary and upstream conditions. As a part of the relicensing, GRDA will incorporate and supplement existing information into a comprehensive hydraulic model to evaluate issues such as sedimentation and the flood inundation area (Holly 1999, 2004; Dennis 2014; USACE 1998, 2015; FERC 2015; Tetra Tech 2015, 2016).

7.2 Water Resources

- Issue: Potential effects of Project operation on water quantity and quality, including water temperature, in the Project Boundary.

When Grand Lake is stratified, water with low DO levels may be delivered to the tailrace through operation of the Project. An existing Dissolved Oxygen Monitoring and Enhancement program is ongoing under current license requirements (Article 403) to mitigate for these effects. Since the implementation of this program, GRDA has almost eliminated instances of chronic or acute DO occurrences below the dam, and monitoring is ongoing. Available information is sufficient to evaluate any potential effects of operational changes. No additional study is proposed.

No adverse impacts to water quantity and quality are anticipated from Project operations. Nonetheless, GRDA has gathered extensive water quality data in the Project Boundary. The current monitoring program includes both near-surface sampling and water column profiles and has been ongoing since 2012. Available information is sufficient to evaluate any potential effects of operational changes. No additional study is proposed.

7.3 Fish and Aquatic Resources

- Issue: Potential effects of Project operation on fish populations within the Project Boundary.

Project operations have the potential to impact habitat for fish and aquatic species. Extensive information is available on fish and aquatic resources in the Project Boundary. Based on surveys conducted by ODWC and GRDA, it is evident that a diverse and healthy warm water fishery is sustained within the Project Boundary; no negative effects of current operations are known. Available information is sufficient to evaluate any potential effects of operational changes. No study is proposed.

7.4 Wildlife and Botanical Resources

- Issue: Potential effect of Project operation, including water level fluctuations, ground-disturbing activities, and maintenance on wildlife and botanical resources.

GRDA did not identify any existing information or data regarding wildlife or botanical resources that suggest that the Project's operation will adversely impact these resources in the Project area. Further, current license commitments (Articles 406 and 411) and a Fish and Waterfowl

Mitigation Plan provide mitigation lands and wildlife management areas to mitigate ongoing impacts and enhance wildlife resources. The existing SMP includes a VMP and measures to limit impacts of any ground-disturbing and ongoing maintenance activities on terrestrial resources. Available information is sufficient to evaluate any potential effects of operational changes. No study is proposed.

7.5 Floodplains, Wetlands, Riparian, and Littoral Habitat

- Issue: Potential effects of Project operation of floodplain, wetland, riparian, and littoral habitat types.

Project operations have the potential to impact floodplain, wetland, riparian, and littoral habitat types. Available information from the national wetland survey and existing protection and mitigation measures included in GRDA's SMP provide sufficient information to categorize resources within the Project Boundary. The proposed hydraulic model will provide additional information to inform the evaluation of potential effects of Project operations on these habitat types.

7.6 Rare, Threatened, and Endangered Species

- Issue: Potential effects of Project operation, including ground-disturbing activities and maintenance on rare, threatened, and endangered species.

Project operation has the potential to affect terrestrial and aquatic rare, threatened, and endangered species through fluctuations in nearshore foraging and spawning areas, or by impacting shoreline habitat characteristics. GRDA does not anticipate direct effects of Project operation on federally listed species or indirect effects on habitats for federally listed species. However, by regulation, FERC is required to comply with Section 7 of the ESA and consult with the USFWS regarding potential Project effects. During the current license term, GRDA worked with agencies and other interested parties to improve egress at caves near the Project area. GRDA implements a Gray Bat Compliance Plan (per license Article 405) and conducts cave monitoring. Available information is sufficient to evaluate any potential effects of operational changes on the gray bat and other listed species habitats. No study is proposed.

7.7 Recreation and Land Use

- Issue: Potential effects of Project operations on public access to Project waters, existing recreational opportunities, and future recreational opportunities within the Project Boundary.

Project operations have the potential to effect public access and recreational opportunities in the Project Boundary. GRDA operates five recreational facilities as a part of the current license, as outlined in the RMP (as required by license Article 407). Existing recreational use information at the Pensacola Project is limited to data collected in support of the development of the required FERC Form 80. These estimates do not provide the level of data necessary to discern any patterns of use that might be related to Project operations. In addition, an up-to-date inventory and condition of existing Project recreation areas may be helpful in examining use patterns and future recreational facility needs. A recreation facilities inventory and use survey is proposed.

7.8 Aesthetic Resources

There are no potential issues related to aesthetic resources. GRDA is proposing no aesthetic resource studies.

7.9 Cultural and Tribal Resources

- Issue: Potential effects of the Project on historic, archeological, and traditional cultural resources that may be eligible for inclusion in the National Register of Historic Places.

Operation of the Project may affect tribal and other cultural resources. However, little is currently known about cultural and tribal resources at the Project, and effects on cultural resources may result from Project-related activities, such as reservoir level fluctuations, modifications to Project facilities, or other Project-related ground-disturbing activities. A Phase I cultural resources background study is proposed to determine locations within the Project Boundary that may experience Project-related effects and to identify specific targeted areas for additional investigation.

- Issue: Potential impact of Project operations on Tribal lands.

The proposed operations model and hydraulic model will provide the necessary information to evaluate any cumulative effect of hydroelectric project operations on any identified Tribal lands relative to the USACE flood control operations.

7.10 Socioeconomic Resources

The presence of the Pensacola Project provides significant economic benefit to the regional economy. Existing and ongoing studies provide extensive information for use in evaluation of Project operations. In addition, the City of Miami, tribes, and other interested parties have raised the issue of flooding in the area and potential economic impacts on the community in response to the PAD questionnaire. The proposed operations model and hydraulic model will provide the necessary information to evaluate any cumulative effect of hydroelectric project operations relative to the USACE flood control operations.

8.0 COMPREHENSIVE PLANS

As detailed in FERC's List of Comprehensive Plans (revised August 2015), Section 10(a)(2)(A) of the FPA requires FERC to consider the extent to which a project is consistent with Federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project.

On April 27, 1988, FERC issued Order No. 481-A establishing that FERC will accord the FPA Section 10(a)(2)(A) comprehensive plan status to any federal or state plan that:

- Is a comprehensive study of one or more of the beneficial uses of the waterway or waterways;

- Specifies the standards, the data, and the methodology used; and
- Is filed with the Secretary of FERC.

According to FERC, a comprehensive plan should contain the following: (1) A description of the waterway or waterways that are the subject of the plan including pertinent maps detailing the geographic area of the plan; (2) a description of the significant resources of the waterway or waterways; (3) a description of the various existing and planned uses of the resources; and (4) a discussion of goals, objectives, and recommendations for improving, developing, or conserving the waterway or waterways in relation to these resources. The description of the significant resources in the area should contain the following elements. The plan should also contain an examination of how the different uses will promote the overall public interest:

- Navigation
- Power development
- Energy conservation
- Fish and wildlife
- Recreational opportunities
- Irrigation
- Flood control
- Water supply
- Other aspects of environmental quality

FERC (August 2015) currently lists 14 comprehensive plans for the State of Oklahoma. Of these 14 listed plans, 11 are potentially relevant to the Pensacola Project; each plan is listed below with a brief explanation for its inclusion as a relevant qualifying comprehensive plan. The comprehensive plans and corresponding published dates identified in the sections below are consistent with FERC's list of comprehensive plans. The descriptions indicate when a plan has been updated.

8.1 Qualifying Comprehensive Plans Relevant to the Project

8.1.1 Department of the Army, Corps of Engineers. Little Rock District and Tulsa District. 1991. Arkansas River Basin, Arkansas and Oklahoma, feasibility report. Little Rock, Arkansas, and Tulsa, Oklahoma. May 1991.

To date, GRDA was unable to obtain a copy of this document. However, GRDA will work to obtain a copy of the document through further consultation with the relicensing parties and will evaluate consistency with the Project in the DLA.

8.1.2 National Park Service. 1982. The Nationwide Rivers Inventory. Department of the Interior, Washington, D.C. January 1982

The Project location is included in the inventory of this management plan which is a comprehensive study of one or more of the beneficial uses of a waterway, waterways, and/or water body; it specifies the standards, the data, and the methodology used; and is filed with the Secretary of the Commission. The Nationwide Rivers Inventory (NRI) is a listing of more than 3,400 free-flowing river segments in the United States that are believed to possess one or more "outstandingly remarkable" natural or cultural values judged to be of more than local or regional significance. Under a 1979 Presidential Directive and related Council on Environmental Quality procedures, all federal agencies must seek to avoid or mitigate actions that would adversely affect one or more NRI segments.

8.1.3 Oklahoma Department of Wildlife Conservation. U.S. Fish and Wildlife Service. 1985. Bottomland hardwoods of eastern Oklahoma. Oklahoma City, Oklahoma. December 1985.

This report discusses the value/importance, trends, identification of significant remaining tracts of BLHs, and alternatives for maintaining/enhancing BLHs in eastern Oklahoma. Approximately 10 percent of commercial forest in eastern Oklahoma is BLH composed of the elm-ash-cottonwood and oak-gum-cypress species associations. BLH forests provide benefits such as fish and wildlife habitat, natural flood control, groundwater recharge, water quality enhancement, waste assimilation, biomass accumulation/production, and nutrient cycling. GRDA currently implements a SMP for the Project. The SMP is a comprehensive plan for Grand Lake that considers GRDA's enabling legislation, the FERC license, historical and current public use, and the need to accommodate future growth and changing use patterns; all while maintaining stewardship for the environmental and socioeconomic resources entrusted to GRDA. Stewardship, Responsible Growth-Wetlands, and WMA are three shoreline management classifications that will continue to protect BLHs and other valued fish and wildlife habitats within the Project Boundary.

8.1.4 Oklahoma Department of Wildlife Conservation. U.S. Fish and Wildlife Service. 1989. Eastern Oklahoma wetlands plan: Lower Mississippi Valley joint venture – North American waterfowl management plan. Oklahoma City, Oklahoma. August 1989.

This plan outlines specific actions to conserve and protect wetlands and waterfowl habitat in eastern Oklahoma and describes strategies to accomplish the actions. The three main goals of the plan are as follows:

1. Protect, enhance, and restore wetlands and waterfowl habitat in eastern Oklahoma;
2. Restore the eastern Oklahoma population of migratory/wintering waterfowl to the 1970-1979 levels; and
3. Stabilize the loss of wetlands and related values in eastern Oklahoma.

GRDA currently implements a SMP for the Project. The SMP is a comprehensive plan for Grand Lake that considers GRDA's enabling legislation, the FERC license, historical and current public use, and the need to accommodate future growth and changing use patterns; all while maintaining stewardship for the environmental and socioeconomic resources entrusted to GRDA. Stewardship, Responsible Growth-Wetlands, and WMA are three shoreline management classifications that will continue to protect wetlands and other valued waterfowl habitats within the Project Boundary.

8.1.5 Oklahoma Water Resources Board. 1997. Update of the Oklahoma comprehensive water plan. Publication Number 139. Oklahoma City, Oklahoma. February 1997.

This plan was updated in 2012 and contains technical data, study findings, reports, and policy recommendations. The plan also includes water supply and demand analysis results as well as forecasted water supply shortages information by region. The beneficial use designations for Grand Lake include public and private water supply and the Project is managed accordingly.

8.1.6 Oklahoma Water Resources Board. 2002. Oklahoma's water quality standards and implementation of Oklahoma's water quality standards. Oklahoma Administrative Code, Title 785, Chapters 45 and 46 effective July 1, 2002. Oklahoma City, Oklahoma.

The Oklahoma WQS serve as the cornerstone of the state's water quality management programs. Title 785 and Chapters 45 and 46 were updated and effective as of July 1, 2013. The purpose of the standards is to promulgate rules which establish classifications of uses of waters of the state, criteria to maintain, and protect such classifications and other standards or policies pertaining to the quality of the waters. The standards specify numerical and narrative criteria to protect beneficial uses designated for certain waters of the State of Oklahoma. GRDA will obtain State water quality certification before FERC issues a new operating license for the Project.

8.1.7 Oklahoma Tourism & Recreation Department. 2001 Statewide Comprehensive Outdoor Recreation Plan (SCORP): The public recreation estate. Oklahoma City, Oklahoma.

The Oklahoma SCORP was updated in 2012 to cover 2013-2017. The SCORP describes recreation resources available in Oklahoma; a description of analysis of recreation users; a description of agencies that manage the public recreation resources; and issues to be addressed and actions to be implemented during 2013-2017 to protect, preserve, and provide for the enjoyment of Oklahoma's great outdoors. GRDA is recognized in the SCORP as a state agency that manages recreation. The Project's FERC-approved recreation plan was developed and is implemented with consideration of state and regional needs, goals, and opportunities.

8.1.8 U.S. Fish and Wildlife Service. 1989. Fisheries-USA: The Recreational Fisheries Policy of the U.S. Fish and Wildlife Service. Washington D.C. 13 pp.

This plan addresses the recreational fisheries policy for every State in the Union specifying the standards and the methodology used; and it is filed with the Secretary of the Commission. Through this plan, the USFWS aims to: effect the preservation and/or increased productivity of fishery resources; ensure and enhance the quality, quantity, and diversity of recreational fishing opportunities; develop and enhance partnerships between governments and the private sector for conserving and managing recreational fisheries; and cooperate to maintain a healthy recreational fisheries industry. Fishing is a year-round activity on Grand Lake and the Project reservoir supports a high quality fishery for Largemouth Bass, Hybrid Striped Bass, White Bass, Crappie, Catfish, and Paddlefish.

8.1.9 U.S. Fish and Wildlife Service. 1979. Unique wildlife ecosystems of Oklahoma. Department of the Interior. Albuquerque, New Mexico. May 18, 1979.

The USFWS defines unique wildlife ecosystems as wildlife habitats that are significantly different from other habitats in the region or the best representative example in the region or larger geographic area and support natural fish and wildlife communities. The plan provides a summary of unique wildlife ecosystems in Oklahoma. GRDA currently implements a SMP for the Project. The SMP is a comprehensive plan for Grand Lake that considers GRDA's enabling legislation, the FERC license, historical and current public use, and the need to accommodate future growth and changing use patterns; all while maintaining stewardship for the environmental and socioeconomic resources entrusted to GRDA. Stewardship, WMA and Responsible Growth – Wetlands are shoreline management classifications that will continue to protect unique wildlife ecosystems of Oklahoma within the Project Boundary.

8.1.10 U.S. Fish and Wildlife Service. 1985. Land protection plan for Texas/Oklahoma bottomland hardwoods and migratory waterfowl. Department of the Interior, Albuquerque, New Mexico. January 15, 1985.

This report provides the status, trends, and values of BLH forest habitat in 28 eastern Oklahoma counties. The report identifies and prioritizes important BLH habitat, which includes 13 tracts located along the Little River, Deep Fork River, Neosho River, Verdigris River, McKinney Creek, Gaines Creek, and Clear and Muddy Boggy Creeks. However, significant amounts of contiguous mature BLH were only identified along the Little River and the Deep Fork River.

8.1.11 U.S. Fish and Wildlife Service. 1986. Whooping Crane Recovery Plan. Department of the Interior, Albuquerque, New Mexico. December 23, 1986.

The Whooping Crane Recovery Plan was updated in 2007. The goal of the plan is to protect the whooping crane and its habitat and allow the overall population to grow so that it is ecologically and genetically stable. Whooping cranes migrate through the Great Plains states, including Oklahoma.

8.2 Non-Relevant Plans

8.2.1 State of Oklahoma. 1969. Oklahoma Scenic River Act. Oklahoma City, Oklahoma. March 17, 1969.

This plan is not applicable to the Project as there are no state-protected river segments in the Project vicinity that have been designated for preservation under the Oklahoma Scenic Rivers Act (Oklahoma Scenic Rivers Commission 2016).

8.2.2 Oklahoma Department of Wildlife Conservation. U.S. Fish and Wildlife Service. 1987. Riparian areas of western Oklahoma. Oklahoma City, Oklahoma.

This plan is not applicable to the Project as it addresses the riparian areas of western Oklahoma and the Project is located in eastern Oklahoma.

8.2.3 Forest Service. 2005. Ouachita National Forest revised land and resource management plan. Department of Agriculture, Hot Springs, Arkansas. September 2005.

This plan is not applicable to the Project as it is not located in the Ouachita National Forest.

9.0 REFERENCES

Section 1.0: Introduction and Background

FERC (Federal Energy Regulatory Commission). 1996. Order Amending License. 77 FERC 61,251. December 3, 1996.

GRDA (Grand River Dam Authority). 2010. Letter from GRDA to FERC with photographs of the installed turbine and generator nameplates on the Pensacola Project's six units. May 12, 2010.

Section 4.0: Project Location, Facilities, and Operations

FERC (Federal Energy Regulatory Commission). 1992. Order Issuing New License and Environmental Assessment, Pensacola Project, FERC No. 1494-002 (59 FERC 63,231). April 29, 1992 (Order); November 19, 1991 (EA).

FERC. 1996. Order Amending License. 77 FERC ¶ 61,251. December 3, 1996.

FERC. 2012. Order Modifying and Approving Temporary Variance from the Rule Curve Requirements under Article 401, Pensacola Hydroelectric Project FERC No. 1494. 140 FERC ¶ 62,123. August 15, 2012.

FERC. 2014. Draft Environmental Assessment for Hydropower License Salina Pumped Storage Project – FERC Project No. 2524-021 Oklahoma. November 2014.

FERC. 2015. Order Approving Request for Temporary Variance, Pensacola Hydroelectric Project FERC No. 1494. 152 FERC ¶ 61,129. August 14, 2015.

FERC. 2016. Order Approving Request for Temporary Variance, Pensacola Hydroelectric Project FERC No. 1494. 156 FERC ¶ 61,106. August 12, 2016.

GRDA (Grand River Dam Authority). 1985. New License Application for the Pensacola Project FERC No. 1494.

GRDA. 2004a. Article 401 Amendment Application. January 29, 2004. Accession No.: 20040130-0300.

GRDA. 2004b. Pensacola Dam - Construction Project Record Drawing Compilation. Prepared by Benham Companies. July 2004.

GRDA. 2008. Shoreline Management Plan. Pensacola Hydroelectric Project, FERC No. 1494. June 11, 2008.

GRDA. 2010. Letter from GRDA to FERC with photographs of the installed turbine and generator nameplates on the Pensacola Project's six units. May 12, 2010.

GRDA. 2011a. Supporting Technical Information Document for the Pensacola Project No. 1494. Compiled by Burns & McDonnell Engineering Company, Inc. Kansas City, Missouri. Revision 1. September 2011.

GRDA. 2011b. Vegetation Management Application Packet. January 25, 2011.

GRDA. 2015. Article 411 Fish and Waterfowl Habitat Management Plan, Annual Report. April 30, 2015.

GRDA. 2016a. Environmental Report Prepared in Support of Non-Capacity License Amendment to Modify Article 401 (Rule Curve), FERC Project No. 1494. Prepared by McMillen Jacobs Associates. May 6, 2016.

GRDA. 2016b. Answer to Grand River Dam Authority's to Motions to Intervene and Comments on License Amendment Application. November 8, 2016.

Holly Jr., F. 2004. Analysis of Effect of Grand Lake Power-Pool Elevations on Neosho River Levels During a Major flood. Prepared for: Robert Sullivan, AGM of Risk Management and Regulatory Compliance, GRDA.

USACE (U.S. Army Corps of Engineers). 1992. Markham Ferry Reservoir Grand-Neosho River, Oklahoma Water Control Manual, Appendix E, Part II to Water Control Master Manual Arkansas River Basin. October 1992.

Section 5.0: General Description of the River Basin

Brock, F.V., K.C. Crawford, R.L. Elliott, G.W. Cuperus, S.J. Stadler, H.L. Johnson, and M.D. Eilts. 1995. The Oklahoma Mesonet: A technical overview. *J. Atmos. Oceanic Technol.*, 12:5-19.

FERC (Federal Energy Regulatory Commission). 1996. Order Amending License. 77 FERC ¶ 61,251. December 3, 1996.

GLWAF (Grand Lake O' the Cherokees Watershed Alliance Foundation). 2008. Grand Lake Watershed Plan for Improving Water Quality Throughout the Grand Lake Watershed. November 18.

GRDA (Grand River Dam Authority). 2008. Shoreline Management Plan. Pensacola Hydroelectric Project, FERC No. 1494. June 11, 2008.

GRDA. 2010. Salina Pumped Storage Project FERC No. 2524, Pre-Application Document. November 2010.

GRDA. 2011. Supporting Technical Information Document for the Pensacola Project No. 1494. Compiled by Burns & McDonnell Engineering Company, Inc. Kansas City, Missouri. Revision 1. September 2011.

GRDA. 2016. Environmental Report Prepared in Support of Non-Capacity License Amendment to Modify Article 401 (Rule Curve), FERC Project No. 1494. Prepared by McMillen Jacobs Associates. May 6, 2016.

Johnson, K.S. and K.V. Luza, Eds. 2008. Earth Sciences and Mineral Resources of Oklahoma, Educational Publication 9. Prepared for Oklahoma Geological Survey. University Printing Services.

McPherson, R.A., C. Fiebrich, K.C. Crawford, R.L. Elliott, J.R. Kilby, D.L. Grimsley, J.E. Martinez, J.B. Basara, B.G. Illston, D.A. Morris, K.A. Kloesel, S.J. Stadler, A.D. Melvin, A.J. Sutherland, and H. Shrivastava. 2007. Statewide monitoring of the mesoscale environment: A technical update on the Oklahoma Mesonet. *J. Atmos. Oceanic Technol.*, 24:301–321.

Mesonet. 2016. Weather, Past Data & Files, Meonet Long-term Averages Maps. [Online] URL: https://www.mesonet.org/index.php (Accessed November 11, 2016).

USACE (U.S. Army Corps of Engineers). 1992. Water Control Manual for Pensacola Reservoir, Grand River, Oklahoma. October 1992.

Section 6.1: Geology, Topography, and Soils

Afridi, Abdul J. 1996. Repeat Shear Method for the Determination of Residual Shear Strength of Rock. Department of Mining Engineering, University of Missouri-Rolla.

Brady, N.C. 1984. The nature and properties of soil (9th ed.): New York, Macmillan, 750 p.

FERC (Federal Energy Regulatory Commission). 1991. Environmental Assessment for Hydropower License: Pensacola Hydro Project (FERC No. 1494-002). November 19, 1991.

FERC. 1996. Order Amending License. 77 FERC ¶ 61,251. December 3, 1996.

FERC. 2009. Environmental Assessment for the Application for Amendment of License, Shoreline Management Plan, Pensacola Project FERC No. 1949. August 2009.

GLWAF (Grand Lake O' the Cherokees Watershed Alliance Foundation, Inc.). 2008. Grand Lake Watershed Plan: For Improving Water Quality Throughout the Grand Lake Watershed. November 18, 2008, Grove, OK.

GRDA (Grand River Dam Authority). 1985. Pensacola Dam Hydropower Project FERC Project No. 1494-002, Federal Energy Regulatory Commission New License Application, Major

Project – Existing Dam. State of Oklahoma Grand River Dam Authority, Vinita, Oklahoma. December 1985.

GRDA. 1995. Stability Investigation Program, Report on Foundation Exploration and Geological Design Parameter. Pensacola Dam, FERC Project No. 1494-OK. March 1995.

GRDA. 2004. Article 401 Amendment Application. January 29, 2004. Accession No.: 20040130-0300.

GRDA. 2008. Shoreline Management Plan. Pensacola Project, FERC No. 1494. Final Draft, June 11, 2008.

GRDA. 2010. Salina Pumped Storage Project FERC No. 2524, Pre-Application Document. Oklahoma Grand River Dam Authority, Vinita, Oklahoma. November 2010.

GRDA. 2011. Vegetation Management Application Packet. January 25, 2011.

Haas and Associates. 1991. Direct Shear Tests on Core from Pensacola Dam Foundation. March 1991.

Haas, Charles J and Abdul J. Afridi. 1995. Rock Property Tests on Core from the Pensacola Dam Foundation. University of Missouri-Rolla. January 1995.

Huffman, G.G. 1958. Geology of the Flanks of the Ozark Uplift, Northeastern Oklahoma. Oklahoma Geological Survey, Bulletin 77.

Huffman, G.G., T.A. Cathey, and J.E. Humphrey. 1963. Guide Book XII, A guide to state parks and scenic areas in the Oklahoma Ozarks. Prepared for Oklahoma

Johnson, K.S. and K.V. Luza, Eds. 2008. Earth Sciences and Mineral Resources of Oklahoma, Educational Publication 9. Prepared for Oklahoma Geological Survey. University Printing Services.

Juracek, K.E. and M.F. Becker. 2009. Occurrence and Trends of Selected Chemical Constituents in Bottom Sediment, Grand Lake O' the Cherokees, Northeast Oklahoma, 1940–2008. Scientific Investigations Report 2009–5258. U.S. Department of the Interior, U.S. Geological Survey prepared in cooperation with the U.S. Fish and Wildlife Service.

NRCS (U.S. Department of Agriculture, Natural Resources Conservation Service). 2016. Soil Survey Data for Pensacola Project Vicinity. Accessed April and November 2016. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

OWRB (Oklahoma Water Resources Board). 2016. Grand Lake Shoreline Mapping Project, Draft Report. July 2016.

USFWS (U.S. Fish and Wildlife Service). 2002. Ozark plateau national wildlife refuge proposed refuge expansion environmental assessment. September 2002.

USGS (U.S. Geological Survey). 1995. Environmental and Hydrologic Setting of the Ozark Plateaus Study Unit, Arkansas, Kansas, Missouri, and Oklahoma. U.S. Geological Survey, Water-Resources Investigations Report 94-4022.

USGS. 2005. Potentiometric surface of the Ozark Aquifer in Northern Arkansas, 2004. U.S. Geological Survey, Scientific Investigations Report 2005-5208.

Section 6.2: Water Resources

Aggus, L.R. 1987. Effects of Acid Mine Drainages from Tar Creek on Fishes and Benthic Macroinvertebrates in Grand Lake, Oklahoma. National Reservoir Research Program, U.S. Fish and Wildlife Service. Prepared for: Oklahoma Ordnance Works, Pryor, OK. Cooperative Agreement 14-06-0009-83-1801.

Allert, A.A., R.J. DiStefano, C.J. Schmitt, J.F. Fairchild, and W.G. Brumbaugh. 2011. Effects of mining-derived metals on riffle dwelling crayfish in southwestern Missouri and southeastern Kansas if the Tri-State Mining District, USA. Prepared by USGS, Columbia MO for U.S. Fish and Wildlife Service. Administrative Report 08-NRDAR-03

Atkinson, CA; Jolley, DF; Simpson, SL. 2007. Effect of overlying water pH, dissolved oxygen, salinity and sediment disturbances on metal release and sequestration from metal contaminated marine sediments. Chemosphere, 69:1428-1437.

Dong, Z., R.C. Jim, E.L. Hatley, A.S.N. Backus, J.P. Shine, J.D. Spengler, L.A. Schaider. 2015. A longitudinal study of mercury exposure associated with consumption of freshwater fish from a reservoir in rural south central USA. Environmental Research, 136:155-162.

Dong, Z., R.A. Lynch, and L.A. Schaider. 2016. Key contributors to variations in fish mercury within and among freshwater reservoirs in Oklahoma, USA. Environ. Sci.: Processes Impacts, 18: 222-236.

Ellis, M.M. 1939. Report on the Pensacola dam impoundment of the Grand River with special reference to fisheries problems in the completed reservoir. Report for U.S. Department of Interior, Interior Fisheries Investigations.

FERC (Federal Energy Regulatory Commission). 1996. Order Amending License. 77 FERC ¶ 61,251. December 3, 1996.

FERC. 2009. Environmental Assessment for the Application for Amendment of License, Shoreline Management Plan, Pensacola Project FERC No. 1949. August 2009.

FERC. 2015. Memorandum to Public File of Pensacola Project, P-1494-432. Supporting information for Commission staff's independent analysis of GRDA's request for expedited approval of a temporary variance from Article 401. August 31, 2015.

GRDA (Grand River Dam Authority). 2008. Shoreline Management Plan. Pensacola Project, FERC No. 1494. Final Draft, June 11, 2008.

GRDA. 2010. Salina Pumped Storage Project FERC No. 2524, Pre-Application Document. November 2010.

GRDA. 2011. Supporting Technical Information Document for the Pensacola Project No. 1494. Compiled by Burns & McDonnell Engineering Company, Inc. Kansas City, Missouri. Revision 1. September 2011.

GRDA. 2015. GRDA's Bacteria Management Plan for Designated Swimming Areas in the Grand River Watershed.

GRDA. 2016. Environmental Report Prepared in Support of Non-Capacity License Amendment to Modify Article 401 (Rule Curve), FERC Project No. 1494. Prepared by McMillen Jacobs Associates. May 6, 2016.

Ingersoll, C.G., C.D. Ivey, W.G. Brumbaugh, J.M. Besser, and N.E. Kemble. 2009. Toxicity assessment of sediments from the Grand Lake O' the Cherokees with the amphipod *Hyalella azteca.* August 27. U.S. Geological Survey Administrative Report CERC-8335-FY09-20-01.

Jones, A.J. and M. Donlan. 2009. Memorandum: 2008 Grand Lake Sampling Results. To: Suzanne, Dudding, U.S. FWS. 15 June. Available February 2012 at: http://www.fws.gov/southwest/es/oklahoma/Documents/Contaminants/2008%20Chemistry Results Overview final.pdf

Jones, J.R., M.F. Knowlton, D.V. Obrecht, and J.L. Graham. 2011. Temperature and oxygen in Missouri reservoirs. Lake and Reservoir Management. June 16, 2011.

Juracek, K.E. and M.F. Becker. 2009. Occurrence and trends of selected chemical constituents in bottom sediment, Grand Lake O' the Cherokees, northeast Oklahoma, 1940-2008. U.S. Geological Survey Scientific Investigations Report 2009-5258.

MacDonald, D.D., C.G. Ingersoll, M. Crawford, H. Prencipe, J.M. Besser, W.G. Brumbaugh, N. Kemble, T.W. May, C.D. Ivey, M. Menehetti, J. Sinclair, and M. O'Hare. 2010. Advanced Screening-Level Ecological Risk Assessment for Aquatic Habitats within the Tri-State Mining District, Oklahoma, Kansas, and Missouri. Final Draft Technical Report. Prepared by USGS, Columbia MO and MacDonald Environmental Sciences Ltd., CH2M Hill, Dallas Texas for the USEPA, Dallas, TX; USEPA Kansas City, MO; and USFWS, Columbia, MO.

McCormick, C.A. 1985. Water Quality and sediments of an area receiving acid-mine drainage in northeastern Oklahoma. M.S. Thesis. Oklahoma State University, Stillwater, OK.

Merwe, D., J.W. Carpenter, J.C. Nietfeld, and J.F. Miesner. 2011. Adverse health effects in Canada Geese (*Branta Canadensis)* associated with waste from zinc and lead mines in the tri-state mining district(Kansas, Oklahoma, and Missouri, USA). Journal of Wildlife Diseases. 47: 650-660.

Mitchell, G. 1942. Report to the Game and Fish Commission of zinc mine pollution. No Publication number.

Morrison S., S. Nikolai, D. Townsend, J. Belden. 2014 Distribution and Bioavailability of trace metals in shallow sediments from Grand Lake, OK. Paper Presented at the American Society of Mining and Reclamation Conference, Oklahoma City, Oklahoma.

Nikolai, S.J. and A.R. Dzialowski. 2014. Effects of internal phosphorus loading on nutrient limitation in a eutrophic reservoir. *Limnologica* 49:33-41.

ODEQ (Oklahoma Department of Environmental Quality). 2007. Fish tissue metals analysis in the Tri-State Mining Area follow-up study. FY 2006 Final Report.

ODEQ. 2014. Water Quality in Oklahoma, 2014 Integrated Report. Prepared Pursuant to Section 303(D) and Section 305(B) of the Clean Water Act.

OWRB (Oklahoma Water Resources Board) and OSU (Oklahoma State University). 1995. Diagnostic and Feasibility Study of Grand Lake O' The Cherokees, Phase I of a Clean Lakes Project, Final Report. March 10, 1995.

OWRB. 2009. Hydrographic Survey of Grand Lake. August 19, 2009.

OWRB. 2011. Hydrographic Survey of GRDA Tailraces. October 11, 2011.

OWRB. 2015. Sample Year 2014 Testing for Pensacola Dam/Neosho River Dissolved Oxygen Mitigation Plan. January 2015.

OWRB. 2016. Water Quality Standards Fact Sheet. Online [URL]: https://www.owrb.ok.gov/about/about_pdf/Fact-Standards.pdf (Accessed April 20, 2016).

Pita, F.W. and N.J. Hyne. 1975. The depositional environment of zinc, lead, and cadmium in reservoir sediments. Water Research, 9:701-706.

USACE (U.S. Army Corps of Engineers). 1992. Water Control Manual for Pensacola Reservoir, Grand River, Oklahoma. October 1992.

USACE. 2016. HEC-HMS model of the Lower Grand Neosho River basin. Model version 4.0, transmitted by UACE SWT to Mead & Hunt on March 23, 2016.

Wetzel, R.G. 2001. Limnology: Lake and River Ecosystems. Academic Press, San Diego. 1006 pp.

Wildman. R.A. 2016. Mercury and methylmercury in a reservoir during seasonal variation in hydrology and circulation. Lake and Reservoir Management, 32:89-100.

Section 6.3: Fish and Aquatic Resources

Bassmaster. 2015. Bassmaster's Best Bass Lakes of 2015. [Online] URL: https://www.bassmaster.com/slideshow/bassmasters-best-bass-lakes-2015. (Accessed June 26, 2016).

Branson, B.A. 1982. The mussels (Unionacea: Bivalvia) of Oklahoma – Part I – Ambleminae. Proc. Okla. Acad. Sci 62:38-48.

Brewer, S. K. and D. J. Orth. 2015. Smallmouth Bass *Micropterus dolomieu* Lacepede, 1802. Pages 9-26 in Tringali, M. D., J. M. Long, T. W. Birdsong, and M. S. Allen, editors. Black Bass Diversity: Multidisciplinary Science for Conservation. American Fisheries Society, Symposium 82, Bethesda, Maryland.

Brewer, S. K., and J. M. Long. 2015. Biology and ecology of Neosho Smallmouth Bass and the genetically-distinct Ouachita lineage. Pages 281-296 in Tringali, M. D., J. M. Long, T. W. Birdsong, and M. S. Allen, editors. Black Bass Diversity: Multidisciplinary Science for Conservation. American Fisheries Society, Symposium 82, Bethesda, Maryland.

Combs, D.L. 1982. Angler Exploitation of Paddlefish in the Neosho River, Oklahoma. North American Journal of Fisheries Management 4:334-342.

Conover, G., R. Simmonds, and M. Whalen. 2007. Management and control plan for bighead, black, grass, and silver carps in the United States. Asian Carp Working Group, Aquatic Nuisance Species Task Force, Washington, D.C.

FERC (Federal Energy Regulatory Commission). 1996. Order Amending License. 77 FERC ¶ 61,251. December 3, 1996.

GRDA (Grand River Dam Authority). 2007. Final Report & Recommendations for GRDA Fish & Wildlife Mitigation Project. Feasibility of Establishing Native Aquatic Plants in Grand Lake. Oklahoma Water Resources Board Lewisville Aquatic Ecosystem Research Facility.

GRDA. 2014. GRDA reminds lake users of issues, tips related to zebra mussels. [Online] URL: http://www.grda.com/grda-reminds-lake-users-of-issues-tips-related-to-zebra-mussels/ (Accessed June 26, 2016).

GRDA. 2015. Request for Extension of Time regarding the Shoreline Management Plan for the Markham Ferry Project

GRDA. 2016a. Environmental Report Prepared in Support of Non-Capacity License Amendment to Modify Article 401 (Rule Curve). Pensacola Hydroelectric Project, FERC No. 1494. May 2016.

GRDA. 2016b. Final Report on Aquatic Resources Enhancement and Monitoring Plan for Article 402. Markham Ferry Hydroelectric Project, FERC No. 2183-062. October 2016.

Hubbs, C. L., and R. M. Bailey. 1940. A revision of the Black Basses (Micropterus and Huro) with descriptions of four new forms. University of Michigan Museum of Zoology Miscellaneous Publications 48: 1–57.

Jager, C.A. and J.D. Schooley. 2016. Oklahoma Department of Wildlife Conservation 2015 Post-season Survey of Paddlefish Permit Holders.

Laird, C. A., and L. M. Page. 1996. Non-native fishes inhabiting the streams and lakes of Illinois. Illinois Natural History Survey Bulletin 35(1):1-51.

Li, S., and F. Fang. 1990. On the geographical distribution of the four kinds of pond-cultured carps in China. Acta Zoologica Sinica 36(3):244-250.

Miller, R.J. and H.W. Robison. 2004. Fishes of Oklahoma. University of Oklahoma Press, Norman, Oklahoma.

Nico, L., P. Fuller and J. Li. 2016. *Hypophthalmichthys nobilis*. USGS Nonindigenous Aquatic Species Database. [Online] URL: http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=551 (Accessed May 13, 2016).

NOAA (National Oceanic and Atmospheric Administration) National Marine Fisheries Service (NMFS). 2016. Essential Fish Habitat Mapper. [Online] URL: http://www.habitat.noaa.gov/protection/efh/habitatmapper.html (Accessed May 16, 2016).

ODWC (Oklahoma Department of Wildlife Conservation). 2005. Final Report. [Online] URL: https://www.wildlifedepartment.com/wildlifemgmt/swg/T14P1.PDF (Accessed October 24, 2016).

ODWC. 2008. Grand Lake Management Plan. Pensacola Hydroelectric Project, FERC No. 1494.

ODWC. 2012. Fish Stocking in 2012, Northeast Region. [Online] URL: http://www.wildlifedepartment.com/fishing/ statewide_stocking.htm#Northeast_Region (Accessed May 10, 2016).

ODWC. 2013. Public Stocking Report.

ODWC. 2014. Public Stocking Report.

ODWC. 2015. Surveys and Reports. [Online] URL: http://www.wildlifedepartment.com/fishing/surveys.htm (Accessed May 16, 2016).

ODWC. 2016a. Bass. [Online] URL: http://www.wildlifedepartment.com/fishing/fishid/largemouthbass.htm (Accessed May 13, 2016).

ODWC. 2016b. White Bass – *Morone chrysops*. [Online] URL: http://wildlifedepartment.com/fishing/ fishid/whitebass.htm (Accessed May 13, 2016).

ODWC. 2016c. Striped Bass Hybrid. [Online] URL: http://wildlifedepartment.com/fishing/fishid/hybrid.htm (Accessed May 13, 2016).

ODWC. 2016d. Crappie. [Online] URL: http://www.wildlifedepartment.com/fishing/fishid/bwcrappie.htm (Accessed May 13, 2016).

ODWC. 2016e. Blue Catfish – *Ictalurus furcatus*. [Online] URL: http://www.wildlifedepartment.com/fishing/fishid/bluecatfish.htm (Accessed May 13, 2016).

ODWC. 2016f. Channel Catfish – *Ictalurus punctatus*. [Online] URL: http://www.wildlifedepartment.com/fishing/fishid/ channelcatfish.htm (Accessed May 13, 2016).

ODWC. 2016g. Flathead Catfish – *Pylodictis olivaris* [Online] URL: http://www.wildlifedepartment.com/fishing/fishid/flatheadcatfish. htm (Accessed May 13, 2016).

ODWC. 2016h. Statewide Stocking Report. [Online] URL: http://www.wildlifedepartment.com/fishing/statewide_stocking.htm #Northeast_Region (Accessed May 16, 2016).

ODWC. 2016i. Electrofishing reports. [Online] URL: http://www.wildlifedepartment.com/fishing/electrofishing.htm (Accessed May 16, 2016).

ODWC. 2016j. Surveys and Reports. [Online] URL: http://www.wildlifedepartment.com/fishing/surveys.htm (Accessed May 16, 2016.

OWRB (Oklahoma Water Resources Board). 2007. Feasibility of establishing native aquatic plants in Grand Lake.

OWRB. 2009. Hydrographic Survey of Grand Lake. Final Report August 19, 2009.

OWRB. 2011. Hydrographic Survey of GRDA Tailraces. October 11, 2011.

Pflieger, W. L. 1997. The fishes of Missouri. Missouri Department of Conservation, Jefferson City, MO. 372 pp.

Pigg, J., J. Smith, and M. Ambler. 1997. Additional records of bighead carp, *Hypophthalmichthys nobilis*, in Oklahoma waters. Proceedings of the Oklahoma Academy of Science 77:123.

Pigg, J., J. Stahl, M. Ambler, and J. Smith. 1993. Two potential sources of exotic fish in Oklahoma. Proceedings of the Oklahoma Academy of Science 73:67.

Rasmussen, J.L. 1998. Aquatic nuisance species of the Mississippi River basin. 60th Midwest Fish and Wildlife Conference, Aquatic Nuisance Species Symposium, Dec. 7, 1998, Cincinnati, OH.

Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott. 1991. World fishes important to North Americans exclusive of species from the continental waters of the United States and Canada. American Fisheries Society Special Publication 21. American Fisheries Society, Bethesda, MD. 243 pp.

Scarnecchia, D.L., B.D. Gordon, J.D. Schooley, L.F. Ryckman, B.J. Schmitz, S.E. Miller, and Y. Lim. 2011. Southern and Northern Great Plains (United States) Paddlefish Stocks Within Frameworks of Acipenseriform Life History and the Metabolic Theory of Ecology. Reviews in Fisheries Science 19: 279-298. DOI: 10.1080/10641262.2011.598123

Scarnecchia, D.L., B.D. Gordon, J.D. Schooley, and A.A. Nealis. 2013. A Comprehensive Plan for the Management of Paddlefish in Oklahoma. Oklahoma Department of Wildlife Conservation, Oklahoma City. 106 pages.

Schooley, J.D. and B.R. Johnston. 2015. Grand Reservoir Paddlefish Telemetry and Spawning Frequency. Grant Report. Project Number: F11AF00318.

Schooley, J.D., D.L. Scarnecchia, and A. Crews. 2014. Harvest Management Regulation Options for Oklahoma's Grand Lake Stock of Paddlefish. Journal of the Southeastern Association of Fish and Wildlife Agencies 1: 89-97.

Schooley, J.D. and D.L. Scarnecchia. 2015. Costs and Consequences of Dam Passage for Paddlefish in Northeast Oklahoma – Rostrum Amputation and the Hydropower Diet Plan. Conference Paper. 2015 Oklahoma Natural Resources Conference.

Schooley, J.D. and S. O'Donnell. 2016. Benthic Habitat Mapping of Grand Lake Tributaries as it Relates to Paddlefish Recruitment. Grant Report. Project Number: F15AF00540.

Schwemm, M.R., A.A. Echelle, and J.D. Schooley. 2015. Fine-scale Genetic Structuring of American Paddlefish Populations in Oklahoma. Grant Report. Project Number: F14AF00156.

Schwemm, M.R., A.A. Echelle, R.A. Van Den Bussche, and J.D. Schooley. 2014. Development of diploid microsatellite markers for the North American paddlefish (Polyodon spathula). Conservation Genetics Resources 6: 217-218. DOI:10.1007/s12686-013-0060-0

Schwemm, M.R., A.A. Echelle, R.A. Van Den Bussche, and J.D. Schooley 2014. Genetic analysis of demographic dynamics of Paddlefish in Grand Lake O' the Cherokees. Grant Report. Project Number: F12AF00948

Soin, S.G. and A.I. Sukhanova. 1972. Comparative morphological analysis of the development of the grass carp, the black carp, the silver carp and the bighead (Cyprinidae). Journal of Ichthyology 12:61-71.

Stark, W. J., and A. A. Echelle. 1998. Genetic structure and systematics of Smallmouth Bass, with emphasis on Interior Highlands populations. Transactions of the American Fisheries Society 127: 393–416.

Taylor, A. T., J. M. Long, M. R. Schwemm, M. D. Tringali, and S. K. Brewer. 2016. Identification of Neosho Smallmouth Bass (*Micropterus Dolomieu Velox*) Stocks for Possible Introduction Into Grand Lake, Oklahoma. Report provided by the Cooperative Fish and Wildlife Research Unit Program under agreement with the U.S. Fish and Wildlife Service. U.S. Department of Interior, Fish and Wildlife Service, Cooperator Science Series FWS/CSS-121-2016, National Conservation Training Center. DOI: 10.13140/RG.2.2.27850.36807

Texas Parks and Wildlife. 2016. Spotted Bass (*Micropterus punctulatus*). [Online] URL: http://tpwd.texas.gov/huntwild/wild/species/spb/ (Accessed May 16, 2016).

Thomas, C. T.H. Bonner, and B.G. Whiteside. 2007. Freshwater Fishes of Texas: A Field Guide. Texas A&M Press.

USGS (U.S. Geological Survey). 2016. NAS – Nonindigenous Aquatic Species. [Online] URL: https://nas.er.usgs.gov/queries/SpecimenViewer.aspx?SpecimenID=1243535 (Accessed October 24, 2016).

USFWS (U.S. Fish and Wildlife Service). 2015. Neosho mucket. http://www.fws.gov/southeast/species/invertebrate/neosho_mucket.html

Xie, P., and Y. Chen. 2001. Invasive carp in China's Plateau lakes. Science 224:999-1000.

Section 6.4: Wildlife and Botanical Resources

Cline, G.R. and Anderson, S. 2013. Introduction to the Snakes of Oklahoma. Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma.

Erickson, N.E. and D.M., Leslie Jr. 1988. Shoreline vegetation and general wildlife values around Grand Lake, Oklahoma. Oklahoma State University. Stillwater, Oklahoma. 70pages. January 1988.

GRDA (Grand River Dam Authority). 2008. Shoreline Management Plan. Pensacola Hydroelectric Project, FERC No. 1494. June 11, 2008.

GRDA. 2010. Salina Pumped Storage Project FERC No. 2524, Pre-Application Document. November 2010.

GRDA. 2015. Pensacola Hydroelectric Project Public Recreation Management Plan Monitoring Report. April 1, 2015.

GRDA. 2016a. Article 411 Fish and Waterfowl Habitat Management Plan, Annual Report. April 27, 2016.

GRDA. 2016b. Environmental Report Prepared in Support of Non-Capacity License Amendment to Modify Article 401 (Rule Curve), FERC Project No. 1494. Prepared by McMillen Jacobs Associates. May 6, 2016.

Noble Foundation (Samuel Roberts Noble Foundation, Inc.). 2016. The Feral Hog in Oklahoma: Current Status and Distribution. [Online]. URL: http://www.noble.org/ag/wildlife/feralhogs/status/ (Accessed May 2016).

OBRC (Oklahoma Bird Records Committee). 2011. The Oklahoma Ornithological Society Checklist of Oklahoma Birds, 4th edition. Oklahoma Ornithological Society, Norman, Oklahoma.

OBS. 2016. Oklahoma Biodiversity Information and Data. Oklahoma Biological Survey, University of Oklahoma, Norman, Oklahoma. [Online]. URL: http://www.biosurvey.ou.edu/srchable.html (Accessed May 6, 2016).

OBTF (Oklahoma Biodiversity Task Force). 2005. Oklahoma's Biodiversity Plan: A Shared Vision for Conserving our National Heritage, edited by N. L. Murray. Oklahoma Department of Wildlife Conservation.

OCES (Oklahoma Cooperative Extension Service). 1998. Riparian Area Management Handbook. Oklahoma State University.

ODAFF (Oklahoma Department of Agriculture, Food, and Forestry Oklahoma Forestry Service). 2010. Oklahoma Forest Resource Assessment. Oklahoma Forestry Services – Oklahoma Department of Agriculture, Food, and Forestry, Oklahoma City, Oklahoma.

ODAFF. 2016. Feral Swine. [Online]. URL: http://www.oda.state.ok.us/ais/ feralswine.htm (Accessed June 2016).

ODWC (Oklahoma Department of Wildlife Conservation). 2011. Wildlife and Land Management Species Spotlight: Raccoon.

ODWC. 2016. Interagency Agreement between Grand River Dam Authority and Oklahoma Department of Wildlife Conservation. January 4, 2016.

OFS (Oklahoma Forestry Services). 2007. Invasive Species. Oklahoma Forestry Services Department of Agriculture Food and Forestry. [Online]. URL http://www.forestry.ok.gov/invasive-species (Accessed May 2016).

OFS. 2011. The Ecoregions of Oklahoma. Oklahoma Forestry Services Department of Agriculture Food and Forestry.

OHR (Oklahoma House of Representatives). 1998. House Bill 2277, 20 October 2003. State of Oklahoma.

OIPC (Oklahoma Invasive Plant Council). 2014. Watch List - Oklahoma Invasive Plant Species.

Stancill, W.J., Haggard, S.B., Raskevitz, R.F., and D.M. Leslie Jr. 1988. Waterfowl Use and Hunting Opportunities on Grand Lake and Ancillary Wetlands. Final Rep., Benham-Holway Power Group, Tulsa, OK.

USDI (U.S. Department of the Interior). 2014. Grand Lake O' the Cherokees Natural Resource Damages: Restoration and Compensation Determination Plan.

USFWS (U.S. Fish and Wildlife Service). 2007. Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife. Federal Register, Vol. 72, No. 130, Monday July 9, 2007, Rules and Regulations.

USGS (U.S. Geological Survey). 2009. The Ozark Highlands-A Distinctive Landscape. U.S. Department of the Interior/U.S. Geological Survey, Fact Sheet 2009-3065. Woods, A.J., Omernik, J.M., Butler, D.R., Ford, J.G., Henley, J.E., Hoagland, B.W., Arndt, D.S., and Moran, B.C. 2005. Ecoregions of Oklahoma (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,250,000).

Woods, A.J., Omernik, J.M., Butler, D.R., Ford, J.G., Henley, J.E., Hoagland, B.W., Arndt, D.S., and Moran, B.C. 2005. Ecoregions of Oklahoma (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,250,000).

Section 6.5: Floodplains, Wetlands, Riparian, and Littoral Habitat

Barbander, J.J., R.E. Masters, R.M. Short. 1985. Bottomland Hardwoods of Eastern Oklahoma: Special Study of Their Status, Trends, and Values. U.S. Fish and Wildlife Service.

Erickson, N.E. and D.M., Leslie Jr. 1988. Shoreline vegetation and general wildlife values around Grand Lake, Oklahoma. Oklahoma State University. Stillwater, Oklahoma. 70 pp. January 1988.

FERC (Federal Energy Regulatory Commission). 1992. Order Issuing New License and Environmental Assessment, Pensacola Project, FERC No. 1494-002 (59 FERC ¶ 63,231). April 29, 1992 (Order); November 19, 1991(EA).

FERC. 1996. Order Amending License. 77 FERC ¶ 61,251. December 3, 1996.

FERC. 2004. Environmental Assessment - Application for Non-Project Use of Project Lands and Waters. Pensacola Project, FERC No. 1494-244. May 2004.

FERC. 2009. Environmental Assessment: Application for Amendment of License, Shoreline Management Plan. Pensacola Hydroelectric Project FERC No. 1494. August 2009.

FERC. 2013. Order Modifying and Approving Shoreline Management Plan. 145 FERC ¶ 62,041. October 17, 2013.

FERC. 2015. Order Approving Temporary Variance, Pensacola Project, FERC No. 1494-432. (152 FERC ¶ 61,129). Federal Energy Regulatory Commission, Washington, D.C. August 14, 2015.

GRDA (Grand River Dam Authority). 2004. Article 401 Amendment Application. January 29, 2004. Accession No.: 20040130-0300.

GRDA. 2008. Shoreline Management Plan. Pensacola Hydroelectric Project, FERC No. 1494. June 11, 2008.

GRDA. 2010. Salina Pumped Storage Project FERC No. 2524, Pre-Application Document. November 2010.

GRDA. 2011. Vegetation Management Application Packet. January 25, 2011.

GRDA. 2016a. Article 411 Fish and Waterfowl Habitat Management Plan, Annual Report. April 27, 2016.

GRDA. 2016b. Environmental Report Prepared in Support of Non-Capacity License Amendment to Modify Article 401 (Rule Curve), FERC Project No. 1494. Prepared by McMillen Jacobs Associates. May 6, 2016.

GRDA. 2016c. Letter from GRDA to FERC regarding Shoreline management classification maps. December 20, 2016.

ODWC (Oklahoma Department of Wildlife Conservation). 2016. Interagency Agreement between Grand River Dam Authority and Oklahoma Department of Wildlife Conservation. January 4, 2016.

OWRB (Oklahoma Water Resources Board). 2005. First annual report for GRDA fish and wildlife mitigation project: feasibility study for establishing vascular aquatic plant communities in the littoral zone of Grand Lake. April 12, 2005. 35pp.

Tetra Tech, Inc. 2015. Hydraulic Analysis of the Effects of Pensacola Dam on Neosho River Flooding in the Vicinity of Miami, Oklahoma. Submitted to: City of Miami, Oklahoma. December 9, 2015.

Tetra Tech, Inc. 2016. Hydraulic Analysis of the Effects of Proposed Rule Curve Change at Pensacola Dam on Neosho River Flooding in the Vicinity of Miami, Oklahoma. Submitted to: City of Miami, Oklahoma. February 3, 2016.

USACE (U.S. Army Corps of Engineers). 1987. Corps of Engineers Wetlands Delineation Manual. Wetlands Research Program Technical Report Y-87-1 (on-line edition). US Army Corps of Engineers Waterways Experiment Station. [Online]. URL: http://www.cpe.rutgers.edu/Wetlands/1987-Army-Corps-Wetlands-Delineation-Manual.pdf

Woods, A.J., Omernik, J.M., Butler, D.R., Ford, J.G., Henley, J.E., Hoagland, B.W., Arndt, D.S., and Moran, B.C. 2005. Ecoregions of Oklahoma (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,250,000).

Section 6.6: Rare, Threatened, and Endangered Species

Central Flyway Council. 2013. Public comments of November 26, 2013. Central Flyway Council, Austin, TX.

Clark, B.K., B.S. Clark, D.M. Leslie, Jr., and M.S. Gregory. 1996. Characteristics of caves used by the endangered Ozark big-eared bat. Wildlife Society Bulletin 24:8–14.

Creighton, J.C. and G. Schnell. 1998. Short-term movement patterns of the endangered American burying beetle *Nicrophorus americanus*. Biological Conservation 86:281-287.

Cross, F.B. and Collins, J.T. 1995. Fishes in Kansas. Second Edition, revised. University of Kansas Museum of Natural History, Lawrence, Kansas, USA.

FERC (Federal Energy Regulatory Commission). 2009. Environmental Assessment: Application for Amendment of License, Shoreline Management Plan. Pensacola Hydroelectric Project FERC No. 1494. August 2009.

Graening, G.O., H.H. Hobbs, M.E. Slay, W.R. Elliott, and A.V. Brown. 2006. Status update for the Bristly Cave Crayfish, *Cambarus setosus* (*Decapoda: Cambaridae*), and range extension into Arkansas. The Southwestern Naturalist 51(3).

GRDA (Grand River Dam Authority). 2004. Analysis of Effect of Grand Lake Power-Pool Elevations on Neosho River Levels During a Major Flood, Docket No. P-1494-000 (filed Jan. 29, 2004).

GRDA. 2008. Shoreline Management Plan. Pensacola Hydroelectric Project, FERC No. 1494. Final Draft, June 11.

GRDA. 2015. Annual Report for Article 405: Gray Bat Compliance Plan of the Pensacola Project (1494-374). June 23, 2015.

GRDA. 2016a. Environmental Report Prepared in Support of Non-Capacity License Amendment to Modify Article 401 (Rule Curve), FERC Project No. 1494. Prepared by McMillen Jacobs Associates. May 6, 2016.

GRDA. 2016b. Annual Report for Article 405: Gray Bat Compliance Plan for the Pensacola Project, Annual Report for Gray Bat Foraging and Vegetation Management Permit Impacts per the Shoreline Management Plan. June 22, 2016.

Haig, S.M. 1992. Piping plover. In A. Poole, P. Stettenheim, and F. Gill (eds.), The birds of North America, No. 2. Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

Hargrave, C.W. and Johnson, J.E. 2003. Status of Arkansas darter, *Etheostoma cragini*, and least darter, *E. microperca*, in Arkansas. Southwestern Naturalist 48: 89-92.

Lee, D.S., Gilbert, C.R., Hocutt, C.H., Jenkins, R.E., McAllister, D.E. and Stauffer, J.R., Jr. 1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History, Raleigh, North Carolina, USA.

Martin, Keith, and Craig Zimmerman. unpublished. Temporal and Spatial Evaluation of Activity Patterns along the Grand Lake Shoreline by Gray Bats (*Myotis grisescens*) and Northern long-eared Bats (*Myotis septentrionalis*). Roger State University.

Masters, R.E. 1993. Oklahoma's Endangered and Threatened Species. Formal Extension Report No. 6. Cooperative Extension Service, Oklahoma State University. Stillwater, Oklahoma. 44pp.

Miller, R.J. and Robison, H.W. 2004. Fishes of Oklahoma. University of Oklahoma Press, Norman, Oklahoma.

NatureServe. 2014. *Etheostoma cragini*. The IUCN Red List of Threatened Species 2014: e.T8112A13309768. [Online] URL: http://dx.doi.org/10.2305/IUCN.UK.2014-3.RLTS.T8112A13309768.en. Downloaded on May 26, 2016.

Newstead, D.J., L.J. Niles, R.R. Porter, A.D. Dey, J. Burger, and O.N. Fitzsimmons. 2013. Geolocation reveals mid-continent migratory routes and Texas wintering areas of red knots *Calidris canutus rufa*. Wader Study Group Bulletin 120(1):53-59.

ODWC (Oklahoma Department of Wildlife Conservation). 2011a. Ozark Cavefish (*Amblyopsis rosae*). [Online]. URL: http://www.wildlifedepartment.com/wildlifemgmt/endangered/cavefish.htm (Accessed June 21, 2016).

ODWC. 2011b. Piping Plover (*Charadrius milodus*). [Online]. URL: http://www.wildlife department.com /wildlifemgmt/endangered/plover.htm (Accessed June 21, 2016).

ODWC. 2013. Public comments of November 20, 2013. Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma.

ODWC. 2015a. Endangered Species Workshop.

ODWC. 2015b. Oklahoma Species List: Federally-listed, Proposed, Candidate, and Species Under Review. [Online]. URL: http://www.wildlifedepartment.com/ wildlifemgmt/ endangeredspecies.htm and [Online]. URL: http://www.wildlife department.com/ wildlifemgmt/endangered/State_Listed_by_ County.pdf (Accessed May 29, 2016).

ODWC. 2015c. Draft Oklahoma Comprehensive Wildlife Conservation Strategy: A Strategic Conservation Plan for Oklahoma's Rare and Declining Wildlife. Oklahoma Department of Wildlife Conservation. September 2015.

ONHI (Oklahoma Natural Heritage Inventory). 2016. Rare and Vulnerable Species of Oklahoma Data. http://oknaturalheritage.ou.edu/plants_rare_vulnerable.htm (Accessed May 28, 2016).

Page, L.M. and Burr, B.M. 2011. Peterson field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Harcourt, Boston, Massachusetts, USA.

Pigg, J. and Gibbs, R. 1994. Update of the distribution records for the Arkansas River darter, *Etheostoma cragini* Gilbert, in northwestern Oklahoma. Proceedings of the Oklahoma Academy of Science 74: 37-38.

Shiver, M.A. 2002. Reproduction and propagation of the Neosho mucket, *Lampsilis rafinesqueana*. Thesis, Southwest Missouri State University.

USFWS (U.S. Fish and Wildlife Service). 1982. Gray bat recovery plan. Minneapolis, Minnesota. 26pp.

USFWS 1989. Ozark Cavefish Recovery Plan. U. S. Fish and Wildlife Service. Atlanta, Georgia. 15 pp.

USFWS. 1995. Ozark Big-Eared Bat (*Corynorhinus townsendii ingens*) Revised Recovery Plan. Tulsa, OK. 51pp.

USFWS. 1996. Western Prairie Fringed Orchid Recovery Plan (*Platanthera praeclara*). USFWS and the Western Prairie Fringed Orchid Recovery Team. September 30, 1996.

USFWS. 1997a. Gray bat (*Myotis grisescens*) Fact Sheet. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. [Online]. URL: http://www.fws.gov/midwest/endangered /mammals/pdf/gray-bat.pdf

USFWS. 1997b. Ozark Cavefish (*Amblyopsis rosea*) Fact Sheet. Updated November 9, 2015. [Online]. URL: https://www.fws.gov/midwest/endangered/fishes/ozkcf_fc.html

USFWS. 2006. Indiana Bat (*Myotis sodalist*): Fact Sheet. Updated October 15, 2015.

USFWS. 2007a. Indiana Bat: Fact Sheet, Finding on Petition to Revise Critical Habitat – Questions and Answers. Updated April 14, 2015.

USFWS. 2007b. Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife. Federal Register, Vol. 72, No. 130, Monday July 9, 2007, Rules and Regulations.

USFWS. 2008. Ozark big-eared bat (*Corynorhinus townsendii ingens*) 5- year review: summary and evaluation. Prepared by Stark, R. Oklahoma Ecological Services Office, Tulsa, Oklahoma.

USFWS. 2009. Western Prairie Fringed Orchid (*Platanthera praeclara*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Twin Cities Field Office, Bloomington, Minnesota. February 2009.

USFWS. 2011a. *Etheostoma cragini*. Species assessment and listing priority assignment form.

USFWS. 2011b. Gray Bat (*Myotis grisescens*): Fact Sheet. December 2011.

USFWS. 2011c. Neosho Madtom. U.S. Fish and Wildlife Service, Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. August 2011.

USFWS. 2011d. Ozark Big-eared Bat. U.S. Fish and Wildlife Service, Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. August 2011.

USFWS. 2011e. Ozark Cavefish. U.S. Fish and Wildlife Service, Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. August 2011.

USFWS. 2011f. Ozark cavefish (*Amblyopsis rosae).* Eigenmann 1898. 5-year review: summary and evaluation. USFWS, Arkansas Ecological Services Field Office, Conway, Arkansas.

USFWS. 2011g. Piping Plover. U.S. Fish and Wildlife Service, Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. August 2011.

USFWS. 2012. Red Knot (*Calidris canutus ssp. Rufa*). Species Profile. Includes links to conservation plans. [Online]. URL: http://www.nrc.gov/docs/ML1219/ML12193A526.pdf

USFWS. 2014a. Rufa Red Knot Background Information and Threats Assessment. Supplement to Endangered and Threatened Wildlife and Plants; Final Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*) [Docket No. FWS–R5–ES–2013–0097; RIN AY17]. U.S. Fish and Wildlife Service Northeast Region, New Jersey Field Office, Pleasantville, New Jersey. November 2014.

USFWS. 2014b. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form: *Etheostoma cragini*, Arkansas darter, Region 6 (Mountain-Prairie Region). April 3, 2014.

USFWS. 2015a. Fish and Wildlife Service Designates Critical Habitat for Two Freshwater Mussels in 12 States. [Online]. URL: http://www.fws.gov/midwest/news/780.html. (Accessed May 25, 2016.)

USFWS. 2015b. Western Prairie-Fringed Orchid. [Online]. URL: http://www.fws.gov/ midwest/endangered/plants/prairief.html (Accessed May 31, 2016).

USFWS. 2016a. American Burying Beetle Impact Assessment for Project Reviews. U.S. Fish and Wildlife Service Southwest Region, Oklahoma Ecological Services Field Office. March 2016.

USFWS. 2016b. American Burying Beetle: Additional Information. [Online]. URL: https://www.fws.gov/southwest/es/oklahoma/ ABB_Add_Info.htm

USFWS. 2016c. Northern Long-Eared Bat (*Myotis septentrionalis*). [Online]. URL: http://www.fws.gov/Midwest/endangered/mammals/ nleb/index.html

USFWS. 2016d. Threatened and Endangered Species Information for Oklahoma. [Online]. URL: https://www.fws.gov/southwest/es/oklahoma

USFWS. 2016e. WNS Zone Map (updated April 29, 2016). [Online]. URL: http://www.fws.gov/Midwest/endangered/mammals/nleb/pdf/WNSZone.pdf

Section 6.7: Recreation and Land Use

Bassmaster. 2015. Bassmaster's Best Bass Lakes of 2015. [Online] URL: https://www.bassmaster.com/slideshow/bassmasters-best-bass-lakes-2015. (Accessed June 26, 2016).

EPA (U.S. Environmental Protection Agency). 2016. American heritage rivers. November 20, 2009. [Online]. URL: http://water.epa.gov/type/watersheds/named/heritage/ (Accessed June 28, 2016).

FERC (Federal Energy Regulatory Commission). 2009. Environmental Assessment Application for Amendment of License Shoreline Management Plan Pensacola Hydroelectric Project FERC No. 1494-348 Oklahoma. August 2009.

FERC. 2014. Draft Environmental Assessment for Hydropower License Salina Pumped Storage Project – FERC Project No. 2524-021 Oklahoma. November 2014.

GRDA (Grand River Dam Authority). 1997. Grand Lake O' The Cherokees Recreation Management Plan Pensacola Hydroelectric Project FERC Project No. 1494-002. Vinita, OK.

GRDA. 2008. Shoreline Management Plan. Pensacola Hydroelectric Project FERC No. 1494. June 2008.

GRDA. 2013. Lake Rules. Title 300. Grand River Dam Authority. Chapter 35. Effective June 27, 2013.

GRDA. 2015a. Pensacola Hydroelectric Project FERC Form 80. April 2015.

GRDA. 2015b. Pensacola Hydroelectric Project Public Recreation Management Plan Monitoring Report. April 2015.

NPS (National Park Service). 2016a. National parks in Oklahoma. [Online]. URL: https://www.nps.gov/state/ok /index.htm accessed June 16, 2016.

NPS. 2016b. National Trails System. [Online] URL: https://www.nps.gov/nts/ maps.html. (Accessed: June 7, 2016).

NPS. 2016c. National Wild and Scenic Rivers System. [Online] URL: https://www.rivers.gov/index.php. (Accessed: June 7, 2016).

Oklahoma Scenic Rivers Commission. 2016. Scenic Rivers. [Online] URL: http://ok.gov/osrc/Scenic_Rivers/index.html. (Accessed: June 7, 2016).

OSU (Oklahoma State University). 2012. Oklahoma's Great Outdoors: The Place, The People, The Providers, The Plan. November 2012.

OTRD (Oklahoma Tourism and Recreation Department). 2012. Statewide Comprehensive Outdoor Recreation Plan 2013 – 2017. November 2012.

State Park. 2015a. Bernice State Park. [Online] URL: http://www.stateparks.com /bernice_state_park_in_oklahoma.html. (Accessed: June 3, 2016).

State Park. 2015b. Cherokee State Park. [Online] URL: http://www.stateparks.com /cherokee_state_park_in_oklahoma.html. (Accessed: June 3, 2016).

State Park. 2015c. Disney/Little Blue State Park. [Online] URL: http://www.stateparks.com /little_bluedisney.html. (Accessed: June 3, 2016).

State Park. 2015d. Honey Creek State Park. [Online] URL: http://www.stateparks.com /honeycreekok.html. (Accessed: June 3, 2016).

State Park. 2015e. Twin Bridges State Park. [Online] URL: http://www.stateparks.com /twin_bridges_state_park_in_oklahoma.html. (Accessed: June 3, 2016).

U.S. Census Bureau. 2015. Oklahoma Quickfacts. [Online]. URL: http://www.census.gov /quickfacts/table/PST045215/40. (Accessed June 1, 2016).

USFWS (U.S. Fish and Wildlife Service). 2002. *Ozark plateau national wildlife refuge* proposed refuge expansion environmental assessment. September 2002. [Online]. URL: http://www.fws.gov/southwest/refuges/oklahoma/Ozark/ (Accessed September 16, 2010).

Wilderness Society. 2016. 113th Congress Wilderness Bills. [Online] URL: [Online]. URL: http://wilderness.org/article/113th-congress-wilderness-bills (Accessed June 16, 2016).

Wilderness.net. 2016. *U.S. national wilderness preservation system.* [Online] URL: http://www.wilderness.net. (Accessed June 16, 2016).

Section 6.8: Aesthetic Resources

GRDA (Grand River Dam Authority). 2008. Shoreline Management Plan. Pensacola Project FERC No. 1494. June 2008.

Section 6.9: Cultural Resources

Adovasio, J.M., and K. Carr. 2002. Paleoindians in Pennsylvania. *In* Ice Age Peoples of Pennsylvania. Edited by J.M. Adovasio and K. Carr. Pennsylvania Historical and Museum Commission, Harrisburg, PA.

BLM (Bureau of Land Management). 1993. Draft Oklahoma Resource Management Plan and Environmental Impact Statement. Bureau of Land Management Oklahoma Resource Area, Moore, OK.

FERC. 2017. Draft Environmental Assessment for Application of Amendment of License Pensacola Hydroelectric Project – FERC Project No. 1494-437 Oklahoma. January 2017.

OHS (Oklahoma Historical Society). 2009. Encyclopedia of Oklahoma: Grand River Dam Authority. [Online] URL: http://www.okhistory.org/publications/enc/entry.php?entry=GR006. (Accessed June 2016).

Perttula, T. K. 1992. The Caddo Nation: Archaeological and Ethnohistoric Perspectives. University of Texas Press, Austin, TX.

USACE (U.S. Army Corps of Engineers). 2005. Arkansas River Navigation Study Final Environmental Impact Statement. U.S. Army Corps of Engineers Little Rock District, Little Rock, AR.

Section 6.10: Socioeconomic Resources

GRDA. (Grand River Dam Authority). 2008. Shoreline Management Plan. Pensacola Hydroelectric Project FERC No. 1494. June 2008.

Oklahoma Department of Commerce. 2012. 2012 Demographic State of the State Report.

Oklahoma Department of Commerce. 2015. Economic Impact of the Grand River Dam Authority. March 2015.

Oklahoma Employment Security Commission. 2016. Oklahoma Economic Indicators. April 2016.

OHS (Oklahoma Historical Society). 2009. Ottawa County.

U.S Census Bureau. 2015. Oklahoma Quickfacts. [Online]. URL: http://www.census.gov/quickfacts/table/PST045215/40. (Accessed June 1, 2016).

U.S. Census Bureau. 2016. Fact Finder. [Online]. URL: http://factfinder.census.gov. (Accessed June 2, 2016).

Section 7: Preliminary Issues, Project Effects, and Studies List

Dennis, Alan C. 2014. Floodplain Analysis of the Neosho River Associated with Proposed Rule Curve Modifications for Grand Lake O' the Cherokees. Master's Thesis. University of Oklahoma Graduate College.

FERC (Federal Energy Regulatory Commission). 2009. Environmental Assessment: Application for Amendment of License, Shoreline Management Plan. Pensacola Hydroelectric Project FERC No. 1494. August 2009.

FERC. 2015. Memorandum: Supporting information for Commission staff's independent analysis of GRDA's request for expedited approval of a temporary variance from Article 401. August 31, 2015.

GRDA (Grand River Dam Authority). 2008. Shoreline Management Plan. Pensacola Hydroelectric Project, FERC No. 1494. June 11, 2008.

GRDA. 2011. Vegetation Management Application Packet. January 25, 2011.

Holly Jr., F. M., editor. 1999. Referee Report: Dalrymple, et al v. GRDA, number Case CJ 94-444, February 1999. District Court of Ottawa County, Oklahoma.

Holly Jr., F. 2004. Analysis of Effect of Grand Lake Power-Pool Elevations on Neosho River Levels During a Major flood. Prepared for: Robert Sullivan, AGM of Risk Management and Regulatory Compliance, GRDA.

OWRB (Oklahoma Water Resources Board). 2005. First annual report for GRDA fish and wildlife mitigation project: feasibility study for establishing vascular aquatic plant communities in the littoral zone of Grand Lake. April 12, 2005. 35pp.

Tetra Tech, Inc. 2015. Hydraulic Analysis of the Effects of Pensacola Dam on Neosho River Flooding in the Vicinity of Miami, Oklahoma. Submitted to: City of Miami, Oklahoma. December 9, 2015.

Tetra Tech, Inc. 2016. Hydraulic Analysis of the Effects of Proposed Rule Curve Change at Pensacola Dam on Neosho River Flooding in the Vicinity of Miami, Oklahoma. Submitted to: City of Miami, Oklahoma. February 3, 2016.

USACE (U.S. Army Corps of Engineers). 1998. USACE. Hydraulic Analysis: Grand Lake Real Estate Adequacy Study. Technical report, USACE, 1998.

USACE. 2015. Peer review of Dennis master's thesis, Floodplain Analysis of the Neosho River Associated with Proposed Rule Curve Modifications for Grand Lake O' the Cherokees. February 20, 2015.

Section 8.0: Comprehensive Plans

Oklahoma Scenic Rivers Commission. 2016. Scenic Rivers. [Online] URL: http://ok.gov/osrc/Scenic_Rivers/index.html. (Accessed: June 7, 2016).

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ATTACHMENT A. CONSULTATION

All information sources cited in this PAD are appropriately referenced and a record of all contacts made with federal and state resource agencies, tribes, local governments, NGOs, and other relicensing participants is provided as Attachment A, including materials from the PAD questionnaire exercise.

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Date	Summary of Contact	Agency/Organization Consulted	Documentation filename (pdf)
9/6/2016	Darrell Townsend and Jacklyn Jaggars (GRDA) met with Derek Smithee (OWRB), Joe Long (ODEQ), and Shanon Phillips (Oklahoma Conservation Commission) to give a presentation on the Pensacola relicensing.	OWRB, ODEQ, Oklahoma Conservation Commission	2016-09-06OWRBandODEQandOCCrelicensingOverview.pdf
9/7/2016	Darrell Townsend (GRDA) met with Kary Stackelbeck, Amanda Regnier, Scott Hammerstedt, and Patrick Livingood (OAS) to give a presentation on the Pensacola relicensing.	OAS	2016-09-07OASrelicensingOverview.pdf
9/8/2016	Jacklyn Jaggars (GRDA) emailed Derek Smithee (OWRB), Joe Long (ODEQ), and Shanon Phillips (Oklahoma Conservation Commission) the Pensacola relicensing overview presentation that was given at a September 6, 2016 meeting.	OWRB, ODEQ, Oklahoma Conservation Commission	2016-09-08OWRBand ODEQandOCCrelicensingOverview.pdf
9/19/2016	Darrell Townsend (GRDA) mailed a Pre-Application Document (PAD) questionnaire to federal and state resource agencies, tribes, and other interested parties.	All stakeholders	2016-09-19PADquestionnaire.pdf
9/20/2016	Darrell Townsend Jacklyn Jaggars, Rich Zamor and Steve Nikolai (GRDA) met with Josh Johnston (ODWC) and Kevin Stubbs (USFWS) to give a presentation on the Pensacola relicensing. GRDA also shared the presentation with David Fenner, Jonna Polk, and Laurence Levesque (USFWS) per discussions at the meeting.	USFWS, ODWC	2016-09-20USFWSandODWCrelicensingOverview.pdf
9/21/2016	Rich Zamor (GRDA) emailed Kevin Stubbs, Daniel Fenner, Jonna Polk, and Laurence Levesque (USFWS) the Pensacola relicensing overview presentation that was given at a September 20, 2016 meeting.	USFWS	2016-09-21USFWSandODWCrelicensingOverview
9/23/2016	Jacklyn Jaggars (GRDA) emailed Kary Stackelbeck (OAS) the Pensacola relicensing overview presentation that was given at a September 7, 2016 meeting.	OAS	2016-09-23OASrelicensingOverview.pdf


FERC Relicensing of GRDA's Pensacola Hydropower Project

FERC Relicensing – What is it

- Through the Federal Power Act (FPA), the Federal Energy Regulatory Commission (FERC) is responsible for licensing and relicensing non-federal hydropower facilities throughout the United States
- The FPA requires that all non-federal hydropower facilities, like GRDA's Pensacola, Markham Ferry, and Salina facilities receive a new license to operate every 30 to 50 years
  - Pensacola – March 31, 2022
  - Markham Ferry – July 31, 2036
  - Salina Pumped Storage – November 30, 2045
- Approximately five year process that will formally begin with GRDA's distribution of the a Notice of Intent (NOI) and Pre-Application Document (PAD) in February or March 2017

FERC Relicensing – What is it

- Collaborative approach for FERC, GRDA, State and Federal Agencies, Indian Tribes, municipalities, and other interested parties to evaluate the resource areas associated with the project
- Driven by regulatory and statutory deadlines for the distribution of documents, conducting meetings, performing studies, and providing comments to GRDA and FERC
- Concurrent with a new license, the process includes obtaining a new Section 401 Water Quality Certificate from ODEQ
- Will result in the issuance of a new 30 to 50 year license for the continued operation of the facility
- Will include routine consultation between the parties and a lot of new acronyms

Schedule Milestones

Primary Activity	Date
Pre-Application Document (PAD) and Notice of Intent (NOI)	February or March 2017
FERC Scoping Meetings and Site Visit	April or May 2017
Develop Study Plans	May to December 2017
Perform Studies and Conduct Study Meetings	2018 and 2019
Draft License Application	Fall 2019
Final License Application	March 31, 2020
FERC Issues New License	March 31, 2022

Notice of Intent (NOI) and Pre-Application Document (PAD)

- First documents to be distributed in support of the relicensing
- The NOI provides basic information regarding the facility and GRDA
- The PAD presents information regarding the relicensing process, the facility, and the surrounding environment
- The PAD will provide available information, as well as the basis for additional information to be collected in support issuing a new license
- In support of preparing the PAD, GRDA will be sending out questionnaires to obtain additional information from parties who may have information that will support the process
- The PAD is being developed and will be distributed in February or March 2017

FERC Scoping Meeting

- As the lead Federal agency, FERC will be performing an environmental review of the facility through the National Environmental Policy Act (NEPA)
- The process will include FERC's issuance of Scoping Document 1 (SD1) that will be based on the NOI and PAD
- FERC will conduct agency and public scoping meetings to present information regarding the process and the facility
- Concurrent with the meetings, a site visit will be performed
- The meetings will allow agencies and the public to provide comments to FERC regarding the process and facility
- The meetings and site visit will take place in spring 2017

Resource Areas to be Evaluated

- Relicensing includes a standard evaluation of the following resource areas
  - Geology, Topography, and Soils
  - Water Resources
  - Fish and Aquatic Resources
  - Wildlife and Botanical Resources
  - Floodplains, Wetlands, Riparian, and Littoral Habitat
  - Rare, Threatened, and Endangered Species
  - Recreation and Land Use
  - Aesthetic Resources
  - Cultural Resources
  - Socioeconomic Resources

Relicensing Considerations

- GRDA will be able to use a variety of existing data in support of the relicensing – for example water quality data and results of previous studies and initiatives
- Where necessary, GRDA will work with FERC and the other parties to obtain the information necessary for FERC to perform their environmental analysis in order to issue the new license
- The relicensing process also provides an opportunity for housekeeping activities such as confirmation of the facility’s project boundary and developing measures that have become standard since the facility’s last relicensing – for example a historic properties management plan

Relicensing Considerations

- Whereas some licensees use the relicensing process to modify the facility, GRDA is not proposing any structural modifications to the facility – for example additional turbines or raising or lowering the dam
- GRDA will likely perform a more comprehensive evaluation of the facility’s existing rule curve in order to optimize the balancing between lake resources – recreation, flood control, and power generation
- Given the time between now and FERC’s issuance of the new license in 2022, GRDA anticipates that the ongoing rule curve amendment process and/or annual variances will continue into the relicensing process

The Role of the Relicensing Parties

- Provide a response to the PAD Questionnaire
- Review documents such as:
  - The NOI and PAD
  - FERC's Scoping Document(s)
  - Proposed and Revised Study Plans
  - Initial and Updated Study Reports
  - Draft and Final License Application
- Participate in relicensing meetings and consultation
- Provide comments to FERC and GRDA

Questions or Follow up

Darrell E. Townsend II, Ph.D.
Assistant General Manager
Ecosystems and Lake Management
Grand River Dam Authority

(918) 256-0616: Office
(918) 530-0297: Cell

dtownsend@grda.com

From: Jaggars, Jacklyn <jjaggars@grda.com>
Sent: Thursday, September 08, 2016 9:21 AM
To: 'DRSMITHEE@owrb.ok.gov'; 'Shanon Phillips'; Stackelbeck, Kary; 'Joe.Long@deq.ok.gov'; 'Andrews, William'
Cc: Andersen, Emily; Townsend, Darrell
Subject: Pensacola Relicensing Powerpoint
Attachments: Pensacola Relicensing Overview.pptx

Categories: Yellow Category, Green Category

Good morning,

Darrell asked me to send each of you the Pensacola Relicensing Overview powerpoint as a follow up to the meetings he had with each of you on 9/6 and 9/7 respectively. The powerpoint provides a good overview of the upcoming FERC relicensing process for the Pensacola Project.

Please let me know if you have any questions and we look forward to working with you during this process.

Sincerely,

Jacklyn
918-256-0723

September 19, 2016

Subject: Pensacola Hydropower Project (FERC No. 1494)
Relicensing Pre-Application Document Questionnaire

To the Attached Distribution List:

Grand River Dam Authority (GRDA) is the Licensee and operator of the Pensacola Hydroelectric Project (FERC No. 1494) (Project) located on the Grand Neosho River (Grand River) in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma. The Project is licensed by the Federal Energy Regulatory Commission (FERC).

The existing FERC license for the Project expires on March 31, 2022. GRDA intends to pursue a new license for the Project and is preparing the Pre-Application Document (PAD) required by FERC's relicensing process. GRDA has retained HDR Engineering, Inc. (HDR) for assistance with the relicensing process, including development of the PAD.

The PAD provides FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project. This information is intended to help identify information needs, develop study requests and study plans, and prepare documents related to analyzing the relicensing application to be prepared by GRDA. To prepare the PAD, GRDA will use information in its possession and information obtained from others. Consistent with this effort, the purpose of this letter is to:

1) Notify interested governmental agencies, local governments, non-governmental organizations, Indian tribes, and individuals of the upcoming relicensing proceeding, and

2) Request your help in identifying existing, relevant, and reasonably available information related to the existing Project environment.

GRDA's goal is to file the PAD during the first quarter of 2017. We are asking for your help to identify additional information of which you may be aware. To facilitate the information search, we have prepared the attached Pre-Application Document Information Questionnaire (PAD Questionnaire).

GRDA is requesting that you provide any relevant information for the PAD. Relevant information would include site-or-region specific studies, data, reports, or management plans on any of the following resource areas:

- Geology, topography and soils
- Water resources
- Fish and aquatic resources
- Wildlife and botanical resources
- Floodplains, wetlands, riparian, and littoral habitat
- Rare, threatened, and endangered species
- Recreation and land use
- Aesthetic resources
- Cultural resources
- Tribal resources
- Socioeconomic resources

To help ensure that your relevant information and resources are available for inclusion in the PAD, please fill out the attached PAD Questionnaire and return to Jacklyn Jaggars (of GRDA) via email at jjaggars@grda.com or in the enclosed self-addressed, stamped envelope.

GRDA intends to include relevant information in the PAD. Therefore, we respectfully request a response within 30 days of receipt of this letter. This will allow time for follow-up contacts that may be necessary. If we do not receive a response from you within 30 days, this will indicate you are not aware of any existing, relevant, and reasonably available information that describes the Project environment or known potential impacts of the Project, and that, unless you are representative of an Indian tribe or federal or state agency, you do not wish to remain on the distribution list for this relicensing process.

We want to thank you in advance for helping identify information that meets the criteria for inclusion in the PAD. We appreciate your assistance and look forward to working with you during the relicensing process. If you have any questions regarding this request or would like additional information, please contact me at dtownsend@grda.com or via phone at 918-256-0616 or Jacklyn Jaggars at jjaggars@grda.com or via phone at 918-256-0723.

Sincerely,

Darrell Townsend

Darrell Townsend, II, Ph.D.
Assistant General Manager
Ecosystems and Lake Management
Grand River Dam Authority

Enclosure

Distribution List

Mr. Ken Collins
U.S. Fish and Wildlife Service
9014 E 21st Street
Tulsa, OK 74129-1428
Ken_collins@fws.gov

Ms. Jonna Polk
U.S. Fish and Wildlife Service
9014 E 21st Street
Tulsa, Oklahoma 74129-1428
Jonna_polk@fws.gov

Mr. Kevin Stubbs
Field Supervisor
U.S. Fish and Wildlife Service
9014 E 21st Street
Tulsa, OK 74129-1428
Kevin_stubbs@fws.gov

U.S. Bureau of Land Management
Oklahoma Field Office
7906 East 33rd Street, Suite 101
Tulsa, OK 74145-1352

U.S. Forest Service
1400 Independence Avenue, SW
Washington, DC 20250

U.S. Bureau of Indian Affairs
Eastern Oklahoma Regional Office
101 North 5th Street
Muskogee, OK 74401-6206

U.S. Bureau of Indian Affairs
Attn: Mosby Halterman
3100 W Peak Boulevard
Muskogee, OK 74401
Mosby.halterman@bia.gov

U.S. Natural Resources Conservation Service
1400 Independence Avenue, SW Room 5105-A
Washington DC 20250

Sue Masica, Regional Director
National Park Service
12795 Alameda Parkway
Denver, CO 80225

Mr. Andrew Commer, Chief
U.S. Army Corps of Engineers, Tulsa District
Attn: CESWT-P-R (Regulatory Branch)
1645 South 101 East Avenue
Tulsa, Oklahoma 74128-4609
Andrew.Commer@usace.army.mil

Mr. Mike Abate
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Mike.r.abate@usace.army.mil

Ms. Jennifer Aranda
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Jennifer.a.aranda@usace.army.mil

Mr. William Chatron
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
William.a.chatron@usace.army.mil

Ms. Tonya Dunn
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Tonya.n.dunn@usace.army.mil

Mr. Greg Estep
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Gregory.estep@usace.army.mil

Mr. Scott Henderson
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Scott.a.henderson@usace.army.mil

Mr. Mike Love
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128
Michael.s.love@usace.army.mil

Distribution List

Mr. Steve Nolan
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609

Mr. Ed Rossman
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Edwin.j.rossman@usace.army.mil

Mr. Terry Rupe
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Terry.d.rupe@usace.army.mil

Mr. David Williams
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609

Ms. Eva Zaki-Dellitt
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Eva.a.zaki-dellitt@usace.army.mil

Dr. William Andrews, Director
U.S. Geological Survey
Oklahoma Water Science Center
202 NW 66th Street, Building 7
Oklahoma City, OK 73116

U. S .Environmental Protection Agency
Region 6
Fountain Place
1445 Ross Avenue
Dallas, TX 75202-2760

U.S. Department of the Army
1645 Randolph Road
Fort Sill, OK 73503

Ms. Nicole McGavock
National Weather Service
Tulsa, OK Weather Forecast Office
10159 E 11th Street, Suite 300
Tulsa, OK 74128
Nicole.mcgavock@noaa.gov

Mr. James Paul
National Weather Service
Tulsa, OK Weather Forecast Office
10159 E 11th Street Suite 300
Tulsa, OK 74128
James.paul@noaa.gov

Mr. Barry Bolton
Oklahoma Department of Wildlife Conservation
Chief of Fisheries Division
PO Box 53465
Oklahoma City, OK 73152
Barry.bolton@odwc.ok.gov

Mr. Richard Hatcher
Director
Oklahoma Department of Wildlife Conservation
PO Box 53465
Oklahoma City, OK 73152
Richard.hatcher@odwc.ok.gov

Mr. Josh Johnston
NE Regional Fisheries Biologist
Oklahoma Department of Wildlife Conservation
PO Box 1201
Jenks, OK 74037
Josh.johnston@odwc.ok.gov

Mr. William Cauthron
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Bill.cauthron@owrb.ok.gov

Mr. Lance Phillips
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Lance.phillips@owrb.ok.gov

Mr. Monty Porter
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Monty.porter@owrb.ok.gov

Distribution List

Mr. Derek Smithee
Water Quality Division
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Derek.smithee@owrb.ok.gov

Mr. Matt Rollins
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Matt.rollins@owrb.ok.gov

Ms. Beth Wilhelm
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Beth.wilhelm@owrb.ok.gov

Mr. Joe Long
Oklahoma Department of Environmental Quality
PO Box 1677
Oklahoma City, OK 73101-1677
joe.long@deq.ok.gov

Ms. Elena Jigoulina
Oklahoma Department of Environmental Quality
PO Box 1677
Oklahoma City, OK 73101-1677
Elena.jigoulina@deq.ok.gov

Dr. Kary Stackelbeck
State Archeologist
Oklahoma Archeological Survey
111 East Chesapeake, Bldg. 134
Norman, OK 73019-0575
lstackelbeck@ouo.edu

Ms. Melvena Heisch
Deputy State Historic Preservation Officer
Oklahoma Historical Society
800 Nazih Zuhdi Drive
Oklahoma City, OK 73105-7917
mheisch@okhistory.org

Ms. Kris Marek
Oklahoma Tourism and Recreation Department
State Parks & Resorts
900 North Stiles Avenue
Oklahoma City, OK 73104
Kris.marek@travelok.com

Oklahoma Department of Transportation
4002 North Mingo Valley Expressway
Tulsa, OK 74116

Mr. Trey Lam
Oklahoma Conservation Commission
2800 North Lincoln Boulevard, Suite 160
Oklahoma City, OK 73105

Oklahoma Department of Agriculture
Food And Forestry
2800 North Lincoln Boulevard, Suite 100
Oklahoma City, OK 73105

Oklahoma Department of Health
4616 East 15th Street
Tulsa, OK 74112

Oklahoma Department of Commerce
900 North Stiles Avenue
Oklahoma City, OK 73104

The Honorable Michael Teague
Secretary of Energy and Environment
100 North Broadway, Suite 2350
Oklahoma City, OK 73102
Michael.teague@ee.ok.gov

Mr. Jeff Southwick
Oklahoma Corporation Commission
2101 North Lincoln Boulevard
Oklahoma City, OK 73105

Mr. Charles Kerns
Oklahoma Office of Emergency Management
PO Box 53365
Oklahoma City, OK 73152-3365
Charles.kerns@oem.ok.gov

Distribution List

Ms. Glenda Longan
Director of Emergency
City of Miami
PO Box 1288
Miami, OK 74355
glongan@miamiokla.net

Mr. Luke Tallant
Office of State Fire Marshal
2401 NW 23rd Street, Suite 4
Oklahoma City, OK 73107
Luke.tallant@fire.ok.gov

Inter-Tribal Council Inc.
PO Box 1308
Miami, OK 74355

Alabama-Quassarte Tribal Town
109 East Broadway Avenue
Wetumka, OK 74883

Apache Tribe of Oklahoma
PO Box 1330
Anadarko, OK 73005

Caddo Nation of Oklahoma
PO Box 487
Binger, OK 73009

U.S. Bureau of Indian Affairs
Cherokee Nation
PO Box 948
Tahlequah, Oklahoma 74465

Cheyenne & Arapaho Tribes
100 Red Moon Circle
Concho, OK 73022

Honorable Chief Chester Brooks
Delaware Tribe of Indians
170 NE Barbara
Bartlesville, OK 74006
cbrooks@delawaretribe.org

Chief Glenna J. Wallace
Eastern Shawnee Tribe of Oklahoma
12755 South 705 Road
Wyandotte, OK 74370
gjwallace@estoo.net

Little Traverse Bay Bands of Odawa Indians
7500 Odawa Circle
Harbor Springs, MI 49740

Chief Douglas G. Lankford
Miami Tribe of Oklahoma
PO Box 1326
Miami, OK 74354
dlankford@miamination.com

Chief Bill Follis
Modoc Tribe of Oklahoma
418 G Street SE
Miami, OK 74354
F1cattlecompany@gmail.com

Muscogee Nation
PO Box 580
Okmulgee, OK 74447

Mr. Farris Barker
Osage Nation Historic Preservation Office
1449 Main Street
Pawhuska, OK 74056

Chief Ethel Cook
Ottawa Tribe of Oklahoma
13 South Highway 69A
Miami, OK 74354
cethel@cableone.net

Chief John Froman
Peoria Tribe of Oklahoma
118 South Eight Tribes Trail
Miami, OK 74354
jfroman@peoriatribe.com

Mr. Everett Bandy
Quapaw Tribe of Oklahoma
PO Box 765
Quapaw, OK 74363
ebandy@quapawtribe.com

Mr. Alan Mauk
Quapaw Tribe of Oklahoma
5681 South 630 Road
Quapaw, OK 74363
alanmauk@aol.com

Distribution List

Chief William Fisher
Seneca-Cayuga Nation
PO Box 453220
Grove, OK 74345-3220
wfisher@sctribe.com

Chief Ron Sparkman
Shawnee Tribe of Oklahoma
29 South Highway 69A
Miami, OK 74354
Rondede1@gmail.com

Ms. Lisa Streetopp
Preservation Office
United Keetoowah Band of Cherokees
PO Box 746
Tahlequah, OK 74665
Ukbthpo-larue@yahoo.com

Wichita and Affiliated Tribes
PO Box 729
Anadarko, OK 73005

Ms. Kathleen A. Welch
Environmental Assistant
Wyandotte Tribe of Oklahoma
64700 East Highway 60
Wyandotte, OK 74370
kwelch@wyandotte-nation.org

Chief Billy Friend
Wyandotte Nation
64700 East Highway 60
Wyandotte, OK 74370
bfriend@wyandotte-nation.org

The Nature Conservancy
408 NW 7th Street
Oklahoma City, OK 73102

Chris Wood, President
Trout Unlimited
1777 N Kent Street, Suite 100
Arlington, VA 22209

American Rivers
1101 14th Street NW Suite 1400
Washington DC 20005

American Whitewater
PO Box 1540
Cullowhee, NC 28723

Ducks Unlimited
Regional Director
Nathan Johnson
1812 Cinnamon Ridge Road
Edmond, OK 73025
njohnson@ducks.org

Tulsa Audubon Society
PO Box 330140
Tulsa, OK 74133

Grand Lake Audubon Society
PO Box 1813
Grove, OK 74345-1813

Grand Lake Watershed Alliance Foundation
PO Box 451185
Grove, OK 74345-1185
glwafadmin@gmail.com

Local Environmental Action Demanded Inc.
223 A Street SE
Miami, OK 74354

Scott Cox, Squadron Commander
Grand Lake Sail and Power Squadron
31380 S 628 Lane
Grove, OK 74344
slcox@suddenlink.net

Mr. Lowell Walker
Craig County Commissioner
District 1
PO Box 397
Vinita, OK 74301

Mr. Hugh Gordon
Craig County Commissioner
District 2
PO Box 397
Vinita, OK 74301

Mr. Dan Peetom
Craig County Commissioner
District 3
PO Box 397
Vinita, OK 74301

Distribution List

Mr. Morris Bluejacket
Craig County Flood Plain Manager
210 West Delaware, Suite 103
Vinita, OK 74301-4236

Craig County Conservation District
235 West Hope Avenue
Vinita, OK 74301-1302

Eastern Trails Museum
215 West Illinois Avenue
Vinita, OK 74301

Doug Smith
Delaware County Commissioner
District 1
327 South 5th Street
Jay, OK 74346

Tom Sanders
Delaware County Commissioner
District 2
327 South 5th Street
Jay, OK 74346

Martin Kirk
Delaware County Commissioner
District 3
327 South 5th Street
Jay, OK 74346

Mr. Robert Real
Delaware County Floodplain Administrator
PO Drawer 309
429 South 9th Street
Jay, OK 74346-0309
delawarecountyem@yahoo.com

Delaware County Conservation District
2749 State Highway 20
Jay, OK 74346

Delaware County Historical Society & Museum
538 Krause Street
Jay, OK 74346

Mr. Terry Hallaeuer
Delaware County Department of Environmental Quality
2096 South Main Street
Grove, OK 74344

Kevin Whiteside
Mayes County Commissioner
District 1
One Court Place, Suite 140
Pryor, OK 74361
Mayesdist1@yahoo.com

Darrell Yoder
Mayes County Commissioner
District 2
One Court Place, Suite 140
Pryor, OK 74361
Darrellyoder2@yahoo.com

Ryan Ball
Mayes County Commissioner
One Court Place, Suite 140
Pryor, OK 74361
Mayes3@sstelco.com

Johnny Janzen
Mayes County Floodplain Manager
1 Court Place, Suite 140
Pryor, OK 74361
mayescountyem@yahoo.com

Mayes County Conservation District
4238 N E 1st
PO Box 36
Pryor, OK 74362

Coo-Y-Yah Museum
847 Highway 69
South 8th Street
Pryor, OK 74361

Chairman John Clark
Ottawa County Commissioner
102 East Central Avenue, Suite 202
Miami, OK 74354
Ottawacountyd1@sbcglobal.net

Distribution List

Gary Wyrick
Ottawa County Commissioner
District #2
102 East Central Avenue, Suite 202
Miami, OK 74354
Ottawacountyd2@hotmail.com

Russell Earls
Ottawa County Commissioner
District #3
102 East Central Avenue, Suite 202
Miami, OK 74354
rearls@ruralinet.net

Joe Dan Morgan
Ottawa County Floodplain Administrator
102 East Central, Suite 104B
Miami, OK 74354
Ocem.morgan@yahoo.com

Ottawa County Conservation District
630 East Steve Owens Boulevard, Suite 3
Miami, OK 74354-7800

Ottawa County Historical Society
(Dobson Museum)
110 A Street SW
Miami, OK 74354

Afton Public Works Authority
PO Box 250
Afton, OK 74331

City of Grove
104 West 3rd
Grove, OK 74344

Ketchum Public Works Authority
PO Box 958
Ketchum, OK 74349

Director Michele Bolton
Miami Area Chamber of Commerce
103 East Central Avenue, Suite 100
Miami, OK 74354
michele@miamiokchamber.com

Mayor Rudy Schultz
City of Miami
PO Box 1288
Miami, OK 74355
rschultz@miamiokla.net

Mr. Dean Kruithof
Acting City Manager
City of Miami
PO Box 1288
Miami, OK 74355
dean@miamiokla.net

Ms. Judy Francisco
City of Miami
PO Box 1288
Miami, OK 74355
jfrancisco@miamiokla.net

Mr. Ronnie Cline
City of Miami
PO Box 1288
Miami, OK 74355
rcline@miamiokla.net

Mr. Brian Forrester
Council Member
NE Ward 1
PO Box 1288
Miami, OK 74355-1288
bforrester@miamiokla.net

Mr. Doug Weston
Council Member
NE Ward 2
PO Box 1288
Miami, OK 74355-1288
dweston@miamiokla.net

Mr. Neal Johnson
Council Member
SW Ward 3
PO Box 1288
Miami, OK 74355-1288
njohnson@miamiokla.net

Distribution List

Ms. Vicki Lewis
Council Member
SE Ward 4
PO Box 1288
Miami, OK 74355-1288
vlewis@miamiokla.net

City of Ketchum PWA
PO Box 958
Ketchum, OK 74349

Town of Langley
PO Box 760
Langley, OK 74350

City of Vinita
PO Box 329
104 East Illinois Avenue
Vinita, OK 74301

City of Wyandotte
212 South Main
Wyandotte, OK 74370

RWD #3 Delaware County
PO Box 1228
Jay, OK 74346

Mayes County – Disney
PO Box 279
Disney, OK 74340

Cherokee Grove Golf at Carey Bay
519 Quail Run Road
Grove, OK 74344

Grand Bluffs Development
32922 Pebble Beach
Afton, OK 74331

Melody Point
2011 Quail Run Road
Grove, OK 74344

Shangri-La Management
310000 South Highway 125
Afton, OK 74331
Shoreline, LLC
PO Box 6586
Grove, OK 74344

Spinnaker Point HOA
450779 East 341 Road
Afton, OK 74331

Tera Miranda Shores Inc.
28251 South 561 Road
Monkey Island, OK 74331

The Honorable James Mountain Inhofe
United States Senate
205 Russell Senate Office Building
Washington DC 20515
Jennie_wright@inhofe.senate.gov

The Honorable James Lankford
United States Senate
B40C Dirksen Senate Office Building
Washington DC 20510
Jeff_underwood@lankford.senate.gov

The Honorable Jim Bridenstine
216 Cannon House Office Building
Washington DC 20515
Joseph.kaufman@mail.house.gov

The Honorable Markwayne Mullin
1113 Longworth House Office Building
Washington DC 20515
Debbie.dooley@mail.house.gov

The Honorable Frank Lucas
2405 Rayburn HOB
Washington DC 20515

The Honorable Charles Wyrick
Oklahoma State Senate
2300 N Lincoln Boulevard Room 522
Oklahoma City, OK 73105

The Honorable Wayne Shaw
Oklahoma State Senate
2300 N Lincoln Boulevard, Room 325
Oklahoma City, OK 73105

The Honorable Doug Cox
House of Representatives
2300 N Lincoln Boulevard, Room 410
Oklahoma City, OK 73105
dougcox@okhouse.gov

Distribution List

The Honorable Chuck Hoskin
House of Representatives
2300 North Lincoln Boulevard, Room 509
Oklahoma City, OK 73105

The Honorable Ben Sherrer
House of Representatives
2300 North Lincoln Boulevard, Room 500
Oklahoma City, OK 73105
bensherrer@okhouse.gov

The Honorable Marty Quinn
Oklahoma State Senate
2300 N Lincoln Boulevard, Room 528B
Oklahoma City, OK 73105
quinn@oksenate.gov

The Honorable Ben Loring
House of Representatives
2300 North Lincoln Boulevard
Oklahoma City, OK 73105
Ben.loring@okhouse.gov

The Honorable Mary Fallin
Governor of Oklahoma
2300 North Lincoln Boulevard, Suite 212
Oklahoma City, OK 73105

The University of Oklahoma
Office of the President
Evans Hall Room 110
660 Parrington Oval
Norman, OK 73109-3073

Oklahoma State University
Burns Hargis, President
107 Whitehurst
Stillwater, OK 74078

Northeastern State University
600 North Grand Avenue
Tahlequah, OK 74464

Northeastern Oklahoma A & M College
200 I Street NE
Miami, OK 74354

Rogers State University
1701 West Will Rogers Boulevard
Claremore, OK 74017

Miami Flood Mitigation Advisory Board
City of Miami
PO Box 1288
Miami, OK 74355-1288

Grand Seaplanes, LLC
5200 South Chestnut Avenue
Broken Arrow, OK 74011

Anglers in Action
PO Box 803
High Ridge, MO 63049

Two Mom's Campground
215 Construction Drive
Disney, OK 74340

Grand Lake Association & Visitor Center
9630 Highway 59 N, Suite B
Grove, OK 74344

Rusty Fleming
Executive Director
Grand Lakers United Enterprise
PO Box 1
Langley, OK 74350

South Grand Lake Area Chamber of Commerce
PO Box 215
Langley, OK 74350
grandlakechamber@gmail.com

Oklahoma Association of Realtors
9807 Broadway Ext
Oklahoma City, OK 73114-6312

Har-Ber Village
4404 West 20th Street
Grove, OK 74344

Shangri-La Marina
57151 East Highway 125
Afton, OK 74331

Cherokee Yacht Club Marina
PO Box 600
Ketchum, OK 74349

Port Carlos
PO Box 780
Ketchum, OK 74349

Distribution List

Arrowhead Yacht Club
PO Box 600
Ketchum, OK 74349

Clearwater Bay Marina
PO Box 219
Disney, OK 74340

Harbors View Marina
451107 East 320 Road
Afton, OK 74331

Thunder Bay Marina LLC
450780 Thunder Bay Road
Afton, OK 74331

Cedar Port Marina
PO Box 600
Ketchum, OK 74349

Tera Miranda Marina Resort
28251 South 561 Road
Monkey Island, OK 74331

Arrowhead Yacht Club South
PO Box 600
Ketchum, OK 74349

Honey Creek Landing Marina
2520 South Main Street
Grove, OK 74344

Willow Park Marina
PO Box 120
Ketchum, OK 74349

Southwinds Marina
PO Box 3977
Bernice, OK 74331

The Landings Marina
PO Box 61250
Oklahoma City, OK 73146

Hammerhead Marina
PO Box 600
Ketchum, OK 74349

Hammerhead Marina West
PO Box 600
Ketchum, OK 74349

Grand Lakeside Marina
11350 North Highway 59
Grove, OK 74344

Indian Hills Resort and Marina
PO Box 3747
Bernice, OK 74331

Hi-Lift Marina LLC
196 Private Road 138
Eucha, OK 74342

Dripping Springs Yacht Club
200 Dripping Springs Landing
Eucha, OK 74342

Grand Red Arrow Marina
453881 East 305 Road
Afton, OK 74331

Elk River Landing
1923 North Barrington Drive
Fayetteville, AR 72701

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

The Grand River Dam Authority (GRDA), with assistance from HDR Engineering, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Pensacola Hydroelectric Project ("Project"). Through the Federal Power Act (FPA), FERC is responsible for licensing and relicensing non-federal hydropower facilities throughout the United States. The FPA requires that all non-federal hydropower facilities, like GRDA's Pensacola Project, receive a new license to operate every 30 to 50 years. The relicensing process takes five (5) years minimum to complete, and formally begins with GRDA's distribution of a Notice of Intent (NOI) and Pre-Application Document (PAD).

The Project is located on the Grand River in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (see attached map). GRDA is preparing a PAD that provides FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project to help identify issues and related information needs, develop study requests and study plans related to the relicensing of the Project, and prepare documents analyzing the Project's potential effects and benefits. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in GRDA's possession.

1. Information about person completing the questionnaire:

Name & Title	
Organization	
Address	
Phone	
Email Address	

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

____ *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

Name & Title	
Organization	
Address	
Phone	
Email Address	

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	
Organization	
Address	
Phone	
Email Address	

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   __ Yes *(If yes, please complete 4a through 4d)* __ No

   a. Please circle the specific resource area(s) that the information relates to:

      - Geology, topography and soils
      - Water resources
      - Fish and aquatic resources
      - Wildlife and botanical resources
      - Floodplains, wetlands, riparian, and littoral habitat
      - Rare, threatened, and endangered species
      - Recreation and land use
      - Aesthetic resources
      - Cultural resources
      - Tribal resources
      - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   c. Where can GRDA obtain this information?

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

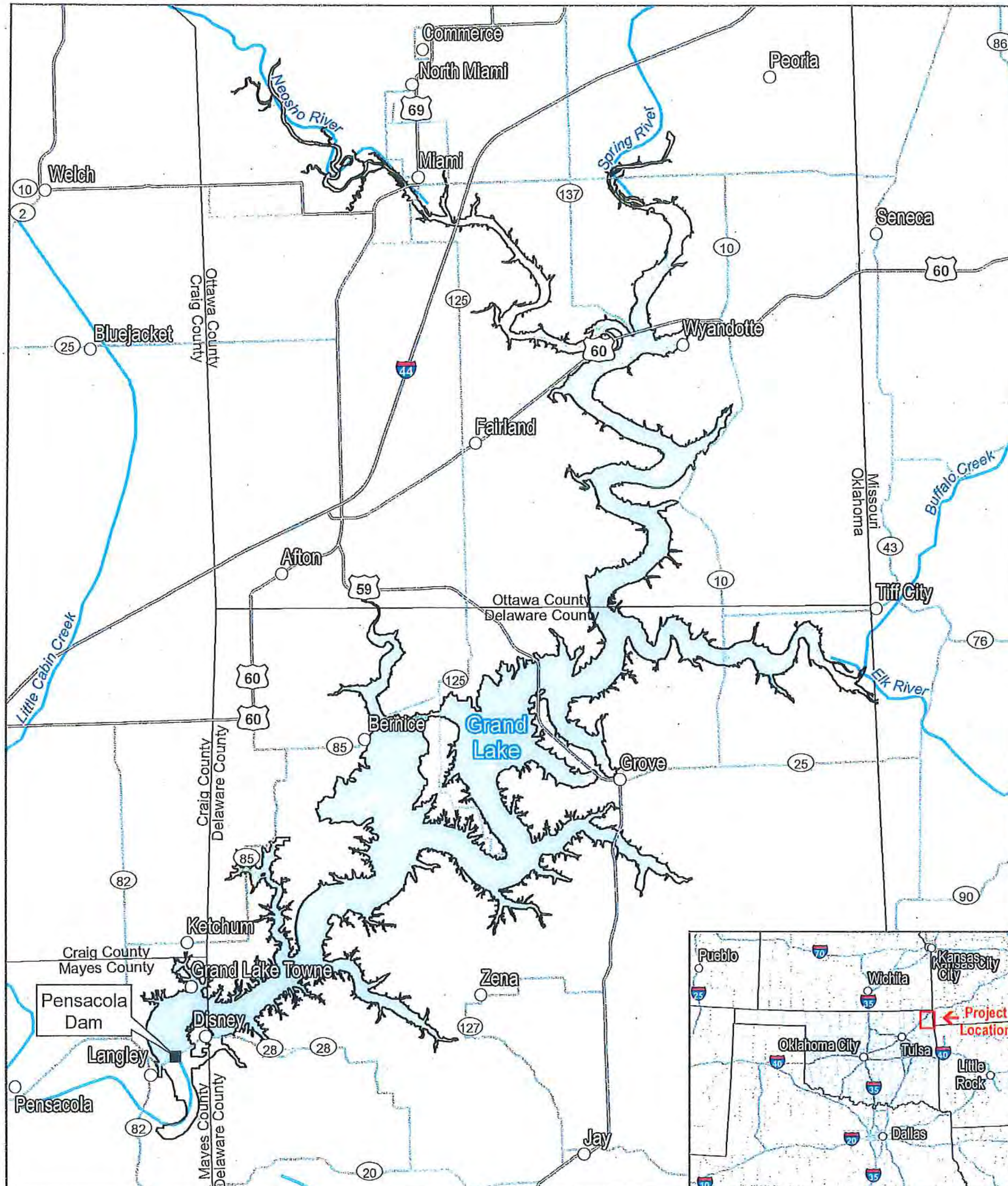
Name	
Address	
Phone	
Email Address	

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

If you have any questions regarding the Pensacola Project, or the upcoming FERC licensing processes, please contact Dr. Darrell Townsend at dtownsend@grda.com or via phone at 918-256-0616 or Ms. Jacklyn Jaggars at jjaggars@grda.com or via phone at 918-256-0723.

Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 30 days of receipt to allow for any follow-up contact by a GRDA or its representative that may be needed. Comments and/or questions about this questionnaire may also be sent via e-mail to: Jacklyn Jaggars at jjaggars@grda.com. Not responding within 30 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project's environment.



N

0 1 2 3 4 5
MILES

GRDA
Grand River Dam Authority

LEGEND

Project Boundary	City
County	Freeway
Grand Lake	Highway
Pensacola Dam	Major Road

PENSACOLA
HYDROELECTRIC PROJECT

DATA SOURCES:
NRCS 2016, ESRI 2016

Hasler
09/19/2016
US POSTAGE

$00.49[0]

ZIP 74350
011D11642043

GRDA
Grand River Dam Authority

ECOSYSTEMS & EDUCATION CENTER
PO Box 70
Langley OK 74350

From: Jaggars, Jacklyn <jjaggars@grda.com>
Sent: Friday, September 23, 2016 12:26 PM
To: Andersen, Emily
Subject: FW: FERC Relicensing 101 w/ ODWC and USFWS
Attachments: Pensacola Relicensing Overview.pptx

From: Zamor, Richard
Sent: Wednesday, September 21, 2016 9:01 AM
To: 'Stubbs, Kevin' <kevin_stubbs@fws.gov>
Cc: Daniel Fenner <daniel_fenner@fws.gov>; Jonna Polk <jonna_polk@fws.gov>; Laurence Levesque <laurence_levesque@fws.gov>; Townsend, Darrell <dtownsend@grda.com>; Jaggars, Jacklyn <jjaggars@grda.com>
Subject: RE: FERC Relicensing 101 w/ ODWC and USFWS

Here you go. Thanks for coming!

RZ

Richard M. Zamor, Ph.D.
Project/Research Director for Water Quality Laboratory
Ecosystems and Lake Management
Grand River Dam Authority

From: Stubbs, Kevin [mailto:kevin_stubbs@fws.gov]
Sent: Tuesday, September 20, 2016 3:18 PM
To: Zamor, Richard
Cc: Daniel Fenner; Jonna Polk; Laurence Levesque
Subject: Re: FERC Relicensing 101 w/ ODWC and USFWS

Rich,

Could you send a copy of the powerpoint GRDA gave today so I can show my supervisors the potential workload and timeframes?

Thanks,

Kevin
918-382-4516

On Thu, Sep 8, 2016 at 3:34 PM, Zamor, Richard <richard.zamor@grda.com> wrote:

> Dear all,
>
> Thanks for agreeing to meet with us to discuss the relicensing process. After talking with Josh and Kevin it looks like the September 20th would be a good day for us to get together and discuss the process. The meeting shouldn't take longer than an hour or so. Also of course if you have any other personnel that might benefit from attending (Kevin I believe

> you said you had a new colleague Larry that might attend, and I would bet that Josh has a few people he might like to attend as well) please be sure to include them and let us know so we can get a good head count.
>
> Let us know if this date and time won't work and we will reschedule asap,
>
> Rich

From: Jaggars, Jacklyn <jjaggars@grda.com>
Sent: Friday, September 23, 2016 12:32 PM
To: Andersen, Emily
Subject: FW: Pensacola Relicensing (FERC 101 Powerpoint)
Attachments: Pensacola Relicensing Overview.pptx

Fyi

From: Jaggars, Jacklyn
Sent: Friday, September 23, 2016 2:31 PM
To: 'Stackelbeck, Kary' <kstackelbeck@ou.edu>
Subject: Pensacola Relicensing (FERC 101 Powerpoint)

Hi Kary,

I think I am losing my mind but when we were going back and forth about sharing documents, I was thinking about the FERC Relicensing powerpoint that Darrell shared with your team during the September 7th meeting, but I forgot to attach it when resending the Lake Hudson archaeology reports that caused us cyberspace issues. So, with that said, attached is the FERC relicensing powerpoint for your records and please feel free to share with your staff as well.

Sorry for the confusion and oversight on my part.

Thanks,
Jacklyn

From: Stackelbeck, Kary [mailto:kstackelbeck@ou.edu]
Sent: Thursday, September 22, 2016 11:13 AM
To: Jaggars, Jacklyn <jjaggars@grda.com>
Subject: Re: GRDA Phase II Archaeology Reports for Lake Hudson

Thanks, Jacklyn. I simply shared the file with Amanda, Scott, and Patrick.

From: Jaggars, Jacklyn <jjaggars@grda.com>
Sent: Thursday, September 22, 2016 10:03:24 AM
To: Stackelbeck, Kary
Subject: FW: GRDA Phase II Archaeology Reports for Lake Hudson

Alright, got another returned email so I shared the link from dropbox. Let me know if you have any other issues.

From: Jaggars, Jacklyn
Sent: Thursday, September 22, 2016 9:55 AM
To: 'Stackelbeck, Kary' <kstackelbeck@ou.edu>
Subject: RE: GRDA Phase II Archaeology Reports for Lake Hudson

Yeah I bet that's why---although I didn't receive an email the first time on the 12th when I sent it. The wonders of cyberspace. ☺ Yes, I have a dropbox account. I'll upload there and send you a link to grab it. Sorry about the inconvenience.

From: Stackelbeck, Kary [mailto:kstackelbeck@ou.edu]
Sent: Thursday, September 22, 2016 9:51 AM
To: Jaggars, Jacklyn <jjaggars@grda.com>
Subject: Re: GRDA Phase II Archaeology Reports for Lake Hudson

OK--I suspect that's why I couldn't find it in my in-box earlier; it may just have been too large for me to actually receive through the University's email system. Do you have an FTP site or similar means to share access to the document on-line?

-Kary

From: Jaggars, Jacklyn <jjaggars@grda.com>
Sent: Thursday, September 22, 2016 9:49:58 AM
To: Stackelbeck, Kary
Subject: RE: GRDA Phase II Archaeology Reports for Lake Hudson

Hi Kary,

I tried to resend yesterday but it was bounced back undeliverable. I'm trying again right now.

Jacklyn

From: Stackelbeck, Kary [mailto:kstackelbeck@ou.edu]
Sent: Wednesday, September 21, 2016 3:58 PM
To: Jaggars, Jacklyn <jjaggars@grda.com>
Subject: Re: GRDA Phase II Archaeology Reports for Lake Hudson

Hi Jacklyn,
Your message prompted me to go back and check to be sure that I did indeed forward it per your request. Apparently, I have not yet done so. Further, I can't seem to locate the original message to which you attached the electronic copy of the report. Would you mind to resend that? Sorry for the hassle.

Thanks,
Kary

From: Jaggars, Jacklyn <jjaggars@grda.com>
Sent: Wednesday, September 21, 2016 3:50:35 PM
To: Stackelbeck, Kary
Subject: RE: GRDA Phase II Archaeology Reports for Lake Hudson

Perfect, thanks for the quick response. Hope all is well.

From: Stackelbeck, Kary [mailto:kstackelbeck@ou.edu]
Sent: Wednesday, September 21, 2016 3:49 PM
To: Jaggars, Jacklyn <jjaggars@grda.com>
Subject: Re: GRDA Phase II Archaeology Reports for Lake Hudson

Hi Jacklyn,
Sure. Their full names are:
Amanda Regnier,

Scott Hammerstedt
Patrick Livingood

Best,
Kary

From: Jaggars, Jacklyn <jjaggars@grda.com>
Sent: Wednesday, September 21, 2016 3:37:15 PM
To: Townsend, Darrell; Stackelbeck, Kary
Subject: RE: GRDA Phase II Archaeology Reports for Lake Hudson

Kary,

We are making a record of consultation for those we share Pensacola documents with---can you tell me Amanda, Patrick and Scott's last name for the record please.

Thanks,
Jacklyn

-----Original Message-----
From: Townsend, Darrell
Sent: Monday, September 12, 2016 12:46 PM
To: Jaggars, Jacklyn <jjaggars@grda.com>; Stackelbeck, Kary <kstackelbeck@ou.edu>
Subject: RE: GRDA Phase II Archaeology Reports for Lake Hudson

Kary,

Please also forward to Amanda, Patrick and Scott.

Thanks,

D.

Darrell E. Townsend II, Ph.D.
Assistant General Manager
Ecosystems and Lake Management
Grand River Dam Authority
(918) 256-0616: Office
(918) 530-0297: Cell

-----Original Message-----
From: Jaggars, Jacklyn
Sent: Monday, September 12, 2016 11:29 AM
To: Stackelbeck, Kary <kstackelbeck@ou.edu>
Cc: Townsend, Darrell <dtownsend@grda.com>
Subject: GRDA Phase II Archaeology Reports for Lake Hudson

Hi Dr. Stackelbeck,

Darrell asked me to forward you a copy of the latest NRHP Report for Lake Hudson after his meeting with you last Wednesday and I am just now getting a chance to do so. Hard copies were forwarded to your agency on August 8th. A copy of the cover letter is attached.

Please let me know you received this email as the documents are large in size.

Thank you,
Jacklyn

-----Original Message-----
From: no_reply_ECO@grda.com [mailto:no_reply_ECO@grda.com]
Sent: Monday, September 12, 2016 10:14 AM
To: Jaggars, Jacklyn <jjaggars@grda.com>
Subject: Message from "RNP0026737421E3"

This E-mail was sent from "RNP0026737421E3" (MP C4503).

Scan Date: 09.12.2016 11:14:18 (-0400)
Queries to: no_reply_ECO@grda.com

Pensacola Hydroelectric Project
Pre-Application Document (PAD) Questionnaire Response Summary

Date	Summary of Contact	Agency/Organization	Documentation filename (pdf)
9/21/2016	Cambra Fields (NRCS, Vinita Field Office) emailed Jacklyn Jaggars (GRDA) requesting PAD questionnaire in electronic format for completion. Jacklyn emailed questionnaire the same day.	NRCS	2016-09-21NRCScFields.pdf
9/23/2016	Laura Holden (City Clerk, Town of Langley) called Jacklyn Jaggars (GRDA) requesting clarification and purpose of questionnaire. Jacklyn answered question clarifying the purpose of the questionnaire.	Town of Langley	Phone Call
9/29/2016	Received completed questionnaire via mail from Cambra Fields (NRCS); remains on mailing list; has additional soil related information that can be found at http://websoilsurvey.nrcs.usda.gov/appl	NRCS	2016-09-29NRCScFields.pdf
09/29/2016	Received completed questionnaire via mail from Doug Smith (Delaware County District 1); no additional information provided, remains on mailing list	Delaware County District 1	2016-09-29DelawareCountyDistrict1DSmith.pdf
09/29/2016	Received completed questionnaire via mail from Judy Florida (Harbors View Marina); indicates Jeff Rose, Regional Manager of Safe Harbor Marinas at 14785 Preston Road, Suite 975, Dallas TX 75254 should receive questionnaire. Phone #972-406-5229; jrose@shmarinas.com; no additional information provided and remains on mailing list. Jacklyn mailed questionnaire packet to Mr. Rose on 9/30/16.	Harbors View Marina	2016-09-29HarborsViewMarinaJFlorida.pdf 2016-09-30JRose.pdf
09/29/2016	Received completed questionnaire via mail from Jo Dan Morgan (Ottawa County Emergency Management); remains on mailing list; no additional information provided.	Ottawa County Emergency Management	2016-09-29OttawaCountyEmergencyManagementJMorgan.pdf
09/29/2016	Received completed questionnaire via mail from Ted Peitz (Southwinds Marina); remains on mailing list; no additional information provided	Southwinds Marina	2016-09-29SouthwindsMarinaTPeitz.pdf

Date	Summary of Contact	Agency/Organization	Documentation filename (pdf)
09/29/2016	Received completed questionnaire via mail from Melissa Shackford (The Nature Conservancy); remains on mailing list; indicates Jay Pruett, Director of Conservation, The Nature Conservancy, 10425 S 82nd E Avenue, Suite 104, Tulsa OK 73133 should receive questionnaire. Phone #918-585-1117; jpruett@tnc.org; provided additional information on RTE on status of gray bat and Ozark cavefish that can be obtained at the US Fish and Wildlife Service Office in Tulsa. Jacklyn mailed questionnaire packet to Mr. Pruett on 9/30/2016.	The Nature Conservancy	2016-09-29TheNatureConservancyMShackford.pdf 2016-09-30JPruett.pdf
09/29/2016	Received completed questionnaire via mail from James Paul (National Weather Service); provided additional information on water resources (ie, rainfall observations and estimates, forecasts, deterministic river forecasts, probabilistic river forecasts) that can be obtained from National Weather Service Arkansas Red Basin River Forecast Center at 918-832-4109 or http://www.weather.gov/abrfc	National Weather Service	2016-09-29NationalWeatherServiceJPaul.pdf
10/03/2016	Bill Keefer (City Manager, City of Grove) emailed Jacklyn Jaggars (GRDA) regarding question 4, specific resource areas of the questionnaire. He asked whether the City of Grove has specific information GRDA needs under the process or if we already have what the City might be able to provide. Jacklyn replied on 10/3/2016.	City of Grove	2016-10-03BKeefer.pdf
10/04/2016	David Hurt (National Parks Service) emailed Jacklyn Jaggars requesting the PAD Questionnaire be sent to IMRextrev@nps.gov for a quicker response time. Jacklyn emailed the questionnaire to the email address on 10/4/2016.	National Parks Service	2016-10-04NationalParksService.pdf
10/05/2016	Brooks Tramell (Oklahoma Conservation Commission) emailed Jacklyn Jaggars the completed questionnaire. Jacklyn replied with a thank you. Remains on mailing list. Can provide additional information in water resources, fish and aquatic resources, RT&E, and land use. Attached additional information to response.	Oklahoma Conservation Commission	2016-10-05OklahomaConservationCommissionBTramell.pdf

Date	Summary of Contact	Agency/Organization	Documentation filename (pdf)
10/05/2016	Received completed questionnaire via mail from William (Bill) Keefer (City of Grove). Remains on mailing list. Includes Debbie Bottoroff (Assistant City Manager) be added to distribution list. Same contact information as Bill; email is dbottoroff@sbcglobal.net	City of Grove	2016-10-05CityofGroveWKeefer.pdf
10/05/2016	Received completed questionnaire via mail from Keith Martin (Rogers State University); remains on mailing list. Can provide information on fish and aquatic resources, wildlife and botanical resources, and RT&E Species.	Rogers State University	2016-10-05RogersStateUniversityKMartin.pdf
10/05/2016	Received completed questionnaire via mail from Robert Steinkirchner (Spinnaker Point Estates); remains on mailing list. Includes Eric Grimshaw as a point of contact. 2639 E 33rd Place, Tulsa OK 74108; 918-625-3807 or egrimshaw@oneok.com	Spinnaker Point Estates	2016-10-05SpinnakerPointEstatesRSteinkirchner.pdf
10/12/2016	Received email from Karen Pritchett (THPO Assistant, United Keetoowah Band of Cherokee Indians in Oklahoma); Recommended Phase 1 survey of all GRDA managed lands in the area of potential effects.	United Keetoowah Band of Cherokee Indians in Oklahoma	2016-10-12UnitedKeetoowahBandKPritchett.pdf
10/13/2016	Received completed questionnaire via mail from Glenna Wallace (Chief, Eastern Shawnee Tribe of Oklahoma); remains on mailing list. Includes Chad Kelly (Tribal Administrator) 10080 S Bluejacket Road, Wyandotte OK 74370; 918-666-5151; ckelly@estoo.net; can provide information on cultural resources, tribal resources and socioeconomic resources; includes letter of opposition on Pensacola Rule Curve License Amendment	Eastern Shawnee Tribe of Oklahoma	2016-10-13EasternShawneeTribeofOKGWallace.pdf 2016-10-13EasternShawneeTrbe_Rule Curve.pdf

Date	Summary of Contact	Agency/Organization	Documentation filename (pdf)
10/13/2016	Received completed questionnaire via mail from Josh Johnston (ODWC); remains on mailing list; indicates Brad Johnston and Ken Cunningham as additional contacts. Indicated Josh Richardson (Wildlife Biologist) at 7201 # 33rd Street, Arcadia OK 73007; 405-590-2585; josh.richardson@odwc.ok.gov should receive questionnaire; can provide information on water resources, fish and aquatic resources, wildlife and botanical resources floodplains, wetlands, riparian, and littoral habitat, RT&E, recreation and land use, and socioeconomic resources. Indicates that ODWC manages the fish and wildlife within the project area. Cooperate with constituents and city/county entities on projects to expand boating and fish access. Also have projects in the area that they keep data pertaining to fish and wildlife populations. Call or email one of the listed contacts for more information. Jacklyn emailed and sent a hard copy of questionnaire to Josh Richardson on 10/14/2016.	Oklahoma Department of Wildlife Conservation	2016-10-13-OKDeptWildlifeConsJJohnston.pdf 2016-10-14ODWCJRichardsonFollowUp.pdf
10/17/2016	Received electronic copy of a response letter via email from Dean Kruithof (Manager, City of Miami) addressing items in the questionnaire. Hard copy letter followed in the mail.	City of Miami	2016-10-17CityofMiamiDKruithof.pdf
10/17/2016	Received email from Ben Loring (State Representative, House District 7); remains on mailing list. Includes request for studies to be done on Spring and Elk River.	Oklahoma State Legislature	2016-10-17OKStateHouseBLoring.pdf
10/18/2016	Received a letter via mail from Melvena Heisch (Deputy State Historic Preservation Officer, OK Historical Society State Historic Preservation Office); comments the PAD is not considered a federal undertaking under Section 106 of the NHPA and the Advisory Council on Historic Preservation's governing regulations at 36 CRF Part 800 and is therefore not subject to our review. Will provide comments upon initiating consultation pursuant to Section 106. Listed Catharine M. Wood, Historical Archaeologist, 405-521-6381.	State Historic Preservation Office	2016-10-18OKHistoricalSocietyMHeisch.pdf

Date	Summary of Contact	Agency/Organization	Documentation filename (pdf)
10/19/2016	Received completed questionnaire via email from Rick DuBois (Environmental Director, Seneca-Cayuga Nation); remains on mailing list. Included Micca Emarthla, PO Box 453220, Grove OK 74345-3220; 918-787-5452 ext 342; memarthla@sctribe.com as additional contact. No additional information provided.	Seneca-Cayuga Nation	2016-10-19SenecaCayugaNationRDuBois.pdf
10/21/2016	Received completed questionnaire via mail from Nicole McGavock (Service Hydrologist, National Weather Service); remains on mailing list. Can provide information on water resources including past rainfall, 7-day rainfall forecast, 5-day river forecast for Neosho & Spring rivers; flood stage information for the Neosho River near Commerce and the Spring River near Quapaw and other points upstream. Information can be obtained at www.weather.gov/tsa	National Weather Service	2016-10-21NationalWeatherServiceNMcGavock.pdf
10/21/2016	Received completed questionnaire via mail from Jeffery Hale (President, Northeastern Oklahoma A&M College); remains on mailing list. Includes Mark Rasor (Vice President for Business) and Steve Stephens (General Counsel) as additional contacts with their applicable contact information.	Northeastern Oklahoma A&M College	2016-10-21NortheasternOklahomaAMCollegeJHale.pdf
10/21/2016	Received completed questionnaire via mail from Logan Pappenfort (Special Project Manager/Section 106 Coordinator, Peoria Tribe of Indians of Oklahoma); remains on mailing list; can provide information on gravel bars and their importance to native aquatic life, land use of recreational spaces in Miami, tribal cemetery and fish hatchery, Peoria Schoolhouse Access, and Peoria Housing Authority.	Peoria Tribe of Indians of Oklahoma	2016-10-21PeoriaTribeofIndiansLPappenfort.pdf
10/24/2016	Received completed questionnaire via email from Josh Richardson (Wildlife Biologist, Oklahoma Department of Wildlife Conservation); remains on mailing list; can provide information on waterfowl surveys, waterfowl harvest estimates by county, current, and wetland maps.	Oklahoma Department of Wildlife Conservation	2016-10-24OkDeptWildlifeConsJRichardson.pdf

Date	Summary of Contact	Agency/Organization	Documentation filename (pdf)
10/25/2016	Received a letter via email from Kary Stackelbeck (State Archaeologist, Oklahoma Archaeological Survey) stating the Survey understands GRDA intends to conduct environmental studies in 2018 and 2019 and they look forward to receiving the resulting documentation as the project moves forward. Remains on mailing list.	Oklahoma Archeological Survey	2016-10-25OKArchaeologicalSurveyKStackelbeck.pdf
10/27/2016	Received email from Kimeka Price (NEPA Project Manager, US EPA Region 6) requesting additional time to provide scoping comments on the project. Jacklyn Jaggars (GRDA) replied that the questionnaire is an information request for project-related information, rather than formal scoping comments under NEPA. Scoping will occur after the relicensing process for the Pensacola Project officially commences with the filing of the NOI/PAD no later than March 31, 2017. Jacklyn also followed up with a phone call to Ms. Price on 10/31/2016. She left a voicemail.	US Environmental Protection Agency, Region 6	2016-10-27EnvironmentalProtectionAgencyKPrice.pdf
12/08/2016	Received a letter via mail from John Fox (Archaeologist, Osage Nation Historic Preservation Office) requesting a consultation meeting for the relicensing process. Remains on mailing list. Jacklyn responded via letter on 1/4/2017.	Osage Nation Tribal Historic Preservation Office	2016-12-08OsageNationJFox.pdf 2017-01-04OsageNationJFoxResponse.pdf
1/19/2017	Received completed questionnaire via fax from Jeannine Hale (Eastern Oklahoma Region, Bureau of Indian Affairs); remains on contact list. Can provide information on tribal land status, upon request to Eastern Oklahoma Regional Office and tribes. Indicates that Principal Chief Baker (Cherokee Nation) should receive the questionnaire; Tahlequah (the Cherokee Nation was sent the questionnaire in the initial mailing). Includes Jessie Dunham (Deputy Regional Director) as additional contact, same mailing address as Jeannine; email address is jessie.dunham@bia.gov.	Bureau of Indian Affairs	2017-01-19BIAJHale.pdf

GRDA
Grand River Dam Authority

September 19, 2016

Subject: Pensacola Hydropower Project (FERC No. 1494)
Relicensing Pre-Application Document Questionnaire

To the Attached Distribution List:

Grand River Dam Authority (GRDA) is the Licensee and operator of the Pensacola Hydroelectric Project (FERC No. 1494) (Project) located on the Grand Neosho River (Grand River) in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma. The Project is licensed by the Federal Energy Regulatory Commission (FERC).

The existing FERC license for the Project expires on March 31, 2022. GRDA intends to pursue a new license for the Project and is preparing the Pre-Application Document (PAD) required by FERC's relicensing process. GRDA has retained HDR Engineering, Inc. (HDR) for assistance with the relicensing process, including development of the PAD.

The PAD provides FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project. This information is intended to help identify information needs, develop study requests and study plans, and prepare documents related to analyzing the relicensing application to be prepared by GRDA. To prepare the PAD, GRDA will use information in its possession and information obtained from others. Consistent with this effort, the purpose of this letter is to:

1) Notify interested governmental agencies, local governments, non-governmental organizations, Indian tribes, and individuals of the upcoming relicensing proceeding, and

2) Request your help in identifying existing, relevant, and reasonably available information related to the existing Project environment.

GRDA's goal is to file the PAD during the first quarter of 2017. We are asking for your help to identify additional information of which you may be aware. To facilitate the information search, we have prepared the attached Pre-Application Document Information Questionnaire (PAD Questionnaire).

GRDA is requesting that you provide any relevant information for the PAD. Relevant information would include site-or-region specific studies, data, reports, or management plans on any of the following resource areas:

- Geology, topography and soils
- Water resources
- Fish and aquatic resources
- Wildlife and botanical resources
- Floodplains, wetlands, riparian, and littoral habitat
- Rare, threatened, and endangered species
- Recreation and land use
- Aesthetic resources
- Cultural resources
- Tribal resources
- Socioeconomic resources

To help ensure that your relevant information and resources are available for inclusion in the PAD, please fill out the attached PAD Questionnaire and return to Jacklyn Jaggars (of GRDA) via email at jjaggars@grda.com or in the enclosed self-addressed, stamped envelope.

GRDA intends to include relevant information in the PAD. Therefore, we respectfully request a response within 30 days of receipt of this letter. This will allow time for follow-up contacts that may be necessary. If we do not receive a response from you within 30 days, this will indicate you are not aware of any existing, relevant, and reasonably available information that describes the Project environment or known potential impacts of the Project, and that, unless you are representative of an Indian tribe or federal or state agency, you do not wish to remain on the distribution list for this relicensing process.

We want to thank you in advance for helping identify information that meets the criteria for inclusion in the PAD. We appreciate your assistance and look forward to working with you during the relicensing process. If you have any questions regarding this request or would like additional information, please contact me at dtownsend@grda.com or via phone at 918-256-0616 or Jacklyn Jaggars at jjaggars@grda.com or via phone at 918-256-0723.

Sincerely,

Darrell Townsend, II, Ph.D.
Assistant General Manager
Ecosystems and Lake Management
Grand River Dam Authority

Enclosure

Distribution List

Mr. Ken Collins
U.S. Fish and Wildlife Service
9014 E 21st Street
Tulsa, OK 74129-1428
Ken_collins@fws.gov

Ms. Jonna Polk
U.S. Fish and Wildlife Service
9014 E 21st Street
Tulsa, Oklahoma 74129-1428
Jonna_polk@fws.gov

Mr. Kevin Stubbs
Field Supervisor
U.S. Fish and Wildlife Service
9014 E 21st Street
Tulsa, OK 74129-1428
Kevin_stubbs@fws.gov

U.S. Bureau of Land Management
Oklahoma Field Office
7906 East 33rd Street, Suite 101
Tulsa, OK 74145-1352

U.S. Forest Service
1400 Independence Avenue, SW
Washington, DC 20250

U.S. Bureau of Indian Affairs
Eastern Oklahoma Regional Office
101 North 5th Street
Muskogee, OK 74401-6206

U.S. Bureau of Indian Affairs
Attn: Mosby Halterman
3100 W Peak Boulevard
Muskogee, OK 74401
Mosby.halterman@bia.gov

U.S. Natural Resources Conservation Service
1400 Independence Avenue, SW Room 5105-A
Washington DC 20250

Sue Masica, Regional Director
National Park Service
12795 Alameda Parkway
Denver, CO 80225

Mr. Andrew Commer, Chief
U.S. Army Corps of Engineers, Tulsa District
Attn: CESWT-P-R (Regulatory Branch)
1645 South 101 East Avenue
Tulsa, Oklahoma 74128-4609
Andrew.Commer@usace.army.mil

Mr. Mike Abate
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Mike.r.abate@usace.army.mil

Ms. Jennifer Aranda
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Jennifer.a.aranda@usace.army.mil

Mr. William Chatron
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
William.a.chatron@usace.army.mil

Ms. Tonya Dunn
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Tonya.n.dunn@usace.army.mil

Mr. Greg Estep
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Gregory.estep@usace.army.mil

Mr. Scott Henderson
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Scott.a.henderson@usace.army.mil

Mr. Mike Love
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128
Michael.s.love@usace.army.mil

Distribution List

Mr. Steve Nolan
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609

Mr. Ed Rossman
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Edwin.j.rossman@usace.army.mil

Mr. Terry Rupe
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Terry.d.rupe@usace.army.mil

Mr. David Williams
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609

Ms. Eva Zaki-Dellitt
U.S. Army Corps of Engineers
1645 South 101 East Avenue
Tulsa, OK 74128-4609
Eva.a.zaki-dellitt@usace.army.mil

Dr. William Andrews, Director
U.S. Geological Survey
Oklahoma Water Science Center
202 NW 66th Street, Building 7
Oklahoma City, OK 73116

U. S .Environmental Protection Agency
Region 6
Fountain Place
1445 Ross Avenue
Dallas, TX 75202-2760

U.S. Department of the Army
1645 Randolph Road
Fort Sill, OK 73503

Ms. Nicole McGavock
National Weather Service
Tulsa, OK Weather Forecast Office
10159 E 11th Street, Suite 300
Tulsa, OK 74128
Nicole.mcgavock@noaa.gov

Mr. James Paul
National Weather Service
Tulsa, OK Weather Forecast Office
10159 E 11th Street Suite 300
Tulsa, OK 74128
James.paul@noaa.gov

Mr. Barry Bolton
Oklahoma Department of Wildlife
Conservation
Chief of Fisheries Division
PO Box 53465
Oklahoma City, OK 73152
Barry.bolton@odwc.ok.gov

Mr. Richard Hatcher
Director
Oklahoma Department of Wildlife
Conservation
PO Box 53465
Oklahoma City, OK 73152
Richard.hatcher@odwc.ok.gov

Mr. Josh Johnston
NE Regional Fisheries Biologist
Oklahoma Department of Wildlife
Conservation
PO Box 1201
Jenks, OK 74037
Josh.johnston@odwc.ok.gov

Mr. William Cauthron
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Bill.cauthron@owrb.ok.gov

Mr. Lance Phillips
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Lance.phillips@owrb.ok.gov

Mr. Monty Porter
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Monty.porter@owrb.ok.gov

Distribution List

Mr. Derek Smithee
Water Quality Division
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Derek.smithee@owrb.ok.gov

Mr. Matt Rollins
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Matt.rollins@owrb.ok.gov

Ms. Beth Wilhelm
Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Beth.wilhelm@owrb.ok.gov

Mr. Joe Long
Oklahoma Department of Environmental Quality
PO Box 1677
Oklahoma City, OK 73101-1677
joe.long@deq.ok.gov

Ms. Elena Jigoulina
Oklahoma Department of Environmental Quality
PO Box 1677
Oklahoma City, OK 73101-1677
Elena.jigoulina@deq.ok.gov

Dr. Kary Stackelbeck
State Archeologist
Oklahoma Archeological Survey
111 East Chesapeake, Bldg. 134
Norman, OK 73019-0575
lstackelbeck@ouo.edu

Ms. Melvena Heisch
Deputy State Historic Preservation Officer
Oklahoma Historical Society
800 Nazih Zuhdi Drive
Oklahoma City, OK 73105-7917
mheisch@okhistory.org

Ms. Kris Marek
Oklahoma Tourism and Recreation Department
State Parks & Resorts
900 North Stiles Avenue
Oklahoma City, OK 73104
Kris.marek@travelok.com

Oklahoma Department of Transportation
4002 North Mingo Valley Expressway
Tulsa, OK 74116

Mr. Trey Lam
Oklahoma Conservation Commission
2800 North Lincoln Boulevard, Suite 160
Oklahoma City, OK 73105

Oklahoma Department of Agriculture Food And Forestry
2800 North Lincoln Boulevard, Suite 100
Oklahoma City, OK 73105

Oklahoma Department of Health
4616 East 15th Street
Tulsa, OK 74112

Oklahoma Department of Commerce
900 North Stiles Avenue
Oklahoma City, OK 73104

The Honorable Michael Teague
Secretary of Energy and Environment
100 North Broadway, Suite 2350
Oklahoma City, OK 73102
Michael.teague@ee.ok.gov

Mr. Jeff Southwick
Oklahoma Corporation Commission
2101 North Lincoln Boulevard
Oklahoma City, OK 73105

Mr. Charles Kerns
Oklahoma Office of Emergency Management
PO Box 53365
Oklahoma City, OK 73152-3365
Charles.kerns@oem.ok.gov

Distribution List

Ms. Glenda Longan
Director of Emergency
City of Miami
PO Box 1288
Miami, OK 74355
glongan@miamiokla.net

Mr. Luke Tallant
Office of State Fire Marshal
2401 NW 23rd Street, Suite 4
Oklahoma City, OK 73107
Luke.tallant@fire.ok.gov

Inter-Tribal Council Inc.
PO Box 1308
Miami, OK 74355

Alabama-Quassarte Tribal Town
109 East Broadway Avenue
Wetumka, OK 74883

Apache Tribe of Oklahoma
PO Box 1330
Anadarko, OK 73005

Caddo Nation of Oklahoma
PO Box 487
Binger, OK 73009

U.S. Bureau of Indian Affairs
Cherokee Nation
PO Box 948
Tahlequah, Oklahoma 74465

Cheyenne & Arapaho Tribes
100 Red Moon Circle
Concho, OK 73022

Honorable Chief Chester Brooks
Delaware Tribe of Indians
170 NE Barbara
Bartlesville, OK 74006
cbrooks@delawaretribe.org

Chief Glenna J. Wallace
Eastern Shawnee Tribe of Oklahoma
12755 South 705 Road
Wyandotte, OK 74370
gjwallace@estoo.net

Little Traverse Bay Bands of Odawa Indians
7500 Odawa Circle
Harbor Springs, MI 49740

Chief Douglas G. Lankford
Miami Tribe of Oklahoma
PO Box 1326
Miami, OK 74354
dlankford@miamination.com

Chief Bill Follis
Modoc Tribe of Oklahoma
418 G Street SE
Miami, OK 74354
F1cattlecompany@gmail.com

Muscogee Nation
PO Box 580
Okmulgee, OK 74447

Mr. Farris Barker
Osage Nation Historic Preservation Office
1449 Main Street
Pawhuska, OK 74056

Chief Ethel Cook
Ottawa Tribe of Oklahoma
13 South Highway 69A
Miami, OK 74354
cethel@cableone.net

Chief John Froman
Peoria Tribe of Oklahoma
118 South Eight Tribes Trail
Miami, OK 74354
jfroman@peoriatribe.com

Mr. Everett Bandy
Quapaw Tribe of Oklahoma
PO Box 765
Quapaw, OK 74363
ebandy@quapawtribe.com

Mr. Alan Mauk
Quapaw Tribe of Oklahoma
5681 South 630 Road
Quapaw, OK 74363
alanmauk@aol.com

Distribution List

Chief William Fisher
Seneca-Cayuga Nation
PO Box 453220
Grove, OK 74345-3220
wfisher@sctribe.com

Chief Ron Sparkman
Shawnee Tribe of Oklahoma
29 South Highway 69A
Miami, OK 74354
Rondede1@gmail.com

Ms. Lisa Streetopp
Preservation Office
United Keetoowah Band of Cherokees
PO Box 746
Tahlequah, OK 74665
Ukbthpo-larue@yahoo.com

Wichita and Affiliated Tribes
PO Box 729
Anadarko, OK 73005

Ms. Kathleen A. Welch
Environmental Assistant
Wyandotte Tribe of Oklahoma
64700 East Highway 60
Wyandotte, OK 74370
kwelch@wyandotte-nation.org

Chief Billy Friend
Wyandotte Nation
64700 East Highway 60
Wyandotte, OK 74370
bfriend@wyandotte-nation.org

The Nature Conservancy
408 NW 7th Street
Oklahoma City, OK 73102

Chris Wood, President
Trout Unlimited
1777 N Kent Street, Suite 100
Arlington, VA 22209

American Rivers
1101 14th Street NW Suite 1400
Washington DC 20005

American Whitewater
PO Box 1540
Cullowhee, NC 28723

Ducks Unlimited
Regional Director
Nathan Johnson
1812 Cinnamon Ridge Road
Edmond, OK 73025
njohnson@ducks.org

Tulsa Audubon Society
PO Box 330140
Tulsa, OK 74133

Grand Lake Audubon Society
PO Box 1813
Grove, OK 74345-1813

Grand Lake Watershed Alliance Foundation
PO Box 451185
Grove, OK 74345-1185
glwafadmin@gmail.com

Local Environmental Action Demanded Inc.
223 A Street SE
Miami, OK 74354

Scott Cox, Squadron Commander
Grand Lake Sail and Power Squadron
31380 S 628 Lane
Grove, OK 74344
slcox@suddenlink.net

Mr. Lowell Walker
Craig County Commissioner
District 1
PO Box 397
Vinita, OK 74301

Mr. Hugh Gordon
Craig County Commissioner
District 2
PO Box 397
Vinita, OK 74301

Mr. Dan Peetom
Craig County Commissioner
District 3
PO Box 397
Vinita, OK 74301

Distribution List

Mr. Morris Bluejacket
Craig County Flood Plain Manager
210 West Delaware, Suite 103
Vinita, OK 74301-4236

Craig County Conservation District
235 West Hope Avenue
Vinita, OK 74301-1302

Eastern Trails Museum
215 West Illinois Avenue
Vinita, OK 74301

Doug Smith
Delaware County Commissioner
District 1
327 South 5th Street
Jay, OK 74346

Tom Sanders
Delaware County Commissioner
District 2
327 South 5th Street
Jay, OK 74346

Martin Kirk
Delaware County Commissioner
District 3
327 South 5th Street
Jay, OK 74346

Mr. Robert Real
Delaware County Floodplain Administrator
PO Drawer 309
429 South 9th Street
Jay, OK 74346-0309
delawarecountyem@yahoo.com

Delaware County Conservation District
2749 State Highway 20
Jay, OK 74346

Delaware County Historical Society &
Museum
538 Krause Street
Jay, OK 74346

Mr. Terry Hallaeuer
Delaware County Department of
Environmental Quality
2096 South Main Street
Grove, OK 74344

Kevin Whiteside
Mayes County Commissioner
District 1
One Court Place, Suite 140
Pryor, OK 74361
Mayesdist1@yahoo.com

Darrell Yoder
Mayes County Commissioner
District 2
One Court Place, Suite 140
Pryor, OK 74361
Darrellyoder2@yahoo.com

Ryan Ball
Mayes County Commissioner
One Court Place, Suite 140
Pryor, OK 74361
Mayes3@sstelco.com

Johnny Janzen
Mayes County Floodplain Manager
1 Court Place, Suite 140
Pryor, OK 74361
mayescountyem@yahoo.com

Mayes County Conservation District
4238 N E 1st
PO Box 36
Pryor, OK 74362

Coo-Y-Yah Museum
847 Highway 69
South 8th Street
Pryor, OK 74361

Chairman John Clark
Ottawa County Commissioner
102 East Central Avenue, Suite 202
Miami, OK 74354
Ottawacountyd1@sbcglobal.net

Distribution List

Gary Wyrick
Ottawa County Commissioner
District #2
102 East Central Avenue, Suite 202
Miami, OK 74354
Ottawacountyd2@hotmail.com

Russell Earls
Ottawa County Commissioner
District #3
102 East Central Avenue, Suite 202
Miami, OK 74354
rearls@ruralinet.net

Joe Dan Morgan
Ottawa County Floodplain Administrator
102 East Central, Suite 104B
Miami, OK 74354
Ocem.morgan@yahoo.com

Ottawa County Conservation District
630 East Steve Owens Boulevard, Suite 3
Miami, OK 74354-7800

Ottawa County Historical Society
(Dobson Museum)
110 A Street SW
Miami, OK 74354

Afton Public Works Authority
PO Box 250
Afton, OK 74331

City of Grove
104 West 3rd
Grove, OK 74344

Ketchum Public Works Authority
PO Box 958
Ketchum, OK 74349

Director Michele Bolton
Miami Area Chamber of Commerce
103 East Central Avenue, Suite 100
Miami, OK 74354
michele@miamiokchamber.com

Mayor Rudy Schultz
City of Miami
PO Box 1288
Miami, OK 74355
rschultz@miamiokla.net

Mr. Dean Kruithof
Acting City Manager
City of Miami
PO Box 1288
Miami, OK 74355
dean@miamiokla.net

Ms. Judy Francisco
City of Miami
PO Box 1288
Miami, OK 74355
jfrancisco@miamiokla.net

Mr. Ronnie Cline
City of Miami
PO Box 1288
Miami, OK 74355
rcline@miamiokla.net

Mr. Brian Forrester
Council Member
NE Ward 1
PO Box 1288
Miami, OK 74355-1288
bforrester@miamiokla.net

Mr. Doug Weston
Council Member
NE Ward 2
PO Box 1288
Miami, OK 74355-1288
dweston@miamiokla.net

Mr. Neal Johnson
Council Member
SW Ward 3
PO Box 1288
Miami, OK 74355-1288
njohnson@miamiokla.net

Distribution List

Ms. Vicki Lewis
Council Member
SE Ward 4
PO Box 1288
Miami, OK 74355-1288
vlewis@miamiokla.net

City of Ketchum PWA
PO Box 958
Ketchum, OK 74349

Town of Langley
PO Box 760
Langley, OK 74350

City of Vinita
PO Box 329
104 East Illinois Avenue
Vinita, OK 74301

City of Wyandotte
212 South Main
Wyandotte, OK 74370

RWD #3 Delaware County
PO Box 1228
Jay, OK 74346

Mayes County – Disney
PO Box 279
Disney, OK 74340

Cherokee Grove Golf at Carey Bay
519 Quail Run Road
Grove, OK 74344

Grand Bluffs Development
32922 Pebble Beach
Afton, OK 74331

Melody Point
2011 Quail Run Road
Grove, OK 74344

Shangri-La Management
310000 South Highway 125
Afton, OK 74331
Shoreline, LLC
PO Box 6586
Grove, OK 74344

Spinnaker Point HOA
450779 East 341 Road
Afton, OK 74331

Tera Miranda Shores Inc.
28251 South 561 Road
Monkey Island, OK 74331

The Honorable James Mountain Inhofe
United States Senate
205 Russell Senate Office Building
Washington DC 20515
Jennie_wright@inhofe.senate.gov

The Honorable James Lankford
United States Senate
B40C Dirksen Senate Office Building
Washington DC 20510
Jeff_underwood@lankford.senate.gov

The Honorable Jim Bridenstine
216 Cannon House Office Building
Washington DC 20515
Joseph.kaufman@mail.house.gov

The Honorable Markwayne Mullin
1113 Longworth House Office Building
Washington DC 20515
Debbie.dooley@mail.house.gov

The Honorable Frank Lucas
2405 Rayburn HOB
Washington DC 20515

The Honorable Charles Wyrick
Oklahoma State Senate
2300 N Lincoln Boulevard Room 522
Oklahoma City, OK 73105

The Honorable Wayne Shaw
Oklahoma State Senate
2300 N Lincoln Boulevard, Room 325
Oklahoma City, OK 73105

The Honorable Doug Cox
House of Representatives
2300 N Lincoln Boulevard, Room 410
Oklahoma City, OK 73105
dougcox@okhouse.gov

Distribution List

The Honorable Chuck Hoskin
House of Representatives
2300 North Lincoln Boulevard, Room 509
Oklahoma City, OK 73105

The Honorable Ben Sherrer
House of Representatives
2300 North Lincoln Boulevard, Room 500
Oklahoma City, OK 73105
bensherrer@okhouse.gov

The Honorable Marty Quinn
Oklahoma State Senate
2300 N Lincoln Boulevard, Room 528B
Oklahoma City, OK 73105
quinn@oksenate.gov

The Honorable Ben Loring
House of Representatives
2300 North Lincoln Boulevard
Oklahoma City, OK 73105
Ben.loring@okhouse.gov

The Honorable Mary Fallin
Governor of Oklahoma
2300 North Lincoln Boulevard, Suite 212
Oklahoma City, OK 73105

The University of Oklahoma
Office of the President
Evans Hall Room 110
660 Parrington Oval
Norman, OK 73109-3073

Oklahoma State University
Burns Hargis, President
107 Whitehurst
Stillwater, OK 74078

Northeastern State University
600 North Grand Avenue
Tahlequah, OK 74464

Northeastern Oklahoma A & M College
200 I Street NE
Miami, OK 74354

Rogers State University
1701 West Will Rogers Boulevard
Claremore, OK 74017

Miami Flood Mitigation Advisory Board
City of Miami
PO Box 1288
Miami, OK 74355-1288

Grand Seaplanes, LLC
5200 South Chestnut Avenue
Broken Arrow, OK 74011

Anglers in Action
PO Box 803
High Ridge, MO 63049

Two Mom's Campground
215 Construction Drive
Disney, OK 74340

Grand Lake Association & Visitor Center
9630 Highway 59 N, Suite B
Grove, OK 74344

Rusty Fleming
Executive Director
Grand Lakers United Enterprise
PO Box 1
Langley, OK 74350

South Grand Lake Area Chamber of Commerce
PO Box 215
Langley, OK 74350
grandlakechamber@gmail.com

Oklahoma Association of Realtors
9807 Broadway Ext
Oklahoma City, OK 73114-6312

Har-Ber Village
4404 West 20th Street
Grove, OK 74344

Shangri-La Marina
57151 East Highway 125
Afton, OK 74331

Cherokee Yacht Club Marina
PO Box 600
Ketchum, OK 74349

Port Carlos
PO Box 780
Ketchum, OK 74349

Distribution List

Arrowhead Yacht Club
PO Box 600
Ketchum, OK 74349

Clearwater Bay Marina
PO Box 219
Disney, OK 74340

Harbors View Marina
451107 East 320 Road
Afton, OK 74331

Thunder Bay Marina LLC
450780 Thunder Bay Road
Afton, OK 74331

Cedar Port Marina
PO Box 600
Ketchum, OK 74349

Tera Miranda Marina Resort
28251 South 561 Road
Monkey Island, OK 74331

Arrowhead Yacht Club South
PO Box 600
Ketchum, OK 74349

Honey Creek Landing Marina
2520 South Main Street
Grove, OK 74344

Willow Park Marina
PO Box 120
Ketchum, OK 74349

Southwinds Marina
PO Box 3977
Bernice, OK 74331

The Landings Marina
PO Box 61250
Oklahoma City, OK 73146

Hammerhead Marina
PO Box 600
Ketchum, OK 74349

Hammerhead Marina West
PO Box 600
Ketchum, OK 74349

Grand Lakeside Marina
11350 North Highway 59
Grove, OK 74344

Indian Hills Resort and Marina
PO Box 3747
Bernice, OK 74331

Hi-Lift Marina LLC
196 Private Road 138
Eucha, OK 74342

Dripping Springs Yacht Club
200 Dripping Springs Landing
Eucha, OK 74342

Grand Red Arrow Marina
453881 East 305 Road
Afton, OK 74331

Elk River Landing
1923 North Barrington Drive
Fayetteville, AR 72701

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

The Grand River Dam Authority (GRDA), with assistance from HDR Engineering, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Pensacola Hydroelectric Project ("Project"). Through the Federal Power Act (FPA), FERC is responsible for licensing and relicensing non-federal hydropower facilities throughout the United States. The FPA requires that all non-federal hydropower facilities, like GRDA's Pensacola Project, receive a new license to operate every 30 to 50 years. The relicensing process takes five (5) years minimum to complete, and formally begins with GRDA's distribution of a Notice of Intent (NOI) and Pre-Application Document (PAD).

The Project is located on the Grand River in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (see attached map). GRDA is preparing a PAD that provides FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project to help identify issues and related information needs, develop study requests and study plans related to the relicensing of the Project, and prepare documents analyzing the Project's potential effects and benefits. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in GRDA's possession.

1. Information about person completing the questionnaire:

Name & Title	
Organization	
Address	
Phone	
Email Address	

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

____ *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	
Organization	
Address	
Phone	
Email Address	

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	
Organization	
Address	
Phone	
Email Address	

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   __ Yes *(If yes, please complete 4a through 4d)*   __ No

   a. Please circle the specific resource area(s) that the information relates to:

      - Geology, topography and soils
      - Water resources
      - Fish and aquatic resources
      - Wildlife and botanical resources
      - Floodplains, wetlands, riparian, and littoral habitat
      - Rare, threatened, and endangered species
      - Recreation and land use
      - Aesthetic resources
      - Cultural resources
      - Tribal resources
      - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   c. Where can GRDA obtain this information?

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

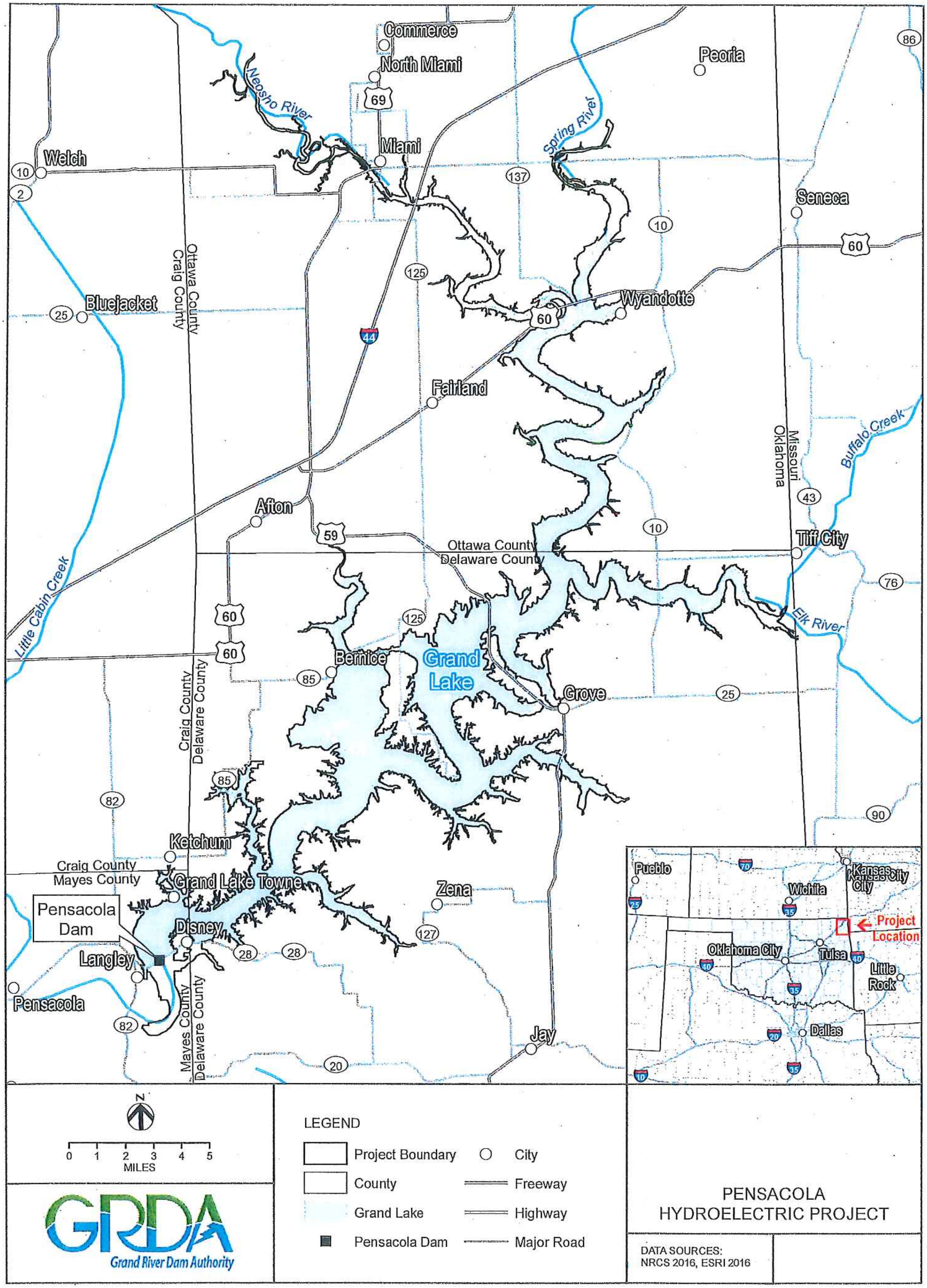
Name	
Address	
Phone	
Email Address	

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

If you have any questions regarding the Pensacola Project, or the upcoming FERC licensing processes, please contact Dr. Darrell Townsend at dtownsend@grda.com or via phone at 918-256-0616 or Ms. Jacklyn Jaggars at jjaggars@grda.com or via phone at 918-256-0723.

Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 30 days of receipt to allow for any follow-up contact by a GRDA or its representative that may be needed. Comments and/or questions about this questionnaire may also be sent via e-mail to: Jacklyn Jaggars at jjaggars@grda.com. Not responding within 30 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project's environment.



Commerce
North Miami
69
Peoria
86
Neosho River
Spring River
Miami
Welch
10
2
137
Seneca
10
60
125
Ottawa County
Craig County
Bluejacket
25
Wyandotte
60
44
Fairland
Missouri
Oklahoma
Buffalo Creek
43
Afton
10
59
Tiff City
Ottawa County
Delaware County
76
Little Cabin Creek
60
125
Elk River
60
Bernice
Grand Lake
85
Grove
25
Craig County
Delaware County
85
82
90
Ketchum
Craig County
Mayes County
Grand Lake Towne
Zena
Pensacola Dam
Disney
127
28
28
Langley
Pensacola
82
Mayes County
Delaware County
Jay
20
Pueblo
70
Kansas City
Wichita
25
35
Project Location
Oklahoma City
Tulsa
40
40
Little Rock
35
Dallas
20
10
35
N
0 1 2 3 4 5
MILES
LEGEND
Project Boundary
City
County
Freeway
Grand Lake
Highway
Pensacola Dam
Major Road
PENSACOLA HYDROELECTRIC PROJECT
DATA SOURCES:
NRCS 2016, ESRI 2016
Grand River Dam Authority

Hasler
09/19/2016
US POSTAGE
$00.49º
ZIP 74350
011D11642043

GRDA
Grand River Dam Authority
ECOSYSTEMS & EDUCATION CENTER
PO Box 70
Langley OK 74350

From: Jaggars, Jacklyn <jjaggars@grda.com>
Sent: Wednesday, September 21, 2016 12:24 PM
To: Andersen, Emily
Subject: FW: Relicensing pre-application
Attachments: PAD Questionnaire and Attachments.pdf

From: Jaggars, Jacklyn
Sent: Wednesday, September 21, 2016 2:23 PM
To: 'Fields, Cambra - NRCS, Vinita, OK' <Cambra.Fields@ok.usda.gov>
Subject: RE: Relicensing pre-application

Yes, please find it attached.

Let me know if there are any additional needs or questions.

Thanks in advance,
Jacklyn

From: Fields, Cambra - NRCS, Vinita, OK [mailto:Cambra.Fields@ok.usda.gov]
Sent: Wednesday, September 21, 2016 2:07 PM
To: Jaggars, Jacklyn <jjaggars@grda.com>
Subject: Relicensing pre-application

Jacklyn,

Is there a way you could send me this info over my email so I can forward it on to someone who could fill it out and send it back to you?

Thank you,

Cambra Fields
Vinita Field Office
918-256-6882 Ext. 3
235 West Hope
Vinita, OK 74301

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1. Information about person completing the questionnaire:

Name & Title	Doug Smith, Commissioner
Organization	Delaware County Dist #1
Address	2001 Industrial 10 Rd Grove, OK 74344
Phone	918-786-9774
Email Address	delcohwy@groveemail.com

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

X *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

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Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	
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Address	
Phone	
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   __ Yes *(If yes, please complete 4a through 4d)*   X No

   a. Please circle the specific resource area(s) that the information relates to:

   - Geology, topography and soils
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   - Tribal resources
   - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   c. Where can GRDA obtain this information?

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

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Phone	
Email Address	

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1. Information about person completing the questionnaire:

Name & Title	Judy Florida, General Manager
Organization	SHM Harbors View Marina
Address	451107 E 320 Rd Afton, OK 74331
Phone	918-782-3277 #3
Email Address	jflorida@shmarinas.com

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

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Name & Title	Judy Florida, General Manager
Organization	SHM Harbors View Marina
Address	451107 E. 320 Rd Afton, OK 74331
Phone	918-782-3277 #13
Email Address	jflorida@shmarinas.com

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	Jeff Rose, Regional Manager
Organization	Safe Harbor Marinas
Address	14785 Preston Rd, Suite 975 Dallas, Tx 75254
Phone	972-406-5229
Email Address	jrose@shmarinas.com

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Pensacola Hydroelectric Project (FERC No. 1494)
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   __ Yes *(If yes, please complete 4a through 4d)*   _✓_No

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1. Information about person completing the questionnaire:

Name & Title	Ted Peitz, owner
Organization	Southwinds Marina
Address	P.O. Box 3977 Bernice, OK 74331-3977
Phone	918.256.8650
Email Address	tpeitz@southwindsmarina.com

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

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Ecosystems & Lake Mgmt
GRDA

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1. Information about person completing the questionnaire:

Name & Title	James Paul Service Coordination Hydrologist
Organization	National Weather Service
Address	10159 East 11th Street, Suite 300 Tulsa OK 74128
Phone	918 832-4109
Email Address	James.Paul@noaa.gov

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

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GRDA

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Address	
Phone	
Email Address	

Name & Title	
Organization	
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Phone	
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Name & Title	
Organization	
Address	
Phone	
Email Address	

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   ✓ Yes *(If yes, please complete 4a through 4d)* __No

   a. Please circle the specific resource area(s) that the information relates to:

      - Geology, topography and soils
      - Water resources
      - Fish and aquatic resources
      - Wildlife and botanical resources
      - Floodplains, wetlands, riparian, and littoral habitat
      - Rare, threatened, and endangered species
      - Recreation and land use
      - Aesthetic resources
      - Cultural resources
      - Tribal resources
      - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

      Rainfall observations & estimates
      Rainfall forecasts
      Deterministic river forecasts
      Probabilistic river forecasts

   c. Where can GRDA obtain this information?

      National Weather Service
      Arkansas-Red Basin River Forecast Center
      918-832-4109
      http://www.weather.gov/abrfc

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	James Paul
Address	10159 East 11th Street Suite 300 Tulsa OK 74128
Phone	918 832 4109
Email Address	James.Paul@noaa.gov

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Ecosystems & Lake Mgmt
GRDA

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

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1. Information about person completing the questionnaire:

Name & Title	Cambra Fields, District Conservationist
Organization	USDA-NRCS
Address	235 W. Hope Ave Vinita, OK 74301
Phone	918-25-6882 Ext 3
Email Address	cambra.fields@ok.usda.gov

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

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   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

      soil related information.

   c. Where can GRDA obtain this information?

      http://websoilsurvey.nrcs.usda.gov/app/

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

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1. Information about person completing the questionnaire:

Name & Title	Joe Dan Morgan, Director Ottawa County Emergency Management	
Organization	Certified Floodplain Manager #OK-14-00023	
Address	123 East Central Ave., Suite 103 Miami, OK 74354-7080	
Phone	Office (918) 541-9391 Fax (918) 541-9391	
Email Address	Cell (918) 961-1676	

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Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

The Grand River Dam Authority (GRDA), with assistance from HDR Engineering, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Pensacola Hydroelectric Project ("Project"). Through the Federal Power Act (FPA), FERC is responsible for licensing and relicensing non-federal hydropower facilities throughout the United States. The FPA requires that all non-federal hydropower facilities, like GRDA's Pensacola Project, receive a new license to operate every 30 to 50 years. The relicensing process takes five (5) years minimum to complete, and formally begins with GRDA's distribution of a Notice of Intent (NOI) and Pre-Application Document (PAD).

The Project is located on the Grand River in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (see attached map). GRDA is preparing a PAD that provides FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project to help identify issues and related information needs, develop study requests and study plans related to the relicensing of the Project, and prepare documents analyzing the Project's potential effects and benefits. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in GRDA's possession.

1. Information about person completing the questionnaire:

Name & Title	Ted Peitz, owner
Organization	Southwinds Marina
Address	P.O. Box 3977 Bernice, OK 74331-3977
Phone	918.256.8650
Email Address	tpeitz@southwindsmarina.com

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

__X__ *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

RECEIVED
SEP 29 2016
Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

The Grand River Dam Authority (GRDA), with assistance from HDR Engineering, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Pensacola Hydroelectric Project ("Project"). Through the Federal Power Act (FPA), FERC is responsible for licensing and relicensing non-federal hydropower facilities throughout the United States. The FPA requires that all non-federal hydropower facilities, like GRDA's Pensacola Project, receive a new license to operate every 30 to 50 years. The relicensing process takes five (5) years minimum to complete, and formally begins with GRDA's distribution of a Notice of Intent (NOI) and Pre-Application Document (PAD).

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1. Information about person completing the questionnaire:

Name & Title	Melissa Shackford, Director of Land Protection
Organization	The Nature Conservancy
Address	408 NW 7th St. Oklahoma City, OK 73102
Phone	405-445-5049
Email Address	mshackford@tnc.org

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

√ *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

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GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	Jay Pruett, Director of Conservation
Organization	The Nature Conservancy
Address	10425 S. 82nd E. Ave., Ste 104 Tulsa, OK 73133
Phone	918-585-1117
Email Address	jpruett @ tnc.org

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	Jay Pruett, Director of Conservation
Organization	The Nature Conservancy
Address	(see above
Phone	
Email Address	

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SEP 29 2016
Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   ✓ Yes *(If yes, please complete 4a through 4d)* __ No

   a. Please circle the specific resource area(s) that the information relates to:

   - Geology, topography and soils
   - Water resources
   - Fish and aquatic resources
   - Wildlife and botanical resources
   - Floodplains, wetlands, riparian, and littoral habitat
   - Rare, threatened, and endangered species
   - Recreation and land use
   - Aesthetic resources
   - Cultural resources
   - Tribal resources
   - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   Status of Gray bat and Ozark Cavefish

   c. Where can GRDA obtain this information?

   Thru the USFWS in Tulsa

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	
Address	
Phone	
Email Address	

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SEP 29 2016
Ecosystems & Lake Mgmt
GRDA

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

GRDA
Grand River Dam Authority

September 30, 2016

Jay Pruett
Director of Conservation
The Nature Conservancy
10425 S 82nd E Avenue, Suite 104
Tulsa OK 73133

**Re: Pensacola Hydropower Project (FERC No. 1494)
Relicensing Pre-Application Document Questionnaire**

Dear Mr. Pruett:

Per Judy Florida's request, we are sending you the enclosed Pensacola Pre-Application Document Relicensing Questionnaire based on her response we received on September 29, 2016. The questionnaire was distributed on September 19, 2016. GRDA would appreciate receiving a response from you by October 20th, if possible.

If you have any questions, please contact me at 918-256-0723 or jjaggars@grda.com.

Sincerely,

Jacklyn Jaggars
Grand River Dam Authority

GRDA
Grand River Dam Authority

September 30, 2016

Jeff Rose
Regional Manager of Safe Harbor Marinas
14785 Preston Road, Suite 975
Dallas TX 75254

Re: Pensacola Hydropower Project (FERC No. 1494)
Relicensing Pre-Application Document Questionnaire

Dear Mr. Rose:

Per Judy Florida's request, we are sending you the enclosed Pensacola Pre-Application Document Relicensing Questionnaire based on her response we received on September 29, 2016. The questionnaire was distributed on September 19, 2016. GRDA would appreciate receiving a response from you by October 20th, if possible.

If you have any questions, please contact me at 918-256-0723 or jjaggars@grda.com.

Sincerely,

Jacklyn Jaggars
Grand River Dam Authority

Jaggars, Jacklyn

From: Jaggars, Jacklyn
Sent: Monday, October 03, 2016 9:30 AM
To: 'Bill Keefer'
Subject: RE: Re Licensing Questionnaire

Yes, we likely already have any information the City of Grove could provide. However, if something comes up, I'll let you know. Yes, please submit the paperwork when complete.

Thanks,
Jacklyn

From: Bill Keefer [mailto:wmkeefer@sbcglobal.net]
Sent: Monday, October 03, 2016 8:52 AM
To: Jaggars, Jacklyn <jjaggars@grda.com>
Subject: Re Licensing Questionnaire

Jacklyn: Looking at correspondence regarding relicensing for the Pensacola Project. Under question 4, it references specific resource areas? Is there specific information that the City of Grove provide for GRDA under this process within those categories? I would imagine that anything we have, GRDA already has? We want to be kept on the mailing list and will send in paperwork.

Thanks.

Bill Keefer
City Manager
City of Grove
(918) 786-6107
wmkeefer@sbcglobal.net

Jaggars, Jacklyn

From:	Jaggars, Jacklyn
Sent:	Tuesday, October 04, 2016 12:15 PM
To:	'IMRextrev, NPS'
Subject:	RE: Pensacola Hydropower Project (FERC No. 1494)
Attachments:	PAD Questionnaire and Attachments.pdf

Good afternoon,

In response to the email correspondence below, please find attached the Pre-Application Document (PAD) Relicensing Questionnaire for the Pensacola Project. If you have any questions, please let me know.

Thank you,
Jacklyn

From: david_hurd@nps.gov [mailto:david_hurd@nps.gov] **On Behalf Of** IMRextrev, NPS
Sent: Tuesday, October 04, 2016 9:46 AM
To: Jaggars, Jacklyn <jjaggars@grda.com>; Townsend, Darrell <dtownsend@grda.com>
Subject: Pensacola Hydropower Project (FERC No. 1494)

To Whom It May Concern:

Our office recently received from you a project for review (Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma). For projects requiring environmental compliance review by the Intermountain Region of the National Park Service in the states of Arizona, Colorado, Montana, New Mexico, Oklahoma, Texas, Utah, or Wyoming, we respectfully request that you do not send hard copy correspondence. Instead, please send electroniccorrespondence to:

IMRextrev@nps.gov

Using this e-mail address for all external review correspondence will facilitate quicker response times on our part and also help eliminate paper waste. To further expedite this process, please also include the county and state of your project.

We appreciate the opportunity to review and comment on your project, and look forward to your electronic submission before processing this request.

Sincerely,

National Park Service
Intermountain Region External Review Team
Serving MT, UT, WY, CO, AZ, NM, OK, TX
imrextrev@nps.gov

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

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1. Information about person completing the questionnaire:

Name & Title	William M Keefer City MANAGER
Organization	City of Grove
Address	104 W 3RD street Grove, OK 74344
Phone	(918) 786-6107
Email Address	wmkeefer@sbcglobal.net

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

X *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	Debbie Bottoroff, Asst. City Mgr
Organization	City of Grove
Address	104 W 3RD Grove, OK 74344
Phone	918 786-6107
Email Address	dbottoroff@sbcglobal.net

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	
Organization	
Address	
Phone	
Email Address	

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Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   __ Yes *(If yes, please complete 4a through 4d)*   __ No

   a. Please circle the specific resource area(s) that the information relates to:

      - Geology, topography and soils
      - Water resources
      - Fish and aquatic resources
      - Wildlife and botanical resources
      - Floodplains, wetlands, riparian, and littoral habitat
      - Rare, threatened, and endangered species
      - Recreation and land use
      - Aesthetic resources
      - Cultural resources
      - Tribal resources
      - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   c. Where can GRDA obtain this information?

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	
Address	
Phone	
Email Address	

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

Jaggars, Jacklyn

From:	Brooks Tramell <Brooks.Tramell@Conservation.ok.gov>
Sent:	Wednesday, October 05, 2016 1:16 PM
To:	Jaggars, Jacklyn
Subject:	Pensacola Hydropower Project (FERC No. 1494) Relicensing Questionnaire
Attachments:	20161005131731952.pdf

Hi Jacklyn,

I have completed the questionnaire on behalf of the Oklahoma Conservation Commission, scanned and attached it to this email. Please let me know if you have any questions or need any additional information.

Thanks,

Brooks

Brooks Tramell
Oklahoma Conservation Commission
4545 N Lincoln Blvd, Ste 11A
Oklahoma City, OK 73105
brooks.tramell@conservation.ok.gov
(405)522-6908

OKLAHOMA CONSERVATION COMMISSION

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

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1. Information about person completing the questionnaire:

Name & Title	Brooks Tramell, Director of Monitoring, Assessment, and Wetlands Programs
Organization	Oklahoma Conservation Commission
Address	2800 North Lincoln Blvd, Suite 160 Oklahoma City, OK 73015
Phone	405-522-6908
Email Address	brooks.tramell@conservation.ok.gov

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

X *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	
Organization	
Address	
Phone	
Email Address	

Name & Title	
Organization	
Address	
Phone	
Email Address	

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Name & Title	
Organization	
Address	
Phone	
Email Address	

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   X Yes *(If yes, please complete 4a through 4d)* ___ No

   a. Please circle the specific resource area(s) that the information relates to:

      - Geology, topography and soils
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      - Fish and aquatic resources
      - Wildlife and botanical resources
      - Floodplains, wetlands, riparian, and littoral habitat
      - Rare, threatened, and endangered species
      - Recreation and land use
      - Aesthetic resources
      - Cultural resources
      - Tribal resources
      - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

      See attachment

   c. Where can GRDA obtain this information?

      See attachment

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	
Address	
Phone	
Email Address	

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

Question 4b:

OCC has historical watershed assessment stream monitoring data including typical water quality, biological (fish and aquatic macroinvertebrate), and instream habitat assessment. This data has been collected through various projects from the late 1980's through 2016. This data is from some of the smaller tributaries including: Sycamore Creek, Lost Creek, Brush Creek, Horse Creek, Little Horse Creek, Tar Creek, Fivemile Creek, Little Fivemile Creek, Drowning Creek, Warren Branch, Honey Creek, Cave Springs Branch, and potentially additional stream sites. Within these data, occasional occurrences of rare or threatened species are documented.

Various watershed studies, plans, and/or reports have been completed through the last 20 years. These include a Grand Lake Watershed Based Plan (Draft), an alluvial floodplain study, and Water Quality Priority Watershed Project reports. Portions of these reports contain general land use information. These reports can be found at https://www.ok.gov/conservation/Agency_Divisions/Water_Quality_Division/WQ_Reports/WQ_Reports_Projects/WQ_Project_Reports_by_Watershed_.html

and

https://www.ok.gov/conservation/Agency_Divisions/Water_Quality_Division/WQ_Projects/

Question 4c:

Specific data can be requested from OCC's Data Record Manager, Karla Spinner by email at karla.spinner@conservation.ok.gov.

In addition, much of the more recent data are summarized in reports which can be found on the OCC website at https://www.ok.gov/conservation/Agency_Divisions/Water_Quality_Division/WQ_Monitoring/WQ_Assessment_Rotating_Basin_Monitoring_Program.html.

Please see the answer for question 4b for information to access additional reports on the Grand Lake Watershed.

Pensacola Hydroelectric Project (FERC No. 1494)
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1. Information about person completing the questionnaire:

Name & Title	Keith W. Martin Dean, Professor of Biology
Organization	Rogers State University
Address	1701 W. Will Rogers Claremore, OK 74017
Phone	918-343-7706
Email Address	Kmartin@rsu.edu

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

✓ *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

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OCT 05 2016
Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	same as above
Organization	
Address	
Phone	
Email Address	

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	
Organization	
Address	
Phone	
Email Address	

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   ✓ Yes *(If yes, please complete 4a through 4d)* ___No

   a. Please circle the specific resource area(s) that the information relates to:

   - Geology, topography and soils
   - Water resources
   - Fish and aquatic resources
   - Wildlife and botanical resources
   - Floodplains, wetlands, riparian, and littoral habitat
   - Rare, threatened, and endangered species
   - Recreation and land use
   - Aesthetic resources
   - Cultural resources
   - Tribal resources
   - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   1) Periodic reports generated via Interagency Agreements between GRDA and Rogers State University.
   2) Past reports to the ODWC & USFWS regarding imperiled cave fauna.

   c. Where can GRDA obtain this information?

   Rogers State University, USFWS Reg. 6 office in Tulsa, OK, & the Oklahoma Dept. of Wildlife Conservation

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	K. Martin
Address	same as above
Phone	
Email Address	

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

Pensacola Hydroelectric Project (FERC No. 1494)
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1. Information about person completing the questionnaire:

Name & Title	ROBERT STEINKIRCHNER MANAGER
Organization	SPINNAKER POINT ESTATES
Address	450779 E. 341 ROAD AFTON OK. 74331
Phone	918. 782-2169
Email Address	spinnptmgr@aol.com

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

X *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

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Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	ERIC GRIMSHAW
Organization	SPINNAKER POINT ESTATES
Address	2639 EAST 33rd PL. TULSA, OK. 74105
Phone	918 · 625 - 3807
Email Address	egrimshaw@oneok.com

Name & Title	
Organization	
Address	
Phone	
Email Address	

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   __ Yes *(If yes, please complete 4a through 4d)*   X No

   a. Please circle the specific resource area(s) that the information relates to:

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      - Aesthetic resources
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      - Tribal resources
      - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   c. Where can GRDA obtain this information?

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	
Address	
Phone	
Email Address	

RECEIVED
OCT 05 2016
Ecosystems & Lake Mgmt
GRDA

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

From: karen pritchett [mailto:kpritchett@ukb-nsn.gov]
Sent: Wednesday, October 12, 2016 2:51 PM
To: Townsend, Darrell <dtownsend@grda.com>; Jaggars, Jacklyn <jjaggars@grda.com>
Cc: cwood@okhistory.org; Eric Oosahwee-Voss <eoosahwee-voss@ukb-nsn.gov>; karen pritchett <kpritchett@ukb-nsn.gov>
Subject: Pensacola Hydropower Project (FERC No. 1494) Relicensing Pre-Applicatin Document Questionnaire

Dear Darrell,

On behalf of Tribal Historic Preservation Officer (THPO) Eric Oosahwee-Voss, please accept this digital communication regarding Pensacola Hydropower Project (FERC No. 1494) Relicensing Pre-Application Document Questionnaire.

Please be advised that the proposed undertaking lies within the traditional territory of the United Keetoowah Band of Cherokee Indians in Oklahoma (UKB). This opinion is being provided by UKB THPO, pursuant to authority vested by the UKB Corporate Board and under resolution 16-UKB-34. The United Keetoowah Band is a Federally Recognized Indian Nation headquartered in Tahlequah, OK.

Information on Native American use in the project vicinity shows that prehistoric, ethnographic, historic, and traditional sites of value to the UKB surround the project area. We intend to be part of the relicensing process and recommend Phase I survey of all GRDA managed lands in the area of potential effects.

Thank you for consulting with the UKB. Please note that these comments are based on information available to us at the time of the project review. We reserve the right to revise our comments as information becomes available. If you have any questions or concerns, please contact me at (918) 458-6715 or kpritchett@unitedkeetoowahband.org or THPO Eric Oosahwee-Voss at (918) 458-6717 or eoosahwee-voss@unitedkeetoowahband.org.

UKB#	U16-751 16.0777

Thank you,
Karen Pritchett
THPO Assistant
Tribal Historic Preservation Office
United Keetoowah Band of Cherokee Indians in Oklahoma
P. O. Box 1245
Tahlequah, OK 74465
918-458-6715

EASTERN SHAWNEE TRIBE
OF OKLAHOMA
12755 S. 705 Road, Wyandotte, OK 74370
Bluejacket Building (918) 666-2435, Fax: 888-971-3905

RECEIVED
OCT 13 2016
Ecosystems & Lake Mgmt
GRDA

October 3, 2016

Subject: **Pensacola Hydropower Project**

The Eastern Shawnee Tribe of Oklahoma is opposed to GRDA's relicensing request to the Federal Energy Regulatory Commission (FERC) for the following reasons;

In 1832 the Mixed Band of Indians now known as the Eastern Shawnee and Seneca Cayuga Tribes were the first to be forcibly removed from Ohio and marched to the northeast section of Indian Territory, now known as Ottawa County and a portion of Delaware County. In that first Trail of Tears, more than 20% died. For the Eastern Shawnee the devastation continued beyond initial loss of life as our total enrolment plummeted to fewer than 70 in the late 1800's. That significant loss of people took its toll. Gone was our language. Gone was the knowledge of how, when, where and why we received our English names. Consequently gone was our history. Gone were our ceremonials as we did not have sufficient numbers to conduct those ceremonials. Our Native American cultural lives were in a state of dormancy until about 1990 when we resolved to reawaken and reactivate our culture.

The first step was to build our own powwow grounds on lands the government gave us in 1939 consisting of 58.19 acres, land that has become sacred to us and becomes more so with each passing year. These powwow grounds provided us the place to begin our healing. This year we celebrated our 25th powwow, an actual modern example of the mythical phoenix rising from its ashes. Now this sacred site becomes more and more endangered because of already frequent flooding and the possibility of increasing the likelihood of more floods.

Also endangered are other sacred, cultural sites including Calamus Pond, a Shawnee Cemetery dating back to 1832 as well as the site of Shawnee National Farm dating back to the late 1800's and currently a proposed economic development site.

Our financial stability is furthered threatened because Bordertown Casino is located at the edge of this 58.19 acre site where the floodwaters threaten our generators and at times makes our property inaccessible due to flooding of roads. Once again the possibility of increasing the likelihood of those floods endangers our financial stability.

Consider also the community ball fields adjoining our property. At least six community ball fields are contiguous with our land, one of them being the official ball field of Seneca High School where their official conference district softball /baseball games and tournaments are held. These fields have been decimated far too often due to floods and with education cutbacks, funds to recreate the high school fields imposes a greater and greater financial burden upon the school and the not-for-profit athletic associations. The possibility of increasing the likelihood of those floods threatens the essence of our community spirit and viability. To relocate this complex with all of its fields and amenities would cost approximately 2 million dollars, money we don't have and they don't either.

Additionally, we have citizens who live throughout Ottawa County who are affected in myriad ways by repeated flooding. They lose their personal homes; their rental residences are left inhabitable; they can't get to work jeopardizing their jobs and livelihood; they can't get to our health clinics due to low lying flooded lands; they can't access tribal services due to inaccessible flooded roads, etc. I implore you to reconsider before making decisions that will increase the likelihood of additional flooding and produce such negative outcomes. The cost in human spirit, impact implications, cultural destruction, financial costs and possible loss of human life is simply unacceptable.

Finally, the Eastern Shawnee Tribe is located on the East side of Spring River, a river whose impact on flooding in the Miami area water basin is unknown because it has never been studied, never analyzed. How do we know what the impact of increased lake levels will be?
The current level which produces backwash is perilous. Increasing levels without data is asinine.

For these reasons, the Eastern Shawnee Tribe of Oklahoma opposes GRDA's permanent relicensing request to FERC to raise water levels.

Respectfully,

Glenna J. Wallace

Glenna J. Wallace, Chief
Eastern Shawnee Tribe of Oklahoma

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OCT 13 2016
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GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

The Grand River Dam Authority (GRDA), with assistance from HDR Engineering, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Pensacola Hydroelectric Project ("Project"). Through the Federal Power Act (FPA), FERC is responsible for licensing and relicensing non-federal hydropower facilities throughout the United States. The FPA requires that all non-federal hydropower facilities, like GRDA's Pensacola Project, receive a new license to operate every 30 to 50 years. The relicensing process takes five (5) years minimum to complete, and formally begins with GRDA's distribution of a Notice of Intent (NOI) and Pre-Application Document (PAD).

The Project is located on the Grand River in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (see attached map). GRDA is preparing a PAD that provides FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project to help identify issues and related information needs, develop study requests and study plans related to the relicensing of the Project, and prepare documents analyzing the Project's potential effects and benefits. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in GRDA's possession.

1. Information about person completing the questionnaire:

Name & Title	Glenna J. Wallace, Chief
Organization	Eastern Shawnee Tribe of Oklahoma
Address	12755 South 705 Road Wyandotte, OK 74370
Phone	918-666-2435 x 1820
Email Address	gjwallace@estoo.net

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

✓ *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	Chad Kelly, Tribal Administrator
Organization	Eastern Shawnee Tribe of OK.
Address	10080 South Bluejacket Road Wyandotte, OK 74370
Phone	918-666-5151
Email Address	ckelly@estoo.net

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	
Organization	
Address	
Phone	
Email Address	

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GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   __ Yes *(If yes, please complete 4a through 4d)* __ No

   a. Please circle the specific resource area(s) that the information relates to:

      - Geology, topography and soils
      - Water resources
      - Fish and aquatic resources
      - Wildlife and botanical resources
      - Floodplains, wetlands, riparian, and littoral habitat
      - Rare, threatened, and endangered species
      - Recreation and land use
      - Aesthetic resources
      - Cultural resources
      - Tribal resources
      - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   c. Where can GRDA obtain this information?

      Listed in letter of objection

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	
Address	
Phone	
Email Address	

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GRDA

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

If you have any questions regarding the Pensacola Project, or the upcoming FERC licensing processes, please contact Dr. Darrell Townsend at dtownsend@grda.com or via phone at 918-256-0616 or Ms. Jacklyn Jaggars at jjaggars@grda.com or via phone at 918-256-0723.

Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 30 days of receipt to allow for any follow-up contact by a GRDA or its representative that may be needed. Comments and/or questions about this questionnaire may also be sent via e-mail to: Jacklyn Jaggars at jjaggars@grda.com. Not responding within 30 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project's environment.

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

The Grand River Dam Authority (GRDA), with assistance from HDR Engineering, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Pensacola Hydroelectric Project ("Project"). Through the Federal Power Act (FPA), FERC is responsible for licensing and relicensing non-federal hydropower facilities throughout the United States. The FPA requires that all non-federal hydropower facilities, like GRDA's Pensacola Project, receive a new license to operate every 30 to 50 years. The relicensing process takes five (5) years minimum to complete, and formally begins with GRDA's distribution of a Notice of Intent (NOI) and Pre-Application Document (PAD).

The Project is located on the Grand River in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (see attached map). GRDA is preparing a PAD that provides FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project to help identify issues and related information needs, develop study requests and study plans related to the relicensing of the Project, and prepare documents analyzing the Project's potential effects and benefits. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in GRDA's possession.

1. Information about person completing the questionnaire:

Name & Title	Josh Johnston - Regional Supervisor Fisheries
Organization	OK. Dept. of Wildlife Conservation
Address	PO Box 1201 Jenks, OK 74037
Phone	(918) 299-2334
Email Address	Josh.Johnston@odwc.ok.gov

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

X *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

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Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	BRAD JOHNSTON - FISHERIES Biologist
Organization	ODWC
Address	61091 EAST 120 ROAD MIAMI, OK 74354
Phone	(918) 542-9422
Email Address	BRAD.Johnston@odwc.ok.gov

Name & Title	KEN CUNNINGHAM - ASSISTANT CHIEF OF FISHERIES
Organization	ODWC
Address	2145 NE 36TH St. OKC, OK 73111
Phone	(405) 521-4606
Email Address	KENNETH.CUNNINGHAM@ODWC.OK.gov

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	Josh RICHARDSON - WILDLIFE Biologist
Organization	ODWC
Address	7201 E. 33RD St. ARCADIA, OK 73007
Phone	(405) 590-2585
Email Address	Josh.RICHARDSON@ODWC.OK.gov

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GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   X Yes *(If yes, please complete 4a through 4d)* __ No

   a. Please circle the specific resource area(s) that the information relates to:

   - Geology, topography and soils
   - Water resources
   - Fish and aquatic resources
   - Wildlife and botanical resources
   - Floodplains, wetlands, riparian, and littoral habitat
   - Rare, threatened, and endangered species
   - Recreation and land use
   - Aesthetic resources
   - Cultural resources
   - Tribal resources
   - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   ODWC MANAGES THE FISH + WILDLIFE WITHIN THE PROJECT AREA. WE ALSO COOPERATE WITH CONSTITUENTS AND CITY/COUNTY ENTITIES ON PROJECTS TO EXPAND BOATING AND FISH ACCESS, AND HAVE PROJECTS IN THE AREA. WE KEEP DATA PERTAINING TO FISH + WILDLIFE POPULATIONS

   c. Where can GRDA obtain this information?

   CALL OR EMAIL ONE OF US.

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	
Address	
Phone	
Email Address	

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

GRDA
Grand River Dam Authority

October 14, 2016

Josh Richardson
Wildlife Biologist
OK Dept of Wildlife Conservation
7201 E 33rd Street
Arcadia OK 73007

Re: Pensacola Hydropower Project (FERC No. 1494)
Relicensing Pre-Application Document Questionnaire

Dear Mr. Richardson:

Per Josh Johnston's request, we are sending you the enclosed Pensacola Pre-Application Document Relicensing Questionnaire based on his response we received on October 13, 2016. The questionnaire was distributed on September 19, 2016. GRDA would appreciate receiving a response from you by October 20th, if possible.

If you have any questions, please contact me at 918-256-0723 or jjaggars@grda.com.

Sincerely,

Jacklyn Jaggars
Grand River Dam Authority

From: Dean Kruithof [mailto:dean@miamiokla.net]
Sent: Monday, October 17, 2016 9:18 AM
To: Townsend, Darrell <dtownsend@grda.com>; Jaggars, Jacklyn <jjaggars@grda.com>
Subject: Pensacola Hydropower Project (FERC No. 1494) Relicensing Pre-Application Document Questionnaire

Darrell & Jacklyn,

It should not come as a surprise that the City of Miami has numerous items that should be included in the Pre-Application Document (PAD). As the GRDA questionnaire form is not conducive to the volume of information in question, we have opted to send the attached letter in its place. A hard copy of this is being sent today. Please list me as the representative contact for the City of Miami. A confirmation of receipt would also be appreciated.

- Dean

Dean Kruithof

City Manager
P.O. Box 1288
129 5th Avenue NW
Miami, OK 74355-1228
918-541-2203 - Office
dean@miamiokla.net

MIAMI
City of Vision, Spirit & Opportunity

Mayor Rudy Schultz
Councilmember Brian Forrester, Ward 1
Councilmember Doug Weston, Ward 2
Councilmember Neal Johnson, Ward 3
Councilmember Vicki Lewis, Ward 4

Dean Kruithof, City Manager
Ben Loring, City Attorney

October 17, 2016

Darrell Townsend, II, Ph.D.
Assistant General Manager
Ecosystems and Lake Management
Grand River Dam Authority
PO Box 70
Langley, OK 74350-0070

Re: Pensacola Hydropower Project (FERC No. 1494) Relicensing Pre-Application Document Questionnaire

Dear Darrell:

The City of Miami is in receipt of GRDA's Pensacola Hydropower Project Relicensing Pre-Application Document Questionnaire, dated on September 19, 2016 ("Questionnaire"). This response is sent on behalf of: Mayor Rudy Schultz; Council Members Neal Johnson, Doug Weston, Brian Forrester, and Vicki Lewis; the Miami Flood Mitigation Advisory Board; Emergency Director Glenda Longan; and myself (note that your mailing list incorrectly has "acting" in my title). Also, be aware, that Ronnie Cline and Judy Francisco have recently retired from the City. They should be replaced with Fire Chief Robert Wright and Administrative Assistant to the City Manager Amber Prewett. Finally, from the City, please add Police Chief Thomas Anderson and Public Works Director Alicia Hogan. Chief Anderson will be assuming Emergency Operations responsibility for the City of Miami when Glenda Longan retires at the end of this year.

This letter constitutes the City's response to the Questionnaire. Due to GRDA's unreasonably short requested response time (30 days), the City herby reserves the right to supplement this response at a later time. As you are aware, the City of Miami and many residents in and around the City have voiced substantial concerns over the last 20 years with the operation of the Pensacola Project. In fact, as of the date of this letter, the City has been forced to close State Highway 125 near the Miami Fairgrounds due to high water. This marks the third time that its closure has been necessary since I assumed the position of City Manager slightly less than two years ago.

According to the Federal Emergency Management Agency's ("FEMA's") NFIP Policy and Claims Report since 1978 up until December 10, 2015, Ottawa County property owners, including the

City of Miami, have had 1,084 flood damage claims, 832 of these being Miami residents. Paid claims for Miami total $19,470,409, add in the rest of Ottawa County and the total is $26,823,321 in paid claims.

Prior to the 2007 flood of record, the City had mitigated approximately 20 properties through the Hazard Mitigation Plan grant process. Beginning in 2006 the City submitted federal grant applications to programs such as the Severe Repetitive Loss and Repetitive Flood Claims. Through various FEMA grant funding another 35 properties were acquired and demolished. However, there are many properties remaining that should be removed from flood prone areas. Eligibility requirements are often difficult to meet and residents must maintain flood insurance. Due to continued flooding issues, the community is slow to recover. Often during flooding events, State Highway 125 at Riverview Park becomes impassable, (more than 30 times since the Pensacola Dam was built). Even locations that are accessible during flooding events have become difficult to develop, due to major roads being impassable caused by flood waters.

With respect to the fourth question of the Questionnaire, relevant items that should be contained in the Pre-Application Document include, but are not limited to, the following:

All Tetra Tech Studies Which Have Previously Been Provided to GRDA

The Tetra Tech studies clearly show that, while the recent rule curve change probably has minimal incremental effect on flooding in Miami, the presence and operation of the Pensacola Dam and Grand Lake significantly increase flood levels. The Tetra Tech studies, as well as other studies (USACE, 1998; Holly, 2001), concluded that the current flood easements are seriously inadequate to protect Miami from flooding caused by the reservoir, a fact that has been well-known to all parties for decades.

A Summary of GRDA Efforts to Increase Reservoir Elevations Without Comprehensive Flood Routing Studies and Without Acquiring Adequate Easements

- FERC Issues Relicensing Order (April 24, 1992).
  - The Commission discusses the historic changes to flood pool elevations. The Order, while accepting the new rule curve, did note that since 1982, as a result of operating to meet the new rule curve, the frequency and magnitude of flood events (i.e., water level exceeding 745 feet PD) increased markedly.
- FERC Issues Order Amending Rule Curve (December 3, 1996).
  - Order acknowledges historical flooding upstream of the project and references the Grand/Neosho River Committee's efforts to study the effects of flooding.
  - The Order adopts a revised rule curve to provide lower elevation during portion of spring and summer period. However, the Commission acknowledges that the full extent of impacts on upstream flooding will not

be available until the Corps of Engineers completes studies authorized by Congress. These studies were never completed.

- GRDA files Application to Amend Rule Curve to Keep it at 744 ft. PD Year Round (January 26, 2004).
- FERC Issues Letter Notifying GRDA that its Application was Deficient (March 16, 2004).
    - Deficiencies identified by FERC included the failure to consult with resource agencies and the failure to include the results of consultation with the Corps regarding reservoir levels, water storage, and flooding issues.
- FERC Issues Letter Notifying Parties that GRDA Withdrew its Application (July 13, 2004).
    - This letter notes that GRDA failed to consult with the City of Miami and the Miami Indian Tribe due to "clerical errors." After meeting with them and learning of their opposition to the amendment, GRDA withdrew its application.
- GRDA Files Request for Temporary Rule Curve Variance Due to Drought Conditions (March 13, 2006).
- FERC Issues Letter Notifying GRDA that Request for Variance is Denied (April 4, 2006).
- City of Miami Letter to FERC Regarding GRDA's Acquisition of Flowage Easements (October 10, 2006).
    - In this letter, the City informs FERC that GRDA has failed to obtain the easements necessary or appropriate for the construction, maintenance, and operation of the project in violation of its license. In addition, GRDA notifies the Commission that both state and federal courts have agreed with the City and found GRDA liable for upstream flooding. Further, the City requests a meeting with FERC to discuss what measures FERC can undertake in order to bring GRDA in compliance with its license, such as requiring the purchase of flowage easements or modifying the operations of the project.
- City of Miami Letter to FERC Regarding GRDA's Acquisition of Flowage Easements (October 15, 2008).
    - In this letter, the City corrects the record that despite certain cryptic statements made by GRDA regarding the commencement of "flood land acquisition," GRDA had indeed failed to contact the City or homeowners

located on flood impacted lands. The City requested that FERC require GRDA to delineate its contact with the City in future reports to FERC.

- GRDA Files Request for Temporary Amendment (April 6, 2011).
- Larry Bork Letter to FERC Opposing Rule Curve Change (April 21, 2011).
- City of Miami Protest of Rule Curve Change (April 27, 2011).
- FERC Letter in Response to GRDA Application for Rule Curve Variance (May 23, 2011).
    - The letter required GRDA to submit a plan and schedule for conducting a flood routing study that evaluates the effects of raising the reservoir elevation on dam safety and operation of the project including spillway adequacy and the impacts on upstream and downstream flooding.
- FERC Issues Letter Dismissing GRDA's Application for a Variance (July 25, 2011).
    - FERC dismissed GRDA's request for a variance because GRDA failed to conduct a flood routing study. Absent such study, the Commission staff concluded that it could analyze the developmental and environmental effects of GRDA's application.
- FERC Letter of July 5, 2012 in Response to Draft GRDA Application for Variance of June 20, 2012.
    - As in the prior year, the Commission noted the absence of a flood routing study and asked that GRDA submit one. FERC staff also noted that GRDA did not give staff sufficient time to act on a final application.
- City of Miami Files Comments on Draft Application (July 6, 2012).
    - In this letter, City states that GRDA has failed to consult with the U.S. Army Corps of Engineers to complete a flood routing study required to justify changes in lake management.
- GRDA Submits Request for Variance (July 24, 2102).
- FERC Issues Order Granting Temporary Variance (August 15, 2012).
    - Order makes it clear the Commission would not have considered any proposal to deviate from the rule curve absent severe drought conditions that were occurring that year.
- City of Miami Letter to FERC Requesting a Meeting with FERC over GRDA License Violations and Certain Misrepresentations (March 5, 2013).

- This letter informs FERC that GRDA falsely claimed that it did not receive comments in connection with a draft Amendment to the Systems Operator and Training Manual. The City did indeed provide comments on how GRDA and the Corps could actually change operations to minimize the risk of flooding. GRDA claimed that the amendment would mitigate flood risk when, in fact, it did not.

- This letter also reminds FERC of GRDA's outstanding failure to undertake necessary land acquisitions (i.e. flowage easements). The City provided a historical background dating back to 1947, and continued for decades, where the Corps concluded that an additional 11,750 acres of easements are necessary "for flood operations of Pensacola Reservoir." The City stated that the Corps was considering undertaking another study.

- GRDA Request for Temporary Variance (March 20, 2013).
- Miami Special Utility Authority (MSUA) Filed an Opposition to Request (March 27, 2013).
- City of Miami Letter Opposing Variance with Timeline (March 28, 2013).
- City of Miami Letter Reply to GRDA Response re Inadequate Easements Letter (April 19, 2013).
- City of Miami and MSUA Intervention and Opposition (May 31, 2013).
- Larry Bork, on Behalf of 445 Citizens and Businesses of Ottawa County, OK, Letter to FERC Opposing Variance (May 31, 2013).
- FERC Issues Order Denying Request for Variance (July 3, 2013).
- GRDA Files Motion for Reconsideration (July 19, 2013).
- City of Miami and MSUA Letter with Supplemental Information and Opposition to Reconsideration (August 1, 2013).
- FERC Issues Order Denying Request for Reconsideration (August 2, 2013).
- GRDA Request for Temporary Variance (May 28, 2015).
- FERC Issues Letter Denying Request for Variance (June 26, 2015).
    - FERC's letter emphasized that the rule curve analysis GRDA supplied, a master's thesis, was deficient because it failed to include "elements necessary for Commission staff to evaluate the proposed rule curve's effect on water surface elevations during storm events." Commission staff commented that GRDA needed to perform a "more robust" flood routing

analysis and respond to the technical comments that the City of Miami submitted.

- GRDA Request for Temporary Variance (July 30, 2015).
- City of Miami Motion to Intervene and Opposition (August 5, 2015).
- FERC Issues Order Approving Request for Variance (August 14, 2015).
- City of Miami Letter Requesting Documents Referenced in FERC's Independent Analysis Cited in Order (August 21, 2015).
- FERC Releases its Independent Analysis (August 31, 2015).
- Technical Conference Regarding Hydrologic Modeling Needs for Anticipated Rule Curve Amendment (December 16, 2015) and Related Supplemental Information Filed February 16, 2016.
- GRDA Prepares Draft Application for License Amendment and Possible Temporary Variance (March 15, 2016).
- City of Miami Comments on GRDA's Draft Application for License Amendment (April 12, 2016) (included in Appendix 17 to GRDA's Application).
- Larry Bork, on Behalf of 493 Citizens and Businesses of Ottawa County, OK, Letter to FERC in Opposition (April 14, 2016).
- GRDA Files Final Application for License Amendment and Possible Temporary Variance (May 6, 2016).
- City of Miami Motion to Intervene and Protest (July 22, 2016).
- City of Miami Submits Hydraulic Models from Tetra Tech Studies (July 22, 2016).
- FERC Issues Order Approving Temporary Variance (August 12, 2016).

Information Related to all Legal Actions Related to Neosho River Flooding

Initial Litigation

- September 23, 1994: *Dalrymple, et al., v. Grand River Dam Authority*, (118 plaintiffs) is Filed in Ottawa County District Court for Inverse Condemnation, Trespass, Strict Liability, Nuisance and Consequential Damage to Private Property for Public Use. Case No. CJ-94-444.
- October 14, 1994: GRDA Files a Notice of Removal in the United States District Court for the Northern District of Oklahoma. Case No. 94-C-970.

- October 21, 1994: GRDA Files a Third Party Complaint Against FERC and the Corps Requiring 3rd Party Defendants to Indemnify GRDA for all Damages. Case No. 94-C-970.

- April 2, 1996: Court Remands Action by Plaintiffs to District Court and Dismisses FERC and the Corps as Third Parties. Case No. 94-C-970.

- May 2, 1996: GRDA Files a Notice of Appeal in the United States Court of Appeals for the 10th Circuit, Case Nos. 96-5113, 96-5114 and 96-5115.

- April 25, 1997: *GRDA v. The Honorable Robert E. Reavis, Judge of the District Court of Ottawa County*, Notice of Original Jurisdiction and Writ of Prohibition Appeal for Ruling Against GRDA. Oklahoma Supreme Court Case No. 89,321.

- June 13, 1997: *GRDA v. The Honorable Robert E. Reavis, Judge of the District Court of Ottawa County*, Dismissed. Oklahoma Supreme Court. Case No. 89321.

- May 28, 1998: Court Opinion Dismissing 3rd Parties and Remands Plaintiffs Back to District Court. United States Court of Appeals for the 10th Circuit. Case Nos. 96-5113, 96-5114 and 96-5115.

- July 11, 1998: GRDA Files for a Rehearing. United States Court of Appeals for the 10th Circuit. Case Nos. 96-5113, 96-5114 and 96-5115.

- July 28, 1998: Court Order (Rehearing Denied) United States Court of Appeals for the 10th Circuit. Case Nos. 96-5113, 96-5114 and 96-5115.

- August 18, 1998: *GRDA v. The Honorable Robert E. Reavis, Judge of the District Court of Ottawa County*, Notice of Original Jurisdiction and Petition for Writ of Prohibition Filed in the Supreme Court of Oklahoma. Case No. 91,772

- August 31, 1998: Order is Filed with the Court for a Trial by Referee, Dr. Forrest Holly. Ottawa County District Court. Case No. CJ-94-444.

- September 21, 1998: *GRDA v. The Honorable Robert E. Reavis, Judge of the District Court of Ottawa County,* Court Opinion (denied). Case No. 91,772.

- July 7, 1999: Two Cases Were Chosen to try as Test Cases in *Dalrymple*, Jeffrey and Carol McCool and Randy and Dena Stoner. Ottawa County District Court. Case No. CJ-94-444.

- August 13, 1999: Findings of Fact and Conclusions of Law for the McCool's and Stoners Filed in Ottawa County District Court by Plaintiffs and Defendant. Ottawa County District Court. Case No. CJ-94-444.

- December 2, 1999: Plaintiffs Filed a Petition with the Oklahoma Court of Civil Appeals to Correct the Order Filed on November 5, 1999 to Specifically Include Dr. Hollys Reports Dated 2/15/1999, 3/29/1999 and 7/26/1999 and Appendix A to the Order of November 5, 1999. Ottawa County District Court. Case No. CJ-94-444.

- December 6, 1999: GRDA Files a Petition in Error in the Oklahoma Civil Court of Appeals. Case 97,020.

- April 2001: The Holly Report is Corrected and the Version Dated April 2001 Controls Over all Other Holly Reports in This Matter. Ottawa County District Court. Case No. CJ-94-444.

- June 15, 2004: Opinion is Entered in Favor of the McCool's and the Stoners in the Oklahoma Court of Civil Appeals. Case 97,020.

- August 16, 2004: GRDA Files a Petition for Certiorari in Oklahoma Court of Civil Appeals. Appellate Case No. 97,020.

- December 6, 2004: Certiorari is denied. Appellate Case No. 97,020.

- April 5, 2005: Order Filed to Distribute Funds. Ottawa County District Court. Case No. CJ-94-444.

- May 21, 2007: Jury Trial of *Dalrymple* (GRDA Settled on day 2) Ottawa County District Court. Case No. CJ-94-444.

- May 29, 2007: Jury Trial of *Brewington* (Plaintiff Verdict). Ottawa County District Court. Case No. CJ-94-444.

- January 18, 2008: *Moseley, Adams, Miami Tire and Rosin* - Dismissed with Prejudice (Settled). Ottawa County District Court. Case No. CJ-94-444.

Subsequent Litigation

- October 5, 2001 *Asbell et al., v. GRDA* Petition Filed in Ottawa County District Court – Inverse Condemnation (48 plaintiffs). Case No. CJ-01-381

- June 8, 2010: Jury Trial Requested. Case No. CJ-01-381

- June 28, 2011: *Perry, Pryor* and *Shaw* Severed as Test Cases and Findings of Fact and Conclusions of Law are Filed. Case No. CJ-01-381.

- June 28, 2011: Petition in Error Filed by GRDA as to Findings of Takings and Damages Awards. Oklahoma Court of Civil Appeals. Case Nos. 109,714, 109,715 and 109,716 Consolidated Under Case No. 109,714.

- July 10, 2013: Oral Argument held. Case No. 109,714.

- December 31, 2013: Reversed and Remanded. Case No. 109,714.

- January 21, 2014: GRDA Files Petition for Certiorari with the Oklahoma Supreme Court. Case No. 109,714.

- March 31, 2014: Petition for Certiorari granted. Case No. 109,714.

- November 11, 2014: Order – Petition for Certiorari Recalled, by the Oklahoma Supreme Court, as Improvidently Granted. Case No. 109,714.

- November 24, 2014: GRDA Files for a Rehearing. Case No. 109,714.

- November 26, 2014: Rehearing Denied. Case No. 109,714.

- February 13, 2015: Remanded to District Court for Redetermination of Date(s) of Taking and the Interest Taken by GRDA, Easement or Fee. Case No. 109714.

- October 5, 2016: Agreed Order of Mediation Filed for November 21-22, 2016. Case No. CJ-01-381.

Most Recent Litigation

- November 26, 2008: *City of Miami et al., v. GRDA,* Petition Filed on Behalf of 456 Entities for Inverse Condemnation – Taking of Flowage Easements, Inverse Condemnation – Excessive use of Flowage Easements, Constitutional Damage to Private Property for Public Use, Strict Liability and Trespass. Case No. CJ-08-619.

- February 2, 2010: Unopposed Motion to Continue filed. Case No. CJ-08-619.

- Currently on hold until further ruling(s) in 2001 litigation.

Related to the second question in the Questionnaire, please keep everyone on your list with the edits mentioned in the first paragraph of this letter.

Related to the third question, you should include:
- Jordan Cash, Administrator, Integris Health Center, 200 2nd Avenue SW, Miami, OK 74354, 918-540-7104, jordan.cash@integrisok.com
- Jeremy Hogan, Superintendent of Miami Public Schools, 26 N Main, Miami, OK 74354, 918-542-8455, jhogan@mpswardogs.com
- Steve Gilbert, Director, Miami Regional Chamber of Commerce, 2 N Main, Miami, OK 74354, 918-542-8405, sgilbert@maimi-ok.org

In closing, the City of Miami, and other interested parties, intend to be fully involved in this relicensing process. The City hopes that GRDA will use the relicensing process to find a way to equitably resolve the long history of flood damage and lawsuits, address the lack of adequate easements, develop sound hydrological information about the entire watershed, and create long range plans to keep Grand Lake healthy and viable. The City encourages GRDA to change its attitude to one that embraces inclusivity and the development of transparent mutual goals which would make this process a valuable experience instead of the adversarial exercise that is anticipated based on GRDA's past actions.

We look forward to your response.

Dean Kruithof
City Manager
P.O. Box 1288
129 5th Avenue NW
Miami, OK 74355-1228
918-541-2203 - Office
dean@miamiokla.net

From: Ben Loring [mailto:bloring@miamiokla.onmicrosoft.com]
Sent: Monday, October 17, 2016 3:16 PM
To: jjaggers@grda.com
Cc: Townsend, Darrell <dtownsend@grda.com>; Edwards, Ellen <eedwards@grda.com>; Dean Kruithof <dean@miamiokla.net>
Subject: GRDA PAD Survey, FERC No. 1494 Relicensing

Dear Darrell,

I am in receipt of your letter dated September 19, 2016. I have also carefully reviewed Miami City Manager, Dean Kruithof's letter of even date herewith, and would fully incorporate same as my response to your survey. Likewise, I also reserve the right to augment this response. I very much want to participate in the Pensacola Project relicensing proceedings.

As I am certain you can appreciate, I find myself in somewhat of an awkward situation. I fully understand the benefits bestowed on the entire State of Oklahoma and on the citizens of the State and of House District 7, by the presence of GRDA and its operation of the Pensacola Dam. But, I likewise have the obligation to protect the interests, the property and the lives of my constituents (which a significant number of my District constituents are the only ones in the entire State) who routinely suffer the consequences of the upstream flooding caused by the operation of the Dam. This conflict is not insurmountable for me personally, and I firmly believe that none of the conflicts between all of these parties are insurmountable. Rest assured, I am ready, willing and able to help in any reasonable way possible to overcome these problems and reach a mutually beneficial resolution.

I would like to add one other item, something that is not asked in your survey. Specifically, while there have been many studies (of varying degrees of reliability) undertaken as to the upstream flooding effects on the Neosho, it is my understanding that little or nothing has been done to study what is happening on the Spring River and the Elk River during flood occurrences. While I understand the much larger population is located along the Neosho, those property owners along the Spring and Elk have just as much right to be safe and secure as anyone else. Further, I can't help but believe that what happens there during a flood occurrence also influences what happens on the Neosho. Until there is an adequate study done along those watersheds, I think it is impossible for FERC to act in a reasonable and responsible manner on your application.

Ben Loring
Representative, HD 7
ben.loring@okhouse.gov
(918) 533-6533
201 16th Pl. SW
Miami, OK 74354

Oklahoma Historical Society *Founded May 27, 1893*
State Historic Preservation Office
Oklahoma History Center • 800 Nazih Zuhdi Drive • Oklahoma City, OK 73105-7917
(405) 521-6249 • Fax (405) 522-0816 • www.okhistory.org/shpo/shpom.htm

October 18, 2016

Dr. Darrell Townsend, Ph.D., Assistant General Manager
GRDA Ecosystems & Lake Management
P.O. Box 70
Langley, OK 74350

RE: File #1173-16; Pensacola Hydropower Project #FERC-1494, Relicensing Pre-Application

Dear Dr. Townsend:

Thank you for notifying our office of the Grand River Dam Authority's (GRDA's) intent to pursue a new Federal Energy Regulatory Commission (FERC) license for the Pensacola Hydroelectric Project (Project) of which, the current FERC license for the Project is set to expire on March 31, 2022.

Based on the information that you have provided, it is our understanding that GRDA is preparing a Pre-Application Document (PAD) that is required by FERC's relicensing process. It is our further understanding that the PAD is not considered a federal undertaking under Section 106 of the National Historic Preservation Act (NHPA) and the Advisory Council on Historic Preservation's governing regulations at 36 CFR Part 800 and is therefore not subject to our review.

When your agency is ready to initiate consultation with our office pursuant to Section 106 of the National Historic Preservation Act, we will provide our comments on your findings at that time.

If you have any questions, please contact Catharine M. Wood, Historical Archaeologist, at 405/521-6381.

Should further correspondence pertaining to this project be necessary, please reference the above underlined file number. Thank you.

Sincerely,

Melvena Heisch
Deputy State Historic
Preservation Officer

MH:pm

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

The Grand River Dam Authority (GRDA), with assistance from HDR Engineering, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Pensacola Hydroelectric Project ("Project"). Through the Federal Power Act (FPA), FERC is responsible for licensing and relicensing non-federal hydropower facilities throughout the United States. The FPA requires that all non-federal hydropower facilities, like GRDA's Pensacola Project, receive a new license to operate every 30 to 50 years. The relicensing process takes five (5) years minimum to complete, and formally begins with GRDA's distribution of a Notice of Intent (NOI) and Pre-Application Document (PAD).

The Project is located on the Grand River in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (see attached map). GRDA is preparing a PAD that provides FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project to help identify issues and related information needs, develop study requests and study plans related to the relicensing of the Project, and prepare documents analyzing the Project's potential effects and benefits. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in GRDA's possession.

1. Information about person completing the questionnaire:

Name & Title	Rick DuBois, Environmental Director
Organization	Seneca-Cayuga Nation
Address	P.O. Box 453220 Grove, OK 74345-3220
Phone	918-787-5452 x341
Email Address	rdubois@sctribe.com

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

✓ *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	Micco Emarthla
Organization	Seneca-Cayuga Nation
Address	P.O. Box 453220 Grove, OK 74345-3220
Phone	918-787-5452 x342
Email Address	memarthla@sctribe.com

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	
Organization	
Address	
Phone	
Email Address	

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   __ Yes *(If yes, please complete 4a through 4d)* ✓ No

   a. Please circle the specific resource area(s) that the information relates to:

   - Geology, topography and soils
   - Water resources
   - Fish and aquatic resources
   - Wildlife and botanical resources
   - Floodplains, wetlands, riparian, and littoral habitat
   - Rare, threatened, and endangered species
   - Recreation and land use
   - Aesthetic resources
   - Cultural resources
   - Tribal resources
   - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   c. Where can GRDA obtain this information?

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	
Address	
Phone	
Email Address	

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

Pensacola Hydroelectric Project (FERC No. 1494)
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1. Information about person completing the questionnaire:

Name & Title	Nicole McGavock, Service Hydrologist
Organization	National Weather Service Tulsa
Address	10159 E. 11th St. Suite 300 Tulsa, OK 74055
Phone	918-832-4115
Email Address	nicole.mcgavock@noaa.gov

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

_✓_ *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

RECEIVED
OCT 21 2016
Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

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✓ Yes *(If yes, please complete 4a through 4d)* __ No

a. Please circle the specific resource area(s) that the information relates to:

- Geology, topography and soils
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- Floodplains, wetlands, riparian, and littoral habitat
- Rare, threatened, and endangered species
- Recreation and land use
- Aesthetic resources
- Cultural resources
- Tribal resources
- Socioeconomic resources

b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

Past rainfall; 7-day rainfall forecast; 5-day river forecast for the Neosho & Spring Rivers; Flood Stage information for the Neosho River near Commerce & the Spring River near Quapaw (and other points upstream)

c. Where can GRDA obtain this information?

www.weather.gov/tsa

d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

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1. Information about person completing the questionnaire:

Name & Title	Jeffrey L. Hale, President
Organization	Northeastern Oklahoma A&M College
Address	200 I Street Miami, OK 74354
Phone	918 540 6201
Email Address	cbigby@NEO.EDU

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

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Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	MARK RASOR, VICE PRESIDENT FOR BUSINESS
Organization	Northeastern Oklahoma A+M College
Address	200 I STREET, MIAMI, OK 74354
Phone	918 540 6213
Email Address	MRASOR@NEO.EDU

Name & Title	Steve Stephens, General Counsel
Organization	OSU - A+M Colleges Board of Regents
Address	2800 N. Lincoln Blvd, OKC, OK 73105
Phone	405 744 9183
Email Address	STEVE.STEPHENS@OKSTATE.EDU

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

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   c. Where can GRDA obtain this information?

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Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

If you have any questions regarding the Pensacola Project, or the upcoming FERC licensing processes, please contact Dr. Darrell Townsend at dtownsend@grda.com or via phone at 918-256-0616 or Ms. Jacklyn Jaggars at jjaggars@grda.com or via phone at 918-256-0723.

Please return this questionnaire in the enclosed, self-addressed, stamped envelope within 30 days of receipt to allow for any follow-up contact by a GRDA or its representative that may be needed. Comments and/or questions about this questionnaire may also be sent via e-mail to: Jacklyn Jaggars at jjaggars@grda.com. Not responding within 30 days indicates that you are not aware of any existing, relevant, and reasonably available information that describes the existing Project's environment.

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1. Information about person completing the questionnaire:

Name & Title	Logan Pappenfort Special Project Manager/Sect. 106 Consultant
Organization	Peoria Tribe of Indians of Oklahoma
Address	118 S. Eight Tribes Trail Miami, OK 74354
Phone	(918) 540-2535
Email Address	lpappenfort@Peoriatribe.com

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

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   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   - Gravel bars important to Native aquatic life
   - land use of Recreational Spaces in Miami
   - Tribal cemetary as well as fish Hatchery, Peoria Schoolhouse access, etc.
   - Peoria Housing authority affected as well as various domestic Housing

   c. Where can GRDA obtain this information?

   - Information on Gravel Bars: Gravel Sources for the Neosho River in KS by Kyle E. Juracek and Charles A. Perry

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	Logan Pappenfort
Address	118 S. Eight Tribes Trail Miami, OK 74354
Phone	(918) 540-2535
Email Address	lpappenfort@Peoriatribe.Com

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

Pensacola Hydroelectric Project (FERC No. 1494)
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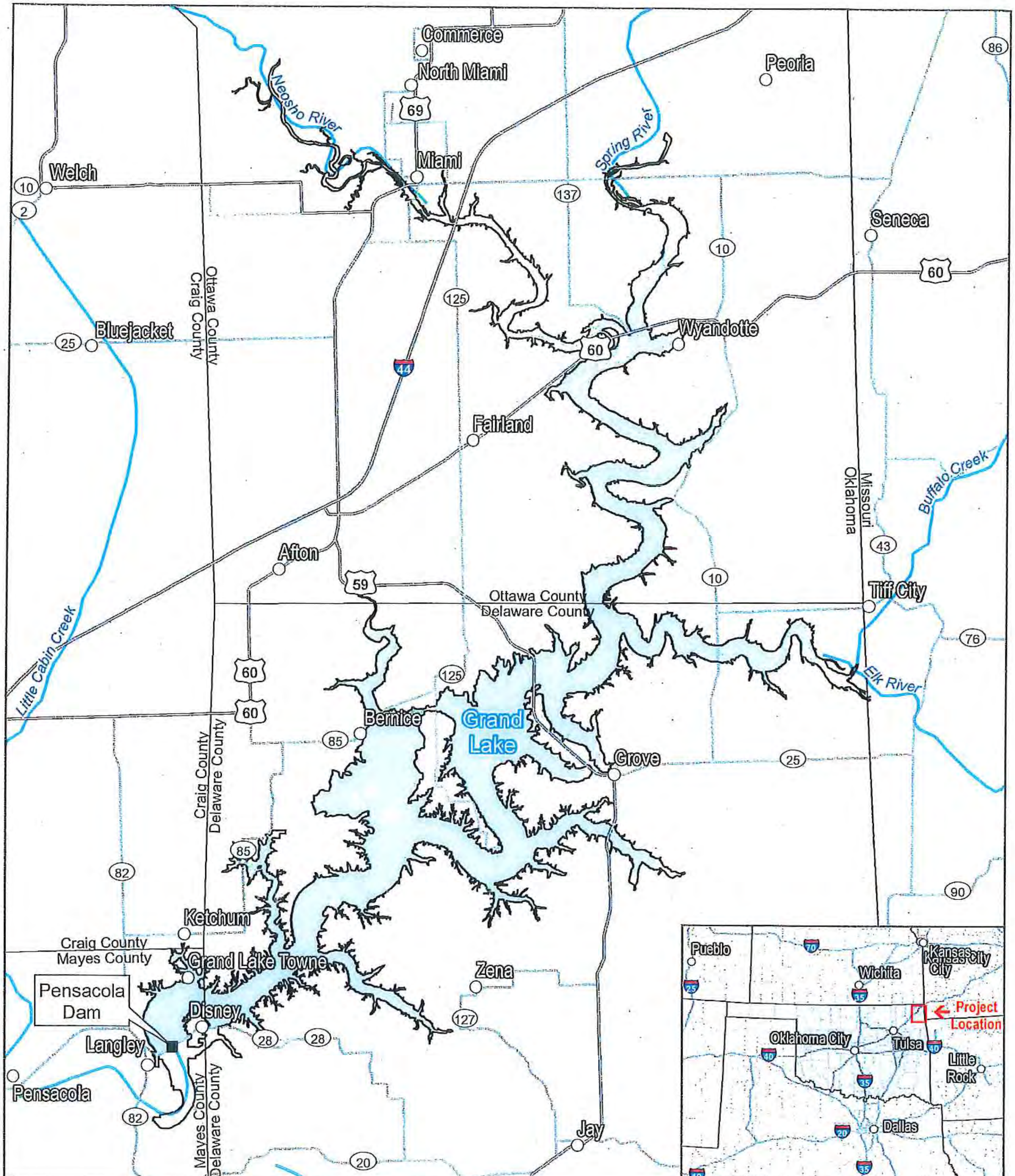

N

0 1 2 3 4 5
MILES

Grand River Dam Authority

LEGEND

	Project Boundary		City
	County		Freeway
	Grand Lake		Highway
	Pensacola Dam		Major Road

PENSACOLA
HYDROELECTRIC PROJECT

DATA SOURCES:
NRCS 2016, ESRI 2016

Pensacola Hydroelectric Project (FERC No. 1494)
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1. Information about person completing the questionnaire:

Name & Title	Josh Richardson Sr. Biologist
Organization	OK. Dept of Wildlife Conservation
Address	PO Box 53465 OKC, OK 73152
Phone	405-590-3585
Email Address	josh.richardson@odwc.ok.gov

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

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Organization	
Address	
Phone	
Email Address	

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	
Organization	
Address	
Phone	
Email Address	

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

   X Yes *(If yes, please complete 4a through 4d)* ___No

   a. Please circle the specific resource area(s) that the information relates to:

   - Geology, topography and soils
   - Water resources
   - Fish and aquatic resources
   - Wildlife and botanical resources
   - Floodplains, wetlands, riparian, and littoral habitat
   - Rare, threatened, and endangered species
   - Recreation and land use
   - Aesthetic resources
   - Cultural resources
   - Tribal resources
   - Socioeconomic resources

   b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

   Waterfow surveys, waterfowl harvest estimates (by county), Current/historic wetland maps

   c. Where can GRDA obtain this information?

   Myself, USFWS (DMBM), CoE, OCC.

   d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	
Address	
Phone	
Email Address	

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

Jaggars, Jacklyn

From: Jaggars, Jacklyn
Sent: Tuesday, October 25, 2016 7:16 PM
To: Stackelbeck, Kary
Subject: Re: Re-licensing PAD questionnaire

Thank you Kary. I'll include your correspondence in the consultation record. Look forward to working with you.

Sent from my iPhone

On Oct 25, 2016, at 6:05 PM, Stackelbeck, Kary <kstackelbeck@ou.edu> wrote:

> Hi Jacklyn,
> Please find attached our response letter to the Pensacola Re-Licensing PAD questionnaire. If you have any questions, please let me know.
>
> Best,
> Kary
>
> **Kary L. Stackelbeck, Ph.D.**
> State Archaeologist
> Oklahoma Archeological Survey
> University of Oklahoma
> 111 E. Chesapeake Street
> Norman, OK 73019-5111
> (405) 325-7211
>
> <20161025175910657.pdf>

Oklahoma Archeological Survey
THE UNVERSITY OF OKLAHOMA

October 25, 2016

Dr. Darrell Townsend, II
Assistant General Manager
Ecosystems and Lake Management
Grand River Dam Authority
P.O. Box 70
Langley, OK 74350-0070

Re: Pensacola Hydropower Project (FERC No. 1494)
Relicensing Pre-Application Document Questionnaire
Craig, Delaware, Mayes, and Ottawa Counties

Dear Dr. Townsend,

We recently received your letter and associated documentation regarding GRDA's preparation of a Pre-Application Document as part of FERC's relicensing process for the above-listed project. As I believe you are already aware, we maintain records regarding numerous archaeological sites in the Project's environment, though that information is not exhaustive of all the data that are available or may be of relevance. From the information provided, I understand that GRDA intends to conduct environmental studies—including those associated with cultural resources—in 2018 and 2019. We look forward to receiving the resulting documentation as the project moves forward.

Should you have any questions about these comments, please let me know.

Sincerely,

Kary L. Stackelbeck, Ph.D.
State Archaeologist

cc: SHPO

Jaggars, Jacklyn

From: Jaggars, Jacklyn
Sent: Thursday, October 27, 2016 8:57 PM
To: Price, Kimeka
Cc: Townsend, Darrell
Subject: Re: Pensacola Hydropower Project (FERC No. 1494) - FERC Pre-Application/Re-licensing

No, the questionnaire is an informal request for project-related information, rather than formal scoping comments under NEPA. Scoping will occur after the relicensing process for the Pensacola Project officially commences with the filing of the Notice of Intent (NOI) and Pre-Application Document (PAD) with the Federal Energy Regulatory Commission (FERC), which will occur no later than March 31, 2017.

I apologize for the significantly delayed response. I have been out of the office on personal leave and have had issues accessing my email on my phone. I will follow up early next week to confirm you have no further questions based on the response.

Jacklyn
Sent from my iPhone

On Oct 27, 2016, at 3:01 PM, Price, Kimeka <Price.Kimeka@epa.gov> wrote:

Mr. Townsend and Ms. Jaggars,

As a follow-up to my voice messages, additional time is needed to provide scoping comments on the subject project. Please let me know if an extension would be approved.

Kimeka Price
Environmental Engineer/NEPA Project Manager
U.S. Environmental Protection Agency Region 6
Compliance Assurance and Enforcement Division
Water Enforcement Branch
Special Projects Section/NEPA Program (6EN-WS)
price.kimeka@epa.gov
214-665-7438

From: Price, Kimeka
Sent: Tuesday, October 25, 2016 8:22 AM
To: dtownsend@grda.com; jjaggars@grda.com
Cc: Price, Kimeka <Price.Kimeka@epa.gov>
Subject: Pensacola Hydroelectric Project

Mr. Townsend and Ms. Jaggars,

As a follow-up to your letter dated September 19, 2016, I am inquiring if your letter is a request for scoping comments under the National Environmental Policy Act (NEPA). Please advise.

Kimeka Price
Environmental Engineer/NEPA Project Manager
U.S. Environmental Protection Agency Region 6
Compliance Assurance and Enforcement Division
Water Enforcement Branch
Special Projects Section/NEPA Program (6EN-WS)
price.kimeka@epa.gov
214-665-7438

TRIBAL HISTORIC PRESERVATION OFFICE

Date: December 8, 2016 **File: 1617-1422OK-11**

RE: GRDA, FERC No. 1494, Pensacola Hydropower Project Relicensing Pre-Application Document, Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma

Grand River Dam Authority
Darrell Townsend
P.O. Box 70
Langley, OK 74350-0070

Dear Dr. Townsend,

The Osage Nation Historic Preservation Office has received a notification letter regarding GRDA, FERC No. 1494, Pensacola Hydropower Project Relicensing Pre-Application Document, Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma. **The Osage Nation requests consulting party status for this project.**

In accordance with the National Historic Preservation Act, (NHPA) [16 U.S.C. 470 §§ 470-470w-6] 1966, undertakings subject to the review process are referred in S101 (d)(6)(A), which clarifies that historic properties may have religious and cultural significance to Indian tribes. Additionally, Section 106 of NHPA requires Federal agencies to consider the effects of their actions on historic properties (36 CFR Part 800) as does the National Environmental Policy Act (43 U.S.C. 4321 and 4331-35 and 40 CFR 1501.7(a) of 1969).

The Osage Nation has a vital interest in protecting its historic and ancestral cultural resources. The Pensacola Project area is a high priority area for the Osage Nation. **Therefore, the Osage Nation requests a consultation meeting for the proposed GRDA, FERC No. 1494, Pensacola Hydropower Project Relicensing Pre-Application Document, Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma**

Should you have any questions or need any additional information, please feel free to contact me at the number listed below. Thank you for consulting with the Osage Nation on this matter.

John Fox
Archaeologist

RECEIVED
DEC 12 2016
Ecosystems & Lake Mgmt
GRDA

627 Grandview, Pawhuska, OK 74056, (918) 287-5328, Fax (918) 287-5376

GRDA
Grand River Dam Authority

January 4, 2017

Mr. John Fox
Archaeologist
Osage Nation
627 Grandview
Pawhuska OK 74056

Re: Pensacola Hydropower Project Relicensing Pre-Application Document (File #617-1422OK-11)

Dear Mr. Fox:

The Grand River Dam Authority (GRDA) received your correspondence dated December 8, 2016 regarding the Pensacola Hydropower Project Relicensing Pre-Application Document (File #617-1422OK-11). GRDA plans to file the Pre-Application Document (PAD) with the Federal Energy Regulatory Commission (FERC) in February 2017. Per 18 CRF § 5.7, FERC will initiate tribal consultation no later than 30 days after the filing (ie, March 3, 2017).

We look forward to working with you during the relicensing process and protecting the Osage Nation's historic and ancestral cultural resources.

If you have any questions, please contact me at 918-256-0723 or jjaggars@grda.com.

Sincerely,

Jacklyn Jaggars
Ecosystems & Lake Management

To: GRDA
Fax: 918 782 4723

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

The Grand River Dam Authority (GRDA), with assistance from HDR Engineering, Inc. (HDR), is beginning the Federal Energy Regulatory Commission (FERC) relicensing process for the existing Pensacola Hydroelectric Project ("Project"). Through the Federal Power Act (FPA), FERC is responsible for licensing and relicensing non-federal hydropower facilities throughout the United States. The FPA requires that all non-federal hydropower facilities, like GRDA's Pensacola Project, receive a new license to operate every 30 to 50 years. The relicensing process takes five (5) years minimum to complete, and formally begins with GRDA's distribution of a Notice of Intent (NOI) and Pre-Application Document (PAD).

The Project is located on the Grand River in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (see attached map). GRDA is preparing a PAD that provides FERC and other entities with existing, relevant, and reasonably available information pertaining to the Project to help identify issues and related information needs, develop study requests and study plans related to the relicensing of the Project, and prepare documents analyzing the Project's potential effects and benefits. This PAD Information Questionnaire will be used to help identify sources of existing, relevant, and reasonably available information that is not in GRDA's possession.

1. Information about person completing the questionnaire:

Name & Title	Jeannine Hale EOR BIA Div. Envir. & Cultural Resource Mgmt
Organization	Bureau of Indian Affairs
Address	P.O. Box 8002 Muskogee OK 74401
Phone	918 781 4660
Email Address	Jeannine-Hale@bia.gov

2. Do you or your organization plan to participate in the Pensacola Project relicensing proceedings? If you do not respond to this questionnaire, unless you are an Indian tribe or federal or state agency, we will assume you want to be removed from future mailings. Please indicate below if you wish to remain on the distribution list.

____ *No, please remove me from the list.*

__✓__ *Yes, please keep me on the mailing list for relicensing information. Include the following individual(s) from our organization who will also be contact point(s) in the relicensing effort.*

RECEIVED
JAN 19 2017
Ecosystems & Lake Mgmt
GRDA

Pensacola Hydroelectric Project (FERC No. 1494)
Relicensing Pre-Application Document Information Questionnaire

Name & Title	Jessie Dunham Deputy Regional Director
Organization	E. OK. Region BIA
Address	same
Phone	918 781 4600
Email Address	jessie.dunham@bia.gov

Name & Title	
Organization	
Address	
Phone	
Email Address	

3. This questionnaire has been sent to the people/organizations shown on the attached distribution list; please let us know if you are aware of anyone else who should receive this questionnaire that has not been identified on this list.

Name & Title	Principal Chief Baker
Organization	Cherokee Nation
Address	Tahlequah
Phone	
Email Address	

Pensacola Hydroelectric Project (FERC No. 1494) Relicensing Pre-Application Document Information Questionnaire

4. Do you or your organization know of existing, relevant, and reasonably available information that describes the existing Project environment (i.e., information regarding the Grand River in or close to the Pensacola Project)?

X Yes *(If yes, please complete 4a through 4d)* __ No

a. Please circle the specific resource area(s) that the information relates to:

- Geology, topography and soils
- Water resources
- Fish and aquatic resources
- Wildlife and botanical resources
- Floodplains, wetlands, riparian, and littoral habitat
- Rare, threatened, and endangered species
- Recreation and land use
- Aesthetic resources
- Cultural resources -(possibly)
- Tribal resources
- Socioeconomic resources

b. Please briefly describe the information or list available documents *(a separate sheet of paper may be used, if more space is needed).*

tribal land status (in a database)

c. Where can GRDA obtain this information?

Contact BIA Eastern Okla. Regional Ofc - and tribes - and request it.

d. In addition to providing written information, if you would like to be contacted by GRDA, please provide a specific representative you wish to designate for a potential follow-up contact by GRDA or its representative.[1]

Representative Contact Information

Name	
Address	
Phone	
Email Address	

[1] Follow-up contacts may be made by either GRDA or its consultant, HDR.

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ATTACHMENT B. PENSACOLA PROJECT ILP PARTICIPANTS

Representatives of federal and state resource agencies, tribes, local governments, NGOs, and members of the public identified as likely participants in the Pensacola Project ILP are listed in Attachment B.

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Attachment B
Pensacola Project ILP Participants

U.S. Army Corps of Engineers
U.S. Department of Agriculture, Natural Resources Conservation Service
U.S. Department of the Army
U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service
U.S. Department of the Interior, Bureau of Indian Affairs
U.S. Department of the Interior, Bureau of Land Management
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service
U.S. Geological Survey
U.S. National Park Service

Governor's Office, Secretary of Energy and Environment
Office of State Fire Marshal
Oklahoma Archaeological Survey
Oklahoma Conservation Commission
Oklahoma Corporation Commission
Oklahoma Department of Agriculture, Food, and Forestry
Oklahoma Department of Commerce
Oklahoma Department of Environmental Quality
Oklahoma Department of Health
Oklahoma Department of Transportation
Oklahoma Department of Wildlife Conservation
Oklahoma Historical Society, State Historic Preservation Office
Oklahoma Office of Emergency Management
Oklahoma Tourism and Recreation Department
Oklahoma Water Resources Board

Inter-Tribal Council of Northeastern Oklahoma
Alabama-Quassarte Tribal Town
Apache Tribe of Oklahoma
Caddo Nation of Oklahoma
Cherokee Nation
Cheyenne and Arapaho Tribes, Oklahoma
Delaware Tribes of Indians
Eastern Shawnee Tribe of Oklahoma
Little Traverse Bay Bands of Odawa Indians, Michigan
Miami Tribe of Oklahoma
Modoc Tribe of Oklahoma
Muscogee (Creek) Nation

Osage Nation Historic Preservation Office
Ottawa Tribe of Oklahoma
Peoria Tribe of Oklahoma
Quapaw Tribe of Oklahoma
Seneca-Cayuga Nation
Shawnee Tribe of Oklahoma
United Keetoowah Band of Cherokees
Wichita and Affiliated Tribes (Wichita, Keechi, Waco, Tawakonie) Oklahoma
Wyandotte Tribe of Oklahoma

American Rivers
American Whitewater
Ducks Unlimited
Grand Lake Audubon Society
Grand Lake Sail and Power Squadron
Grand Lake Watershed Alliance Foundation
Local Environmental Action Demand (LEAD) Agency
The Nature Conservancy
Trout Unlimited
Tulsa Audubon Society

Craig County Commissioners
Craig County Floodplain Manager
Craig County Conservation District (USDA-NRCS)
Eastern Trails Museum (Craig County)
Delaware County Commissioners
Delaware County Floodplain Administrator
Delaware County Historical Society and Museum
Delaware County Conservation District
Delaware County Department of Environmental Quality
Mayes County Commissioners
Mayes County Floodplain Managers
Mayes County Conservation District
Coo-Y-Yah Museum
Ottawa County Emergency Management
Ottawa County Commissioners
Ottawa County Conservation District
Ottawa County Historical Society (Dobson Museum)

Afton Public Works Authority
City of Grove
Ketchum Public Works Authority
City of Miami
City of Vinita

Town of Langley
Town of Afton
Town of Ketchum
Town of Fairland
Town of Bernice
Town of Disney
Town of Wyandotte
RWD #3 Delaware County
RWD #3 Mayes County- Disney
Cherokee Grove Golf at Carey Bay
Grand Bluffs Development
Shangri-La Management
Shoreline, L.L.C.
Spinnaker Point Estates
Tera Miranda Shores, Inc.

James Inhofe, United States Senate
James Lankford, United States Senate
Jim Bridenstine, United States House of Representatives
Markwayne Mullin, United States House of Representatives
Frank Lucas, United States House of Representatives
Michael Bergstron, State Senator
Wayne Shaw, State Senator
Marty Quinn, State Senator
Josh West, House of Representatives
Chuck Hoskin, House of Representatives
Ben Loring, House of Representatives/City of Miami
Tom Gann, House of Representatives
Mary Fallin, Governor of Oklahoma

University of Oklahoma
Oklahoma State University
Northeastern State University
Northeastern Oklahoma A&M College
OSU-A&M College Board of Regents
Rogers State University

Anglers in Action (Tournament Trail and Big Bass Bash)
Grand Lake Association
Grand Lake United Enterprise (GLUE)
Grand Seaplanes, LLC
Har-Ber Village
Miami Area Chamber of Commerce
Miami Flood Mitigation Advisory Board

Oklahoma Association of Realtors
South Grand Lake Chamber of Commerce

Commercial Marina Owners (slips > 50)

ATTACHMENT C. 1992 LICENSE ORDER AND RELEVANT LICENSE AMENDMENTS

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1 FERC - 75 FERC, 59 FERC ¶62,073, Grand River Dam Authority, Project No. 1494-002 - Oklahoma, Federal Energy Regulatory Commission, (Apr. 24, 1992)

Click to open document in a browser

Grand River Dam Authority, Project No. 1494-002 - Oklahoma

[63,217]

[¶62,073]

Grand River Dam Authority, Project No. 1494-002 - Oklahoma

Order Issuing New License (Major Project)

(Issued April 24, 1992)

Fred E. Springer, Director, Office of Hydropower Licensing.

Grand River Dam Authority (GRDA) has filed a license application under Part I of the Federal Power Act (Act) to continue to operate and maintain the 86.9-megawatt (MW) Pensacola Project located on the Grand (Neosho) River in Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma. The Grand (Neosho) River is a navigable waterway of the United States. [1]

Notice of the application has been published. The comments filed by agencies and individuals have been fully considered in determining whether to issue this license. The State of Oklahoma filed an untimely motion to intervene in the licensing proceeding on June 15, 1987, stating that Oklahoma has interests in the proceeding, but does not oppose the project licensing. On September 12, 1991, the Commission granted the State of Oklahoma late intervention.

Comprehensive Development

Sections 4(e) and 10(a)(1) of the Act require the Commission to give equal consideration to all uses of the waterway on which a project is located. When the Commission reviews a proposed project, the recreational, fish and wildlife, and other nondevelopmental values of the involved waterway are considered equally with power and other developmental values. In determining whether, and under what conditions, a hydropower license should be issued, the Commission must weigh the costs and benefits of the various developmental and nondevelopmental uses of the waterway.

A. *Recommended Alternative*

The alternatives to relicensing GRDA's proposed Pensacola Project are denial of a license, issuance of a nonpower license to another entity, or issuance of a new license with enhancement measures. If the Commission were to issue a nonpower license for the project, then GRDA would have to replace the capacity and energy of the project with other resources. Staff estimates the additional cost to GRDA's ratepayers would be $6.03 million.

Based on staff's independent review and evaluation of the existing project and the alternatives, I have selected issuing a license, with the measures that are being required in this license, as the preferred option. I selected this option because the overall benefits of the project from both a power and an environmental standpoint, outweigh the consequences associated with denying the license application or issuance of a nonpower license to another entity.

The environmental assessment (EA) analyzes the effects of GRDA's existing hydropower project on the Grand (Neosho) River and tributaries and recommends eight measures proposed or recommended by GRDA, various agencies, and staff in order to protect and enhance the existing environmental resources. These measures include:

1. implementing staff's recommended reservoir level management plan, with the following target reservoir surface elevations: from October 16 through October 31, raise reservoir level from 741 feet to about elevation

[63,218]

742 feet Pensacola Datum (PD); from November 1 through April 15, maintain reservoir level at elevation 742 feet PD; from April 16 through May 31, raise the reservoir level to 745 feet PD and from June 1 to July 5 maintain the reservoir level at about 745 feet PD; from July 6 through July 15, reservoir level would decrease to 743 feet PD; from July 16 through July 31, maintain reservoir elevation at about 743 feet PD; from August 1 through August 14, reservoir level would decrease from 743 feet to about 741 feet PD; from August 15 through October 15, reservoir level would be maintained at about 741 feet PD; [2]

2. seeding a maximum of 1,000 acres of mudflats with Japanese millet and/or other appropriate vegetation in concert with the implementation of the reservoir level management plan and monitoring the effectiveness of the mudflat seeding;

3. developing and implementing a plan to monitor and enhance dissolved oxygen (DO) concentrations as measured immediately downstream of the project's tailrace in the Grand (Neosho) River to ensure that the releases from the project are meeting the standards of the plan;

4. managing 1,630 acres of project lands as a wildlife management area;

5. preparing and implementing a long-term recreation plan for Grand Lake;

6. upgrading public access facilities at Duck Creek located in the Ketchum recreation area;

7. protecting undiscovered properties listed on or eligible for listing on the *National Register* in the project area that could be adversely affected by future ground-disturbing activities or by project operation; and,

8. cooperating with the U.S. Fish and Wildlife Service (FWS), and The Nature Conservancy, Oklahoma Chapter (TNC) in order to assist TNC in attaining TNC's management strategies for the protection of the federally listed endangered gray bat (*Myotis grisescens*).

B. *Developmental and Nondevelopmental Uses of the Waterway*

The Pensacola Project, with the required enhancement measures, would provide a number of benefits. The project would continue to provide 86.9 MW of dependable capacity and generate an estimated 370,000 megawatthours (MWh) of relatively low-cost electricity annually, which would be used by GRDA to serve its contract customers. [3] The levelized costs of the project generation would include only the project's operation and maintenance (O&M) costs, and the administrative and general costs. The GRDA estimated that these costs are 4.0 mills per kilowatthour (kWh), which I conclude are small compared to the value of the power.

The potential improvements to fish and wildlife resources and associated costs of staff's required measures are discussed below.

Measures 1 and 2 would protect and enhance the fishery and terrestrial resources by: (a) exposing approximately 3,000 acres of mudflats located between elevations 742 feet PD and 745 feet PD that would revegetate naturally thereby providing fish nursery habitat that would be inundated the following spring and early summer (from May 15 through July 1); (b) stabilizing the water level elevations to maximize benefits to spawning fish (such as, crappie and black bass); (c) creating a greater expanse of mudflats for seeding (500 to 1,000 acres) in order to provide a food source for waterfowl and other wildlife species (such as, white-tailed deer); and (d) providing for vegetation density and increased diversity as a result of natural revegetation and mudflat seeding.

The Oklahoma Department of Wildlife Conservation (ODWC) estimated an average cost of $10 per acre for Japanese millet seeding (letter dated February 20, 1991, Steven Alan Lewis, Director, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma). Both the ODWC and FWS stated that several seeding attempts may be necessary in any one season to ensure success. Consequently, the estimated cost to seed 1,000 acres at $10 per acre would be $10,000 per season. Based on the average generation, staff estimates that $10,000 would amount to less than 0.03 mill per kWh in additional O&M costs.

Measure 3, developing and implementing a plan to monitor and enhance DO concentrations as measured immediately downstream of the project's tailrace in the Grand (Neosho) River, would enhance downstream aquatic habitat and fishery resources and, thus, improve recreational resources.

Measure 4 would provide 1,630 acres of project lands as a wildlife management area. Terrestrial resources would be enhanced by protecting "islands" of habitat and protecting natural diversity in addition to providing for recreation (such as, public hunting).

[63,219]

Measure 5 would provide the Grand Lake area with a comprehensive, long-term recreation plan which would primarily: (a) determine whether capacities of the lake's other recreational facilities, especially boat launches, are sufficient to meet current and future demand; and (b) assess the lake's carrying capacity for boating. Staff estimated that a comparable recreation plan would cost approximately $30,000 to $50,000 to prepare (personal communication, Alan Graefe, Associate Professor, Pennsylvania State University, University Park, Pennsylvania, September 19, 1991).

Measure 6 would improve public access facilities at Duck Creek located in the Ketchum recreation area. The estimated cost for these recreational enhancement measures would be approximately $27,000. Based on the average generation, staff estimates that $27,000 would amount to less than 0.1 mill per kWh, or about $3,000 annually, in additional O&M costs.

Measure 7 would protect (if needed) undiscovered properties listed on or eligible for listing on the *National Register* in the project area that could be adversely affected by future ground-disturbing activities or by project operation.

Measure 8 would protect the federally listed endangered gray bat (*Myotis grisescens*), thereby contributing to a potential increase in its population.

The required fish and wildlife measures and recreational measures would have a capital cost of approximately $87,000. Based on the average generation, staff calculates that $87,000 would amount to approximately 0.02 mill per kWh, or about $10,000 annually, in additional O&M costs. The environmental benefits derived from the above-required measures are worth the $10,000 annual cost.

Cost estimates associated with the required reservoir level management plan, developing and implementing a plan to monitor and enhance DO, protecting (if needed) undiscovered properties listed on or eligible for listing on the *National Register*, protecting the federally listed endangered gray bat, and managing 1,630 acres of project lands as a wildlife management area have not been calculated. Their associated costs, however, would be reasonable in comparison to the benefits that would be provided.

The FWS and the ODWC recommended that GRDA modify the project to comply with state water quality standards for DO. The tailrace discharges directly into the next downstream reservoir.

Staff considered four alternatives for improving water quality downstream of the Pensacola Project and developed cost estimates for implementing these alternatives.

The first alternative, diffused air injection, is commonly employed in wastewater treatment plants for delivery of oxygen, and would require a series of air compressors to supply air, a header and piping system, and a series of diffusers mounted on the piping system. Staff estimates the total 30-year levelized cost of the diffuser alternative would be about $1,339,000 annually.

The second alternative, surface aeration, would employ a series of aspirating aerators that float on the surface in the tailrace. Although the aspirating-propeller aerator has been in use for over 50 years, it has only been recently considered as a viable alternative to aerate tailraces. Staff estimates the total 30-year levelized cost of the surface aerator alternative would be about $1,583,000 annually.

The third alternative is injection of pure oxygen in the forebay upstream of the intake structure. Diffusers would be placed in the deep waters of the forebay to take advantage of the depth (high pressures) to increase oxygen transfer and the local currents to aerate only the water passing through the turbines. Staff estimates the total 30-year levelized cost of the forebay oxygen injection alternative would be about $617,000 annually.

The fourth alternative, of shutting the project down and spilling all of the discharges over the spillway, would improve water quality by two methods. First, the water would be withdrawn from the upper levels of the reservoir which would have a higher oxygen content. Second, the spilling itself would increase the DO content. Based on a five-month shutdown period of June through October, a value of energy at the alternative cost of fuel for a fossil-fueled steam-electric plant, and the capacity at the cost of installing simple-cycle combustion turbines, staff estimates the total levelized cost of the project shutdown alternative would be about $7,827,000 annually.

The levelized annual costs of the four alternatives are summarized below in table 4.

Table 4. Summary of annual operating costs for four alternatives for improving water quality at the Pensacola Project.

Alternative	Annual Levelized Capital Costs (dollars)	Annual Levelized Operating Costs (dollars)	Total Annual Levelized Costs (dollars)	Annual Cost (mills/KWh)
Diffused air	384,000	955,000	1,339,000	3.62
Surface aerators ...	705,000	878,000	1,583,000	4.28
Oxygen injection ..	22,000	595,000	617,000	1.67
Project shutdown ...	----	----	7,827,000	36.27 [4]

[63,220]

The four alternatives for improving downstream DO concentrations were analyzed to enhance DO concentrations to the state standards during the critical summer period. Based on this analysis, I am not requiring implementation of project shutdown because of the significantly high total annual levelized costs ($7,827,000) associated with this alternative. Implementation of an oxygen injection system at the Pensacola Project offers the lowest annual levelized costs for increasing DO concentrations to the state standards, but would still increase the cost of power generation from the project by over $600,000 annually. I conclude that this cost is not justified because comparable benefits to the environmental resources would not be derived by enhancing downstream DO concentrations to the levels recommended by the fishery agencies.

Because there is no downstream riverine reach that would benefit from, and because of the high costs incommensurate with the benefits associated with, the above alternatives, I am not requiring any of the staff's alternatives. However, since there may be other less costly alternative measures that staff has not analyzed and that would be effective in enhancing DO levels in the tailrace, I am requiring that the licensee develop and implement a plan to monitor and enhance DO concentrations as measured immediately downstream of the projects' tailrace in the Grand (Neosho) River. The plan would include less costly measures which the licensee has investigated and therefore, proposes to improve downstream DO concentrations. For example, an oxygen injection system could be installed and tested to determine the extent of DO enhancement that occurs with incremental increases of oxygen injection.

Furthermore, FWS and ODWC recommended that GRDA acquire and provide annual funds to develop and manage 3,400 acres (originally 19,000 acres) of bottomland hardwood forest. In addition, ODWC made two other recommendations for GRDA to: (1) consider the development of a fish hatchery and/or nursery pond complex; and (2) establish two staff positions. I am not requiring these measures for reasons discussed under "Recommendations of Federal and State Fish and Wildlife Agencies."

Section 10(a)(2) of the Act requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. Under section 10(a)(2), federal and state agencies filed ten comprehensive plans that address various resources specific to Oklahoma, eight of which we have identified as relevant to this project. [5] No conflicts were found.

Based on a review of the agency and public comments filed in this proceeding and on staff's independent analysis, I conclude that issuing a new license for the Pensacola Hydroelectric Project with staff's required enhancement measures and other special license conditions would permit the best comprehensive development of the Grand (Neosho) River.

Recommendations of Federal and State Fish and Wildlife Agencies

Section 10(j) of the Act requires the Commission to include license conditions, based on recommendations of federal and state fish and wildlife agencies, for the protection of, mitigation of adverse impacts to, and enhancement of fish and wildlife resources. In the EA for the Pensacola Project, attached to and made part of this license, the staff addresses the concerns of the federal and state fish and wildlife agencies, and the license includes conditions consistent with the recommendations of the agencies except for those recommendations discussed below.

Pursuant to section 10(j) of the Act, staff determined that the FWS and ODWC recommendations for GRDA to: (1) acquire and provide annual funds to develop and manage 3,400 acres (originally 19,000 acres) of bottomland hardwood forest just upstream of Grand Lake; and (2) modify the project to comply with state water quality standards for DO [6] would be inconsistent with section 10(a) of the Act. In the staff's analysis for improving water quality, the associated cost estimates for implementing any one of the four alternatives developed by the staff would reduce the project's economic benefits, which now flow to GRDA's ratepayers, without a commensurate increase

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in resource benefits. Also, the FWS and ODWC did not offer any specific proposal to modify the project.

In addition, staff determined that the recommendations made by ODWC for GRDA to: (1) consider the development of a fish hatchery and/or nursery pond complex was inconsistent with section 313(b) of the Act; and (2) establish two staff positions, was outside the scope of section 10(j). [7]

Pursuant to section 10(j)(2) of the Act, staff attempted to resolve the inconsistencies with the FWS and ODWC at a section 10(j) teleconference meeting on February 11, 1992. [8] The issue pertaining to the FWS's and ODWC's recommendation for GRDA to acquire and provide annual funds to develop and manage 3,400 acres (originally 19,000 acres) of bottomland hardwood forest just upstream of Grand Lake is discussed below. The FWS stated that this recommended measure is to offset continuing bottomland forest losses from past, ongoing, and future lake-related development.

a. *Annual Funds to Develop Lands Affected by Original Project Construction and Operation*

The FWS and the ODWC originally recommended that GRDA acquire and provide annual funds to develop and manage 19,000 acres of bottomland hardwood forest, including an identified 4,500-acre tract of bottomland hardwood forest along the Grand River just upstream of the lake. The FWS's and ODWC's recommendations involve mitigation relative to pre-project conditions (about 15,000 acres) and losses due to original inundation, which is contrary to the Commission's policies on relicensing. [9] In addition, the approximate cost to acquire the 19,000 acres is between $400 and $600 per acre, which could total within a range of $7,600,000 to $11,400,000 (personal communication, Gary Hunt, Manager, Environmental Services, Benham-Holway Power Group, Tulsa, Oklahoma, September 16, 1991). Based on average generation, staff estimated that at $600 per acre and capitalized over a 30-year period, the annual cost would amount to about $1.1 million dollars or 3.0 mills per kWh.

The Pensacola dam, one of three flood control reservoirs on the Grand (Neosho) River, was authorized and constructed under authority of the Flood Control Act of 1941, Public Law 77-228 for flood protection to the lower Grand and Arkansas River Valleys. At that time, Congress determined that the reservoir's construction and operation were in the public interest. In addition, the project was licensed by the Federal Power Commission in July 1939 to generate low-cost electrical power for use by the citizens of Oklahoma. Flood control and power benefits have been derived from the project for a half century. Mitigation should not be required to offset the original loss of natural resources.

I conclude that FWS's and ODWC's above-recommended measure regarding annual funds to develop lands, to the extent the lands are to compensate for pre-project losses, is contrary to the Commission's relicensing policy and Part I of the Act, as previously discussed. Therefore, I am not requiring this measure.

b. *Annual Funds to Develop Lands Affected by Future Project Operation*

By letter dated January 10, 1992, the FWS stated that 1936 and 1939 photographs indicate that there may have been more agricultural land and less bottomland forest in the area affected by the Grand Lake reservoir than was originally estimated. Consequently, of the pre-project bottomland forest within the area above the flood control pool affected by lake-related development, results indicate that this area of bottomland forest would be reduced from 9,998 acres to 1,774 acres and subsequently result in a lower mitigation requirement (from 19,000 acres to 3,400 acres).

During the section 10(j) teleconference meeting, the GRDA stated that, of the 3,400 acres of bottomland hardwood forest, that the FWS and ODWC recommend for acquisition, the bottomland forest located above the top of the flood control pool and extending 500 feet inland will decrease, between 1989 through 2018, from 4437 acres to 4297 acres, which represents a net loss of 140 acres displaced by shoreline development. Furthermore, the GRDA stated that the 1,630 acres of project lands proposed as a wildlife management area would compensate for the future-predicted loss of 140 acres. FWS and ODWC voiced no objections to GRDA's assessment.

Although GRDA, ODWC, and FWS estimated that 140 acres would represent the acreage displaced by future-related shoreline development, it is uncertain that this amount would represent the actual future development

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loss. However, I believe the 1,630 acres of project lands proposed as a wildlife management area is an appropriate enhancement measure agreed to by the parties, and I am requiring this measure in this license.

c. *Modify the Project to Comply with State Water Quality Standards*

The issue pertaining to the FWS's and ODWC's recommendation for GRDA to modify the project to comply with state water quality standards for DO was resolved. Neither FWS nor ODWC voiced any opposition to staff's initial recommendation to not require project modifications, but to develop and implement a plan to monitor and enhance DO concentrations downstream of the project. Further, staff's recommendation is consistent with a similar requirement contained in the 401 water quality certificate, and the Pensacola Project must operate in compliance with the requirements of the Oklahoma State 401 water quality certificate.

d. *Fish Hatchery*

The ODWC recommends that construction and operation of a fish hatchery be included in the new license for this project, as "mitigation for fisheries losses and impacts caused by hydropower operation." [10] This recommended measure could only be mitigation if hydropower operations degraded a previously existing resource. However, the fishery resource of Grand Lake did not exist before hydropower operations commenced. Indeed, it was the construction of the project that created Grand Lake and its fishery.

However, ODWC's fish hatchery recommendation is an enhancement recommendation within the scope of section 10(j) and will be considered on its merits as such. In a filing with the Commission on February 25, 1992, ODWC states that fluctuating water levels owing to power generation may, depending on season and environmental conditions at the time, harm spawning and survival of young fish. ODWC further contends that under the new GRDA rule curve, establishment of emergent vegetation in the fluctuation zone is unlikely, limiting cover for young fish. ODWC concludes that these factors "may" cause annual year classes of bass and crappie insufficient to provide satisfactory recreational fishing opportunities. A fish hatchery or rearing facility would provide a continuing source for supplemental restocking. ODWC estimates a capital cost of about $1.6 million and annual operating costs of about $100,000 for the facility.

While I agree that ODWC's recommended facility would enhance the Grand Lake fishery, I conclude that in light of its cost, it is not supported by substantial evidence. Currently, there is insufficient evidence regarding adverse impacts to nursery and cover area due to fluctuating water surface elevations to warrant requiring the GRDA to construct a fish hatchery or fish rearing facility. However, should the ODWC wish to collect data to describe the strength of year classes of fishes inhabiting Grand Lake (along with any other data that the ODWC deems necessary) and relate these data with water surface elevation fluctuation data (provided by GRDA), I would consider the fish hatchery or further enhancement if the data indicate that such a measure is warranted.

Therefore, I am requiring GRDA to consult with the ODWC to determine if the ODWC wishes to conduct such an assessment, and if so, to assemble historical and collect current data on water surface elevation for Grand Lake and to provide these data to the ODWC for use in a fisheries-water surface elevation fluctuation assessment. If the ODWC does wish to conduct a fisheries-water surface elevation fluctuation assessment, interim reports and a final report should be submitted to the Commission. The final report should include any recommendations from the ODWC and any proposal from the GRDA (developed in consultation with the ODWC) to enhance the fishery resources of Grand Lake, based upon the results of this assessment.

e. *Creation of Staff Positions*

I find that ODWC's recommendation for GRDA to create two positions (fish/wildlife biologist and a technician) has not been supported by substantial evidence as to why this measure should be provided by GRDA. More important, there is no specific link between this measure and appropriate fish and wildlife measures as stipulated under section 10(j) of the Act. I conclude that this recommendation is outside the scope of section 10(j). The implementation of the required measures in this license would require GRDA to continue to consult with the agencies and implement enhancement measures at the Pensacola Project. The personnel selected to participate in these activities would be at the discretion of GRDA. I, therefore, am not requiring that GRDA implement this recommendation.

f. *Mudflat Seedings*

As discussed on page 22 of the EA dated November 19, 1991, mudflat seedings may not be as successful in lakes with a wide amplitude

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of water level changes, such as occurs in Grand Lake. The ODWC and FWS recommended that GRDA annually seed 1,000 acres (originally 3,087 acres) of mudflats with millet, wheat and/or other appropriate vegetation. By letter dated February 24, 1992, the ODWC recommended that a minimum of 10 attempts (equivalent to one attempt per year or 10 years) to seed 1,000 acres of mudflats should be required (Steven Alan Lewis, Director, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma). The ODWC did not provide any rationale for their recommended minimum of 10 attempts.

Based on the best available information, including literature, personal communications with Dr. Wayne Ellison, Plant Taxonomist, Dr. Elroy Rice, Ecologist, University of Oklahoma, Norman, Oklahoma, and Mr. Bruce Hoagland, Wetlands Ecologist, Oklahoma Natural Heritage Inventory, Norman, Oklahoma, and the uncertainties inherent in annual hydrology (such as inflows, flooding, and drought), the success of such plantings would likely be observed after a period of approximately 5 years. Therefore, I am requiring that GRDA annually seed a maximum of 1,000 acres of mudflats with Japanese millet and/or other appropriate vegetation and monitor the effectiveness of the seeding.

g. *Conclusion*

As a result of the technical input of the FWS and ODWC during the section 10(j) meeting and comments on the EA, staff modified its earlier recommendations outlined in the EA. I am requiring that the following environmental enhancement measures be included in this license for the Pensacola Hydroelectric Project. These measures are: (1) implementing staff's recommended reservoir level management plan; (2) seeding a maximum of 1,000 acres of mudflats with Japanese millet and/or other appropriate vegetation and monitoring the effectiveness of the mudflat seeding; (3) monitoring DO concentrations; (4) managing 1,630 acres of project lands as a wildlife management area; (5) cooperating with the FWS and TNC in attaining TNC's management strategies for the protection of the federally listed endangered gray bat (*Myotis grisescens*); and (6) protecting the federally listed endangered bald eagle (*Haliaeetus leucocephalus*) by restricting shoreline development in bald eagle high-use areas.

I believe that the above measures required by this license would provide a greater level of protection and enhancement to fish and wildlife resources than what currently exists at the project. I conclude that the project as licensed herein achieves a proper balance between power production, economic benefits to GRDA's ratepayers from the project, and environmental protection and enhancement consistent with sections 10(j) and 10(a) of the Act.

ECPA Considerations

Section 10(a)(2)(C) and section 15(a) of the Act, requires the Commission to consider in writing the following factors in issuing new licenses.

Consumption Efficiency Improvement Programs (section 10(a)(2)(C))

Since the GRDA sells only to wholesale customers and has no commercial transactions with end-use customers (except for the large industrial customers) there is no opportunity for GRDA to advocate, advise, or assist customers in improving the consumption efficiency of electricity.

GRDA's industrial customers need neither encouragement nor assistance in maximizing energy conservation, and reducing peak demands by the practice of load management. Their competitive position and income statements take care of these issues quite effectively.

The Plans and Abilities of the Applicant to Comply with the Articles, Terms, and Conditions of Any License Issued to It and Other Applicable Provisions of Part I of the Act (Section 15(a)(2)(A))

Staff has reviewed GRDA's license application and its record of compliance with the existing license in an effort to judge its ability to comply with the articles, terms, and conditions of any license issued, and with other applicable provisions of this part of the Act.

Staff's review of GRDA's compliance record indicates that it has in the past complied in a good faith manner to all articles, terms, and conditions of its current license. As a result of our review, I conclude GRDA can satisfy the conditions of a new license.

The Plans of the Applicant to Manage, Operate, and Maintain the Project Safely (Section 15(a)(2)(B))

In response to staff's data request of March 2, 1987, GRDA described in detail how it operates the project under flood conditions and under normal conditions.

Under flood conditions, GRDA follows instructions from the U.S. Army Corps of Engineers (Corps) with respect to operating the reservoir. When the reservoir surface rises to elevation 743.93 feet NGVD, [11] the Corps takes charge of releasing water from the flood pool and issues instructions regarding the rates of

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release, times to start the release, and times to stop the release. GRDA makes releases at Pensacola Dam using the Taintor gates at both the main and the auxiliary spillways. GRDA personnel operate the gates to comply with the Corps' instructions.

GRDA's operating personnel communicate with the Corps' personnel on a daily basis, providing the Corps with streamflow information for the tributaries flowing into the Grand Lake O' the Cherokees. The streamflow data from the inflow tributaries can be retrieved on command from a computer terminal, which is located at the powerhouse and utilizes a satellite communications system.

With respect to downstream public safety, GRDA operates a warning siren at the powerhouse to warn of an impending water release or change in discharge. GRDA also plans to install a second warning siren between the two auxiliary spillways which would operate simultaneously with the existing siren.

GRDA proposes no significant changes to the operation of the project. Additionally, there are no projected changes in downstream development that would affect the emergency action plan (EAP) currently on file with the Commission. GRDA performs EAP practice drills periodically and, based on the results of the drills, makes any necessary adjustments to the EAP.

GRDA installed safety line and marker buoys across the spillway channel upstream of the spillway to prevent boaters from being swept over the spillway during times when releases are made.

GRDA has a comprehensive monitoring program for the Pensacola Project. The program monitors, by direct measurement, the intensity of uplift pressures under the main spillway and nonoverflow sections of the dam. The dam has a total of 32 piezometers. The licensee's independent consultant for the Part 12 Inspection Program thoroughly reviews the piezometric data, as does GRDA staff and the Atlanta Regional Office (ARO) staff. In addition to the monitoring program, GRDA has an in-house program for the inspection, operation, and maintenance of various project facilities.

GRDA has an excellent employee safety record with only three lost-time accidents during the period from 1978 to 1987, and none of those accidents occurred at the project.

With respect to public safety, GRDA reported that 80 drownings and 21 injuries occurred within the project boundaries during the period from 1953 to 1987. GRDA states that in many of these cases the individuals were elderly and may have suffered heart attacks. There are no routine procedures established for determining whether these deaths are due to heart attack or drowning. Staff concludes that these incidents could not have been averted by modifying the operation or inspection procedures at the project.

As a result of staff's review of GRDA's plans, I conclude that it would be able to manage, operate, and maintain the Pensacola Project in a safe manner.

The Plans and Abilities of the Applicant to Operate and Maintain the Project in a Manner Most Likely to Provide Efficient and Reliable Electric Service (Section 15(a)(2)(C))

Staff reviewed GRDA's plans and its ability to operate and maintain the project in a manner most likely to provide efficient and reliable electric service.

GRDA is currently investigating the feasibility of refurbishing the turbines and generators to increase power production. In 1987 GRDA installed the latest state-of-the-art flow meters on each penstock, which will make it possible to determine accurate operating efficiencies of the existing turbines. These data will enable GRDA to perform Index Testing which it will use to develop new operating guidelines based on more accurate performance levels of the power generation units.

GRDA adopted a new reservoir operating rule curve in 1984, which has resulted in increased energy production. GRDA proposed further revisions to the rule curve in August 1990 and is currently analyzing potential impacts on generation.

GRDA installed a state-of-the-art communication system which includes satellite communication facilities and a system control and data acquisition (SCADA) system.

In addition to the Pensacola Project, GRDA has a conventional hydro project and a pumped-storage hydro project downstream plus a large coal-fired steam-electric plant. GRDA coordinates the operation of these plants along with power purchases using its SCADA system.

Based on staff's review of the information, I conclude that GRDA has been operating the project in an efficient manner within the constraints of the existing license and that it would continue to provide efficient and reliable electric service in the future.

The Need of the Applicant Over the Short and Long Terms for the Electricity Produced by the Project to Serve Its Customers (Section 15(a)(2)(D))

GRDA uses the Pensacola Project power to meet its customers' loads. The project's first generating facility was completed in 1941.

Staff evaluated the short-term and long-term need for the power generated by the project,

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and also looked at the scenario of GRDA not receiving a new license for the project.

GRDA states that the use of any reasonable alternative source to replace the project power would impose additional costs on its ratepayers, should it lose the project license.

Historically, the project has produced about 370 million kilowatthours of renewable energy annually. The project has a dependable capacity of 86 MW.

If the Commission were to issue a nonpower license for the project, GRDA would have to replace the capacity and energy of the project with other resources. Staff estimates the additional cost to GRDA's ratepayers would be about $6.03 million.

I conclude that the project power would have to be replaced with alternative generation only if the Commission were to issue a nonpower license for the project.

I also conclude:

• Power from the existing Pensacola Project is needed.

• The existing hydroelectric project is one of the cheaper power resources available.

The Existing and Planned Transmission Services of the Applicant (Section 15(a)(2)(E))

GRDA has proposed no changes in its transmission services. It supplied staff with single line diagrams of its system facilities and has provided information on various load flow cases at different system generation levels.

If the generation from the Pensacola Project were not available for distribution on GRDA's system, then it would have to import power from much greater distances which would result in increased loss of power, and higher costs to its customers.

Staff has examined the single line diagrams of GRDA's transmission system and find the system extensive. I conclude GRDA's transmission services are adequate.

Whether the Plans of the Applicant Will be Achieved, to the Greatest Extent Possible, in a Cost Effective Manner (Section 15(a)(2)(F))

GRDA plans no significant project changes, except those periodically required to ensure the project safety.

GRDA plans to study the feasibility of refurbishing the six turbine-generator units for the purpose of increasing power production. Additionally, GRDA is evaluating the impacts of implementing a new reservoir operating rule curve proposed in 1990 and the resource agency recommendations relating to that curve. GRDA has recently installed state-of-the-art flow meters in each of the penstocks and plans to develop new guidelines for operating the units at higher efficiencies using the flow meters.

I conclude that the project fully develops the economical hydropower potential of the site.

The Applicant's Record of Compliance with the Terms and Conditions of the Existing License (Sections 15(a)(3)(A) and (B))

The compliance record of GRDA with the terms and conditions of the existing license is satisfactory. GRDA has generally made timely filings and submittals, and has maintained the project in a satisfactory manner.

License Term

Section 15 of the Act specifies that any license issued shall be for a term which the Commission determines to be in the public interest, but not less than 30 years, nor more than 50 years. This provision is consistent with Commission policy which establishes 30-year terms for those projects which proposed no new construction or capacity, 40-year terms for those projects that proposed a moderate amount of new development, and 50-year terms for those projects that proposed a substantial amount of new development.

GRDA proposes no redevelopment of the existing project facilities and no changes in operation of the project. Accordingly, the new license for the Pensacola Project will be for a term of 30 years.

Summary of Findings

An EA was issued for this project. Background information, analysis of impacts, support for related license articles, and the basis for a finding of no significant impact on the environment are contained in the EA attached to this order. Issuance of this license is not a major federal action significantly affecting the quality of the human environment.

The design of this project is consistent with the engineering standards governing dam safety. The project will be safe if operated and maintained in accordance with the requirements of this license. Analysis of related issues is provided in the Safety and Design Assessment. [12]

I conclude that the project would not conflict with any planned or authorized development, and would be best adapted to comprehensive development of the waterway for beneficial public uses.

The Director orders:

(A) This license is issued to the Grand River Dam Authority (Licensee), for a period of 30

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years, effective the first day of the month in which this order is issued, to operate and maintain the Pensacola Project. This license is subject to the terms and conditions of the Act, which is incorporated by reference as part of this license, and subject to the regulations the Commission issues under the provisions of the Act.

(B) The project consists of:

(1) All lands, to the extent of the Licensee's interests in those lands, enclosed by the project boundary shown by exhibit G:

Exhibit G-	FERC No.	Showing
1	1494-205	Project Boundary/Land Ownership
2	1494-206	Project Boundary/Land Ownership
3	1494-207	Project Boundary/Land Ownership
4	1494-208	Project Boundary/Land Ownership
5	1494-209	Project Boundary/Land Ownership
6	1494-210	Project Boundary/Land Ownership
7	1494-211	Project Boundary/Land Ownership
8	1494-212	Project Boundary/Land Ownership
9	1494-213	Project Boundary/Land Ownership
10	1494-214	Project Boundary/Land Ownership
11	1494-215	Project Boundary/Land Ownership
12	1494-216	Project Boundary/Land Ownership
13	1494-217	Project Boundary/Land Ownership
14	1494-218	Project Boundary/Land Ownership
15	1494-219	Project Boundary/Land Ownership
16	1494-220	Project Boundary/Land Ownership
17	1494-221	Project Boundary/Land Ownership
18	1494-222	Project Boundary/Land Ownership
19	1494-223	Project Boundary/Land Ownership
20	1494-224	Project Boundary/Land Ownership

21	1494-225	Project Boundary/Land Ownership
22	1494-226	Project Boundary/Land Ownership
23	1494-227	Project Boundary/Land Ownership
24	1494-228	Project Boundary/Land Ownership
25	1494-229	Project Boundary/Land Ownership
26	1494-230	Project Boundary/Land Ownership
27	1494-231	Project Boundary/Land Ownership
28	1494-232	Project Boundary/Land Ownership
29	1494-233	Project Boundary/Land Ownership
30	1494-234	Project Boundary/Land Ownership
31	1494-235	Project Boundary/Land Ownership
32	1494-236	Project Boundary/Land Ownership
33	1494-237	Project Boundary/Land Ownership

(2) Project works consisting of: (a) a reinforced-concrete dam consisting of a multiple arch section 4,284 feet long, a spillway 861 feet long containing 21 Taintor gates, a nonoverflow gravity section 451 feet long, and two nonoverflow abutments, comprising an overall length of 5,950 feet and maximum height of 147 feet; (b) a reinforced-concrete gravity-type spillway section 886 feet long containing 21 Taintor gates and located about one mile east of the main dam; (c) a reservoir, known as Grand Lake O' the Cherokees (Grand Lake), having a surface area of 46,500 acres and a storage capacity of 1,680,000 acre-feet at a normal maximum water surface elevation of 744 feet NGVD; (d) six 15-foot-diameter and one 3-foot-diameter steel penstocks supplying flow to six turbine-generators of 14.4-MW capacity each and one turbine-generator of 500-kW capacity, located in a powerhouse immediately below the dam; (e) a tailrace approximately 300 feet wide and a spillway channel approximately 850 feet wide, both about 1.5 miles long; and (f) appurtenant facilities.

The project works generally described above are more specifically shown and described by those portions of exhibits A and F below:

Exhibit A - The following sections of exhibit A filed December 23, 1985:

Section 3, pages A-3 and A-4, entitled "Turbine-Generator Description;" section 4, page A-4, entitled "Primary Transmission Lines;" and section 5, page A-4, entitled "Additional Mechanical, Electrical, and Transmission Equipment."

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Exhibit FERC No.   Showing

F-1	1494-168	Vicinity Map
F-2	1494-169	Section and Elevation of Dam and Powerhouse
F-3	1494-170	Section and Elevation of Dam
F-4	1494-171	Abutment--East End of Dam
F-5	1494-172	Transverse Sections Through Powerhouse
F-6	1494-173	Dam--Plan and Elevation
F-7	1494-174	Rock Profile--Borings
F-8	1494-175	Installation Fifth Unit, Plan and Elevation of Dam and Powerhouse
F-9	1494-176	Typical Buttress Details
F-10	1494-177	Buttress Slab Details
F-11	1494-178	Buttress Top Details
F-12	1494-179	Details Buttress No. 52
F-13	1494-180	Typical Arch Details
F-14	1494-181	Intake Structure--General
F-15	1494-182	Intake--Details Below Deck
F-16	1494-183	Intake--Details of Deck
F-17	1494-184	Temporary and Permanent Outlets
F-18	1494-185	Gravity Spillway Sections
F-19	1494-186	Gravity Non-Overflow Sections
F-20	1494-187	Inspection Gallery Gravity Section

F-21	1494-188	Training Wall--Main Spillway
F-22	1494-189	East Spillways--Weir and Pier Details
F-23	1494-190	East Spillways--Abutment Details
F-24	1494-191	Radial Gates--Main Spillway
F-25	1494-192	Radial Gates--East Spillway
F-26	1494-193	Bridge--Details, Arch Sections
F-27	1494-194	Bridge--Details, Arch Sections
F-28	1494-195	Powerhouse Area--General Layout
F-29	1494-196	Powerhouse--Plan at Elevation 660
F-30	1494-197	Powerhouse--Plan at Elevation 630
F-31	1494-198	Powerhouse--Plan at Elevation 606
F-32	1494-199	Powerhouse--Longitudinal Sections
F-33	1494-200	Powerhouse--Plans at House Unit
F-34	1494-201	15-Foot Penstocks
F-35	1494-202	36-Inch Penstocks

(3) All of the structures, fixtures, equipment or facilities used to operate or maintain the project and located within the project boundary, all portable property that may be employed in connection with the project and located within or outside the project boundary, and all riparian or other rights that are necessary or appropriate in the operation or maintenance of the project.

(C) The exhibits A, F, and G described above are approved and made part of the license.

(D) This license is subject to the articles set forth in Form L-3 (October 1975) [reported at 54 FPC 1817], entitled "Terms and Conditions of License for Constructed Major Project Affecting Navigable Waters of the United States," and the following additional articles:

Article 201. The Licensee shall pay the United States the following annual charges as determined by the Commission, effective the first day of the month in which this license is issued for the purposes of:

a. Reimbursing the United States for the cost of administration of Part I of the Act. The authorized installed capacity for that purpose is 115,900 horsepower.

Article 202. Pursuant to section 10(d) of the Act, a specified reasonable rate of return upon the net investment in the project shall be used for determining surplus earnings of the project for the establishment and maintenance of amortization reserves. One half of the project surplus earnings, if any, accumulated under the license, in excess of the specified rate of return per annum on the net investment, shall be set aside in a project amortization reserve account at the end of each fiscal year. To the extent that there is a deficiency of project earnings below the specified rate of return per annum for any fiscal year under the license, the amount of that deficiency shall be deducted from the amount of any surplus earnings subsequently accumulated, until absorbed. One-half of the remaining surplus earnings, if any, cumulatively computed, shall be set aside in the project amortization reserve account. The amounts established in the project amortization

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reserve account shall be maintained until further order of the Commission.

The annual specified reasonable rate of return shall be the sum of the annual weighted costs of long-term debt, preferred stock, and common equity, as defined below. The annual weighted cost for each component of the reasonable rate of return is the product of its capital ratio and cost rate. The annual capital ratio for each component of the rate of return shall be calculated based on an average of 13 monthly balances of amounts properly included in the Licensee's long-term debt and proprietary capital accounts as listed in the Commission's Uniform System of Accounts. The cost rates for long-term debt and preferred stock shall be their respective weighted average costs for the year, and the cost of common equity shall be the interest rate on 10-year government bonds (reported as the Treasury Department's 10-year constant maturity series) computed on the monthly average for the year in question plus four percentage points (400 basis points).

Article 401. The Licensee shall operate the Pensacola Project to control fluctuations of the reservoir surface elevation for the protection of fish, wildlife, and recreational resources associated with the Grand Lake O' the Cherokees (Grand Lake) reservoir. The Licensee shall act, to the extent practicable (except as necessary for the Department of the Army, Tulsa District, Corps of Engineers to provide flood protection in the Grand (Neosho) River), to maintain the reservoir surface elevations, as measured immediately upstream of the project dam. These target reservoir surface elevations are as follows:

(1) From October 16 through October 31, each year -- raise the reservoir surface elevation from elevation 741 feet to about elevation 742 feet Pensacola Datum (PD) to inundate the seeded mudflat areas supporting mature Japanese millet (seed heads) on which waterfowl feed and to provide habitat for invertebrates that are consumed by waterfowl.

(2) From November 1 through April 15, each year -- target the reservoir surface elevation at about elevation 742 feet PD to: (a) provide for maturation of Japanese millet (seed heads) on which waterfowl feed; (b) protect and enhance the fisheries habitat; and (c) minimize potential flooding of Beaver Dam Cave, which is used as a maternity site by the federally listed endangered gray bat (*Myotis grisescens*).

(3) From April 16 through May 31, each year -- raise the reservoir surface elevation from about elevation 742 feet to about elevation 745 feet PD to inundate approximately 3,000 acres of naturally revegetated mudflats and to provide maximum fishery benefits. From June 1 through July 5, each year -- maintain the reservoir surface elevation at about elevation 745 feet PD.

(4) From July 6 through July 15, each year -- lower the reservoir surface elevation from elevation 745 feet to about elevation 743 feet PD to expose mudflats for natural revegetation (such as, sedges, smartweed, and native grasses). From July 16 through July 31, each year -- maintain the reservoir surface elevation at about elevation 743 feet PD.

(5) From August 1 through August 14, each year -- lower the reservoir surface elevation from about elevation 743 feet to about elevation 741 feet PD to provide bare, moist mudflat acreage (500 to 1,000 acres) for Japanese millet seeding.

(6) From August 15 through October 15, each year maintain the reservoir surface elevation at about elevation 741 feet PD to provide for maturation of Japanese millet.

Article 402. Within 6 months from the date of issuance of this license, the Licensee shall consult with the Oklahoma Department of Wildlife Conservation (ODWC) to determine if the ODWC wishes to conduct an assessment of the impacts of water surface elevation fluctuation on fisheries recruitment, and if so, to provide water surface elevation data for Grand Lake O' the Cherokees (Grand Lake) reservoir to the ODWC for use in a fisheries-water surface elevation fluctuation assessment. Documentation that the ODWC does or does not wish to conduct such fisheries studies, shall be filed with the Commission within six months from the date of issuance of this license.

If the results of the water surface elevation monitoring and the fisheries studies (conducted by the ODWC) indicate that alternative measures need to be implemented at the project to enhance spawning and recruitment in Grand Lake, then ODWC may file a final report, for Commission consideration, including recommendations on the measures to enhance the fish populations, including a schedule and associated costs for implementing the recommended measures. The ODWC will also include the comments of the Licensee and the U.S. Fish and Wildlife Service on the report.

Article 403. Within 6 months from the date of issuance of this license, the Licensee shall file with the Commission for approval, a plan to monitor dissolved oxygen (DO) concentrations in the Grand (Neosho) River downstream of the project tailrace during the critical summer

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period of June 1 through September 30, annually. The exact sampling locations shall be determined in consultation with the Oklahoma Water Resources Board (OWRB), the U.S. Fish and Wildlife Service (FWS), and the Oklahoma Department of Wildlife Conservation (ODWC).

The Licensee shall prepare the plan after consultation with the OWRB, the FWS, and the ODWC. The Licensee shall include with the plan documentation of consultation with the agencies, copies of agency comments or recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the plan. The Licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations prior to filing the plan with the Commission. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on project-specific information.

The plan shall include, but not be limited to, the following: (a) a description of the method for monitoring DO concentrations and the location at which DO will be monitored; and (b) a schedule for submitting the monitoring results with the Commission and the consulted agencies. The Commission reserves the right to require changes to the plan. Upon Commission approval, the Licensee shall implement the plan, including any changes required by the Commission.

The results of the water quality monitoring shall be filed with the Commission as a final report according to the approved schedule, along with comments from the consulted agencies. The Licensee shall include in the final report, for Commission approval, recommendation(s) on measures to improve DO concentrations. Any recommendation(s) provided in the report shall also include a schedule for implementing the measure(s) at the project.

The recommended measure(s) to improve downstream DO concentrations shall be developed in consultation with the OWRB, FWS, and ODWC. The licensee shall allow a minimum of 30 days for the consulted agencies to comment and to make their own recommendations, based on the results of the water quality monitoring, on measure(s) to improve DO concentrations in the project tailrace, prior to filing the report with the Commission. Upon approval by the Commission, the Licensee shall implement the measure(s) to improve DO concentrations. The Commission reserves the right to require modifications to the recommendations included in the final report.

Article 404. Within 6 months from the date of issuance of this license, the Licensee shall file with the Commission for approval a plan to annually seed a maximum of 1,000 acres of mudflats, located between reservoir surface elevations 741 feet and 742 feet Pensacola Datum, with Japanese millet and/or other appropriate vegetation in concert with the implementation of the reservoir level management plan as stipulated in article 401. The mudflat seeding plan, developed for the enhancement of wildlife resources associated with the Grand Lake O' the Cherokees (Grand Lake) and in consultation with the U.S. Fish and Wildlife Service (FWS), the Oklahoma Department of Wildlife Conservation (ODWC), and the University of Oklahoma or other qualified entity, shall, at a minimum, include the following: (1) a map of sufficient scale identifying the location and acreage of the mudflats to be seeded; (2) a description of the plant species used and planting densities; (3) a monitoring program to evaluate the effectiveness of the mudflat seeding; (4) an implementation schedule; and (5) provisions for the filing of annual monitoring reports with the consulted agencies and the Commission.

If the results of the monitoring indicate that the Japanese millet and/or other applicable vegetation has not germinated by the fifth year, the mudflat seeding shall be terminated by mutual agreement among the FWS, ODWC, GRDA, and University of Oklahoma or other qualified entity, and after notification to the Commission of the agreed-upon termination.

The Licensee shall include with the plan documentation of consultation with the agencies before preparing the plan, copies of agency comments or recommendations on the completed plan after it has been prepared and provided to the agencies, and specific descriptions of how all the agency comments are accommodated by the plan. The Licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations prior to filing the plan with the Commission. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons based on project specific information.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the Licensee shall implement the plan, including any changes required by the Commission.

Article 405. Within 6 months from the date of issuance of this license, the Licensee, after consultation with The Nature Conservancy, Oklahoma Chapter (TNC) and the U.S. Fish and Wildlife Service, (FWS), shall implement the following measures to protect the federally listed endangered gray bat (*Myotis grisescens*).

(1) The Licensee shall provide the funds, equipment, and/or personnel necessary to construct, maintain, repair, and replace when necessary

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cave gates, fences, fence gates, signs, and vehicle barriers at one of the following historical gray bat caves in the Grand Lake area: DL-38 (the preferred site), OT-4, or OT-13.

(2) The Licensee shall provide assistance to TNC in maintaining, repairing, and replacing when necessary gates, fences, fence gates, signs, alarm system, and vehicle barriers at Twin Cave.

(3) The Licensee shall improve cave security at the cave protected under no. 1 above and Twin Cave through intermittent checks by the Grand River Dam Authority lake patrol.

(4) The Licensee shall evaluate the effectiveness of cave management features described above and once every five years submit a progress report to the FWS, Tulsa Field Office. The report shall provide the status of gray bats in Beaver Dam Cave (numbers of bats, frequency and magnitude of flooding during the five-year period) and the status of gray bat use in Twin Cave and the other managed cave.

(5) The Licensee shall develop and implement an educational program on the gray bat and cave conservation, which shall be included in the Licensee's public relations programs. The educational program shall include, but not be limited to, the following: (a) identification, life history, and beneficial qualities of the gray bat; (b) the need for protecting the gray bat; and (c) cave conservation. The educational program shall be available, upon request, to the local schools and organizations.

Article 406. Use of 1,630 acres of project lands as a wildlife management area, described on page 7 and identified in table 1 of the Supplemental Information to New License Application for Major Project - Existing Dam, filed with the Commission on August 31, 1990, is approved and made a part of this license and shall be implemented upon issuance of this license.

Article 407. Within 2 years from the date of issuance of this license, the Licensee shall file with the Commission, for approval, a long-term recreation plan for the Pensacola Project. Besides providing for recreation at the project, the plan shall provide for protection of the federally listed endangered bald eagle (*Haliaeetus leucocephalus*) by restricting shoreline development in bald eagle high use areas.

The recreation plan, at a minimum, shall include:

(1) a lake-use report that consists of: (a) estimates of existing and potential future use of Grand Lake by activity (such as, powerboating, sailing, fishing, waterskiing, waterfowl hunting); (b) the level of use (carrying capacity) that would begin to detract from a safe or enjoyable recreation experience; (c) recommended measures for managing lake use if it exceeds the carrying capacity determined in item (b); (d) a plan for providing public access to accommodate projected increases in lake use over the term of the license within the identified carrying capacity; and (e) a description of the methodologies used to satisfy the requirements of items (a) and (b);

(2) a list of maintenance standards for public recreation areas, including the entities that are responsible for maintaining each public recreation facility at Grand Lake;

(3) continued provision of a lake patrol and information center, including additional signs or brochures warning boaters of any hazardous areas created by reservoir drawdown to surface elevation 741 feet Pensacola Datum for mudflat seeding required in article 404;

(4) continued management of lakeshore development via the current permitting system; and

(5) a plan for managing fishing tournaments.

If any new recreation facilities are proposed for construction during the term of the license, the plan shall also include the following: (a) detailed descriptions of the facilities and a map of sufficient scale showing the type and location of each facility; (b) cost estimates and a schedule for completing the facilities; and (c) a description of how the recreational facilities shall be operated and maintained during the term of the license and the entity responsible for operation and maintenance. The needs of the disabled shall be considered in the design and construction of all recreational facilities.

The Licensee shall prepare the lake use report and final recreation plan after consultation with the Oklahoma Tourism and Recreation Department, the U.S. Fish and Wildlife Service, the Oklahoma Department of Wildlife Conservation, and the National Park Service. The Licensee shall include with the final plan documentation of consultation and copies of comments and recommendations on the lake use report and final plan after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated. The Licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations prior to filing the final plan with the Commission. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on project-specific information.

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The Commission reserves the right to require changes to the plan. Upon Commission approval, the Licensee shall implement the plan, including any changes required by the Commission.

Article 408. Within 1 year from the date of issuance of this license, the Licensee shall upgrade or arrange for the upgrading of the Duck Creek boat launch facilities at the Ketchum Recreation Area. Specifically, the Licensee shall: (1) elevate, to at least reservoir surface elevation 746 feet Pensacola Datum, and gravel the parking area; (2) widen the access road to accommodate two vehicles; (3) trim the brush along the access road; and (4) place a sign at the entrance of the access road to designate the area.

The Licensee shall upgrade these facilities after consultation with the Oklahoma Tourism and Recreation Department, the Oklahoma Department of Wildlife Conservation, and the Department of the Army, Tulsa District, Corps of Engineers. The Licensee shall, within 90 days of completion of construction of the recreation facilities, as improved, file as-built drawings of those recreation facilities.

The Licensee shall file a statement with the as-built drawings, indicating the entity responsible for operation and maintenance of the facilities.

Article 409. The Licensee, before starting any land-clearing or ground-disturbing activities within the project boundaries, other than those specifically authorized in this license, including recreation developments at the project, shall consult with the State Historic Preservation Officer (SHPO).

If the Licensee discovers previously unidentified archeological or historic properties during the course of constructing or developing project works or other facilities (including recreation developments) at the project, the Licensee shall stop all land-clearing and land-disturbing activities in the vicinity of the properties and consult with the SHPO.

In either instance, the Licensee shall file for Commission approval a cultural resource management plan prepared by a qualified cultural resource specialist after having consulted with the SHPO. The management plan shall include the following items: (1) a description of each discovered property indicating whether it is listed on or eligible to be listed on the *National Register of Historic Places;* (2) a description of the potential effect on each discovered property; (3) proposed measures for avoiding or mitigating effects; (4) documentation of the nature and extent of consultation; and (5) a schedule for mitigating effects and conducting additional studies. The Commission may require changes to the plan.

The Licensee shall not begin land-clearing or ground-disturbing activities, other than those specifically authorized in this license, or resume such activities in the vicinity of a property, discovered during construction or operation, until informed that the requirements of this article have been fulfilled.

Article 410. (a) In accordance with the provisions of this article, the Licensee shall have the authority to grant permission for certain types of use and occupancy of project lands and waters and to convey certain interests in project lands and waters for certain types of use and occupancy, without prior Commission approval. The Licensee may exercise the authority only if the proposed use and occupancy is consistent with the purposes of protecting and enhancing the scenic, recreational, and other environmental values (especially federally listed species) of the project. For those purposes, the Licensee shall also have continuing responsibility to supervise and control the use and occupancies for which it grants permission, and to monitor the use of, and ensure compliance with the covenants of the instrument of conveyance for, any interests that it has conveyed, under this article. If a permitted use and occupancy violates any condition of this article or any other condition imposed by the Licensee for protection and enhancement of the project's scenic, recreational, or other environmental values, or if a covenant of a conveyance made under the authority of this article is violated, the Licensee shall take any lawful action necessary to correct the violation. For a permitted use or occupancy, that action includes, if necessary, canceling the permission to use and occupy the project lands and waters and requiring the removal of any noncomplying structures and facilities.

(b) The type of use and occupancy of project lands and water for which the Licensee may grant permission without prior Commission approval are: (1) landscape plantings; (2) noncommercial piers, landings, boat docks, or similar structures and facilities that can accommodate no more than 10 watercraft at a time and where said facility is intended to serve single-family type dwellings; and (3) embankments, bulkheads, retaining walls, or similar structures for erosion control to protect the existing shoreline. To the extent feasible and desirable to protect and enhance the project's scenic, recreational, and other environmental values, the Licensee shall require multiple use and occupancy of facilities for access to project lands or waters. The Licensee shall also ensure, to the satisfaction of the Commission's authorized representative, that the use and occupancies for which it grants permission are maintained in good repair and comply with

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applicable state and local health and safety requirements. Before granting permission for construction of bulkheads or retaining walls, the Licensee shall: (1) inspect the site of the proposed construction, (2) consider whether the planting of vegetation or the use of riprap would be adequate to control erosion at the site, and (3) determine that the proposed construction is needed and would not change the basic contour of the reservoir shoreline. To implement this paragraph (b), the Licensee may, among other things, establish a program for issuing permits for the specified types of use and occupancy of project lands and waters, which may be subject to the payment of a reasonable fee to cover the Licensee's costs of administering the permit program. The

Commission reserves the right to require the Licensee to file a description of its standards, guidelines, and procedures for implementing this paragraph (b) and to require modification of those standards, guidelines, or procedures.

(c) The Licensee may convey easements or rights-of-way across, or leases of, project lands for: (1) replacement, expansion, realignment, or maintenance of bridges and roads for which all necessary state and federal approvals have been obtained; (2) storm drains and water mains; (3) sewers that do not discharge into project waters; (4) minor access roads; (5) telephone, gas, and electric utility distribution lines; (6) nonproject overhead electric transmission lines that do not require erection of support structures within the project boundary; (7) submarine, overhead, or underground major telephone distribution cables or major electric distribution lines (69 kV or less); and (8) water intake or pumping facilities that do not extract more than one million gallons per day from a project reservoir. No later than January 31 of each year, the Licensee shall file three copies of a report briefly describing for each conveyance made under this paragraph (c) during the prior calendar year, the type of interest conveyed, the location of the lands subject to the conveyance, and the nature of the use for which the interest was conveyed.

(d) The Licensee may convey fee title to, easements or rights-of-way across, or leases of project lands for: (1) construction of new bridges or roads for which all necessary state and federal approvals have been obtained; (2) sewer or effluent lines that discharge into project waters, for which all necessary federal and state water quality certification or permits have been obtained; (3) other pipelines that cross project lands or waters but do not discharge into project waters; (4) nonproject overhead electric transmission lines that require erection of support structures within the project boundary, for which all necessary federal and state approvals have been obtained; (5) private or public marinas that can accommodate no more than 10 watercraft at a time and are located at least one-half mile from any other private or public marina; (6) recreational development consistent with an approved exhibit R or approved report on recreational resources of an exhibit E; and (7) other uses, if: (i) the amount of land conveyed for a particular use is five acres or less; (ii) all of the land conveyed is located at least 75 feet, measured horizontally, from the edge of the project reservoir at normal maximum surface elevation; and (iii) no more than 50 total acres of project lands for each project development are conveyed under this clause (d)(7) in any calendar year. At least 45 days before conveying any interest in project lands under this paragraph (d), the Licensee must submit a letter to the Director, Office of Hydropower Licensing, stating its intent to convey the interest and briefly describing the type of interest and location of the lands to be conveyed (a marked exhibit G or K map may be used), the nature of the proposed use, the identity of any federal or state agency official consulted, and any federal or state approvals required for the proposed use. Unless the Director, within 45 days from the filing date, requires the Licensee to file an application for prior approval, the Licensee may convey the intended interest at the end of that period.

(e) The following additional conditions apply to any intended conveyance under paragraph (c) or (d) of this article:

(1) Before conveying the interest, the Licensee shall consult with federal and state fish and wildlife or recreation agencies, as appropriate, and the State Historic Preservation Officer.

(2) Before conveying the interest, the Licensee shall determine that the proposed use of the lands to be conveyed is not inconsistent with any approved exhibit R or approved report on recreational resources of an exhibit E; or, if the project does not have an approved exhibit R or approved report on recreational resources, that the lands to be conveyed do not have recreational value.

(3) The instrument of conveyance must include covenants running with the land adequate to ensure that: (i) the use of the lands conveyed shall not endanger health, create a nuisance, or otherwise be incompatible with overall project recreational use; and (ii) the grantee shall take all reasonable precautions to insure that the construction, operation, and maintenance of structures or facilities on the conveyed lands will occur in a manner that will protect the scenic, recreational, and environmental values of the project.

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(4) The Commission reserves the right to require the Licensee to take reasonable remedial action to correct any violation of the terms and conditions of this article, for the protection and enhancement of the project's scenic, recreational, and other environmental values.

(f) The conveyance of an interest in project lands under this article does not in itself change the project boundaries. The project boundaries may be changed to exclude land conveyed under this article only upon approval of revised exhibit G or K drawings (project boundary maps) reflecting exclusion of that land. Lands conveyed under this article will be excluded from the project only upon a determination that the lands are not necessary for project purposes, such as operation and maintenance, flowage, recreation, public access, protection of environmental resources, and shoreline control, including shoreline aesthetic values. Absent extraordinary circumstances, proposals to exclude lands conveyed under this article from the project shall be consolidated for consideration when revised exhibit G or K drawings would be filed for approval for other purposes.

(g) The authority granted to the Licensee under this article shall not apply to any part of the public lands and reservations of the United States included within the project boundary.

Article 501. If the Licensee's project was directly benefitted by the construction work of another licensee, a permittee, or the United States on a storage reservoir or other headwater improvement during the term of the original license (including extensions of that term by annual licenses), and if those headwater benefits were not previously assessed and reimbursed to the owner of the headwater improvement, the Licensee shall reimburse the owner of the headwater improvement for those benefits, at such time as they are assessed, in the same manner as for benefits received during the term of this new license.

(E) The Licensee shall serve copies of any Commission filing required by this order on any entity specified in this order to be consulted on matters related to that filing. Proof of service on these entities must accompany the filing with the Commission.

(F) This order is issued under authority delegated to the Director and constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 C.F.R. section 385.713 .

Environmental Assessment

Federal Energy Regulatory Commission

Office of Hydropower Licensing, Division of Project Review

Pensacola Hydroelectric Project

FERC Project No. 1494-002 -- Oklahoma

November 19, 1991

I. Application

On December 23, 1985, Grand River Dam Authority (GRDA) filed an application for a relicense for the existing Pensacola Hydroelectric Project, FERC Project No. 1492. On April 29, 1988, July 3, 1990, and August 30, 1990, GRDA supplemented its application.

The Pensacola Hydroelectric Project is located on Grand (Neosho) River near the Towns of Langley and Disney, Mayes County, Oklahoma (*see* figure 1).

II. Purpose and Need for Power

A. *Purpose*

The existing Pensacola Hydroelectric Project would continue to generate an estimated 370,000 megawatthours (MWh) of electric energy per year, which would be used by GRDA to serve its contract customers. There are no competing applications for the Pensacola Project. This environmental assessment (EA) analyzes the effects associated with the issuance of a new license for the project and recommends terms and conditions to become a part of any license issued.

The Federal Power Act (Act) provides the Federal Energy Regulatory Commission (Commission) with the exclusive authority to license nonfederal waterpower projects on navigable waterways and federal lands. Pursuant to section 15(a)(1) of the Act, upon expiration of a license, if the federal government does not exercise its right to take over the project (with equitable compensation) as provided by section 14 of the Act, then the Commission can issue a new license to either the existing license or a new licensee.

For any license issued, the Commission must determine that the project adopted will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and development purposes for which licenses are issued, the Commission shall give equal consideration to the purposes of energy conservation, the protection, mitigation of damage to, and enhancement of fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality.

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B. *Need for Power*

The GRDA is an agency of the State of Oklahoma. This agency was created to control, store, preserve, use, and sell water of the Grand River and its tributaries; and to develop, generate, distribute, and sell electric power and energy, steam, and treated water. The GRDA has applied for a new 50-year license to continue operation of the Pensacola Project.

The GRDA began construction on Pensacola dam in 1938. The dam began impounding water when the gates were closed in March 1940. On November 19, 1941, President Roosevelt issued an Executive Order directing the Federal Works Administrator to take possession of and operate the Pensacola Project. On August 31, 1943, President Roosevelt issued an Executive Order transferring management of the Pensacola Project to the Department of Interior (Interior). On September 1, 1943, Interior created the Southwestern Power Administration, which operated the project. This action was an effort to further national defense during World War II. On August 31, 1946, the Pensacola Project was returned to GRDA by Congressional legislation. The project has been operated and maintained by GRDA since that date.

As a wholesale Oklahoma State utility, GRDA supplies the capacity and energy (electric) requirements of 60 wholesale-contract customers. Fourteen of the 60 wholesale customers are municipalities, three are Rural Electrification Administration contract customers, and 43 are large-demand industrial customers. Fifty years of the project's operating history are adequate confirmation of GRDA's need for the Pensacola Hydroelectric Project power.

III. Proposed Project and Alternatives

A. *Proposed Project*

The existing project (*see* figure 2) consists of:

1. a main dam, which has a maximum height of 147 feet, and is comprised of (a) a 53.5-foot-long nonoverflow abutment section on the west end, (b) a 4,284-foot-long multiple-arch section with a crest elevation of 757 feet Pensacola Datum (PD), (c) an 861-foot-long main spillway section, which has a crest elevation of 730 feet PD and is controlled by 21 Taintor gates each 36 feet long by 25 feet high, (d) a 451-foot-long nonoverflow gravity section on the east end, and (e) a 300-foot-long nonoverflow abutment section consisting of a concrete core wall;

2. two auxiliary spillways with approximate lengths of 464 feet and 422 feet about 1.0 mile east of the main dam, which consist of concrete gravity overflow type spillways with crest elevations of 740 feet PD controlled by a total of 21 Taintor gates each 37 feet long by 15 feet high;

3. the Grand Lake O' the Cherokees (Grand Lake) reservoir, which has a surface area of 46,500 acres and a storage volume of 1,680,000 acre-feet at the maximum power pool of 745 feet PD;

4. a 27-foot by 246-foot intake structure;

5. a powerhouse with dimensions of 87.75 feet by 279.0 feet, located immediately downstream of the western end of the dam, which contains seven turbine-generator units with a total nameplate capacity of 86,900 kilowatts (kW); and,

6. appurtenant equipment and facilities.

In addition to power generation, Grand Lake reservoir is used for flood control. The flood storage allocation lies between elevations 745 feet PD and 755 feet PD. Whenever the reservoir elevation is within the limits of the flood pool, the Department of the Army, Tulsa District, Corps of Engineers (Corps) directs the water releases from the dam.

B. *Proposed Enhancement Measures*

1. Construction. None.

2. Operation. The GRDA proposes to minimize public disturbance and other impacts to the federally listed endangered bald eagle (*Haliaeetus leucocephalus*) by: (a) protecting the bald eagle communal roost at Twin Bridges State Park from boat and land access during winter (from November through March); (b) closing during winter or moving the boat access ramp on the Neosho River side of Twin Bridges State Park; (c) enforcing laws that prohibit blackbird shooting at Twin Bridges State Park in order to prevent potential lead poisoning of bald eagles which use this area; and (d) restricting shoreline development in bald eagle high use areas.

To enhance terrestrial resources, GRDA proposes to manage, in cooperation with the Oklahoma Department of Wildlife Conservation (ODWC), approximately 1,630 acres of project lands as a wildlife management area.

The GRDA proposes to implement a new reservoir level management plan, which would modify the Grand Lake operating rule curve. The end-of-the-month target for reservoir elevation would be: from October through March, elevation 742 feet Pensacola Datum (PD); for April, a gradual rise in lake level; from May through July, elevation 743.5 feet PD; and from August through September, elevation 741 feet PD.

In addition, GRDA proposes to assist the ODWC in seeding mudflats. The GRDA states that detailed procedures regarding the mudflat seeding plan will be developed in consultation

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with the ODWC. Furthermore, GRDA proposes to rely on ODWC to schedule the seeding program and to identify when reseeding is required (Grand River Dam Authority, 1991a).

The GRDA would continue to provide a lake patrol and information center at the Pensacola dam.

C. *Alternatives to the Proposed Project*

1. Federal Takeover: The federal government could, by Act of Congress, take over this project and operate it according to section 14 of the Act, 16 U.S.C. section 807 (a). On its own motion or upon recommendation of a federal department or agency, the Commission could recommend this alternative to Congress, after notice and opportunity for hearing. No entity has recommended federal takeover of the Pensacola Project and we see no reason to exercise this option. Therefore, this alternative has not been given any further consideration.

2. Denial of License: Denial of the license would result in the cessation of hydropower generation at the project. This action could lead to removal of the power facilities or removal of all project works. The GRDA would have to find a replacement source of energy. Possible alternative sources of power include construction of a coal-fueled, condensing steam turbine-generator, a coal-fueled cogeneration unit, diesel generation, combustion turbines,

and additional purchases from other power companies. Each of these alternative power sources rely on the consumption of nonrenewable fuels.

Denial of the license application would also result in no requirement for GRDA to provide enhancement measures discussed in section V.B. of this report and no dam safety oversight by the Commission. Therefore, this alternative has not been given further consideration.

3. Alternative Project Operations: Alternative modes of operation of the project considered include the proposed mode and the current mode of operation. Currently, GRDA operates the project according to a new reservoir operating rule curve, which was implemented in 1982. Proposed project operation is discussed in sections V.B.2, V.B.3, V.B.4, and V.B.7 of this report.

D. *Alternative of No Action*

No action on the application for a license is not a reasonable alternative since the Commission has found that the project requires a license and must take some administrative action on all pending applications.

IV. Consultation and Compliance

A. *Agency Consultation*

The following entities commented on the application subsequent to the public notice, which was issued on March 25, 1987. All comments become part of the record and are considered during the staff's analysis of the proposed project.

Commenting agencies and other entities -- Date of letter

U.S. Department of the Interior -- 05/14/87

National Marine Fisheries Service -- 05/31/88

Oklahoma Department of Wildlife Conservation -- 08/17/88, 02/20/91

U.S. Fish and Wildlife Service -- 04/13/87, 09/09/88, 08/30/90, 09/20/90, 10/17/90, 12/21/90, 07/09/91

By letters dated February 2, 1989, August 30, 1990, February 22, 1991, and August 16, 1991, GRDA responded to the agency comments.

In addition to providing comments, organizations and individuals may petition to intervene and become a party to any subsequent proceedings. The State of Oklahoma filed an untimely motion on June 15, 1987, to intervene in the licensing proceeding, stating that the GRDA is a governmental agency of the state. The State of Oklahoma has interests in the proceeding, but does not oppose the project licensing. On September 12, 1991, the Commission granted the State of Oklahoma late intervention. The GRDA did not respond to the motion to intervene.

B. *Water Quality Certification*

On September 12, 1984, GRDA requested that the Oklahoma Water Resources Board (OWRB) issue a section 401 water quality certificate for the Pensacola Project. The GRDA received section 401 water quality certification, as required by the Clean Water Act, from the OWRB on January 16, 1985. In the certification, the OWRB required that GRDA monitor water quality when dissolved oxygen (DO) levels are low.

V. Environmental Analysis

A. *General Description of the Locale* (Source: Federal Energy Regulatory Commission, 1978).

1. Grand (Neosho) River Basin. The Grand (Neosho) River rises in the Flint Hills of east central Kansas, near Parkerville in Morris County, and flows southeasterly for a distance of 314 miles, thence generally south for 164 miles to its confluence with the Arkansas River

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at river mile 459.5 near Muskogee, Oklahoma. The stream is known as the Grand River from its mouth to Spring River, at river mile 131, and as the Neosho River upstream from the mouth of Spring River. The drainage basin is about 260 miles in length with a maximum width of 90 miles near the Kansas-Oklahoma state line and a minimum width of 20 miles at about river mile 380. The river basin has a total area of 12,110 square miles of which 6,220 square miles are in Kansas, 2,960 are in Missouri, 2,930 are in Oklahoma, and 410 are in Arkansas.

The river traverses the transition area between the Central Lowland to the west and the Ozark Plateau on the east. The Flint Hills, in the area of origin in southeastern Kansas, and the Sandstone Hills in the Lowland Plains in eastern Oklahoma, provide minor relief. The gentle slopes of the prairies are in considerable contrast to the rugged terrain with its steep slopes and narrow valleys which are characteristic of the Ozark Plateau. Elevations range from approximately 1,500 feet mean sea level (m.s.l.) in the upper basin to about 500 feet m.s.l. in the lower basin. Principal tributaries of the Grand (Neosho) River are Spring River, Cottonwood River, Elk River, Labette Creek, Big Cabin Creek, Spavinaw Creek, and Lightning Creek.

Agriculture and the raising of livestock are common throughout the area. Corn, small grains, sorghum, alfalfa, fruits, and vegetables are the principal crops grown.

Mineral deposits found in the basin are coal, clay, lead, zinc, lime, petroleum, natural gas, stone, and sand and gravel. The mining of these deposits is an important economic activity. In addition to mining, other industries in the basin include chemical and food processing. Hunting and fishing enhance the recreational values of the river basin.

2. Proposed and Existing Hydropower Development. As of February 6, 1991, there are five hydroelectric projects in the Grand (Neosho) River Basin. Of these, four are operating major projects licensed by the Commission and one is a Corps project. One of the four projects licensed by the Commission is a pumped-storage project (Federal Energy Regulatory Commission, 1991).

In addition to the five operating hydroelectric projects, the Commission has issued a preliminary permit to study the hydropower potential at a sixth site.

The Pensacola dam is located at river mile 77.0 on the Grand (Neosho) River and its reservoir impoundment extends about 66 miles upstream from the dam. The next dam downstream is the Markham Ferry Project, FERC Project No. 2183, at river mile 47.4 and its reservoir impoundment (Lake Hudson) extends to the powerhouse of the Pensacola Project. The next dam upstream of Pensacola dam on the Grand (Neosho) River creates the John Redmond Lake which is located at river mile 343.7. The John Redmond Reservoir is one of three Corps' flood control projects in the headwaters of the Grand (Neosho) River Basin and does not have any hydropower equipment installed.

The only hydroelectric project located upstream of the Pensacola Project is the Riverton Project, FERC Project No. 9419, which is on the Spring River.

3. Target Resources. We identified water quality (i.e., DO concentrations) as an important resource within the Grand River Basin that may be cumulatively affected by multiple development within the basin. Protecting the Grand River Basin's water quality (i.e., DO) is important because the basin serves as a receiving water for effluents from sewage treatment plants, septic tank fields, and nonpoint agricultural runoff. The river also serves as a water supply for municipal users as well as a recreational resource.

Relicensing the existing Pensacola Project with our recommendation to enhance DO concentrations as measured immediately downstream of the project's tailrace in the Grand (Neosho) River would improve water quality in the Grand River downstream of the project and have cumulative beneficial impacts on aquatic habitat and fishery resources.

B. *Proposed Project*

We have reviewed the existing project in relation to the environmental resources in the project impact area and have concluded that there would be no direct or indirect adverse environmental impacts on aesthetic resources because (1) no aesthetic issues have been raised by any resource agency or other entities during the consultation process and (2) no construction activities are proposed. Implementation of our recommended reservoir level management plan would have a long-term, positive aesthetic effect on the project area landscape because of less dewatering and exposure of shoreline.

1. Geological Resources

Affected Environment: The existing project is located on the border between the Ozark Plateau and the Prairie Plains. Bedrock in the project area includes limestone, chert, sandstone, and shale. The project dam is constructed on chert. The southern and eastern portions of the project area (the lower portion of the reservoir) reflect the rugged topography of the Ozark Plateau, which consists of deep ravines and narrow valleys separated by broad, gently rolling uplands. The banks of the lower

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portions of the reservoir are mostly limestone bluffs and steep rocky beaches. The northern and western portions of the project area lie in the Prairie Plains which are typified by gently rolling plains with occasional hills and ridges. The shoreline in these portions of the reservoir generally have gentler slopes. Wetlands are confined to inlets and coves along the numerous small tributaries that enter the reservoir, and are more abundant along the upper, more shallow reaches of the reservoir. Extensive cave systems occur in some of the limestone formations along the reservoir.

Environmental impacts and recommendations: The resource agencies have not raised any issues or made any comments or recommendations concerning geology or soil resources. Implementation of our recommended reservoir level management plan and associated grain seeding for the Pensacola Project would increase vegetative cover on currently exposed mudflats (*see* sections V.B.3, page 12 and V.B.4, page 20). The seeding of mudflats would protect these areas from soil erosion and reduce the potential for turbidity.

Unavoidable Adverse Impacts: None.

2. Water Resources

Affected Environment: Pensacola dam impounds Grand Lake O' the Cherokees (Grand Lake), which has a surface area of approximately 46,500 acres. In addition to hydropower generation, project waters are used for water supply, flood control, and recreation. There are 18 sewage treatment plants releasing effluent into Grand Lake or its tributaries.

The Pensacola Project operates in a peaking mode with releases from six turbines having a total hydraulic capacity of 10,200 cubic feet per second (cfs). Releases may be made irregularly in response to system power demands and flood control and are generally greatest from November to May. During the warmer periods of the year when inflows to the project are lowest, generation releases are phased back. There is no required release flow; however, the downstream gage records a minimum flow of approximately 25 cfs, probably derived from a combination of project leakage and inflow from a small tributary upstream from the gage.

In operating the Pensacola Project for hydropower, GRDA controls use of the pool up to 745 feet PD. Between 745 feet PD and 755 feet PD, the Corps controls releases, managing for flood control.

Until 1982, GRDA operated the Pensacola Project allowing the pool elevation to fall to 734 feet PD during the summer and 730 feet PD during drought years. In 1982, GRDA implemented a modified reservoir level management rule curve for the Pensacola Project principally to improve fish and wildlife resources and recreational resources. The minimum pool elevation was set at 740 feet PD with a drawdown to 732 feet PD during extreme drought. By June 1, the pool would be at its maximum elevation of 745 feet PD.

Since 1982, as a result of operating to meet the new rule curve, the frequency and magnitude of flood events (i.e., water level exceeding 745 feet PD) increased markedly (Grand River Dam Authority, 1990a). From 1976 to 1982 pool elevations exceeded 746 feet PD twice; from 1982 to 1989, 746 feet PD was exceeded at least once every year. The new operations have clearly reduced the project's capacity to store inflows during the hydrologic year and have increased the frequency of its function in flood control.

GRDA has monitored water quality in Grand Lake and in the project's powerhouse tailrace. Water temperature, DO, pH, and conductivity were profiled in the respective water columns. Data revealed that Grand Lake was strongly stratified in late May 1987 and 1988, and that stratification persisted through late October in 1986, 1987, and 1988. DO concentrations in the hypolimnion (lower depths) of Grand Lake commonly approached zero during the summer and fall. Hypolimnetic waters, low in DO, were entrained by the project for hydropower generation and released into the tailrace, frequently creating low DO conditions downstream (table 1). During the study period, DO concentrations were less than 5.0 mg/l on a number of sampling dates and less than 2.0 mg/l on one occasion.

Environmental impacts and recommendations:

Dissolved oxygen: The OWRB defines the Grand River in the project area as a primary warmwater fishery. State water quality standards for DO vary seasonally to enhance fish spawning success:

Month/day -- Daily average DO concentration standard

4/1 to 6/15 -- 6.0 mg/l (not less than 5.0 for 8 hrs/day)

6/16 to 10/15 -- 5.0 mg/l (not less than 4.0 for 8 hrs/day)

10/16 to 3/31 -- 5.0 mg/l (instantaneous minimum).

Project operation degrades water quality in the Grand River downstream from the Pensacola dam during the summer and fall. The data provided by GRDA (table 1) show that violations of Oklahoma state standards for DO concentrations can be expected from late May or June through October.

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Table 1. Discharges and average tailrace DO concentrations at the Pensacola Project, 1986-1990 (source: Grand River Dam Authority, 1988b; personal communication, Gary Hunt, Manager, Environmental Services, Benham-Holway Power Group, Tulsa, Oklahoma).

Date	Discharge cfs	Tailrace DO mg/1	Date	Discharge cfs	Tailrace DO mg/1
10/ 9/86	9,960	4.3	6/10/88	0	6.2
10/17/86	10,830	4.3 *	6/14/88	0	6.5
10/23/86	11,210	4.4	6/21/88	500	4.6 *
10/28/86	11,100	4.0	6/30/88	0	5.0
11/19/86	11,120	9.1	7/19/88	2,180	3.4 *

12/17/86	10,530	10.9	7/26/88	1,210	2.5	*
1/13/87	4,960	11.4	8/ 2/88	0	2.4	*
2/ 4/87	9,520	11.6	8/ 9/88	0	3.0	*
3/13/87	11,070	10.8	8/18/88	0	3.2	*
4/ 8/87	11,470	9.3	8/24/88	0	2.5	*
5/27/87	9,520	5.5	9 1/88	0	4.1	*
6/ 3/87	11,090	5.1	9 13/88	0	3.4	*
6/ 9/87	11,230	5.2	9 22/88	missing	4.3	*
6/16/87	1,060	4.6	9 30/88	1,544	6.3	
6/23/87	2,380	2.7	10/ 7/88	2,470	6.3	
6/30/87	2,380	2.8	1 19/89	3,110	12.0	
7/15/87	10,380	5.2	2/28/89	7,500	12.6	
7/21/87	1,190	2.7	3 23/89	10,910	12.5	
7/29/87	0	4.7	4 24/89	1,230	10.3	
8/ 4/87	1,200	2.9	5 25/89	11,130	8.4	
8/11/87	600	1.6	6 29/89	0	3.1	*
8/20/87	2,980	4.6	7 25/89	0	4.8	*
8/27/87	7,740	5.3	8/23/89	11,580	3.9	*
9/ 4/87	4,800	5.2	10/ 4/89	0	6.2	
9/ 9/87	960	3.4	10/30/89	0	7.8	

9/15/87	1,440	4.7	11/15/89	830	8.3	
9/24/87	1,210	5.5	1/10/90	0	12.9	
10/ 1/87	3,630	7.2	2/ 9/90	6,030	12.8	
10/ 6/87	730	7.8	3/27/90	12,360	8.1	
10/15/87	730	5.7	5/ 2/90	12,140	9.3	
10/22/87	1,330	6.0	6/18/90	12,410	4.4	*
10/27/87	2,540	6.3	7/10/90	50	2.7	*
2/24/88	10,560	12.9	8/ 6/90	60	6.2	
3/24/88	10,450	11.8	9/ 5/90	0	2.6	*
4/27/88	12,170	8.2	10/ 2/90	5,240	4.8	*
5/25/88	2,950	8.1				

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* violation of Oklahoma DO

standards

The GRDA dismissed the impacts of low DO concentration conditions as not being harmful to fish which, GRDA stated, are free to move out of the tailrace into Lake Hudson proper.

The ODWC and U.S. Fish and Wildlife Service (FWS) recommended that GRDA develop means to improve DO concentrations in the project tailwater in order to comply with state DO standards. Such modifications would enhance downstream aquatic habitat and fishery resources and, thus, improve recreational resources. GRDA's fishery study reached the same conclusion (Grand River Dam Authority 1990a). The agencies recommended downstream reaeration, air injection, destratification, or multilevel withdrawal as possible means for achieving the desired water quality improvements. Releasing well-oxygenated surface water during the summer and fall is an additional option not explicitly suggested by the agencies. Use of a surface (Garten) pump to force well-oxygenated surface waters down to the level of the project intakes might also prove a relatively inexpensive, effective method. By letter dated March 17, 1986, the U.S. Environmental Protection Agency commented that if state water quality standards for DO are not being met downstream of the project, GRDA should take corrective actions to attain and maintain the standards (Clinton B. Spotts, Regional EIS Coordinator, Environmental Protection Agency, Dallas, Texas).

The GRDA rejected the agency-recommended methods to improve downstream water quality. Basically, GRDA contended that any of the proposed methods would be too costly and would only benefit a few fishermen.

DO concentrations of the Grand River downstream from the Pensacola Project would need to be increased in order to enhance and improve

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downstream aquatic resources, in particular, aquatic habitat and fishery resources. Such improvements would also benefit water quality in the downstream Lake Hudson.

A number of options have been identified which may serve to help the licensee achieve downstream DO enhancement objectives. Other options for increasing aeration could include: Howell-Bunger valves or, as previously mentioned, epilimnion surface water pumps to drive surface waters down to the level of the intakes. These options, among others have recently been discussed in a document, "Assessment and Guide for Meeting Dissolved Oxygen Standards for Hydroelectric Plant Discharges" (Electric Power Research Institute, 1990).

Therefore, if a license is issued for the Pensacola Project, we recommend the licensee consult with the ODWC, FWS, and OWRB to develop and implement a plan to enhance DO concentrations as measured immediately downstream of the project's tailrace in the Grand River. The licensee should include in the plan a provision to monitor downstream DO concentrations in the project's tailrace to ensure that the releases from the project are meeting the standards of the plan.

Unavoidable Adverse Impacts: None.

3. Fishery Resources

Affected Environment: According to GRDA, fish fauna of Grand Lake are typical of regional reservoirs. Predominant species are those which occurred historically in the river prior to impoundment. These species include longnose gar, gizzard shad, carp, river carpsucker, smallmouth buffalo, channel catfish, blue catfish, flathead catfish, warmouth, spotted bass, white bass, hybrid striped bass/white bass, logperch, paddlefish, bluegill, largemouth bass, white crappie, freshwater drum, skipjack herring, emerald shiner, river shiner, red shiner, ghost shiner, silverband shiner, bullhead minnow, blue sucker, river redhorse, and river darter. Both the lake and tailrace fisheries provide valuable recreation resources for the region.

Environmental Impacts and Recommendations

a. *Reservoir Level Management Plan*: The modified reservoir level management rule curve instituted by GRDA in 1982 had the effect of lessening annual water level fluctuations and maintaining pool elevations higher than previously. Operating the project under the previous rule curve (i.e., prior to 1982) created extensive mudflat areas that were not exposed; the 1982 modified rule curve narrowed the range of surface elevation changes to about 5 feet, significantly diminishing the amount of mudflat areas that were not exposed (for further discussion on mudflats, refer to section V.B.4, page 20).

According to one of GRDA's fishery studies, one of the effects associated with the implementation of the modified rule curve in 1982 was a decline in the number of young-of-year largemouth bass being produced. These studies showed that additional minor changes in the operating rule curve implemented in 1982 could result in significant benefits to the fishery resources in the reservoir. Improving reservoir level management to promote nursery cover and increased production had the greatest potential for enhancing fisheries by increasing largemouth bass recruitment.

GRDA has now proposed some additional modifications to its reservoir level management plan. During the spring (April), GRDA would gradually raise the lake level by 1.5 feet to 743.5 feet PD to increase nursery areas for fish and would maintain this elevation from May through July. From August through September, GRDA would lower the pool by 2.5 feet to 741 feet PD to create a greater expanse of mudflats for seeding. From October through March, the elevation would be maintained at 742 feet PD.

By letter dated September 20, 1990, the FWS stated that any improvements resulting from GRDA's proposed additional modifications to its reservoir level management plan would be inadequate (Stephen W. Forsythe, Field Supervisor, U.S. Fish and Wildlife Service, Tulsa, Oklahoma). The FWS recommended that GRDA develop a better plan in coordination with ODWC and FWS. By letter dated July 20, 1990, the ODWC recommended the development of a reservoir level management plan to improve fish production and nursery cover availability in coordination with FWS and ODWC (Steven Alan Lewis, Director, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma).

By letter dated February 20, 1991, the ODWC provided its reservoir level management plan to GRDA (Steven Alan Lewis, Director, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma). The ODWC's recommended reservoir level management plan is similar to GRDA's, but includes a higher maximum elevation and a lower minimum elevation (see diagram 1 below).

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Diagram 1 Comparison of ODWC's recommended reservoir level and GRDA's proposed rule curve and GRDA's rule curve

From November 1 through March 31, both ODWC's and GRDA's rule curves would set the reservoir elevation at 742 feet PD. According to ODWC, if water level fluctuates drastically from November through March, fishery benefits may be diminished; to maximize fishery benefits the water level must be stabilized at 742 feet PD beginning on November 1 of each year. ODWC would allow the elevation to rise to 745 feet PD by May 15, while GRDA would increase the reservoir only to 743.5 feet PD by May 1. The ODWC would have its recommended pool elevation 745 feet PD held until July 1, while GRDA would maintain its pool elevation 743.5 feet PD until August 1. The ODWC stated that the naturally revegetated area between 742 feet PD and 745 feet PD that would be inundated with their recommended elevation maintenance would provide improved fish nursery habitat from May 15 until July 1 (*see* table 2).

Table 2. Oklahoma Department of Wildlife Conservation's recommended reservoir level management plan and potential improvements to fish and wildlife resources (source: Letter dated February 29, 1991, from Steven Alan Lewis, Director, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma).

Date	Elevation (Feet PD)	Potential Improvements
April 1--July 1	742.0--745.0. The increases in lake level beginning April 1, should reach 745.0 by May 15. Lake	Habitat development: 3,000 acres available for natural revegetation to provide fish nursery habitat (May 15--July 1). Stable water levels would benefit spawning fish (i.e., crappie and black bass).

	level should be maintained at 745.0 until July 1.	
July 1--Aug. 7	Lake level begins to decrease to 742.0	Expose mudflats for natural revegetation.
Aug. 7--Aug. 15	Decrease lake level from 742.0 to 740.5 (1.5 feet). Lake level constant at 740.5.	Provides moist mudflat acreage (500 to 1,000 acres) for millet seeding.

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Sept. 1--Sept. 30	Lake level constant at 740.5.	Provides for millet growth.
Oct. 1--Oct. 31	Increase lake level to 741.0.	Planted millet tall enough to support some inundation.
Nov. 1--Mar. 31	Maintain lake level at 742.0	Provides for maturation of millet and waterfowl to feed on the

millet seeds. Also, fish nursery

habitat becomes available.

ODWC further recommended starting drawdown to the 742 feet PD elevation on July 1, to be achieved by August 7, and followed by another drop to 740.5 feet PD by August 15. ODWC prefers to begin dropping the lake level by July 1 to expose mudflats for natural revegetation. The GRDA has found ODWC's 745 feet PD elevation recommendation acceptable, but GRDA does not concur with the shorter duration for holding the reservoir at that elevation (letter dated August 16, 1991, Carolyn Elefant, Attorney, Duncan & Allen, Washington, D.C.). GRDA stated that starting rapid drawdown in July "would affect the most efficient use of the storage capacity of the reservoir" which, GRDA states, is most valuable in July and August, the summer peak demand season. GRDA would, instead, start its drawdown to 741 feet PD on August 1 and would maintain this elevation until October 1, when it would allow the pool to increase to 742 feet PD by November 1. ODWC would hold the pool elevation at 740.5 feet PD from August 15 until September 30, when it recommends allowing the elevation to increase to 742 feet PD by November 1.

The reservoir level management plans recommended by ODWC and proposed by GRDA (if we incorporate GRDA's acceptance of ODWC's maximum pool elevation) are quite similar. The major elements in ODWC's reservoir level management plan are also recommended in on of the fishery studies supplied by GRDA (Grand River Dam Authority 1990a). The primary differences between the two plans are in the dates of initiation of drawdown; while ODWC would start drawdown earlier, it would do so from a greater elevation, and, hence, would only be 4 weeks ahead of GRDA's proposed drawdown target date, if optimal conditions were met. Increasing the maximum normal pool elevation to 745 feet PD would provide approximately 3,000 acres of nursery areas for fish. Dropping the level to elevation 740.5 feet PD, only half a foot below GRDA's proposed minimum pool elevation, would provide moist mudflat acreage (500 to 1,000 acres) for grain seeding, thereby providing for waterfowl feeding.

For the previously discussed reasons, which cite the benefits to the fishery resources, we concur with the ODWC's recommended reservoir level management plan and therefore, recommend the following target reservoir levels; from November 1 through March 31, maintain reservoir level at elevation 742 feet PD; from April 1 through July 1, the increase in reservoir level beginning April 1 would reach 745 feet PD by May 15 and the reservoir level would be maintained at 745 feet PD until July 1; between July 1 and August 7, reservoir level would decrease to 742 feet PD; between August 7 and August 15, reservoir level would decrease from 742 feet to 740.5 feet PD; from September 1 through September 30, reservoir level would be at 740.5 feet PD; and from October 1 through October 31, reservoir level would increase to 741 feet PD.

We recognize that these reservoir elevations are targets, and, given the uncertainties inherent in annual hydrology (i.e., inflows, flooding, and drought), it is improbable that the target elevations would be precisely achieved on a regular basis, especially at a peaking power project. However, these target levels should be maintained, to the extent practical.

b. *Entrainment*: The GRDA performed a number of studies to determine the effects of project operation on the fishery resources in the Grand River (Grand River Dam Authority 1990a). GRDA determined that the impact on entrained ichthyoplankton was negligible when compared to the ichthyoplankton population of the entire reservoir. The only adult species entrained in significant numbers was the gizzard shad, and even the impact on them was minimal or inconsequential. Based on the results of the entrainment studies, the resource agencies concluded that there was no need to change project operations or structures to prevent fish entrainment mortality. On the basis of the studies conducted, we also conclude that no changes are necessary to project structures or operations to protect fishery resources associated with entrainment at the project.

c. *Water quality enhancement*: The OWRB defines the Grand River in the project area as a primary warmwater fishery. The downstream tailwater sports fishery is outstanding in spring and late fall when water released from the Pensacola dam is of good quality (personal communication, Jim Smith, Regional Fisheries Biologist, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma, March 20, 1991). Resident fish in Lake Hudson move into the tailrace to spawn and feed. However, during the period when Grand Lake is

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stratified and released water is of poor quality, fish move out of the tailrace area. GRDA's study concluded that improved water quality in the tailrace would enhance its recreational value. Fishing should remain excellent during the late spring to early fall period if the water quality remains good each year.

Maintenance of Oklahoma state standards for DO levels during project operation may cause slight to moderate production impairment for all life stages (Environmental Protection Agency, 1986). However, according to available data (*see* table 1, page 10), state DO standards may be frequently violated from May through October, often causing severe impacts to all life stages (Environmental Protection Agency, 1986).

To sustain the quality of the fishery throughout the year, the FWS and ODWC recommended that GRDA undertake measures to improve water quality (i.e., increase DO concentrations) in the project's tailrace in order to comply with state DO standards. The agencies recommended several alternatives, including downstream recreation, air injection, destratification, or multilevel withdrawal.

We conclude that GRDA should take steps to improve DO concentrations downstream from Pensacola dam as a means to improving aquatic habitat and the downstream fishery. Therefore, if a license is issued for the Pensacola Project, we recommend that the licensee consult with the ODWC, OWRB, and FWS to develop and implement a plan for modifying the project operationally or structurally, as discussed in section V.B.2, page 11, to enhance DO concentrations as measured immediately downstream of the project's tailrace in the Grand (Neosho) River.

d. *Fish hatchery*: The ODWC recommended that GRDA *consider* the development of a fish hatchery and/or nursery pond complex at the Pensacola Project and its other projects. The ODWC asserts that a hatchery facility dedicated to GRDA projects would help ensure the availability of fish species (i.e., hybrid white bass, x striped bass, walleye, paddlefish) important to the Grand Lake sport fishery.

The GRDA, in its response to ODWC's above recommendation, does not believe that GRDA's ratepayers should subsidize the ODWC. The ODWC funds fish and wildlife projects by the collection of fees for fishing and hunting licenses on a statewide basis. Furthermore, the GRDA stated that it would continue to cooperate with the ODWC in their management of the reservoir fisheries.

We conclude that with the implementation of our measures (i.e., DO enhancement, reservoir level management plan, mudflat seeding, *etc.*), the fishery resources associated with the continued operation of the Pensacola Project would be enhanced in the project area. The ODWC has not identified any state-designated fishery management goals or objectives that would be served by GRDA's construction, operation, and maintenance of a fish hatchery and/or nursery pond. Neither has ODWC provided any substantial evidence to support this recommendation. Furthermore, ODWC has not demonstrated that the benefits of a fish hatchery and/or nursery pond complex are worth the costs. We, therefore, conclude that ODWC has not provided adequate justification for the above recommendation, and we do not recommend that GRDA implement any such recommendation.

Unavoidable Adverse Impacts: None.

4. Terrestrial Resources

Affected Environment: The existing project is located in northeastern Oklahoma, where two forest regions overlap. The first region is the Oak-Hickory Forest Section of the Eastern Deciduous Forest Province. The second region is the Oak-Hickory-Bluestem Parkland Section of the Prairie Parkland Province (Bailey, 1976). Overlap of these two regions contributes to a diverse fauna in the area of the project.

The existing project is situated in a unique area where seven distinct habitats occur--upland deciduous forest, bottomland hardwood forest, grassland/savannah, agricultural land (flat, tillable), steep rocky shoreline, emergent wetlands, and mudflats (Erickson and Leslie, 1988). Table 2 identifies these various habitats by elevation (excluding developed areas, ponded water, scrub/shrub wetlands, and upland coniferous forest). The GRDA operates Grand Lake reservoir up to elevation 745 feet PD for hydropower.

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Table 3. Terrestrial habitats (acres) at Grand Lake (Source: Grand River Dam Authority, 1988a, as modified by the staff).

Terrestrial Habitats (acres)	Elevation 735.0--742.0 feet PD	Elevation 742.0--755.0 feet PD
Upland deciduous forest	1,411.0	2,784.2
Bottomland hardwood forest	1,719.6	5,555.0
Grassland/savannah	151.7	1,955.3
Agricultural land:		
cropland	0.0	439.6
pasture	19.8	1,138.1
Steep rocky shoreline (miles) ...	137.9	
Emergent wetlands	34.0	144.6
Mudflats	4,993.9	645.1

The vegetative community of the upland deciduous forest consists primarily of post oak, blackjack oak, northern red oak, black hickory, and mockernut hickory. Extensive grazing has eliminated the majority of herbaceous understory; however, common species include Virginia creeper, trumpet-creeper, greenbriar, and grapevine.

The bottomland hardwood forest is characterized by eastern cottonwood and black willow in areas that undergo periodic flooding (*e.g.*, exposed mudflats), followed by the establishment of elm, green ash, maple, pin oak, and hackberry on stable land surfaces (Teskey and Hinckley, 1977). Secondary succession includes dominance by boxelder and silver maple. Typical understory species include buckbrush, trumpet-creeper, greenbriar, grapevine, and poison ivy. Wetland species, such as smartweed, jewelweed, and bedstraw are also common in the understory.

Vegetation associated with the grassland/savannah habitat is primarily legumes. Agricultural land is either planted in sorghum or is fallow (Erickson and Leslie, 1988).

The steep rocky shoreline measures 137.9 miles, which comprises 22 percent of the total 624 miles of shoreline (Erickson and Leslie, 1988). Vegetation consists primarily of sycamore and slippery elm, interspersed with white ash. Grass and trumpet-creeper are common in the understory.

Grand Lake and its surrounding area contain numerous wetlands. In general, wetlands are abundant along the upper, shallow reaches of the reservoir. In the lower area of the reservoir, the reservoir bank consists primarily of limestone bluffs and wetlands are restricted to inlets and coves of inundated tributaries. Emergent wetlands are comprised of sedge (*Carex* sp.), smartweed, and reed canary grass.

Research indicates that mud substrates and silt deposits are generally more fertile and provide better growth conditions than sand and gravel for certain wetland vegetation (Citizen Utilities Company, 1991; Penfound, 1953; Kadlec, 1962). In the project area, mudflats are dominated by smartweed, sedge (*Carex* sp.), and reed canary grass. Saplings, such as black willow, eastern cottonwood, and silver maple also occur. The ODWC stated that mudflats produce smartweed and other herbaceous vegetation valuable to waterfowl. This forage is available for use by waterfowl in the fall if the lake water levels are properly maintained (letter dated August 17, 1988, Steven Alan Lewis, Director, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma). Perennials such as smartweed not only produce seeds, but also provide excellent habitat for invertebrates. These invertebrates are consumed directly by waterfowl (Fredrickson and Taylor, 1982; Kadlec, 1962). In addition, mudflats provide resting and loafing sites for waterfowl and places to feed or nest (McDonald, 1955).

In the project area, white-tailed deer, striped skunk, raccoon, fox squirrel, opossum, eastern cottontail, and red fox inhabit the upland deciduous forest. Raptors, such as barred owl, red-tailed hawk, and red-shouldered hawk, also occur. Many of these species, with the addition of muskrat and beaver, are also common in the bottomland hardwood forest.

Common wildlife species associated with the grassland/savannah and abandoned agricultural lands include least shrew, deer mouse, black-tailed jack rabbit, and badger. Raptors, such as rough-legged hawk and short-eared owl, are also common.

Grand Lake and its adjacent wetlands are used primarily by migrating and wintering waterfowl. Waterfowl survey results (Stancill *et al.*, 1988) indicate that Grand Lake is used primarily by wintering waterfowl (i.e., gadwell, green-winged teal, and snow geese) from September through January. During the spring migration (from February through April), blue-winged teal, northern shoveler, lesser scaup, and ruddy duck are common on Grand Lake. Pelicans were observed from February through November; over 19,000 pelicans were recorded during one aerial survey in October. Some species,

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such as Canada goose, wood duck, and mallard, occur on Grand Lake throughout the year. Various nongame mammals, birds, reptiles, and amphibians are known to occur in the project area.

Environmental impacts and recommendations:

a. *Reservoir Level Management Plan*: The FWS and the ODWC recommended that GRDA develop a plan for managing environmental resources in the project area and that the plan be developed in consultation with the ODWC. The agencies recommended that the plan address reservoir level management, mudflat seeding, recreation resources, tailwater fishery, habitat improvements, provisions for personnel, and supplemental fish stocking.

The GRDA proposes to implement a reservoir level management plan, which would modify its existing plan for reservoir level management that was implemented in 1982. The target end-of-the-month reservoir elevation would be: from October through March, elevation 742 feet PD; for April, a gradual rise in lake level; from May through July, elevation 743.5 feet PD; and from August through September, elevation 741 feet PD.

As previously discussed in the section on fishery resources, page 12, the ODWC has recommended reservoir levels different from the reservoir levels included in GRDA's proposed reservoir level management plan (*see* diagram 1, page 13). The ODWC has stated that improvements to fish and wildlife resources would be derived from the implementation of its recommended reservoir levels. Table 2, page 14, summarizes the ODWC's recommended reservoir level management plan and potential improvements to fish and wildlife resources (letter dated February 20, 1991 from Steven Alan Lewis, Director, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma).

We conclude that waterfowl and wildlife benefits would also accrue as a result of a controlled reservoir drawdown. In particular, water level management would promote maximum vegetative seed production, produce vegetation of greater density and diversity, and provide food and cover for many kinds of wildlife, especially for waterfowl feeding (Kadlec, 1962; Fredrickson and Taylor, 1982). As previously discussed (*see* section V.B.2a., page 12), our recommended reservoir level management plan would also improve fish nursery habitat.

Therefore, if a license is issued for the Pensacola Project, we recommend that the licensee implement the reservoir level management plan that we previously described and recommended in the fishery resources section.

b. *Mudflat Seeding*: The FWS and ODWC originally recommended that GRDA annually seed 3,087 acres of existing mudflats with millet, wheat and/or other appropriate vegetation. In particular, the FWS stated that reservoir level fluctuations resulting from the reservoir level modifications implemented by GRDA in 1982 has resulted in the lost opportunity for seeding 4,281 acres of mudflats for waterfowl and fishery management purposes because the lake would not be drawn down to levels prior to 1982. Consequently, the FWS recommended that, in order to adequately mitigate for these mudflat losses, a total of 3,087 acres of remaining mudflats should be seeded. This measure would enhance the fishery resources of Grand Lake's littoral zone. The ODWC estimated an average cost of $10 per acre for Japanese millet seeding. Both agencies stated that several seeding attempts may be necessary in any one season to ensure success. Consequently, the estimated cost to seed 3,087 acres at $10 per acre would be $30,870.00 per season.

On our site visit to the Pensacola Project, on September 23 and 24, 1991, the ODWC and the FWS restated their position concerning their original recommendation on the seeding of mudflats. The agencies stated that the mudflats referred to should only include acreage exposed below 742 feet PD for grain seeding, whereas, the acreage between elevations 742 feet and 745 feet PD should be allowed to revegetate naturally. Consequently, the approximate total acreage recommended by the agencies for seeding with grain is 1,000 acres. Therefore, the agencies stated that their earlier recommendation to seed 3,087 acres of mudflats should be disregarded (personal communications, Jim Smith, Regional Fisheries Biologist, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma, October 4, 1991; Steve Hensley, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, Tulsa, Oklahoma, October 7, 1991).

On September 24, 1991, GRDA and staff conducted an aerial view of the mudflat areas along Grand Lake's tributaries and the upper reaches of Grand Lake, in particular Spring River, that are recommended for seeding. Grand Lake's elevation was at 741.5 feet PD during our observations. We were able to view the mudflats in the upper reaches of Grand Lake, including along Spring River, which are visible at elevation 742 feet PD.

Research on the effects of reservoir drawdown on wetland vegetation has shown that such drawdowns can: (1) produce a temporary abundance of food in the form of seeds of wetland plants; (2) provide suitable conditions for the establishment of emergent cover; and (3) result in soil improvement and in improved

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aquatic plant food production upon reflooding (Kadlec, 1962). Kadlec also concluded that the most favorable increase in soil fertility was obtained when the organic portion of the soil remained moist or even very wet during the drawdown. Fredrickson and Taylor (1982) and Meeks (1969) concluded that reservoir drawdowns can: (1) concentrate prey for wildlife; (2) create habitat conditions that can be exploited by a variety of wildlife; and (3) provide soil and water conditions that promote the germination and growth of a wide variety of plants.

Furthermore, research has shown that when the bottom of an impoundment is exposed after a drawdown, the organic matter deteriorates quickly and nutrients are then available for new plant growth (Fredrickson and Taylor, 1982; Penfound, 1953). The new vegetative growth may stimulate production of invertebrates when the area is reflooded.

We conclude that the annual seeding of mudflats with millet, wheat and/or other appropriate vegetation will enhance plant communities associated with mudflats by establishing new vegetative growth, will provide habitat for invertebrates that are consumed directly by waterfowl, will provide suitable emergent cover for waterfowl, especially during the breeding season, and will provide fish nursery habitat. The GRDA has stated that the mudflats to be seeded and procedures for seeding will be done in cooperation with the ODWC (Carolyn Elefant, Attorney, Duncan & Allen, Washington, DC, February 22, 1991).

However, mudflat seedings may not be as successful in lakes with a wide amplitude of water level changes, such as occurs in Grand Lake (Penfound, 1953; Fredrickson and Taylor, 1982; McDonald, 1955). The success of such plantings would likely be observed after a period of from 3 to 5 years (personal communications, Dr. Wayne Ellison, Plant Taxonomist and Dr. Elroy Rice, Ecologist, University of Oklahoma, Norman, Oklahoma, August 27, 1991).

If a new license is issued for the Pensacola Project, the licensee should, in consultation with the FWS, ODWC, and the University of Oklahoma, annually seed a maximum of 1,000 acres of mudflats with millet, wheat and/or other appropriate vegetation in concert with the implementation of our recommended reservoir level management plan. The licensee, in consultation with the ODWC, FWS, and the University of Oklahoma, should also develop a plan and a schedule for monitoring the effectiveness of the mudflat seeding. If the results of this monitoring indicate that the millet and/or other appropriate vegetation has not germinated, then the mudflat seeding should be terminated by mutual agreement among the FWS, ODWC, GRDA, and after notification to the Commission of the agreed-upon termination.

c. *Wildlife Management Area*: The GRDA proposes to manage 1,630 acres of project lands as a wildlife management area and allow public hunting. The 1,630 acres are not contiguous and individually range in size from 30 acres to 800 acres. This acreage is located either adjacent to streams entering the reservoir or as islands within the reservoir. Of the 1,630 acres, 1,200 acres are located in Upper Grand Lake and along Spring and Neosho Rivers.

According to the FWS, the 1,630 acres are good waterfowl areas and provide a winter roost area for the federally listed bald eagle. Furbearers, such as raccoon and opossum, and other wildlife inhabit these areas. The FWS therefore supports GRDA's proposal to manage 1,630 acres of project lands as a wildlife management area (personal communication, Steve Hensley, Fish and Wildlife Biologist, U.S. Fish and Wildlife, Tulsa, Oklahoma, August 7, 1991).

On September 24, 1991, GRDA and staff conducted an aerial view of the 1,630 acres of land identified as a wildlife management area. The GRDA's proposal to manage this acreage as a wildlife management area would protect "islands" of habitat and protect natural diversity in addition to providing for recreation. Based on 1986 aerial photographs depicting the 1,630 acres in relation to Grand Lake, our aerial view of this acreage, and reports in the literature (Fredrickson and Taylor, 1982; Kadlec, 1962; and Krull, 1970) we conclude that GRDA should be required to implement their proposal to manage these project lands as a wildlife management area.

Therefore, if a license is issued for the Pensacola Project, we recommend that the licensee manage the 1,630 acres of project lands as a wildlife management area.

d. *Bottomland Hardwood Forest Compensation*: The FWS and the ODWC recommended that GRDA acquire and provide annual funds to develop and manage 19,000 acres of bottomland forest in order to mitigate for bottomland forest losses resulting from a combination of *past* and *future* lake-related development and losses due to original inundation. The agencies have identified a 4,500-acre tract of bottomland forest along the Grand River just upstream of the lake, which is included in the total 19,000 acres.

Using the Habitat Evaluation Procedures, the FWS (1990c) stated that to mitigate the losses of bottomland forest from such development (i.e., residential, commercial, and recreational developmental) surrounding Grand Lake

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would require 19,574 acres of bottomland forest. However, the FWS further stated that the greatest mitigation need for bottomland forest losses occurs within a 500-foot area above the top of the flood pool (755+ feet PD). Therefore, the FWS concentrated the mitigation of bottomland forest losses to this area and recommended 19,000 acres of bottomland forest be acquired and managed to mitigate the continuing impact of lake-related development that would not occur without construction and continued existence of Grand Lake. Of the approximate 19,000 acres, 4,051 acres are predicted to be cleared as a result of future lake-related development (U.S. Fish and Wildlife Service, 1990c).

We believe, however, that any appropriate "mitigation" or enhancement measures needed for the existing Pensacola Project should be done in the context of today's environment and in relation to today's needs. [1] To require mitigation for the future predicted loss of bottomland hardwood forests is not an appropriate recommendation because it is not a reasonably foreseeable future action and not directly related to the continued operation of the project. It is unknown whether or not this land (about 4,000 acres) would be on project lands. If the acreage would be on project lands, then under certain circumstances, the sale of this land would require notification to the Commission, and the Commission would require appropriate review and consideration of mitigative measures, if needed.

The FWS's and ODWC's recommendations for 19,000 acres involve mitigation relative to pre-project conditions (about 15,000 acres) and future predicted lake-related development and losses (about 4,000 acres) due to original inundation. We conclude that the agencies' recommendation that GRDA acquire and provide annual funds to develop and manage 19,000 acres of bottomland forest is therefore inappropriate.

The approximate cost to acquire 19,000 acres of bottomland hardwood forest, including the identified 4,500-acre tract of bottomland hardwood forest, is between $400 and $600 per acre, which could total within a range of $7,600,000 to $11,400,000 (personal communication, Gary Hunt, Manager, Environmental Services, Benham-Holway Power Group, Tulsa, Oklahoma, September 16, 1991).

We do not recommend that GRDA be required to acquire and provide annual funds to develop and manage 19,000 acres of bottomland forest, including the identified 4,500-acre tract of bottomland forest along the Grand River.

e. *Grand Lake biologist and technician recommendation*: The ODWC recommended that GRDA create two positions (fish/wildlife biologist and a technician) at the Pensacola Project and GRDA's other projects. The ODWC asserts that these positions would provide GRDA with the capability to (for example): conduct fisheries survey work; coordinate the placement of signs and fencing; coordinate aerial seeding programs; coordinate and organize volunteers; and coordinate boating and fishing access projects.

The GRDA (1991b), in its response to ODWC's above recommendation, stated that GRDA's Lake Patrol and Hydropower Department would continue to cooperate with the ODWC and the OTRD. The GRDA stated that it does not want to assume these agencies' responsibilities pertaining to state resources nor to establish user fees that would be required to fund such ventures.

We believe that ODWC's recommendation for GRDA to create two positions (fish/wildlife biologist and a technician) has not been supported by substantial evidence as to why these two positions should be provided by GRDA and is not an appropriate fish and wildlife recommendation under Section 10(j) of the Act because this recommendation does not provide measures for the protection, mitigation of damages to, and enhancement of fish and wildlife as stipulated under Section 10(j) of the Act. The implementation of our recommended measures would require GRDA to continue to consult with the agencies and implement enhancement measures at the Pensacola Project. The personnel selected to participate in these activities would be at the discretion of GRDA. We, therefore, do not recommend that GRDA create two positions (fish/wildlife biologist and a technician) as enhancement measures at the Pensacola Project and GRDA's other projects.

Unavoidable Adverse Impacts: Minor, temporary disturbances to vegetation and wildlife would occur associated with the upgrading of public access facilities at Duck Creek located in the Ketchum recreation area (*see* section V.B.7c., page 37).

5. Threatened and Endangered Species

Affected Environment: By letter dated October 29, 1984, the FWS determined that the federally listed endangered bald eagle (*Haliaeetus leucocephalus*) and gray bat (*Myotis grisescens*) and threatened Ozark cavefish

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(*Amblyopsis rosae*) are known to occur in the project area. In recent correspondence, the FWS stated that their determination in the letter dated October 29, 1984, was still valid, with the addition of the Neosho madtom (*Noturus placidus*), recently listed as threatened (letter dated August 30, 1990, from Stephen W. Forsythe, Field Supervisor, U.S. Fish and Wildlife Service, Tulsa, Oklahoma).

The FWS stated that two gray bat caves are located in the project area, Twin Cave and Beaver Dam Cave. The Ozark cavefish also occurs in Twin Cave. The FWS determined that the operation of Grand Lake is not having an impact on the Ozark cavefish in Twin Cave. However, the FWS determined that Beaver Dam Cave is within Grand Lake's flood pool and is inundated occasionally by flood pool operation. According to the FWS, drowned gray bats have been reported from Beaver Dam Cave after such inundation (letter dated August 30, 1990, Stephen W. Forsythe, Field Supervisor, U.S. Fish and Wildlife Service, Tulsa, Oklahoma).

In addition, the FWS determined that the operation of Grand Lake, especially for flood control, could be effecting the known population of Neosho madtom at Stepps Ford (located west of Commerce, Ottawa County, Oklahoma) and other populations that may exist within the flood pool. Therefore, the FWS recommended that a survey of Grand and Spring Rivers within the Grand Lake flood pool be conducted to determine if additional populations of the Neosho madtom exist in areas influenced by the reservoir.

The Nature Conservancy (TNC) stated that Twin Cave is well-known to area residents and the resulting human visitation and vandalism has had a negative impact on the gray bat and possibly other cave species, including the Ozark cavefish. Twin Cave was once a maternity colony site for gray bats, but due to human disturbance, the gray bats abandoned the site during the 1970's. Indications are that all or a portion of the maternity colony has moved to Beaver Dam Cave, located in the flood pool of Grand Lake. As a result of TNC's recent purchase of 40 acres of land over and immediately adjacent to Twin Cave, TNC's management strategies are to: (a) increase the number of gray bats using Twin Cave in order to provide the energy source (bat guano) for the Ozark cavefish; and (b) provide protection for the gray bat from human disturbance to encourage the maternity colony of gray bats to return to Twin Cave. It is anticipated that reestablishing the Twin Cave gray bat population would help reduce the impact of flooding on gray bats using Beaver Dam Cave (letter dated June 25, 1991, from Nora Jones, Director of Science and Stewardship, The Nature Conservancy, Oklahoma Chapter, Tulsa, Oklahoma).

Environmental Impacts and Recommendations:

a. *Section 7 consultation*: In our letter dated February 22, 1991, to the FWS pursuant to section 7 of the Endangered Species Act (ESA), we concluded that no direct or indirect effects to the federally listed endangered gray bat and threatened Neosho madtom would occur as a result of continued hydroelectric operation and maintenance of the existing Pensacola Project. Our conclusions were based on GRDA's use of reservoir storage in Grand Lake up to 745 feet PD for hydropower purposes. The gray bat cave entrances at Twin Cave and Beaver Dam Cave are located at elevations 840 feet and 749 feet PD, respectively. The Grand Lake flood pool, that the FWS states may affect the Neosho madtom is between elevations 745 feet and 750 feet PD. This potentially affected area recommended by the FWS to be surveyed for the Neosho madtom is controlled by the Corps for flood control storage, as mandated by the Flood Control Act of 1944, and not subject to Commission authority. Therefore, regarding the hydroelectric operation and maintenance of the Pensacola Project, we concluded in our February 22, 1991, letter to FWS that section 7 formal consultation, pursuant to the ESA, is not required.

By letter dated April 26, 1991, to the Corps, we reiterated our no effect determination regarding hydroelectric operation and maintenance of the Pensacola Project on the federally listed gray bat and Neosho madtom. We also stated that we believe that the Corps' operation of the flood control storage may be having an impact on the aforementioned species. We concluded that the Corps may need to prepare a biological assessment for these two species and submit it to the FWS for concurrence. In addition, we requested that the Corps provide us with information regarding the Neosho madtom and alternative actions that the Corps may consider in its operation at

Grand Lake for providing conservation measures for both the federally listed Neosho madtom and the gray bat at Beaver Dam Cave.

By letter dated June 11, 1991, the Corps concurred with us regarding their responsibility for operating the reservoir for flood control between elevations 745 feet and 755 feet PD. However, the Corps stated that without the Pensacola dam there would be no flood pool to operate. Consequently, the Corps stated that the primary responsibility for Section 7 formal consultation of the ESA lies with the Commission and not the Corps. The Corps stated that no studies have been conducted on the Neosho

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madtom and gray bat with respect to its operation.

The FWS disagreed with our no affect determination regarding the Pensacola Project and its effect on the federally listed gray bat and Neosho madtom. Consequently, the FWS requested that the Commission initiate Section 7 formal consultation; however, prior to initiating Section 7 formal consultation, the FWS requested a survey for the Neosho madtom, as previously discussed (letter dated July 9, 1991, from Stephen W. Forsythe, Field Supervisor, U.S. Fish and Wildlife Service, Tulsa, Oklahoma).

b. *Biological assessment*

i. *Bald eagle* (*Haliaeetus leucocephalus*): The FWS determined that there would be no affect on the federally listed endangered bald eagle. Therefore, the measures originally proposed by GRDA for the protection of the bald eagle (*see* page 3), except for restricting shoreline development in bald eagle high use areas, are no longer necessary (personal communication, Steve Hensley, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, Tulsa, Oklahoma, October 7, 1991). Therefore, if a license is issued for the Pensacola Project, the licensee should restrict shoreline development in bald eagle high use areas.

ii. *Ozark cavefish* (*Amblyopsis rosae*): The Ozark cavefish was federally listed as threatened on December 3, 1984 (*Federal Register* 49:43,965-43,969). The Ozark cavefish is one of the most cave-adapted members of the family *Amblyopsidae* and one of the most cave-adapted vertebrates known (U.S. Fish and Wildlife Service, 1989). A commensal association exists between the Ozark cavefish (the one which is benefitted) and the federally listed gray bat (*Myotis grisescens*) (the one which is neither benefitted nor harmed). There is some evidence that the Ozark cavefish feeds directly on bat guano (U.S. Fish and Wildlife Service, 1989). Both species inhabit Twin Cave, as discussed below. By letter dated August 30, 1990, the FWS determined that, regarding the Pensacola Project, there would be no affect on the Ozark cavefish in Twin Cave (Steven W. Forsythe, Field Supervisor, U.S. Fish and Wildlife Service, Tulsa, Oklahoma).

iii. *Neosho madtom* (*Noturus placidus*): The Neosho madtom was federally listed as threatened on May 22, 1990 (*Federal Register* 55:21,148-21,153). The current distribution of this small catfish is restricted to the Neosho (Grand) River in Oklahoma drainage; the Neosho, Cottonwood, and Spring Rivers in southeastern Kansas, southwestern Missouri, and northeastern Oklahoma (U.S. Fish and Wildlife Service, 1990b).

The Neosho madtom prefers riffle areas within shallow rivers with a substratum of loosely packed gravel pebbles less than one inch in diameter. The size of substrate particles preferred by the Neosho madtom varies with the size of the individual: the larger the fish, the larger the substrate particles. The Neosho madtom has been collected from areas with a fine gravel or sand bottom overlain with leaf litter and detritus in the Spring and Illinois rivers (Taylor, 1969; Moss, 1981; Cross and Collins, 1975). Adult Neosho madtoms utilize moderate to swift current, while juveniles are most often found in areas of low current (U.S. Fish and Wildlife Service, 1990a). The Neosho madtom is not known to occur in reservoirs constructed within the species range.

Little is currently known about the specific water quality requirements of the Neosho madtom, its reproductive biology, and the possible competition with the slender madtom (U.S. Fish and Wildlife Service, 1990b). Neosho madtoms feed on aquatic insects, primarily the larvae of caddisflies, mayflies, dipterans, and chironomids. Plant material does not seem to be an important food item (Moss, 1981).

Records indicate that the original range of the Neosho madtom included the entire Neosho (Grand) River drainage mainstreams and at least the lower portion of the Illinois River in Oklahoma. The range of the Neosho madtom has decreased and continues to be threatened by reservoir construction and associated inundation of riffle habitat, gravel dredging, increased water demands for agriculture and municipal use, water quality degradation, and drought. The lower sections of the Neosho (Grand) River in Oklahoma is a series of reservoirs (*e.g.*, Pensacola dam, Ft. Gibson dam, and Markham Ferry dam) that have inundated as much as one-third of the original range of the species (Wagner *et al.*, 1984). The most downstream locality for Neosho madtom in the Neosho River is below Stepps Ford, west of Commerce, Ottawa County, Oklahoma (Wagner *et al.*, 1984).

By letter dated August 30, 1990, the FWS recommended that a survey of the Neosho (Grand) and Spring Rivers within the Grand Lake flood pool be conducted to determine if additional populations of the Neosho madtom exist in areas influenced by the reservoir.

During the week of July 27, 1991, Messrs. Bill Stark and Geff Luttrell, Doctoral Candidates, Oklahoma State University, Department of Zoology, Stillwater, Oklahoma, surveyed the entire mainstream of the Neosho (Grand) and Spring Rivers and major tributaries to the Neosho (Grand) and Spring Rivers for the Neosho madtom. These areas coincided with the areas requested by the FWS to be surveyed.

Survey results indicated that the Neosho madtom is present in riffle habitat within the Neosho (Grand) River and the major tributaries. The Neosho madtom inhabits riffle areas that may be influenced by backwater effects resulting from the Corps' operation of Grand Lake for flood control storage.

Three adult and 4 subadult Neosho madtoms were identified near Stepps Ford. At a bend of the Neosho (Grand) River and a major tributary,

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2 subadult Neosho madtoms were identified. This same riffle area was sampled in the winter of 1990, in which between 12 and 15 adult Neosho madtoms were identified. Researchers are unsure why only 2 Neosho madtoms were identified in 1991, while in 1990, approximately 15 Neosho madtoms were identified. Researchers speculate that high water temperature and low DO (heat stress) may have contributed to a decrease in species number (personal communication, Bill Stark, Doctoral Candidate, Oklahoma State University, Stillwater, Oklahoma, August 5, 1991). No Neosho madtoms were encountered in the Spring River in Oklahoma.

The channel catfish, bigmouth buffalo, and white bass are predatory species on the Neosho madtom. These predatory species inhabit the Neosho (Grand) and Spring Rivers. It is unknown what degree of impact would occur, if any, or how the Neosho madtom would disperse as a result of periodic inundation of its riffle habitat. If the Neosho madtom's riffle habitat is inundated, the Neosho madtom may survive the inundation, but may not survive predation (personal communication, Bill Stark, Doctoral Candidate, Oklahoma State University, Stillwater, Oklahoma, August 5, 1991). It is possible that Neosho madtoms emigrate to adjacent riffles during periods of typically higher streamflows (U.S. Fish and Wildlife Service, 1990b).

Based on the views of recognized experts and the best scientific and commercial data available, we conclude that continued operation of the Pensacola Project would not contribute significantly to the cumulative impact that has already resulted to the Neosho madtom due to reservoir construction and associated inundation of riffle habitat, gravel dredging, increased water demands for agriculture and municipal use, water quality degradation, and drought. Therefore, regarding the Pensacola Project, no specific measures to minimize impact on the Neosho madtom are needed.

iv. *Gray bat* (*Myotis grisescens*): The gray bat was federally listed as endangered on April 28, 1976 (*Federal Register* 41:17,740).

The gray bat inhabits a limited geographic range in limestone karst areas of the southeastern United States (U.S. Fish and Wildlife Service, 1982). Although populations are found primarily in Alabama, Arkansas, Kentucky, Missouri, and Tennessee, the species occurs in adjacent states, including northeastern Oklahoma.

Most gray bats migrate seasonally between winter (hibernating) and summer (maternity) caves, which may vary in distance from 10 miles to more than 200 miles. Gray bats enter hibernation by early October and emerge in late March or early April (U.S. Fish and Wildlife Service, 1982). The young are born in May or June (Missouri Department of Conservation, 1980).

Most winter caves are deep and vertical that have low (6-11 degrees Celsius) temperatures. Prior to recent declines in the gray bat population, individual hibernating populations of gray bats contained from 100,000 to 1.5 million bats. Approximately 95 percent of the known gray bat population hibernates each winter in only nine caves, with more than one-half of the total population in a single cave.

Summer caves, especially those used by maternity colonies, are located near rivers or reservoirs over which the bats feed (Tuttle, 1976). Summer cave temperatures range between 14 and 25 degrees Celsius. Each summer colony occupies a traditional home range that often contains several roosting caves scattered along as much as 45 miles of river or reservoir borders (U.S. Fish and Wildlife Service, 1982). Undisturbed summer colonies in Tennessee and Alabama contain from 5,000 to 250,000 bats each, with most numbering 10,000 to 50,000 (Tuttle, 1979). Summer colonies disperse in July and August, when the bats begin migration to hibernation sites (Missouri Department of Conservation, 1980). Gray bats frequenting the Grand Lake area, located in Oklahoma, are summer residents which hibernate in Missouri and northern Arkansas caves (Grand River Dam Authority, 1986).

Optimum gray bat foraging habitat appears to consist of rivers or reservoirs bordered by forest. Gray bats feed almost exclusively over water along river or reservoir edges (LaVal *et al.*, 1977a). Although little is known about the gray bat's diet, limited observations indicate that within a variety of insects which are eaten, the majority are mayflies (U.S. Fish and Wildlife Service, 1987). Gray bat feeding areas have not been found along sections of river or reservoir where adjacent forest has been cleared (LaVal *et al.*, 1977).

The gray bat inhabits Twin Cave and Beaver Dam Cave, which are approximately 2.0 miles apart and located near the Pensacola Project. The number of gray bats using Twin Cave has risen from 0 in the early 1980's [before The Nature Conservancy (TNC) management] to between 4,000 and 5,000 gray bats in 1990 (letter dated June 25, 1991, from Nora Jones, Director of Science and Stewardship, The Nature Conservancy, Oklahoma Chapter, Tulsa, Oklahoma). The number of gray bats using Beaver Dam Cave is estimated at between 5,000 and 10,000 (personal communication, Steve Hensley, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, Tulsa, Oklahoma, September 24, 1991).

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TNC stated that Twin Cave is well-known to area residents and the resulting human visitation and vandalism has had a negative impact on the gray bat and possibly other cave species, including the federally listed threatened Ozark cavefish (*Amblyopsis rosae*). Twin Cave was once a maternity colony site for gray bats, but due to human disturbance, the gray bats abandoned the site during the 1970's. Indications are that all or a portion of the maternity colony has moved to Beaver Dam Cave, located in the flood pool of Grand Lake.

As a result of TNC's recent purchase of 40 acres of land over and immediately adjacent to Twin Cave, TNC's management strategies are to: (a) increase the number of gray bats using Twin Cave in order to provide the energy source (bat guano) for the Ozark cavefish; and (b) provide protection for the gray bat from human disturbance to encourage the maternity colony of gray bats to return to Twin Cave. It is anticipated that reestablishing the Twin Cave gray bat population would help reduce the impact of flooding on gray bats using Beaver Dam Cave (letter dated June 25, 1991, from Nora Jones, Director of Science and Stewardship, The Nature Conservancy, Oklahoma Chapter, Tulsa, Oklahoma).

On September 24, 1991, FWS, ODWC, GRDA, and staff conducted a site visit to Twin Cave and Beaver Dam Cave. Beaver Dam Cave is located on private property. Grand Lake's elevation was at 741.5 PD during our observations. The Twin Cave and Beaver Dam Cave entrances are at elevations 840 feet and 749 feet PD, respectively. The FWS stated that Beaver Dam Cave is used as a maternity site by gray bats between April 15 and October 1.

At our site visit to both bat caves, the agencies' concerns focused on Beaver Dam Cave and Grand Lake exerting a backwater influence, thereby flooding Beaver Dam Cave and adversely affecting the gray bat. When Grand Lake is below elevation 745 feet PD, there is no effect on the gray bat inhabiting Beaver Dam Cave (personal communication, Steve Hensley, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, Tulsa, Oklahoma, September 24, 1991). However, backwater from Grand Lake enters the site at approximately elevation 746 feet PD. At elevation 747 feet PD, water starts to fill the lower areas of the entry room floor and by elevation 749 feet PD, the floor of the entry room is covered. At elevation 751 feet PD, the main crawlway between the entry room and the main room of Beaver Dam Cave is under water, effectively closing off all entry to the cave (Benham-Holway Power Group, 1986).

According to the Corps (Juhlin, 1986) the entrance to Beaver Dam Cave is infrequently inundated during the month of June. Grand Lake elevation at 748 feet PD occurs on an average of once in 4.5 years and elevation 751 feet PD occurs once in 9.5 years. The duration that these elevations are equalled or exceeded are 8 percent for elevation 748 feet PD and 5 percent for elevation 751 feet PD. The higher reservoir elevations are slightly more frequent in May (elevation 748 feet PD occurs once in 4.5 years and elevation 751 feet PD occurs once in 6.2 years).

Benham-Holway Power Group (1986) stated that on June 7, 1982, lake elevation was at 749 feet PD and there were an estimated 30 to 40 (aborted) young in the water and both pregnant and nonpregnant dead and dying adults (10 to 15) were clinging to the Beaver Dam Cave's walls. During the spring of 1986, prolonged high water forced beavers to abandon bank dens and take refuge in Beaver Dam Cave, thereby blocking the cave entrance and creating stressful flight situations for gray bats entering the crawlway inside the cave. It is unknown, however, whether the gray bats' death actually resulted from drowning due to inundation or from natural mortality.

The GRDA's use of reservoir storage in Grand Lake up to 745 feet PD for hydropower purposes and the Corps' use of Grand Lake for flood control storage between elevations 745 feet and 750 feet PD contribute to the potential inundation of Beaver Dam Cave and may affect the gray bat.

We recommend that GRDA cooperate with the Corps, FWS, and TNC in order to assist TNC in attaining TNC's management strategies for Twin Cave and the gray bat. Providing protection for the gray bat from human disturbance in order to encourage the maternity colony of gray bats to return to Twin Cave would involve either assisting TNC with security at Twin Cave, maintaining the fence that surrounds Twin Cave, or moving the grate from the entrance of Twin Cave to further inside Twin Cave. Consequently, these measures would offset the impact on the gray bat, which results from the operation of Grand Lake for *both* hydropower and flood control storage.

Therefore, if a license is issued for the Pensacola Project, the licensee should cooperate with the Corps, the FWS, and TNC in order to assist TNC in attaining TNC's management strategies for Twin Cave and the gray bat. The licensee should, in consultation with the Corps, FWS, and TNC, prepare a plan describing measures that would be implemented to offset the impact on the gray bat, which results from the operation of Grand Lake for *both* hydropower and flood control storage; and, the cost

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for each measure and the entity(ies) responsible for the costs and implementation of each measure.

Unavoidable Adverse Impacts: There would be no effect on the federally listed endangered bald eagle. Shoreline development would be restricted in bald eagle high use areas. There would be no effect on the threatened Ozark cavefish. Continued operation of the Pensacola Project would not contribute significantly to the cumulative impact that has already resulted to the federally listed threatened Neosho madtom. No specific measures to minimize impact on the Neosho madtom are needed.

The GRDA's use of reservoir storage in Grand Lake up to 745 feet PD for hydropower purposes *and* the Corps' use of Grand Lake for flood control storage between elevations 745 feet and 750 feet PD contribute to the potential inundation of Beaver Dam Cave and may affect the gray bat.

6. Cultural Resources

Affected environment: Although the four counties around Pensacola reservoir contain a number of properties that are listed on the *National Register of Historic Places* and the Oklahoma Landmarks Inventory, only one, the Splitlog (or Cayuga Mission) Church is in the immediate vicinity of the project. It is located near an arm of the reservoir.

Environmental impacts and recommendations: The Splitlog Church would not be affected by continued operation of the project. The State Historic Preservation Officer (SHPO) recommended a finding of no effect (letters from Earle Metcalf, State Historic Preservation Officer, Oklahoma Historical Society, Oklahoma City, Oklahoma, October 1, 1984, and March 6, 1986). In view of the results of discovery efforts and the SHPO's recommendation and because no land-disturbing activities are proposed, we find that the project would have no effect on any structure, site, building, district, or object listed on or eligible for listing on the *National Register.*

Nevertheless, there is still the possibility that there could be undiscovered properties in the project area that could be adversely affected by future ground-disturbing activities or by project operation. Before engaging in any ground disturbance, or if properties are found during project operation, GRDA should take the following actions: (a) consult with the SHPO; (b) based on consultation with the SHPO, prepare a plan describing the appropriate course of action and a schedule for carrying it out; (c) file the plan for Commission approval; and (d) take the necessary steps to protect the properties until notified by the Commission that all of these requirements have been satisfied.

Unavoidable adverse impacts: None.

7. Recreation and Other Land and Water Uses

Affected Environment: The project's impoundment, Grand Lake, is one of Oklahoma's more popular recreation areas for boating and fishing. Grand Lake supports a high-quality sport fishery for largemouth bass, striped bass, white bass, crappie, catfish, and paddlefish. Several fishing tournaments are held at the lake each summer. Additionally, over 700 keeled sailboats and many large yachts use the lake.

Most land surrounding Grand Lake is privately owned. Consequently, the lake's shore areas are highly developed and contain commercial resorts, private homes and condominiums, municipal and state parks, marinas, and private docks. Although Grand Lake lands are mostly privately owned, GRDA owns title to the shoreline up to elevation 750 feet m.s.l., [2] and has authority to prescribe and enforce rules and regulations for commercial and recreational use of the lake. GRDA manages the shoreline via a permitting system and operates a lake patrol to enforce boating regulations. Currently, over 2,600 private and 120 commercial boat docks have been permitted. GRDA also operates a tourist center at the dam and provides guided tours from Memorial Day through Labor Day. Information on reservoir conditions is available to the public through a 24-hour telephone line.

Environmental Impacts and Recommendations:

a. *Recreation Plan*

By letter dated February 20, 1991, ODWC raised several recreation issues at the project. These issues include: (i) maintenance of existing recreation facilities; (ii) access to boat launches during high water periods; (iii) need for additional recreation facilities; and (iv) registration of fishing tournaments. The ODWC believes that these issues should be addressed in a recreation plan.

The GRDA has shown that occupancy rates for Grand Lake public campgrounds rarely exceed 50 percent. However, the number of boats and boat docks on the lake, and level of use of Grand Lake state parks, indicate that water-based activities, not camping, are the major attraction. From July 1987 through August 1988, over one million visits to Grand Lake state parks were recorded. No analysis has

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been done to determine whether capacities of the lake's other recreation facilities, especially boat launches, are sufficient to meet current and future demand, nor has the lake's carrying capacity been assessed. The GRDA predicts that visitation to Grand Lake state parks alone will reach 1.7 million persons during the term of a new license. The Oklahoma Tourism and Recreation Department (OTRD), in a letter dated July 18, 1988, agreed with this use projection.

Public access at Grand Lake received considerable attention during the term of the initial license for the project, resulting in the construction of over 20 recreational facilities. However, recreation facilities continue to be developed in the absence of a comprehensive, long-term recreation plan. There are also indications that Grand Lake could approach carrying capacity for boating during the term of a new license.

The State of Oklahoma has established a boating capacity standard of 15 water acres per boat (Oklahoma Tourism and Recreation Department, 1987). There are currently about 6,000 boat slips (3,400 commercial and about 2,600 private) on Grand Lake (personal communication, Gary Hunt, Manager, Environmental Services, Benham-Holway Power Group, Tulsa, Oklahoma, July 2, 1991). Grand Lake's surface area is 46,500 acres. Dividing the number of boat slips into the lake surface area gives, potentially, 7.75 acres per slip. [3]

We conclude that the size of the Grand Lake (46,500 acres with 624 miles of shoreline) and its high degree of development and use point to a need for development of a long-term recreation plan. If a license is issued for the Pensacola Project, the licensee should, in consultation with the ODWC, the OTRD, and the National Park Service (NPS), develop a long-term recreation plan for Grand Lake. The plan should address the issues of lake carrying capacity, the provision of public access to meet projected increases in use, recreation facility maintenance, and safety. The plan should also include provisions for managing 1,630 acres of project lands as a wildlife management area, which GRDA also proposes for public hunting. For further discussion on the 1,630 acres, *see* section V.B.4., page 22.

b. *Public Access at Twin Bridges State Park*

Lish (1987) assessed the effects of an increased pool elevation (lake level) on the wintering federally listed bald eagle. Furthermore, Lish assessed the potential conflict between the bald eagle and recreational use in and near Twin Bridges State Park. By letter dated September 9, 1988, the FWS concurred with the recommendations contained in Lish's study, which are discussed below.

However, the FWS determined that there would be no effect on the federally listed endangered bald eagle. Except for the FWS's recommendation of restricting shoreline development in bald eagle high use areas, the measures originally proposed for the protection of the bald eagle, including closing during winter (from November through March) or moving the boat access ramp on the Neosho River side of Twin Bridges State Park, are no longer necessary (Steve Hensley, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, Tulsa, Oklahoma, September 24, 1991).

Lish (1987) recorded approximately 80 wintering bald eagles at a communal night roost located on GRDA property near Twin Bridges State Park. This bald eagle roost is located on a small island at the confluence of the Neosho and Spring Rivers, just south of Twin Bridges State Park. Lish (1987) noted that access to the roost via boats appears to be the major source of disturbance to the bald eagle and recommended restricting public access to this area during the winter (from November through March).

A primary bald eagle feeding/loafing area is a grove of cottonwoods located on the west side of the Neosho River immediately north of its confluence with the Spring River. The main boat ramp at Twin Bridges State Park is located on the opposite shore. Lish (1987) stated that, during some high-use weekends, there was significant disturbance (evacuation) of bald eagles as a result of boat launching at the park. Therefore, Lish recommended moving this boat launch to the opposite (Spring River) side of the park or closing the launch when bald eagles are present.

Lish (1987) also recommended strict enforcement of existing laws that prohibit the shooting of blackbirds at a blackbird roost located on the opposite side of the State Park. The concern is that the bald eagle ingests lead shot resulting from feeding on blackbirds.

The ODWC is opposed to limiting access to Twin Bridges State Park. The ODWC stated that, since there is little access to this upper end of the lake, winter fishing opportunities would suffer. The best fishing for paddlefish occurs in March and the ODWC stated that there has been no determination that human activity at the park is adversely affecting the bald eagles.

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GRDA proposes to designate the roosting area a bald eagle sanctuary from November through March, and to cooperate with agency efforts to reduce disturbance of the roost by limiting public access to the island. GRDA also stated that the blackbird shooting is occurring on non-GRDA lands, and therefore, is not under GRDA jurisdiction.

Compared to other areas of Grand Lake, there is less public access available to the upper, northern region. We agree that Twin Bridges State Park is a key public access point. It received more use than any other Grand Lake state park during 1987/1988: 314,770 recorded visits. Current recreational activity does not adversely affect the federally listed bald eagle occurring at Twin Bridges State Park (personal communications, Ron Suttles, Environmental Biologist, Oklahoma Department of Wildlife Conservation, Tulsa, Oklahoma, March 8, 1991; and Steve Hensley, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, Tulsa, Oklahoma, September 9, 1991). Closing or moving the boat access ramp on the Neosho River side would have minimal effect on boat traffic since there are other launching facilities nearby. Therefore, we do not recommend any action that would limit public use of Twin Bridges State Park.

Designating the bald eagle roosting area a sanctuary would draw undue attention to the site and could have the undesirable effect of encouraging more human activity there. Also, because of the roost's island location, limiting access would be very difficult. Therefore, we do not recommend that the bald eagle roost be designated a sanctuary, nor do we recommend that any effort be made on the part of GRDA to limit public access to the roost.

Although ingestion of lead shot by bald eagles is a concern, enforcement of hunting regulations is not a GRDA responsibility. This responsibility rests with the ODWC. Therefore, we do not recommend any specific GRDA action regarding the blackbird roost.

c. High-Water Access at Duck Creek

By letter dated February 20, 1991, ODWC stated that the entrance road, parking area, and boat launch at Duck Creek located in the Ketchum recreation area is too low and, therefore, is prone to flooding. The ODWC recommended raising these access facilities to accommodate above-normal lake levels.

In a letter dated July 9, 1991, to the ODWC, Mr. Robert Sullivan, Jr., Assistant General Manager, of Grand River Dam Authority, stated that this entire recreation area is below elevation 751.1 feet PD. Mr. Sullivan further stated that a logical improvement for the area would be to elevate the parking area and the roadway leading to the boat ramp from Highway 85-A.

On September 24, 1991, GRDA, ODWC, FWS, and staff conducted a site visit to Duck Creek located in the Ketchum Recreation Area. We discussed the following enhancement measures for this recreation area: (1) elevate and gravel the parking lot; (2) widen the access road to accommodate two vehicles; (3) trim the brush along the access road; and (4) place a sign at the entrance of the access road to designate the area.

We estimate the cost for recreational enhancement measures at Duck Creek to be approximately $27,000. Therefore, if a license is issued for this project, the licensee should: (1) elevate, to at least 746 feet PD, and gravel the parking area; (2) widen the access road to accommodate two vehicles; (3) trim the brush along the access road; and (4) place a sign at the entrance of the access road to designate the area.

d. *Reservoir Elevation Management Plan*: The GRDA proposes to implement a reservoir level management plan. The purpose of the reservoir level management plan is to enhance fish and wildlife resources and the recreational resources without adversely affecting power generation at Pensacola dam. According to GRDA, lowering the lake elevation between 734 feet and 735 feet PD, as was done routinely prior to 1982, adversely impacts a large number of boat docks.

By letter dated November 20, 1984, the OTRD stated that the reservoir elevation management proposal would not have any negative environmental impacts on the lake facilities that they operate (Tom Creider, Director, Division of Planning and Development, Oklahoma Tourism and Recreation Department, Oklahoma City, Oklahoma). Additionally, a 1988 study on waterfowl hunting indicated that, according to the hunter group surveyed, hunting has improved somewhat since the modified reservoir elevation management plan, implemented in 1982 by GRDA, has been in effect (Stancill *et al.*, 1988).

The ODWC recommends a reservoir level management plan that would follow a rule curve similar to that proposed by GRDA (*see* diagram 1, page 13). As discussed in the fishery and terrestrial resources sections, pages 12 and 20, respectively, the ODWC's recommendation includes a slightly higher maximum elevation (745 feet PD vs. 743.5 feet PD) and a slightly lower minimum elevation (740.5 feet PD vs. 741 feet PD) than that proposed by GRDA.

The reservoir level management plans recommended by ODWC and proposed by GRDA would result in more stable lake levels and would avoid drawing the lake down to levels,

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which would negatively affect the lake's recreation facilities. Therefore, from a recreation standpoint, if a license is issued for the Pensacola Project, the licensee should implement the reservoir level management plan that we previously described and recommended.

Unavoidable Adverse Impacts: None.

C. *Impacts of Denial of License*

As discussed in section III.C., page 4, denial of the license would result in the cessation of generation of hydropower at the project and could lead to removal of the project's generating facilities and dam.

Denial of the license would require that 370,000 MWh of low-cost, nonpolluting hydropower energy, which derives primary energy from a renewable resource, would have to be replaced with increased loading of GRDA's 812 MW of coal-fired, steam-electric capacity. The project's generation is equivalent to that which would be produced by burning 624,000 barrels of oil or 154,000 tons of coal annually in a steam-electric generating plant.

If the replacement power were generated by coal-fired, steam-electric plants equipped with flue gas desulfurization systems, the combustion of the required coal would produce about 83.3 tons of the oxides of sulfur, 714 tons of the oxides of nitrogen, 71.4 tons of carbon monoxide, and 432,000 tons of carbon dioxide annually. Carbon dioxide is considered to be a prime contributor to global warming and the oxides of nitrogen and sulfur are considered to be prime contributors to the production of acid rain.

D. *Impacts of the No-Action Alternative*

The Pensacola Project is constructed and operating. As discussed in section III.D, page 5, the no-action alternative is not reasonable and, therefore, not discussed further.

VI. Comprehensive Development and Recommended Alternative

Sections 4(e) and 10(a)(1) of the Federal Power Act (Act) require the Commission to give equal consideration to all uses of the waterway on which a project is located. When the Commission reviews a proposed project, the recreational, fish and wildlife, and other nondevelopmental values of the involved waterway are considered equally with power and other developmental values. In determining whether, and under what conditions, a hydropower license should be issued, the Commission must weigh the costs and benefits of the various developmental and nondevelopmental uses of the waterway.

A. *Recommended Alternative*

The alternatives to relicensing the Pensacola Project, as proposed by GRDA, are denial of a license, issuance of a nonpower license to another entity, or issuance of a new license with enhancement measures. If the Commission were to issue a nonpower license for the project, then GRDA would have to replace the capacity and energy of the project with other resources. We estimate the additional cost to GRDA's ratepayers would be $6.03 million.

Based on our independent review and evaluation of the existing project and the alternatives, we have selected issuing a license, with our recommended measures, as the preferred option. We recommend this option because the overall benefits of the project from both a power and an environmental standpoint, outweigh the consequences associated with denying the license application or issuance of a nonpower license to another entity.

The Pensacola Project, with our recommended measures, would provide a number of benefits. The project would continue to provide 86 MW of dependable capacity. An estimated 370,000 MWh of relatively low-cost electricity would continue to be generated annually, which would be used by GRDA to serve its contract customers. The project's generation is equivalent to that which would be produced by burning 624,000 barrels of oil or 154,000 tons of coal annually in a steam-electric generating plant.

The levelized costs of the project generation would include only the project's operation and maintenance (O&M) costs, and the administrative and general costs. The GRDA estimated that these costs are 4.0 mills per kWh, which we conclude are small compared to the value of the power.

This EA analyzes the effects of GRDA's existing hydropower project on the Grand (Neosho) River and tributaries and recommends eight measures proposed or recommended by GRDA, various agencies, and us in order to protect and enhance the existing environmental resources. These measures include:

1. implementing our recommended reservoir level management plan, with the following target reservoir elevations: from November 1 through March 31, maintain reservoir level at elevation 742 feet PD; from April 1 through July 1, the increase in reservoir level beginning April 1 would reach 745 feet PD by May 15 and the reservoir level would be maintained at 745 feet PD until July 1; between July 1 and August 7, reservoir level would decrease to 742 feet PD; between August 7 and August 15, reservoir level would decrease from 742 feet to 740.5 feet PD; from September 1 through September 30,

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reservoir level would be at 740.5 feet PD; and from October 1 through October 31, reservoir level would increase to 741 feet PD;

2. developing and implementing a plan to enhance DO concentrations as measured immediately downstream of the project's tailrace in the Grand (Neosho) River; in the plan, a provision to monitor downstream DO concentrations in the project's tailrace to ensure that the releases from the project are meeting the standards of the plan;

3. seeding a maximum of 1,000 acres of mudflats with millet, wheat, and/or other appropriate vegetation each year and monitoring the effectiveness of the mudflat seeding;

4. managing 1,630 acres of project lands as a wildlife management area;

5. preparing and implementing a long-term recreation plan for Grand Lake;

6. upgrading public access facilities at Duck Creek located in the Ketchum recreation area;

7. protecting undiscovered properties listed on or eligible for listing on the *National Register* in the project area that could be adversely affected by future ground-disturbing activities or by project operation; and,

8. consulting with the Corps, FWS, and TNC in order to assist TNC in attaining TNC's management strategies for the protection of the federally listed endangered gray bat.

B. *Developmental and Nondevelopmental Uses of the Waterway*

The FWS and the ODWC recommended that GRDA acquire and provide annual funds to develop and manage 19,000 acres of bottomland hardwood forest, including an identified 4,500-acre tract of bottomland hardwood forest along the Grand River just upstream of the lake. The FWS's and ODWC's recommendations involve mitigation relative to pre-project conditions and future lake-related development and losses due to original inundation, which is contrary to the Commission's policies on relicensing. [4] In addition, the approximate cost to acquire this acreage is between $400 and $600 per acre, which could total within a range of $7,600,000 to $11,400,000 (personal communication, Gary Hunt, Manager, Environmental Services, Benham-Holway Power Group, Tulsa, Oklahoma, September 16, 1991). Based on average generation, we estimated that at $600 per acre and capitalized over a 30-year period, a total of $1.1 million dollars would amount to 3.0 mills per kWh.

The Pensacola dam, one of three flood control reservoirs on the Grand (Neosho) River, was authorized and constructed under authority of the Flood Control Act of 1941, Public Law 77-228 for flood protection to the lower Grand and Arkansas River Valleys. At that time, Congress determined the reservoir construction and operation were in the public interest. In addition, the project was licensed by the Federal Power Commission in July 1939 to generate low-cost electrical power for use by the citizens of Oklahoma. Flood control and power benefits have been derived from the project for a half century. Therefore, mitigation should not be required to offset the original loss of natural resources.

We do not recommend that GRDA be required to acquire and provide annual funds to develop and manage 19,000 acres of bottomland hardwood forest, including an identified 4,500-acre tract of bottomland hardwood forest along the Grand River just upstream of the lake.

The potential improvements to fish and wildlife resources and associated costs of our recommended measures are discussed below.

Measures 1 and 3 would protect and enhance the fishery and terrestrial resources by: (a) exposing approximately 3,000 acres of mudflats located between elevations 742 feet PD and 745 feet PD that would revegetate naturally thereby providing fish nursery habitat that would be inundated the following spring and early summer (from May 15 through July 1); (b) stabilizing the water level elevations to maximize benefits to spawning fish (i.e., crappie and black bass); (c) creating a greater expanse of mudflats for seeding (500 to 1,000 acres) in order to provide a food source for waterfowl and other wildlife species (i.e., white-tailed deer); and (d) providing for vegetation density and increased diversity as a result of natural revegetation and mudflat seeding.

The ODWC estimated an average cost of $10 per acre for Japanese millet seeding (letter dated February 20, 1991, Steven Alan Lewis, Director, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma). Both the ODWC and FWS stated that several seeding attempts may be necessary in any one season to ensure success. Consequently, the estimated cost to seed 1,000 acres at $10 per acre would be $10,000 per season. Based on the average generation, we conclude that $10,000 would amount to less than 0.1 mill per kWh in additional O&M costs.

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Measure 2, developing and implementing a plan to enhance DO concentrations as measured immediately downstream of the project's tailrace in the Grand (Neosho) River would enhance downstream aquatic habitat and fishery resources and, thus, improve recreational resources.

We looked at four alternatives for improving water quality downstream of the Pensacola Project and developed cost estimates for implementing these alternatives.

a. *Diffused air injection*: The first alternative, diffused air injection, is commonly employed in wastewater treatment plants for delivery of oxygen. The system would require a series of air compressors to supply air, a header and piping system, and a series of diffusers mounted on the piping system. The diffusers have a series of tiny concentric circular slits that allow air to be released into the tailrace waters. Compressed air is introduced via diffusers, and a portion is absorbed while in contact with the water. The amount of oxygen absorbed depends upon the airflow rate, the contact time, oxygen deficit, contact area (bubble diameter), and water temperature.

We assumed that this alternative would be constructed in the tailrace of the powerhouse; however, it could conceivably be installed in the reservoir upstream of the intake structure.

We estimate that 21 400-horsepower (hp) compressors would have to be installed to deliver the necessary oxygen into the tailrace. We also estimate that this alternative would require about 11,300 13-inch-diameter diffusers installed on the piping system. We did not examine the physical layout of such a scheme in tailrace channel and thus cannot address the practicality of the diffused air alternative. We found the present worth of the series of annual operating costs, added them to the installation costs, and levelized the total cost over a 30-year period. We estimate the total 30-year levelized cost of the diffuser alternative would be about $1,339,000 annually.

b. *Surface aeration*: The second alternative, surface aeration, would employ a series of aspirating aerators that float on the surface in the tailrace. Each aerator would have an electric motor which would turn a hollow rotating shaft extending below the water surface with an aspirating propeller mounted on the end. These aspirating aerators direct a current of air and water downward, which provides a strong mixing current. As the propeller turns, it forces water across the bottom of the shaft enclosure, creating a vacuum of 35- to 45-inches of water. The vacuum draws in air, and the action of the propeller forces the air down into the water. The unit is usually mounted at a 25- to 30-degree angle to the water surface. The mixing action in combination with the depth provides up to twice the oxygen transfer efficiencies of more typical surface aerators.

When the aeration is not needed, or when flood flows threaten the installation, the units could be withdrawn. Although the aspirating-propeller aerator has been in use for over 50 years, it has only been recently considered as a viable alternative to aerate tailraces. We estimate that about 76 100-hp aerator units would have to be installed in the tailrace. We found the present worth of the series of annual operating costs, added them to the installation costs, and levelized the total cost over a 30-year period. We estimate the total 30-year levelized cost of the surface aerator alternative would be about $1,583,000 annually.

c. *Injection of pure oxygen in the forebay upstream of the intake structure*: In the third alternative, injection of pure oxygen in the forebay upstream of the intake structure, diffusers would be placed in the deep waters of the forebay to take advantage of the depth (high pressures) to increase oxygen transfer and the local currents to aerate only the water passing through the turbines. Two important site-specific design parameters are the reservoir depth for the diffusers and the depth of the penstock intake. Given sufficient reservoir depth, transfer efficiency can reach 100 percent. However, if the withdrawal zone in a stratified reservoir is totally within the hypolimnion, the bubbles may rise above the withdrawal zone before absorption occurs. We assumed that the oxygen would be purchased and stored in its liquid form (LOX).

This alternative would require headers and a piping system, with diffusers mounted, installed in the deep waters of the reservoir. Working in deep water would greatly increase the cost of installation. We estimate this alternative would require about 467 13-inch-diameter diffusers, which is significantly fewer than the first alternative we described. We found the present worth of the series of annual operating costs, added them to the installation costs, and levelized the total cost over a 30-year period. We estimate the total 30-year levelized cost of the forebay oxygen injection alternative would be about $617,000 annually.

d. *Shutting the project down*: The fourth alternative, of shutting the project down and spilling all of the discharges over the spillway, would improve water quality by two methods. First, the water would be withdrawn from the upper levels of the reservoir which would have a higher oxygen content. Second, the spilling itself would increase the DO content.

In this alternative, we assumed that the project would be shut down for a five-month period of June through October. The project has a

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dependable capacity of 86 MW. By not generating during this period, the dependable capacity rating of the project would be reduced to zero MW. We, therefore, valued the cost of this alternative at the cost of replacement energy and capacity. We valued the energy at the alternative cost of fuel for a fossil-fueled steam-electric plant and the capacity at the cost of installing simple-cycle combustion turbines. We estimate the total levelized cost of the project shutdown alternative would be about $7,827,000 annually.

We have summarized the levelized annual costs of the four alternatives below in table 4. In deriving these estimated costs, however, we lacked considerable data and thus had to make numerous simplifying assumptions. Consequently, these estimated costs should be considered "ballpark" estimates. Assuming that the project annual generation is 370 gigawatthours (GWh), we also calculated the costs in mills per kWh.

Table 4. Summary of annual operating costs for four alternatives for improving water quality at the Pensacola Project.

Alternative	Annual Levelized Capitol Costs (dollars)	Annual Levelized Operating Costs (dollars)	Total Annual Levelized Costs (dollars)	Annual Cost (mills/kWh)
Diffused air	384,000	955,000	1,339,000	3.62
Surface aerators ...	705,000	878,000	1,583,000	4.28
Oxygen injection ..	22,000	595,000	617,000	1.67
Project shutdown ...	----	----	7,827,000	36.27 [5]

The four alternatives for improving downstream DO concentrations were analyzed to enhance DO concentrations to the state standards during the critical summer period. Based on this analysis, we do not recommend implementation of project shutdown because of the significantly high total annual levelized costs (i.e., $7,827,000) associated with this alternative. Implementation of an oxygen injection system at the Pensacola Project offers the lowest annual levelized costs for increasing DO concentrations to the state standards, but would still increase the cost of power generation from the project by over $600,000 annually. We conclude that this cost is not justified because comparable benefits to the environmental resources would not be derived by enhancing downstream DO concentrations to the levels recommended by the fishery agencies.

In lieu of the agencies' recommendations, we recommend that the licensee, for any license issued for the Pensacola Project, develop and implement a plan to monitor and enhance DO concentrations as measured immediately downstream of the projects' tailrace in the Grand (Neosho) River. We further recommend that the licensee investigate measures to improve downstream DO concentrations. For example, an oxygen injection system could be installed and tested to determine the extent of DO enhancement that occurs with incremental increases of oxygen injection.

Measure 4 would provide 1,630 acres of project lands as a wildlife management area. Terrestrial resources would be enhanced by protecting "islands" of habitat and protecting natural diversity in addition to providing for recreation (public hunting).

Measure 5 would provide the Grand Lake area with a comprehensive, long-term recreation plan which would primarily: (a) determine whether capacities of the lake's other recreational facilities, especially boat launches, are sufficient to meet current and future demand; and (b) assess the lake's carrying capacity for boating. We estimated that a comparable recreation plan would cost approximately $30,000 to $50,000 to prepare (personal communication, Alan Graefe, Associate Professor, Pennsylvania State University, University Park, Pennsylvania, September 19, 1991).

Measure 6 would improve public access facilities at Duck Creek located in the Ketchum recreation area. We estimated the cost for these recreational enhancement measures would be approximately $27,000. Based on the average generation, we conclude that $27,000 would amount to less than 0.1 mill per kWh in additional O&M costs.

Measure 7 would protect (if needed) undiscovered properties listed on or eligible for listing on the National Register in the project area that could be adversely affected by future ground-disturbing activities or by project operation.

Measure 8 would protect the federally listed endangered gray bat, thereby contributing to a potential increase in its population.

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Based on cost estimates provided by the agencies and GRDA, our recommended fish and wildlife measures and recreational measures would have a capital cost of approximately $87,000. Based on the average generation, we conclude that $87,000 would amount to approximately 0.2 mill per kWh in additional O&M costs. Cost estimates associated with the recommended reservoir level management plan, protecting (if needed) undiscovered properties listed on or eligible for listing on the *National Register*, protecting the federally listed endangered gray bat, and managing 1,630 acres as a wildlife management area have not been calculated. Their associated costs, however, would be reasonable in comparison to the benefits that would be provided.

Cost estimates for DO enhancement have been calculated. As we stated previously, these cost estimates should be considered "ballpark" estimates. The Pensacola Project has, for the most part, paid off the original construction debt. Consequently, the cost of producing power at the project is the project O&M. GRDA has informed us that its O&M costs are about 4.0 mills per kWh. We note, therefore, that, while the unit cost of the forebay oxygen injection alternative would be small (1.67 mills per kWh), implementation of this alternative would increase the cost of power from the project by over $600,000 annually or about 42 percent. Cost estimates for implementing the other alternatives could total within a range of $1,000,000 to $7,000,000 annually.

Because of these significantly high costs, we do not recommend implementation of these three alternatives. Instead, we recommend that the licensee be required to develop and implement a plan to monitor and enhance downstream DO concentrations by investigating measures, such as an oxygen injection system, that can improve DO concentrations above the existing concentrations.

Based on a review of the agency and public comments filed in this proceeding and on our independent analysis pursuant to Sections 4(e), 10(a)(1), and 10(a)(2) of the Act, we conclude that the licensing and continued operation of the Pensacola Hydroelectric Project, with our recommended measures for the protection and enhancement of the environment, would permit the best comprehensive development of the Grand (Neosho) River.

VII. Consistency With Fish and Wildlife Recommendations

Pursuant to section 10(j) of the Act, the recommendations of the federal and state fish and wildlife agencies are inconsistent with the purpose and requirements of Part I of the Act or other applicable law. Specifically, we believe that FWS's and ODWC's recommendations for GRDA to: (1) acquire and provide annual funds to develop and manage 19,000 acres of bottomland hardwood forest, including an identified 4,500-acre tract of bottomland hardwood forest along the Grand River just upstream of the lake; and (2) modify the project to comply with state water quality standards for DO would be inconsistent with section 10(a) of the Act. The FWS's and ODWC's recommendations are inconsistent with section 10(a) of the Act because the costs associated with implementation of these recommendations, as previously discussed, would reduce the project's economic benefits, which now flow to GRDA's ratepayers.

We believe that ODWC's recommendations for GRDA to: (1) *consider* the development of a fish hatchery and/or nursery pond complex; and (2) create two positions (fish/wildlife biologist and a technician) would be inconsistent with section 10(a) of the Act.

The ODWC has not identified any state-designated fishery management goals or objectives that would be served by GRDA's construction, operation, and maintenance of a fish hatchery and/or nursery pond. Neither has ODWC provided any substantial evidence to support this recommendation. Furthermore, ODWC has not demonstrated that the benefits of a fish hatchery and/or nursery pond complex are worth the costs.

The ODWC has recommended that GRDA create two positions (fish/wildlife biologist and a technician) at the Pensacola Project and GRDA's other projects. We believe that ODWC's recommendation for GRDA to create two positions (fish/wildlife biologist and a technician) has not been supported by substantial evidence as to why these two positions should be provided by GRDA and is not an appropriate fish and wildlife recommendation under section 10(j) of the Act because this recommendation does not provide measures for the protection, mitigation of damages to, and enhancement of fish and wildlife as stipulated under section 10(j) of the Act.

In lieu of FWS's and ODWC's recommendations, we will recommend for inclusion in any new license issued for the Pensacola Project the environmental measures identified above as measures 1 through 8.

VIII. Conclusion

The project is constructed and operating. An unavoidable adverse impact resulting from the existing project would be minor, temporary disturbances to terrestrial resources due to upgrading public access facilities at Duck Creek located in the Ketchum recreation area.

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On the basis of our independent environmental analysis, issuance of a new license for the Pensacola Project would not constitute a major federal action significantly affecting the quality of the human environment.

IX. Literature Cited

Bailey, Robert G. 1976. Ecoregions of the United States. U.S. Forest Service, Ogden, Utah (map only: scale 1:7,500,000).

Benham-Holway Power Group. 1986. Assessment of impact on the gray bat and Ozark cavefish. Pensacola Hydroelectric Project, FERC Project No. 1494. Tulsa, Oklahoma. July 1986. 13 pp. and appendices.

Citizens Utilities Company. 1991. Clyde Pond water level management report, Clyde River Hydroelectric Project, FERC Project No. 2306. Stamford, Connecticut. April 1991.

Cross, F.B. and J.T. Collins. 1975. Fishes in Kansas. University of Kansas Museum of Natural History. Public Education Series No. 3. 189 pp.

Electric Power Research Institute. 1990. Assessment and guide for meeting dissolved oxygen water quality standards for hydroelectric plant discharges. Palo Alto, California. November 1990.

Environmental Protection Agency. 1986. Ambient water quality criteria for dissolved oxygen. EPA 440/5-86-003, Washington, D C.

Erickson, Nanette E. and David M. Leslie. 1988. Shoreline vegetation and general wildlife values around Grand Lake, Oklahoma. Oklahoma Cooperative Fish and Wildlife Research Unit, Oklahoma State University, Stillwater, Oklahoma. 23 pp. and appendices.

Federal Energy Regulatory Commission. 1978. Planning status report. Grand (Neosho) River Basin, Missouri, Arkansas, Kansas, Oklahoma. Federal Energy Regulatory Commission, Office of Electric Power Regulation, Washington, D.C. Revised 1978. 13 pp.

------------. 1991. Computer data base. Federal Energy Regulatory Commission, Office of Hydropower Licensing, Washington, DC. February 6, 1991.

Fredrickson, Leigh H. and T. Scott Taylor. 1982. Management of seasonally flooded impoundments for wildlife. U.S. Fish and Wildlife Service, Washington, D C. 22 pp. and appendices.

Grand River Dam Authority. 1986. Amendments and supplemental information (submitted through March 1987), Pensacola dam Hydroelectric Project, FERC Project No. 1494. Vinita, Oklahoma. May 1986.

------------. 1988a. Supplemental information response to FERC letter dated October 3, 1986 (Schedule B comments 8-11 and 14-15). Vinita, Oklahoma. April 1988.

------------. 1988b. Pensacola Hydropower Project, No. 1494, application for new license, Quarterly progress report, Vinita, Oklahoma. December 1988.

------------. 1990a. Response to additional information dated October 3, 1986 Schedule B (items 2, 3, and 4). Vinita, Oklahoma. July 6, 1990.

------------. 1990b. Supplemental information response to FERC letter dated October 3, 1986 (Schedule B, items 11 and 14) and December 10, 1986 (Schedule A). Vinita, Oklahoma. August 1990.

------------. 1991a. Grand River Dam Authority's response to the U.S. Fish and Wildlife Services's comments on GRDA's mitigation plan for Pensacola Project, FERC Project No. 1494-002 . Washington, D.C. February 22, 1991.

------------. 1991b. Grand River Dam Authority's response to the Oklahoma Department of Wildlife Conservation's recommendations and comments on GRDA's mitigation plan. Washington, D.C. August 16, 1991.

Juhlin, Randy. 1986. Hydrologist, Department of the Army, Tulsa District, Corps of Engineers, Tulsa, Oklahoma. Telephone conversation between Mr. Juhlin and Benham-Holway Power Group, Tulsa, Oklahoma. July 1, 1986.

Kadlec, John A. 1962. Effects of a drawdown on a waterfowl impoundment. Ecology. 43:267-280.

Krull, John N. 1970. Aquatic plant-macroinvertebrate associations and waterfowl. Journal of Wildlife Management. 34:707-717.

LaVal, R.K., R.L. Clawson, M.L. LaVal, and W. Caire. 1977. Foraging behavior and nocturnal activity patterns of Missouri bats, with special emphasis on the endangered species *Myotis grisescens* and *Myotis sodalis.* J. Mamm., 58:592-599.

Lish, James W. 1987. Diet, population size, and locations of high use areas for bald eagles (*Haliaeetus leucocephalus*) wintering on Grand Lake during January-March, 1987. Oklahoma Cooperative Fish and Wildlife Research Unit, Oklahoma State University, Stillwater, Oklahoma. 21 pp.

[63,260]

Meeks, Robert L. 1969. Effects of drawdown on plant succession. Journal of Wildlife Management. 33:817-821.

McDonald, Malcolm E. 1955. Cause and effects of a die-off of emergent vegetation. Journal of Wildlife Management. 19:24-35.

Missouri Department of Conservation. 1980. Fact sheet on bats. Jefferson City, Missouri. 4 pp.

Moss, R. 1981. Life History information for the Neosho madtom (*Noturus placidus*). Kansas Nongame Wildlife Improvement Program. Contract No. 38. 32 pp.

Oklahoma Tourism and Recreation Department. 1987. Oklahoma Statewide Comprehensive Outdoor Recreation Plan. Oklahoma City, Oklahoma. 216 pp.

Penfound, Wm. T. 1953. Plant communities of Oklahoma lakes. Ecology. 34:561-583.

Stancill, W.J., S.B. Haggard, R.F. Raskevitz, and D.M. Leslie, Jr. 1988. Waterfowl use and hunting opportunities on Grand Lake and ancillary wetlands. Oklahoma Cooperative Fish and Wildlife Research Unit. Stillwater, Oklahoma. 97 pp.

Taylor, William R. 1969. A revision of the catfish genus *Noturus rafinesque*, with an analysis of higher groups in the *Ictaluridae.* U.S. National Museum Bulletin 282. Smithsonian Institution Press, Washington, D.C. pp.168-173.

Teskey, R.O. and T.M. Hinckley. 1977. Impact of water level changes on woody riparian and wetland vegetation communities. vol. III: The Central Forest Region. U.S. Fish and Wildlife Service, Nat. Stream Alter. Team, FWS/OBS-77/60. 36 pp.

Tuttle, M.D. 1976. Population ecology of the gray bat (*Myotis grisescens*): factors influencing growth and survival of newly volant young. Ecology. 57:587-595.

------------. 1979. Status, causes of decline, and management of endangered gray bats. Journal of Wildlife Management. 43:1-17.

U.S. Fish and Wildlife Service. 1982. Gray bat recovery plan, U.S. Fish and Wildlife Service, Denver, Colorado. 21 pp + appendices.

------------. 1987. Region 4 endangered species notebook. Gray bat (*Myotis griesescens*). U.S. Fish and Wildlife Service, Atlanta, Georgia.

------------. 1989. Ozark cavefish recovery plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 15 pp.

------------. 1990a. Endangered and threatened wildlife and plants; Neosho madtom determined to be threatened. *Federal Register* 55: 21148-21153.

------------. 1990b. Neosho madtom recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado. 66 pp.

------------. 1990c. Terrestrial wildlife evaluation of the Pensacola Hydroelectric Project (FERC Project No. 1494) using the Habitat Evaluation Procedures. U.S. Fish and Wildlife Service, Tulsa, Oklahoma. October 17, 1990.

Wagner, B., A.A. Echelle, and O.E. Maughan. 1984. Statues of three Oklahoma fishes (*Notropis perpallidus*, *Noturus placidus*, *Percina nasuta*). Contract No. 14-16-0009-1513-WO2-MI. Final report to U.S. Fish and Wildlife Service from Oklahoma Cooperative Fishery Research Unit. Stillwater, Oklahoma. 30 pp.

X. List of Preparers

Patti Leppert-Slack -- Environmental Coordinator, Terrestrial Resources, Threatened and Endangered Species (Ecologist; M.A., Recreation and Parks/Biology).

J.T. Griffin -- Cultural Resources (B.A., Anthropology, Master of Public Administration).

Mary Golato -- Editor/Public Utilities Specialist (B.S., English).

Peter A. Leitzke -- Geology and Soils (Geologist; M.A., Geological Sciences).

Dr. Frank Miller -- Purpose and Need for Power (Electrical Engineer; Doctor of Engineering and Electrical Engineering).

Steven G. Naugle -- Aesthetic Resources (Landscape Architect; B.S., Landscape Architecture).

Vince Yearick -- Recreation and Other Land and Water Uses (Environmental Protection Specialist; M.S., Recreation and Parks).

David E. Zehner -- Safety and Design Assessment (Civil Engineer; Degree of Engineer (Professional Degree), Geotechnical Engineering).

Form L-3
(October, 1975)

FEDERAL ENERGY REGULATORY COMMISSION

TERMS AND CONDITIONS OF LICENSE FOR CONSTRUCTED
MAJOR PROJECT AFFECTING NAVIGABLE
WATERS OF THE UNITED STATES

Article 1. The entire project, as described in this order of the Commission, shall be subject to all of the provisions, terms, and conditions of the license.

Article 2. No substantial change shall be made in the maps, plans, specifications, and statements described and designated as exhibits and approved by the Commission in its order as a part of the license until such change shall have been approved by the Commission: Provided, however, That if the Licensee or the Commission deems it necessary or desirable that said approved exhibits, or any of them, be changed, there shall be submitted to the Commission for approval a revised, or additional exhibit or exhibits covering the proposed changes which, upon approval by the Commission, shall become a part of the license and shall supersede, in whole or in part, such exhibit or exhibits theretofore made a part of the license as may be specified by the Commission.

Article 3. The project area and project works shall be in substantial conformity with the approved exhibits referred to in Article 2 herein or as changed in accordance with the provisions of said article. Except when emergency shall require for the protection of navigation, life, health, or property, there shall not be made without prior approval of the Commission any substantial alteration or addition not in conformity with the approved plans to any dam or other project works under the license or any substantial use of project lands and waters not authorized herein; and any emergency alteration, addition, or use so made shall thereafter be subject to such modification and change as the Commission may direct. Minor changes in project works, or in uses of project lands and waters, or divergence from such approved exhibits may be made if such changes will not result in a decrease in efficiency, in a material increase in cost, in an adverse environmental impact, or in impairment of the general scheme of development; but any of such minor changes made without the prior approval of the Commission, which in its judgment have produced or will produce any of such results, shall be subject to such alteration as the Commission may direct.

Article 4. The project, including its operation and maintenance and any work incidental to additions or alterations authorized by the Commission, whether or not conducted upon lands of the United States, shall be subject to the inspection and supervision of the Regional Engineer, Federal Energy Regulatory Commission, in the region wherein the project is located, or of such other officer or agent as the Commission may designate, who shall be the authorized representative of the Commission for such purposes. The Licensee shall cooperate fully with said representative and shall furnish him such information as he may require concerning the operation and maintenance of the project, and any such alterations thereto, and shall notify him of the date upon which work with respect to any alteration will begin, as far in advance thereof as said representative may reasonably specify, and shall notify him promptly in writing of any suspension of work for a period of more than one week, and of its resumption and completion. The Licensee shall submit to said representative a detailed program of inspection by the Licensee that will provide for an adequate and qualified inspection force for construction of any such alterations to the project. Construction of said alterations or any feature thereof shall not be initiated until the program of inspection for the alterations or any feature thereof has been approved by said representative. The Licensee shall allow said representative and other officers or employees of the United States, showing proper credentials, free and unrestricted access to, through, and across the project lands and project works in the performance of their official duties. The Licensee shall comply with such rules and regulations of general or special applicability as the Commission may prescribe from time to time for the protection of life, health, or property.

<u>Article 5</u>. The Licensee, within five years from the date of issuance of the license, shall acquire title in fee or the right to use in perpetuity all lands, other than lands of the United States, necessary or appropriate for the construction maintenance, and operation of the project. The Licensee or its successors and assigns shall, during the period of the license, retain the possession of all project property covered by the license as issued or as later amended, including the project area, the project works, and all franchises, easements, water rights, and rights or occupancy and use; and none of such properties shall be voluntarily sold, leased, transferred, abandoned, or otherwise disposed of without the prior written approval of the Commission, except that the Licensee may lease or otherwise dispose of interests in project lands or property without specific written approval of the Commission pursuant to the then current regulations of the Commission. The provisions of this article are not intended to prevent the abandonment or the retirement from service of structures, equipment, or other project works in connection with replacements thereof when they become obsolete, inadequate, or inefficient for further service due to wear and tear; and mortgage or trust deeds or judicial sales made thereunder, or tax sales, shall not be deemed voluntary transfers within the meaning of this article.

Article 6. In the event the project is taken over by the United States upon the termination of the license as provided in Section 14 of the Federal Power Act, or is transferred to a new licensee or to a non-power licensee under the provisions of Section 15 of said Act, the Licensee, its successors and assigns shall be responsible for, and shall make good any defect of title to, or of right of occupancy and use in, any of such project property that is necessary or appropriate or valuable and serviceable in the maintenance and operation of the project, and shall pay and discharge, or shall assume responsibility for payment and discharge of, all liens or encumbrances upon the project or project property created by the Licensee or created or incurred after the issuance of the license: Provided, That the provisions of this article are not intended to require the Licensee, for the purpose of transferring the project to the United States or to a new licensee, to acquire any different title to, or right of occupancy and use in, any of such project property than was necessary to acquire for its own purposes as the Licensee.

Article 7. The actual legitimate original cost of the project, and of any addition thereto or betterment thereof, shall be determined by the Commission in accordance with the Federal Power Act and the Commission's Rules and Regulations thereunder.

Article 8. The Licensee shall install and thereafter maintain gages and stream-gaging stations for the purpose of determining the stage and flow of the stream or streams on which the project is located, the mount of water held in and withdrawn from storage, and the effective head on the turbines; shall provide for the required reading of such gages and for the adequate rating of such stations; and shall install and maintain standard meters adequate for the determination of the amount of electric energy generated by the project works. The number, character, and location of gages, meters, or other measuring devices, and the method of operation thereof, shall at all times be satisfactory to the Commission or its authorized representative. The Commission reserves the right, after notice and opportunity for hearing, to require such alterations in the number, character, and location of gages, meters, or other measuring devices, and the method of operation thereof, as are necessary to secure adequate determinations. The installation of gages, the rating of said stream or streams, and the determination of the flow thereof, shall be under the supervision of, or in cooperation with, the District Engineer of the United States Geological Survey having charge of stream-gaging operations in the region of the project, and the Licensee shall advance to the United States Geological Survey the amount of funds estimated to be necessary for such supervision, or cooperation for such periods as may mutually agreed upon. The Licensee shall keep accurate and sufficient records of the foregoing determinations to the satisfaction of the Commission, and shall make return of such records annually at such time and in such form as the Commission may prescribe.

Article 9. The Licensee shall, after notice and opportunity for hearing, install additional capacity or make other changes in the project as directed by the Commission, to the extent that it is economically sound and in the public interest to do so.

Article 10. The Licensee shall, after notice and opportunity for hearing, coordinate the operation of the project, electrically and hydraulically, with such other projects or power systems and in such manner as the Commission any direct in the interest of power and other beneficial public uses of water resources, and on such conditions concerning the equitable sharing of benefits by the Licensee as the Commission may order.

Article 11. Whenever the Licensee is directly benefited by the construction work of another licensee, a permittee, or the United States on a storage reservoir or other headwater improvement, the Licensee shall reimburse the owner of the headwater improvement for such part of the annual charges for interest, maintenance, and depreciation thereof as the Commission shall determine to be equitable, and shall pay to the United States the cost of making such determination as fixed by the Commission. For benefits provided by a storage reservoir or other headwater improvement of the United States, the Licensee shall pay to the Commission the amounts for which it is billed from time to time for such headwater benefits and for the cost of making the determinations pursuant to the then current regulations of the Commission under the Federal Power Act.

Article 12. The United States specifically retains and safeguards the right to use water in such amount, to be determined by the Secretary of the Army, as may be necessary for the purposes of navigation on the navigable waterway affected; and the operations of the Licensee, so far as they affect the use, storage and discharge from storage of waters affected by the license, shall at all times be controlled by such reasonable rules and regulations as the Secretary of the Army may prescribe in the interest of navigation, and as the Commission may prescribe for the protection of life, health, and property, and in the interest of the fullest practicable conservation and utilization of such waters for power purposes and for other beneficial public uses, including recreational purposes, and the Licensee shall release water from the project reservoir at such rate in cubic feet per second, or such volume in acre-feet per specified period of time, as the Secretary of the Army may prescribe in the interest of navigation, or as the Commission may prescribe for the other purposes hereinbefore mentioned.

Article 13. On the application of any person, association, corporation, Federal agency, State or municipality, the Licensee shall permit such reasonable use of its reservoir or other project properties, including works, lands and water rights, or parts thereof, as may be ordered by the Commission, after notice and opportunity for hearing, in the interests of comprehensive development of the waterway or waterways involved and the conservation and utilization of the water resources of the region for water supply or for the purposes of steam-electric, irrigation, industrial, municipal or similar uses. The Licensee shall receive reasonable compensation for use of its reservoir or other project properties or parts thereof for such purposes, to include at least full reimbursement for any damages or expenses which the joint use causes the Licensee to incur. Any such compensation shall be fixed by the Commission either by approval of an agreement between the Licensee and the party or parties benefiting or after notice and opportunity for hearing. Applications shall contain information in sufficient detail to afford a full understanding of the proposed use, including satisfactory evidence that the applicant possesses necessary water rights pursuant to applicable State law, or a showing of cause why such evidence cannot concurrently be submitted, and a statement as to the relationship of the proposed use to any State or municipal plans or orders which may have been adopted with respect to the use of such waters.

Article 14. In the construction or maintenance of the project works, the Licensee shall place and maintain suitable structures and devices to reduce to a reasonable degree the liability of contact between its transmission lines and telegraph, telephone and other signal wires or power transmission lines constructed prior to its transmission lines and not owned by the Licensee, and shall also place and maintain suitable structures and devices to reduce to a reasonable degree the liability of any structures or wires falling or obstructing traffic or endangering life. None of the provisions of this article are intended to relieve the Licensee from any responsibility or requirement which may be imposed by any other lawful authority for avoiding or eliminating inductive interference.

Article 15. The Licensee shall, for the conservation and development of fish and wildlife resources, construct, maintain, and operate, or arrange for the construction, maintenance, and operation of such reasonable facilities, and comply with such reasonable modifications of the project structures and operation, as may be ordered by the Commission upon its own motion or upon the recommendation of the Secretary of the Interior or the fish and wildlife agency or agencies of any State in which the project or a part thereof is located, after notice and opportunity for hearing.

Article 16. Whenever the United States shall desire, in connection with the project, to construct fish and wildlife facilities or to improve the existing fish and wildlife facilities at its own expense, the Licensee shall permit the United States or its designated agency to use, free of cost, such of the Licensee's lands and interests in lands, reservoirs, waterways and project works as may be reasonably required to complete such facilities or such improvements thereof. In addition, after notice and opportunity for hearing, the Licensee shall modify the project operation as may be reasonably prescribed by the Commission in order to permit the maintenance and operation of the fish and wildlife facilities constructed or improved by the United States under the provisions of this article. This article shall not be interpreted to place any obligation on the United States to construct or improve fish and wildlife facilities or to relieve the Licensee of any obligation under this license.

Article 17. The Licensee shall construct, maintain, and operate, or shall arrange for the construction, maintenance, and operation of such reasonable recreational facilities, including modifications thereto, such as access roads, wharves, launching ramps, beaches, picnic and camping areas, sanitary facilities, and utilities, giving consideration to the needs of the physically handicapped, and shall comply with such reasonable modifications of the project, as may be prescribed hereafter by the Commission during the term of this license upon its own motion or upon the recommendation of the Secretary of the Interior or other interested Federal or State agencies, after notice and opportunity for hearing.

Article 18. So far as is consistent with proper operation of the project, the Licensee shall allow the public free access, to a reasonable extent, to project waters and adjacent project lands owned by the Licensee for the purpose of full public utilization of such lands and waters for navigation and for outdoor recreational purposes, including fishing and hunting: Provided, That the Licensee may reserve from public access such portions of the project waters, adjacent lands, and project facilities as may be necessary for the protection of life, health, and property.

Article 19. In the construction, maintenance, or operation of the project, the Licensee shall be responsible for, and shall take reasonable measures to prevent, soil erosion on lands adjacent to streams or other waters, stream sedimentation, and any form of water or air pollution. The Commission, upon request or upon its own motion, may order the Licensee to take such measures as the Commission finds to be necessary for these purposes, after notice and opportunity for hearing.

Article 20. The Licensee shall clear and keep clear to an adequate width lands along open conduits and shall dispose of all temporary structures, unused timber, brush, refuse, or other material unnecessary for the purposes of the project which results from the clearing of lands or from the maintenance or alteration of the project works. In addition, all trees along the periphery of project reservoirs which may die during operations of the project shall be removed. All clearing of the lands and disposal of the unnecessary material shall be done with due diligence and to the satisfaction of the authorized representative of the Commission and in accordance with appropriate Federal, State, and local statutes and regulations.

__Article 21__. Material may be dredged or excavated from, or placed as fill ~~in~~, project lands and/or waters only in the prosecution of work specifically authorized under the license; in the maintenance of the project; or after obtaining Commission approval, as appropriate. Any such material shall be removed and/or deposited in such manner as to reasonably preserve the environmental values of the project and so as not to interfere with traffic on land or water. Dredging and filling in a navigable water of the United States shall also be done to the satisfaction of the District Engineer, Department of the Army, in charge of the locality.

__Article 22__. Whenever the United States shall desire to construct, complete, or improve navigation facilities in connection with the project, the Licensee shall convey to the United States, free of cost, such of its lands and rights-of-way and such rights of passage through its dams or other structures, and shall permit such control of its pools, as may be required to complete and maintain such navigation facilities.

__Article 23__. The operation of any navigation facilities which may be constructed as a part of, or in connection with, any dam or diversion structure constituting a part of the project works shall at all times be controlled by such reasonable rules and regulations in the interest of navigation, including control of the level of the pool caused by such dam or diversion structure, as may be made from time to time by the Secretary of the Army.

__Article 24__. The Licensee shall furnish power free of cost to the United States for the operation and maintenance of navigation facilities in the vicinity of the project at the voltage and frequency required by such facilities and at a point adjacent thereto, whether said facilities are constructed by the Licensee or by the United States.

__Article 25__. The Licensee shall construct, maintain, and operate at its own expense such lights and other signals for the protection of navigation as may be directed by the Secretary of the Department in which the Coast Guard is operating.

__Article 26__. If the Licensee shall cause or suffer essential project property to be removed or destroyed or to become unfit for use, without adequate replacement, or shall abandon or discontinue good faith operation of the project or refuse or neglect to comply with the terms of the license and the lawful orders of the Commission mailed to the record address of the Licensee or its agent, the Commission will deem it to be the intent of the Licensee to surrender the license. The Commission, after notice and opportunity for hearing, may require the Licensee to remove any or all structures, equipment and power lines within the project boundary and to take any such other action necessary to restore the project waters, lands, and facilities remaining within the project boundary to a condition satisfactory to the

United States agency having jurisdiction over its lands or the Commission's authorized representative, as appropriate, or to provide for the continued operation and maintenance of nonpower facilities and fulfill such other obligations under the license as the Commission may prescribe. In addition, the Commission in its discretion, after notice and opportunity for hearing, may also agree to the surrender of the license when the Commission, for the reasons recited herein, deems it to be the intent of the Licensee to surrender the license.

Article 27. The right of the Licensee and of its successors and assigns to use or occupy waters over which the United States has jurisdiction, or lands of the United States under the license, for the purpose of maintaining the project works or otherwise, shall absolutely cease at the end of the license period, unless the Licensee has obtained a new license pursuant to the then existing laws and regulations, or an annual license under the terms and conditions of this license.

Article 28. The terms and conditions expressly set forth in the license shall not be construed as impairing any terms and conditions of the Federal Power Act which are not expressly set forth herein.

Dr. Marc Zimmerman -- Water Resources, Fishery Resources (Ecologist; Ph.D., Zoology).

[63,261]

Figure 1 Location of existing Pensacola Hydroelectric Project FERC No 1494 Oklahoma

[63,262]

Figure 2 Location of project features for existing Pensacola Hydroelectric Project FERC No 1494 Oklahoma

-- Footnotes --

[63,217]

Footnotes

1 *See* 5 A.R. 118.

[63,218]

2 As a result of technical input of the FWS and ODWC during the section 10(j) process, this measure differs from the reservoir level management plan recommended in the EA.

3 The project's generation is equivalent to that which would be produced by burning 624,000 barrels of oil or 154,000 tons of coal annually in a steam-electric generating plant.

[63,219]

|[4] Annual cost was divided by

215.8 GWh, the assumed project generation with 5 months of

shutdown, instead of 370 GWh.

[63,220]

5 Unique wildlife systems of Oklahoma, 1979, U.S. Fish and Wildlife Service; Land protection plan for Texas/Oklahoma bottomland hardwoods and migratory waterfowl, 1985, U.S. Fish and Wildlife Service; Bottomland hardwoods of eastern Oklahoma, 1985, Oklahoma Department of Wildlife Conservation; Riparian areas of western Oklahoma, 1987, Oklahoma Department of Wildlife Conservation; Eastern Oklahoma wetlands plan: Lower Mississippi Valley joint venture-North American waterfowl management plan, 1989, Oklahoma Department of Wildlife Conservation; Oklahoma comprehensive water plan, 1980, Oklahoma Water Resources Board; Oklahoma's water quality standards, 1985, Oklahoma Water Resources Board; Oklahoma scenic river act, 1969, State of Oklahoma.

6 The FWS and ODWC offered no specific proposal to modify the project.

[63,221]

7 These two recommendations were only made by ODWC.

8 The Oklahoma Water Resources Board, Grand River Dam Authority, and the law firm of Duncan & Allen also were in attendance.

9 . . . "evaluation and consideration of the appropriateness of requiring enhancement measures is done in the context of today's environment and in relation to today's needs and problems, not in the context of the world as it existed 50 years ago." 54 *Federal Register* at 23,776 (June 2, 1989).

[63,222]

10 Letter from Steven Alan Lewis, Director, Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma, filed with the Commission on February 25, 1992.

[63,223]

11 Elevation 745 feet Pensacola Datum.

[63,225]

12 Staff has prepared a Safety and Design Assessment for the Pensacola Project No. 1494, which is available in the Commission's public file associated with this project.

[63,246]

1 . . . "evaluation and consideration of the appropriateness of requiring enhancement measures is done in the context of today's environment and in relation to today's needs and problems, not in the context of the world as it existed 50 years ago." 54 *Federal Register* at 23,776 (June 2, 1989).

[63,251]

2 Original license for the Pensacola Hydroelectric Project dated July 12, 1939.

[63,252]

3 This assumes, unrealistically, that there are boats in every slip and that, at any one time, all of these boats are on the water. However, this figure does not include boating use that occurs via trailered boats, not permanently docked, that are launched daily at the many public access points on the lake.

[63,255]

4 "...evaluation and consideration of the appropriateness of requiring enhancement measures is done in the context of today's environment and in relation to today's needs and problems, not in the context of the world as it existed 50 years ago." 54 *Federal Register* at 23,776 (June 2, 1989).

[63,257]

|[5] Annual cost was divided by

215.8 GWh, the assumed project generation with 5 months of

shutdown, instead of 370 GWh.

UNITED STATES OF AMERICA76 FERC ¶62,162
FEDERAL ENERGY REGULATORY COMMISSION

Grand River Dam Authority) Project No. 1494-120

ORDER AMENDING LICENSE
Issued September 4, 1996

On March 12, 1996, Grand River Dam Authority (GRDA), licensee for the Pensacola Project, filed an application for amendment of license to upgrade six of the project's generating units. The Pensacola Project is on the Grand (Neosho) River in Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma.

BACKGROUND

On April 24, 1992, the Commission issued a new license to the GRDA for the continued operation and maintenance of the Pensacola Project. 1/ The project consists of the main dam with a gated spillway section, an auxiliary gated spillway, a reservoir known as the Grand Lake O' the Cherokees, a powerhouse containing seven generating units, a tailrace, a spillway channel, and appurtenant facilities. A breakdown of the turbine and generator capacities for the seven licensed units follows:

Licensed Units

Unit No.	Turbine			Generator
	Rated Head (ft)	Max. Hydraulic Capacity (cfs)	Rated Output (kW)	Nameplate Capacity (kW)
1-6	115	2,020	14,390	14,400
7	115	60	500	500
Total	-	12,180	86,840	86,900

The six 14.4-MW generating units are over 50 years old. Severe turbine runner cavitation has been an ongoing problem at the project, causing cracks to form in the turbine runners. The licensee recently performed tests on the generators that indicate the windings are below minimum industry standards. Also, insulation failures are an ongoing problem with the generator cables running between the generators and switchyard.

1/ 59 FERC ¶ 62,073.

APPLICATION FOR AMENDMENT

GRDA proposes to upgrade the turbines and generators of the existing six 14.4-MW generating units and replace other electrical equipment to accommodate the upgraded units. The licensee proposes to upgrade one unit a year for six consecutive years after the Commission grants approval for the upgrade.

The proposed turbine upgrades include replacing the existing runners with new runners that have higher efficiency and capacity, and are more cavitation resistant than the existing runners. The upgrades will increase the rated output of each turbine from 14,390 kW to 17,446 kW and the maximum hydraulic capacity of each turbine from 2,020 cfs to 2,317 cfs. GRDA proposes to rewind the generators which should increase the nameplate ratings from 14,400 kW to 22,500 kW. The licensee also proposes to replace the aging step-up transformers, the deteriorated cables from the generator to the switchyard, and the plant ventilation system as part of the unit upgrades.

A breakdown of the turbine and generator capacities for the proposed upgrades follows:

Proposed Units

Unit No.	Turbine			Generator
	Rated Head (ft)	Max. Hydraulic Capacity (cfs)	Rated Output (kW)	Nameplate Capacity (kW)
1-6	117.5	2,317	17,446	22,500
7	115	60	500	500
Total	-	13,962	105,176	135,500

The larger hydraulic capacities of the six units will allow GRDA to pass more water through the generating units than would normally have been passed through the spillway gates. The application indicates the monthly volume of water flowing through the units will increase by as much as eight percent, primarily during spring. GRDA states it requested project bidders to include estimates for enhancing dissolved oxygen (DO) levels by turbine air induction. If the DO enhancement is cost effective, GRDA plans to have a model test done to confirm the effectiveness of the DO enhancement. GRDA states it will incorporate the air induction feature into the upgrades if the model test confirms the feature is a cost effective method for DO enhancement.

ECONOMIC IMPACTS

GRDA's application for amendment includes estimates for project costs. The costs include $26,000,000 for equipment maintenance and transformer replacement, and $5,000,000 for capacity upgrades. GRDA estimates that the upgrades would increase the project's dependable capacity by 20.7 MW (from 86.3 MW to 107.0 MW) and the average annual generation by about 35.9 GWh (from 320.0 GWh to 355.9 GWh). Staff compared the $5,000,000 cost of the upgrades to the benefits from increasing the project's annual generation and dependable capacity. 2/

Based on a period of analysis of 26 years (i.e., the remaining life of the license) and an assumed discount rate of 10%, staff estimates that the proposed upgrade would have an annual power value of about $2,900,000 (1996$) compared to an annual cost of $1,097,000 (1996$). Therefore, staff agrees with GRDA that the upgrades are economically beneficial.

DISCUSSION ON ENVIRONMENTAL ISSUES

Prior to filing its application, GRDA received comments from the U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (FWS), Oklahoma Historical Society (OHS), and Oklahoma Department of Wildlife Conservation (ODWC). None of the agencies objected to the proposed amendment. The Commission issued a public notice concerning the application on April 20, 1996. The FWS, OHS, and ODWC provided further comments in response to the notice.

Commission staff prepared a draft environmental assessment (DEA) on the licensee's proposal to upgrade the six generating units. On July 18, 1996, the Commission issued a notice of availability of the DEA for public review. The only comments received on the DEA were provided by the FWS in a letter dated August 6, 1996, which was filed on August 13, 1996.

After the comment period closed, a final environmental assessment (FEA) was prepared which incorporates all comments filed with the Commission regarding GRDA's amendment application. 3/ In

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2/Staff estimated the cost of alternative capacity on an assumed capacity value of $109/kW-year (at a fixed charge rate of 14 percent), which is based on a combined-cycle combustion turbine plant fueled by natural gas (the cheapest, most reasonable capacity addition available). The project cost of energy generation is assumed to be 1.775 cents/kWh based on natural gas-fueled electric plants in the West South Central Division of the United States. Staff estimated the 1996 cost of fuel based on information from the Energy Information Administration (1995).

3/Final Environmental Assessment for the Pensacola Hydroelectric the FEA, staff concluded that the proposed amendment, with staff's recommendations on cultural resources, would not constitute a major federal action significantly affecting the quality of the human environment.

The primary concerns expressed by the EPA, FWS, and ODWC involved impacts to DO in the project's tailwater. The concerns of the OHS involved cultural resources.

A. Dissolved Oxygen

The FEA discusses the expected effects of the proposed upgrades on DO. The proposed increased hydraulic capacity of the project's turbines is likely to draw a greater proportion of the increased flow from the low DO hypolimnion during the summer. The FEA concludes that, with GRDA annually releasing a slightly larger volume of water (an average of 5.0 percent more) through the turbines over a shorter period of time, DO concentrations in the tailrace should not be any lower than those already observed at the project.

Since GRDA's ability to release the increased flows would be limited by the availability of water and the operating constraints of the project's present rule curve (i.e., GRDA would have to limit releases to maintain the reservoir elevation levels specified in the rule curve), the FEA concludes that the proposed upgrade would not impact DO concentrations in the tailrace any different than what was anticipated at relicensing.

At the time of relicensing, the Commission staff considered four alternatives for improving water quality downstream of the Pensacola Project and developed cost estimates for implementing these alternatives. The alternatives included diffused air injection, surface aeration, injection of pure oxygen in the forebay upstream of the intake structure, and shutting down the project and spilling all the discharges over the spillway. The Commission staff determined that the four alternatives were too costly relative to the benefits to environmental resources. However, article 403 of the new license required GRDA to develop and implement a plan to monitor and enhance DO concentrations as measured immediately downstream of the project's tailrace.

GRDA submitted its DO monitoring and enhancement plan under license article 403. On September 20, 1995, the Commission issued an order modifying and approving the plan. 4/ The approved plan requires GRDA to continuously monitor DO concentrations in the project tailwater and to develop, through consultation with the

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Project, FERC No. 1494-120, dated August 1996. The FEA is attached to this order.

4/ 72 FERC ¶62,250.

Oklahoma Department of Environmental Quality, the FWS, and the ODWC, DO enhancement recommendations after the first year of monitoring.

In its amendment application, GRDA proposes a study to model the effects of turbine aeration and study the cost-benefit of turbine aeration. In the FEA staff concluded that turbine aeration would be a possible method for GRDA to comply with the intent of article 403 and the order modifying and approving the DO monitoring and enhancement plan.

By letters dated May 17, 1996, the ODWC and FWS indicate GRDA has yet to consult with the agencies in developing the enhancement plan for DO in the project tailrace. Both agencies recommend that GRDA initiate consultation on the issue of DO and include enhancement as part of the plant upgrade. The FWS, in its comment letter on the DEA, further recommends the Pensacola license be amended to require GRDA to maintain Oklahoma State water quality standards in the tailwater and downstream of the project. The FWS also recommends an article be added to the license to require GRDA to mitigate impacts related to changes in the downstream flow regime.

The FEA concludes that, since the impacts to DO concentrations as a result of changes to the downstream flow regime are expected to be similar to those anticipated at licensing, further measures to enhance DO concentrations at the project are not needed at this time. The GRDA is already required by the September 20, 1995, order to monitor DO concentrations in the project tailrace and develop enhancement measures, in consultation with the resource agencies, as part of its first DO monitoring report to be filed by January 31, 1997.

With respect to the FWS's recommendation to require state water quality standards at the project, this issue was addressed in the Commission's January 23, 1996, Order Denying Rehearing. 5/ In the order, the Commission stated article 403 of the project license only required GRDA to develop a monitoring plan and, based on the results of monitoring, recommend measures to improve DO concentrations in the project discharge. The relicensing order did not require GRDA to maintain state water quality standards in the tailwater downstream of project during the period of monitoring. Therefore, the FWS's recommendation would be more appropriate once the monitoring has been completed and enhancement measures have been evaluated.

5/ 74 FERC ¶ 61,058.

B. Cultural Resources

By letter dated January 31, 1996, the OHS's State Historic Preservation Officer (SHPO) concurred that the proposed upgrade to the six turbines would have no effect on the Pensacola Dam and Hydroelectric Plant, properties eligible to be listed on the National Register of Historic Places. However, the SHPO requests the opportunity to review descriptions, photographs, and drawings of any changes in the proposal concerning the visible alterations to the property prior to any demolition or new construction.

GRDA's amendment involves replacing the 6 turbines, improving the existing fan enclosures, and replacing the static exciters and generator lead cables from the powerhouse to the switchyard. Since GRDA will be making in-kind replacements, this undertaking will not involve a significant alteration of the powerhouse roof or any alteration of the dam. Because the dam is eligible for listing on the National Register of Historic Places, GRDA should be required to file descriptions, photographs, and drawings of any proposed changes or alterations to the project with the SHPO for comment.

The SHPO should be given at least 30 days to comment on the filing. The GRDA should then be required to file with the Commission, for approval, at least 90 days prior to the start of any demolition or alteration of the project, the proposed changes or alterations to the project, along with a copy of the SHPO's comments. If the SHPO does not comment, GRDA should include its letter of request. No demolition or alteration of the project should take place until the licensee is informed by the Commission.

SUMMARY OF FINDINGS

This order approves the application for amendment of license to upgrade six of the generating units at the Pensacola Project and amends the project description to increase the authorized installed capacity from 86,900 kW to 105,176 kW. 6/ Staff finds that approving this amendment does not materially affect the Commission's determination that the Pensacola Project is best adapted to the comprehensive development of the waterway.

This order requires the licensee to start construction of the unit upgrades within two years and complete construction within eight years from the date of this order. This order also requires the licensee to notify the Commission, within 90 days from the start of construction, of the date unit fabrication began. The date will be used to amend license article 201 concerning the assessment of annual charges. The licensee shall pay revised annual charges effective the

6/The project's authorized capacity is the lesser of the ratings of the generator or turbine units.

date of commencement of construction of the revised capacity. 7/

This order requires the licensee to file descriptions, photographs, and drawings of any proposed changes, with a copy of SHPO's comments, to the Commission for approval at least 90 days prior to any demolition or alteration at the project. Furthermore, this order requires the licensee to submit an as-built exhibit A describing the characteristics of the generating units 90 days after the upgrades to all six units have been completed.

The Director orders:

(A) The application for amendment of license for the Pensacola Project, FERC No. 1494, filed on March 12, 1996, is approved effective the date this order is issued.

(B) The revised exhibit A filed on March 12, 1996, entitled "Exhibit A - Description of Proposed Plant Upgrades" is approved, superseding Section 3 of the exhibit A filed on December 23, 1985, which was approved in the license.

(C) The project description in ordering paragraph (B)(2) of the license is revised, in part, as follows:

"(2) Project works consisting of: ... (d) six 15-foot-diameter penstocks supplying flow to six turbines each rated at 17,446 kW attached to six generators each rated at 22,500 kW and one 3-foot-diameter penstock supplying flow to one turbine rated at 500 kW attached to an identically rated generator, located in the powerhouse immediately below the dam; (e) ..."

(D) The licensee shall start refurbishing the six turbine-generator units and appurtenant equipment within two years from the date of this order and complete construction within eight years from the date of this order.

(E) Within 90 days after the start of construction, the licensee shall notify the Commission of the date unit fabrication began. The filing should include written documentation and photographs of all works performed since the start of construction. The date of commencement of construction will be used to amend license article 201 for the assessment of annual charges.

(F) The licensee shall file descriptions, photographs, and

7/See, 66 FERC ¶61,086, issued January 18, 1994. The order states that, "With respect to substantial changes in installed capacity that receive prior approval, the effective date for revised annual charges will be the date of the commencement of construction of the revised capacity."

drawings of any proposed changes or alterations to the project with the Oklahoma State Historic Preservation Officer (SHPO) for comment. The SHPO shall be given at least 30 days to comment on the filing. The licensee shall file with the Commission, for approval, at least 90 days prior to the start of any demolition or alteration of the project, descriptions, photographs, and drawings of the proposed changes or alterations to the project, along with a copy of the SHPO's comments. If the SHPO does not comment, the licensee shall include with its filing a copy of its letter of request to the SHPO. No demolition or alteration of the project shall take place until the licensee is informed by the Commission.

(G) Within 90 days from completion of the upgrades to all six units, the licensee must submit an as-built Exhibit A describing the actual capacities of the upgraded turbines and generators and the date each unit began operation.

(H) Unless otherwise directed in this order, the licensee shall file an original and eight copies of any filing required by this order with:

The Secretary
Federal Energy Regulatory Commission
Mail Code: DPCA, HL-21
888 First Street, N.E.
Washington, D.C. 20426

In addition, the licensee shall serve copies of these filings on any entity specified in this order to be consulted on matters related to these filings. Proof of service on these entities shall accompany the filings with the Commission.

(I) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of this order, pursuant to 18 C.F.R. §385.713.

J. Mark Robinson
Director, Division of Project Compliance
and Administration

Project No. 1494-120

ENVIRONMENTAL ASSESSMENT

APPLICATION FOR AMENDMENT OF LICENSE

PENSACOLA HYDROELECTRIC PROJECT

FERC NO. 1494-120

OKLAHOMA

Federal Energy Regulatory Commission
Office of Hydropower Licensing
Division of Project Compliance and Administration
888 First Street, N.E.
Washington, D.C. 20426

September 1996

Project No. 1494-120

ENVIRONMENTAL ASSESSMENT
FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF HYDROPOWER LICENSING
DIVISION OF PROJECT COMPLIANCE AND ADMINISTRATION

Project Name: Pensacola Hydroelectric Project

FERC Project No. 1494-120

A. APPLICATION

1. Application type: Amendment of License
2. Date filed with the Commission: March 12, 1996
3. Applicant: Grand River Dam Authority
4. Water Body: Grand River
5. Nearest city or town: Langley and Disney
6. Counties: Craig, Delaware, Mayes and Ottawa
   State: Oklahoma

B. PURPOSE AND NEED FOR ACTION

On March 12, 1996, the Grand River Dam Authority (GRDA or licensee) filed an Application for Amendment to the license for the Pensacola Hydroelectric Project No. 1494-120, to replace the project's six aging turbines with more efficient models and to refurbish the generator equipment. The existing turbines are more than 50 years old. The proposed amendment would increase the installed capacity of the 6 units from 86.3 megawatts (MW) to 104.7 MW (an increase of 21.2 percent) and the hydraulic capacity from 12,120 cubic feet per second (cfs) to 13,902 cfs (an increase of 14.7 percent).

C. PROPOSED ACTION AND ALTERNATIVES

1. Background

Between 1938 and 1940, GRDA constructed Pensacola dam on the Grand River in Mayes County, Oklahoma. The federal government took over and operated the Pensacola Project from 1943 to 1946 during World War II. Following the war, Congress returned the project to GRDA on August 31, 1946. GRDA has operated and maintained the project since that date.

The original license for the Pensacola Project was issued on July 26, 1939. The Commission granted an "Order Issuing New License" for a term of 30 years on April 24, 1992 (59 FERC ¶62,073, 1992). The project as licensed consisted of: (a) a reinforced-concrete dam consisting of a multiple arch section 4,284 feet long, a spillway 861 feet long containing 21 Tainter gates, a non-overflow gravity section 451 feet long, and two non-overflow abutments, comprising an overall length of 5,950 feet and maximum height of 147 feet; (b) a reinforced-concrete gravity-type spillway section 886 feet long containing 21 Tainter gates and located about 1 mile east of the main dam; (c) a reservoir, known as Grand Lake O' the Cherokees (Grand Lake), having a surface area of 46,500 acres and a storage capacity of 1,680,000 acre-feet at normal maximum water surface elevation of 745 feet, Pensacola Datum (PD) 8/; (d) six 15-foot-diameter and one 3-foot-diameter steel penstocks supplying flow to six turbine-generators of 14.4-MW capacity each and one turbine-generator of 500-kW capacity, located in a powerhouse immediately below the dam; (e) a tailrace approximately 300 feet wide and a spillway channel approximately 850 feet wide, both about 1.5 miles long; and (f) appurtenant facilities.

The Pensacola Project operates with reservoir surface elevations maintained between elevations 741 feet and 745 feet PD at the dam, based on the established rule curve. When the water surface elevation is between elevation 745 feet and 755 feet PD at the dam, the U.S. Department of the Army, Tulsa District, Corps of Engineers (Corps) directs the water releases from the dam. Releases may be made irregularly (i.e., peaking) in response to system power demands and flood control and are generally greatest from November to May.

The Commission issued an environmental assessment (EA), evaluating the environmental impacts of issuing a new license for the project on November 19, 1991. During preparation of the EA, consultation and comments were solicited from agencies and other entities that could be affected by the proposed project. When the Commission issued the License Order for the project in 1992, it included articles to protect and enhance environmental resources.

On April 21, 1995, GRDA filed a request for guidance from the Commission's Division of Project Compliance and Administration (DPCA) on whether proposed upgrades and rehabilitation activities being considered by GRDA would qualify for a non-capacity amendment. By letter dated May 16, 1995, the Commission determined that the proposed activities would meet the requirements for a non-capacity amendment because the resulting increase in hydraulic capacity would be less than 15 percent. On March 12, 1996, GRDA filed the subject amendment to the license for the Pensacola Hydroelectric Project.

2. Proposed Action

The licensee proposes to upgrade the six licensed 14.4-MW Francis turbines; rewind the six 14.4-MW generators; and replace the

8/ Pensacola Datum = NGVD + 1.07 feet

generator lead cables and switchyard transformers to prevent potential outages. While investigating the options available for rehabilitating the generating units, GRDA discovered that technological advancements had improved turbine and generator efficiencies such that the project's units could be upgraded to significantly improve output.

The maximum hydraulic capacity of each turbine would increase from 2,020 cfs to 2,317 cfs, or by 14.7 percent. The turbine nameplate capacity for each unit would increase from 14,390 kilowatts (kW) to 17,466 kW, or by 21.2 percent. The generator nameplate capacity for each unit would increase from 14,400 kW to 22,500 kW, or by 56.3 percent. The larger hydraulic capacity of the turbines would allow the units to generate more power using flows that presently pass through the spillway gates. The total average increase in turbine discharge volume into the tailwaters will be approximately 5 percent and will occur mostly during the spring months.

3. Action Alternative

The staff reviewed the amendment application to determine if there were any reasonable alternatives to the proposed action that should be considered. No reasonable alternatives were identified.

4. No-action Alternative

Under the no-action alternative, the project would continue to operate under the terms and conditions of the license issued on April 24, 1992, without an increase in nameplate capacity, hydraulic capacity, or energy production.

D. CONSULTATION AND COMMENTS

On August 31, 1995, the licensee solicited and received comments from the following agencies regarding the proposed amendment:

Commenting Entity	Date of Letter
Oklahoma Department of Wildlife Conservation	October 12, 1995
U.S. Environmental Protection Agency	October 12, 1995
U.S. Department of the Interior	October 13, 1995
Oklahoma Historical Society	January 31, 1996

None of the consulted agencies objected to the proposed amendment.

The Commission issued a public notice of the proposed amendment on April 20, 1996. Comments were received from the Oklahoma Historical Society, filed on May 15, 1996, the Oklahoma Department of Wildlife Conservation (ODWC), and the U.S. Department of the Interior, Fish and Wildlife Service (FWS), both filed May 20, 1996.

On July 18, 1996, the Commission issued a notice of availability of draft environmental assessment (DEA) for public review. The only comments received on the DEA were provided by the FWS in a letter dated August 6, 1996, which was filed on August 13, 1996.

E. AFFECTED ENVIRONMENT

The Grand River originates in the Flint Hills in east central Kansas and flows southeasterly for 314 miles and then southerly for 164 miles to its confluence with the Arkansas River. The Grand River basin covers 12,110 square miles in Kansas, Oklahoma, Missouri and Arkansas. The Pensacola Hydroelectric Project is located at river mile 77 on the Grand River in Mayes County, Oklahoma and creates Grand Lake which extends about 66 miles upstream from Pensacola dam. Grand Lake covers 46,500 acres at its maximum power pool elevation of 745 feet PD.

The next dam upstream at river mile 343.7 impounds the John Redmond reservoir and is one of three Corps flood control projects in the headwaters of the Grand River Basin. Immediately downstream, the Markham Ferry Project No. 2183 impounds Lake Hudson. The Lake Hudson backwaters extend to the powerhouse of the Pensacola Project and are maintained at elevation 618-619 feet. The tailwater of the Pensacola Project is in close proximity to a downstream reservoir, does not receive spillway discharges, and possesses a small, narrow stilling basin (Fisher, 1990).

1. Geology and Soils

The Pensacola Project is located on the northeast border of Oklahoma between the Ozark Plateau and the Prairie Plains. The terrain is rugged and characterized by deep ravines and narrow valleys separated by broad, gently rolling uplands in the southern and eastern portions of the project area. The reservoir banks in these areas are mostly limestone bluffs and steep rocky beaches. The tailwater area is riverine in character with a narrow and relatively shallow channel. In contrast, the northern and western portions of the project area are typified by gently rolling plains with occasional hills and ridges characteristic of the Prairie Plains. In these areas, the banks have gentler slopes with wetlands at the inlets and coves along the numerous small tributaries.

2. Water Quality and Quantity

Grand Lake is a 46,500-acre reservoir used for flood control, recreation, water supply, and assimilation of discharge from more than a dozen sewage treatment facilities. GRDA proposes to increase the total hydraulic capacity of the 6 units from 12,120 cfs to 13,902 cfs.

Water Quality

Water quality sampling has been conducted on Grand Lake and River for temperature, dissolved oxygen (DO), pH, and conductivity. DO has been the recurring parameter of concern. The state DO standards for the Grand River, which are seasonal, are defined as:

April 1 through June 15 - 6 mg/l
June 16 through October 15 - 5 mg/l
October 16 through March 31 - 5 mg/l

From April 1 through October 15, DO is allowed to drop an additional 1 mg/l each day for a period not to exceed 8 hours.

Sampling of the impoundment from 1986 through 1989 shows that the impoundment stratifies each year beginning in mid-May and remains stratified through mid-October. When a reservoir is stratified, the surface waters are constrained from mixing with deeper waters by a sharp, temperature-induced density gradient. The isolated, deeper (hypolimnetic) waters receive little or no input of oxygenated waters from inflow or the atmosphere. Oxygen in the hypolimnion is used up by normal biological respiratory processes, decomposition of organic materials, and reactions with other oxidizable materials.

In Grand Lake, the hypolimnetic waters have DO levels near 0 mg/l (Sorenson, 1990). The 23-foot-high intake is about 40 to 60 feet below the typical impoundment elevation. The deep intake of the powerhouse often draws much of its turbine flow from the deeper lake waters, and low DO waters are discharged to the project tailrace. The EA (FERC, 1992) summarizes the results of monitoring tailrace DO concentrations under various turbine discharge rates. These data show many violations of the state standards for DO and many observations of DO discharges less than 3 mg/l, especially during the summer months of June through September.

Water Quantity

In 1982, the Pensacola Project operating rule curve was modified to reduce impoundment fluctuations. With existing project turbine hydraulic capacity (12,120 cfs), the annual plant factor is 46 percent. The mean flow of the Grand River below the project is 6,809 cfs while the maximum recorded flow was 300,000 cfs. The larger hydraulic capacity of the turbines would allow the units to generate more power using flows that presently pass through the spillway gates. The total average increase in turbine discharge volume into the tailwaters will be approximately 5 percent and will occur mostly during the spring months. Releases may be made irregularly in response to system power demand or flood control and are generally the greatest from November to May. There are no required minimum flows. The downstream gage records a minimum flow of 25 cfs which is probably derived from a combination of leakage and inflow from a small tributary upstream from the gage.

3. Fisheries

The predominant fish species in Grand Lake in the vicinity of the project intake are gizzard shad, white crappie, brook silverside, bluegill, and white bass (Sorenson, 1990). These five species constituted about 75 percent of the total catch in the fish sampling survey conducted by Sorenson (1990) in the vicinity of the Grand Lake dam. Channel catfish, largemouth bass, smallmouth buffalo, longear sunfish, and green sunfish account for another 20 percent of the fish in the project area. Other sport fisheries in the lake include striped bass and paddlefish. Recent research on the impoundment has focused on management of impoundment water levels on a seasonal basis to improve production of largemouth bass. Sport fish species in the tailrace include white bass, white crappie, and channel catfish.

4. Terrestrial Resources

The location of the existing project within the Oak-Hickory Forest Section of the Eastern Deciduous Forest Province and the Oak-Hickory-Bluestem Parkland Section of the Prairie Parkland Province (Bailey, 1976, as cited in FERC, 1992) contributes to a diverse fauna. There are seven distinct habitats in the project area: upland deciduous forest, bottomland hardwood forest, grassland/savannah, agricultural land, steep rocky shoreline, emergent wetlands, and mudflats (Erickson and Leslie, 1988, as cited in FERC, 1992). These habitats support a wide array of wildlife species.

Article 404 of the existing license requires: (1) the seeding of 1,000 acres of mudflats with Japanese millet and/or other appropriate vegetation in concert with the implementation of the reservoir level management plan and monitoring the effectiveness of the mudflat seeding; and (2) managing 1,630 acres of project lands as a wildlife management area to protect wildlife habitat. Both the mudflats and the wildlife management areas are located along the shore or on islands in the impoundment upstream of the dam.

5. Threatened and Endangered Species

The federally listed endangered bald eagle (*Haliaeetus leucocephalus*), gray bat (*Myotis grisescens*), and threatened Ozark cavefish (*Amblyosis rosae*) and Neosho madtom (*Noturus placidus*) occur in the project area (FWS, 1984 and 1990, as cited in FERC, 1992). The bald eagle can be expected to forage in the tailwaters. A large part of the bald eagles diet is composed of fish and blackbirds.

The gray bat is found in Beaver Dam Cave, Twin Cave, and Jailhouse Cave. Twin Cave, located about 1 mile south of Grand Lake, is not affected by project operations because its elevation of 770 feet PD is well above the flood control pool. Beaver Dam Cave is affected by pool levels. Inundation of the Beaver Dam Cave begins when the elevation of Grand Lake reaches 746 feet PD. At 749 feet PD, the cave's entry room and main chamber begin to fill, and at 751 feet PD the entry to the cave is completely inundated and blocked. Jailhouse Cave is located downstream of the project's dam on Summerfield Creek, a tributary of the Neosho River.

Jailhouse Cave and Twin Cave are the only caves in the vicinity of the project with known Ozark cavefish populations.
The Neosho madtom is found upstream of the dam and is known to exist in the Steppes Ford area.

6. Recreation Resources

Grand Lake supports a high-quality sport fishery for largemouth bass, striped bass, white bass, crappie, catfish, and paddlefish. More than 700 keeled sailboats and many large yachts use the lake. Most of the land surrounding Grand Lake is privately owned and the lake shoreline is highly developed, supporting multiple residential and commercial uses. GRDA owns title to the shoreline up to elevation 750 feet PD and has permitted more than 2,600 private and 120 commercial boat docks as of 1991. The Cherokee/Disney State Park is adjacent to the dam and powerhouse. Recreation use adjacent to the dam includes an active warmwater tailrace fishery. Water levels in the tailrace below the dam are influenced by the headwater of Lake Hudson and the generation releases from the Pensacola Project.

7. Cultural Resources

By letter dated January 31, 1996, the Oklahoma State Historic Preservation Officer (SHPO) determined that the Pensacola Dam and Hydroelectric Plant Project is eligible for listing in the National Register of Historic Places. The only other property listed in the National Register in the immediate vicinity of the project is the

Splitlog Church.

F. ENVIRONMENTAL IMPACTS

1. Proposed Action

The environmental impacts associated with the increased installed capacity are related to the increase in maximum hydraulic capacity of each of the six turbines from 2,020 cfs to 2,317 cfs. With this increase in capacity, greater quantities of water would be diverted through the turbines. Consequently, the change in project capacity would have no impact on geology and soils; terrestrial resources; and recreation resources. The possible impacts of the increased installed capacity are associated with water quality and quantity; fisheries; threatened and endangered species; and cultural resources.

a. Geology and Soils

By letter dated October 12, 1995, the U.S. Environmental Protection Agency (EPA) expressed concern about the impact of dredging activities related to general maintenance of the intake facilities on water quality and on the associated biota in Grand Lake and Grand River. GRDA does not propose dredging activities as part of its proposed upgrade. Therefore, there would not be any impacts associate with the subject amendment.

b. Water Quality and Quantity

Dissolved Oxygen

The proposed increased hydraulic capacity of the project turbines is likely to draw a greater proportion of the increased flow from the low DO hypolimnion during the summer months. The project intake is 40 to 60 feet below the surface of the impoundment and the August thermocline 9/ is typically at about 30 feet of water depth. Therefore, there is the potential for the project to release greater volumes of low DO water through the turbines into the tailrace during the critical summer DO period of June through September.

We evaluated GRDA's comparison of turbine flow of the existing plant to the proposed upgrade on an average monthly basis (GRDA, 1995; Table B-1). For the month of June, GRDA estimates a potential increase of only 8.0 percent in the volume of flow to be released,

9/The thermocline is a thermal layer that forms in lakes during the warm season, intermediate between the upper warm layer (epilimnion) and the lower colder layer (hypolimnion).

from 334,390 acre-feet to 361,149 acre-feet. For July, August, and September, the potential increases in volume of water released are estimated at 5.0 percent (315,080 acre-feet to 331,233 acre-feet), 2.0 percent (207,440 acre-feet to 212,009 acre-feet) and 4.0 percent (175,019 acre-feet to 182,401 acre-feet), respectively.

These increases, according to GRDA's estimates, will be released over a shorter period of time. In June, GRDA estimates project operating time will be decreased 6.0 percent, from 2,380 hours to 2,241 hours. In July, August, and September, project operating time is estimated to be decreased 8.0 percent (2,243 hours to 2,055 hours), 11.0 percent (1,476 hours to 1,316 hours) and 9.0 percent (1,246 hours to 1,132 hours), respectively.

From water quality monitoring data collected by GRDA from 1986 through 1990, DO concentrations in the hypolimnion of the reservoir commonly approached zero during the summer and the fall (FERC, 1992). Hypolimnetic waters, low in DO, were entrained by the project and released into the tailrace, frequently creating low DO conditions downstream. During the 1986 to 1990 study period, DO concentrations were found to be less than state standards. Concentrations of DO less than 5.0 mg/L were recorded in the tailrace on a number of sampling dates, and on one occasion, a DO concentration of 1.6 mg/L was recorded (FERC, 1992).

With GRDA releasing a slightly larger volume of water (an average of 5.0 percent more) through the turbines over a shorter period of time, we would not expect DO concentrations in the tailrace to be any lower than those already observed at the project. Hypolimnetic waters, low in DO, will still be entrained through the project and released downstream. The DO concentration of this hypolimnetic water withdrawn from the reservoir and discharged downstream will remain the same.

Further, GRDA's ability to release these increased flows would be limited by the availability of water and the operating constraints of its present rule curve (i.e., GRDA would have to limit releases to maintain the reservoir elevation levels specified in the rule curve). Therefore, we would not expect the proposed upgrade to impact DO concentrations in the tailrace any different than what was anticipated at relicensing.

At the time of relicensing, the Commission staff considered four alternatives for improving water quality downstream of the Pensacola Project and developed cost estimates for implementing these alternatives. The alternatives included diffused air injection, surface aeration, injection of pure oxygen in the forebay upstream of the intake structure, and shutting down the project and spilling all the discharges over the spillway. The Commission staff determined that the four alternatives were too costly relative to the benefits to environmental resources. However, article 403 of the new license required the GRDA to develop and implement a plan to monitor and enhance DO concentrations as measured immediately downstream of the project's tailrace.

The GRDA submitted its DO monitoring and enhancement plan under license article 403. On September 20, 1995, the Commission issued an order modifying and approving the plan. 10/ The approved plan requires GRDA to continuously monitor DO concentrations in the project tailwater and to develop, through consultation with the Oklahoma Department of Environmental Quality, the FWS, and the ODWC, DO enhancement recommendations after the first year of monitoring. The monitoring is scheduled to occur during the summer of 1996.

In its amendment application, the licensee proposes a study to model the effects of turbine aeration and study the cost-benefit of turbine aeration if its amendment to the license is approved. A report by EPRI (1990) shows that turbine aeration is a suitable method of raising the DO levels at hydroelectric projects. At the Conowingo Project (FERC No. 405), retrofitting a turbine aeration system to the existing project turbines raised DO in the tailrace from 1.5 mg/l to 5.0 mg/l.

Turbine aeration would be a possible method for GRDA to comply with the intent of article 403 and the order modifying and approving the DO monitoring and enhancement plan. By letters dated May 17, 1996, the ODWC and FWS indicate GRDA has yet to consult with the agencies in developing the enhancement plan for DO in the project tailrace. Both agencies recommend that GRDA initiate consultation on the issue of DO and include enhancement as part of the plant upgrade.

The FWS, in its comment letter on the DEA, recommends the Pensacola license be amended to require GRDA to maintain Oklahoma State water quality standards in the tailwater and downstream of the project. Further, the FWS recommends an article be added to the license to require GRDA to mitigate for impacts related to changes in the downstream flow regime.

Since the impacts to DO concentrations, as a result of changes to the downstream flow regime, are expected to be similar to those anticipated at licensing, we do not recommend, at this time, any new measures to enhance DO concentrations at the project. Article 403 of the project license required GRDA to develop a monitoring plan, and based on the results of monitoring, recommend measures to improve

10/ 72 FERC ¶62,250.

DO concentrations in the project discharge. However, the relicensing order did not require GRDA to maintain state water quality standards in the tailwater downstream of project during the period of monitoring.

The GRDA is already required by the September 20, 1995 order to monitor DO concentrations in the project tailrace and develop enhancement measures, in consultation with the resource agencies, as part of its first DO monitoring report to be filed by January 31, 1997. The GRDA should take this opportunity to consult with the agencies regarding the proposed study to model the effects of turbine aeration. The GRDA should then file the results of the turbine aeration study, along with the consulted agencies' comments on the study, as well as any other possible enhancements, as part of its requirements under the September 20, 1995 Order.

Impoundment Fluctuations

The 14.7 percent increase in hydraulic capacity will increase the rate at which the project can draw down the impoundment level through turbine operations. Article 401 of the existing license sets specific drawdown limits to enhance impoundment fisheries, wildlife and recreational resources. Fisher and Zale (1990) reported on the seasonal reservoir elevations that provide favorable spawning and nursery conditions for largemouth bass in Grand Lake; this information was used in the EA (FERC, 1992) in determining the suitability of the seasonal drawdown schedule to enhance fish and wildlife resources.

We examined the effect of the increased hydraulic capacity of the turbines. In a full day of continuous operation of all six turbines, the incremental drawdown associated with the increased turbine capacity would be about 1 inch. It is unlikely this rate of drawdown would affect stranding of fish in the reservoir, influence spawning and nursery habitat, or reduce the productivity potential of Grand Lake for largemouth bass. Mobile and active aquatic species like fish are not expected to be stranded unless impoundment elevations were changing by rates of inches per hour or inches per minute. The inch-per-day increase in potential impoundment drawdown rate would also have no effect on water-based recreation. The present rule curve used to operate the project would be unchanged, so we expect no difference in seasonal water levels or drawdowns as a result of the increased hydraulic capacity. 11/

11/On April 22, 1996, GRDA filed an application to amend the existing license article 401 to modify the present rule curve. The impacts of this proposed action are being reviewed in a separate NEPA proceeding.

c. Fisheries

Fish Entrainment

The 14.7 percent increase in the hydraulic capacity of the project could increase flows through the project. Increasing flows through the turbines could have an effect on the rate of impingement and entrainment of fish through the project's trash racks and turbines. Fish can be impinged upon (trapped against) the trashracks or entrained (transported) through the turbines. The impact of entrainment/impingement to the fishery is related to the injury to, or possible death of, individual fish.

One method of assessing entrainment/impingement impacts to fish is to evaluate the approach velocity at the project's intake. Approach velocity is the speed of water in the impoundment just upstream of the intake trashracks. For a fish to avoid being entrained through the trashracks and project turbines, it would have to be able to swim at a speed greater than the approach velocity.

Studies conducted at the site on susceptibility to entrainment (Sorenson, 1990) conclude that entrainment of important game fish was limited because these species are not relatively abundant near the project intake. The report did indicate that young gizzard shad were particularly susceptible to entrainment due to coldwater-induced lethargy and limited swimming capability of the small fish in the coldwater season. However, this species continues to dominate the species assemblage in Grand Lake despite its selective entrainment under current operating conditions. The licensing EA determined that the only adult species entrained in significant numbers was the gizzard shad, and that the impact was minimal or inconsequential. Therefore, the EA concluded no changes to project operations or structures were needed to protect fishery resources associated with entrainment at the project.

The ODWC, in its letter of May 17, 1996, stated that, should information become available indicating losses are higher than projected, the issue should be re-evaluated. The ODWC also recommended additional mitigation measures should be incorporated to reflect these losses.

We calculated the approach velocity to be 2.45 feet per second (fps) with the proposed capacity increase and 2.14 fps at the licensed capacity. With an increase in approach velocity of only 0.31 fps, we would expect entrainment rates to remain similar. Although there is the potential for a slight increase in approach velocity, the conclusions of Sorenson's (1990) study and the EA are not likely to change with a velocity change of this magnitude. Therefore, we conclude the impact to the fishery will be no different than that anticipated at licensing and no changes are necessary to project structures or operations to protect fishery resources.

d. Threatened and Endangered Species

The habitats of the endangered gray bat and the Neosho madtom are located upstream of the dam. The proposed upgrade of the turbines and refurbishing of the generating equipment would not change how project operation affects impoundment levels and associated upstream species because the project would be required to operate within the present rule curve which establishes the water level elevations. Greater efficiency in power generation would not change existing water level elevations. There would be no impacts on these threatened and endangered species, since the capacity upgrade would not change the reservoir level management plan and target reservoir surface elevations required under the new license issued in 1992. 12/ There would be no difference in impacts not already anticipated at relicensing.

Within the project area, the bald eagle can be expected to use the project tailwaters for foraging. Since fish entrainment rates should remain the same, and impacts to the fishery resources in the project tailwater will remain the same, the food available in the tailwaters for the foraging bald eagle would not be impacted by the proposed upgrade. Therefore, there would no difference in impacts to the bald eagle not already anticipated at relicensing.

The habitats of the gray bat in Jailhouse Cave and the ozark cavefish in Jailhouse Cave and Twin Cave downstream of the dam are located outside the area of influence of the Pensacola Project and would not be affected by the proposed upgrade.

e. Cultural Resources

By letter dated January 31, 1996, the SHPO concurred that the proposed upgrade to the six turbines would have no effect on the Pensacola Dam and Hydroelectric Plant. This finding of no effect is based on a verbal communication between the SHPO and GRDA that the

12/As noted earlier, GRDA has filed an application for an amendment to modify the rule curve. The impacts of the modification to the rule curve on threatened and endangered species will be considered again in the EA for proposed rule curve modification.

concrete roof would be repaired or partially replaced "in-kind" and that no new penetrations or new mechanical equipment will be located on the roof surface. The SHPO requests the opportunity to review descriptions, photographs, and drawings of any changes in the proposal concerning the visible alterations to the property prior to any demolition or new construction.

The licensee's amendment involves replacing the 6 turbines; improving the existing fan enclosures; and replacing the static exciters and generator lead cables from the powerhouse to the switchyard. Since the licensee will be making in-kind replacements, this undertaking will not involve a significant alteration of the powerhouse roof, nor any alteration of the dam. However, because the dam is eligible for listing, we recommend the licensee be required to file descriptions, photographs, and drawings of any proposed changes or alterations to the project with the SHPO for comment. The SHPO should be given at least 30 days to comment on the filing. If the SHPO does not comment, the licensee should include its letter of request. The licensee should then be required to file with the Commission, for approval, at least 90 days prior to the start of any demolition or alteration of the project, the proposed changes or alterations to the project, along with a copy of the SHPO's comments, if available, on the proposed changes or alterations to the project. No demolition or alteration of the project should take place until the licensee is informed by the Commission.

2. No-action Alternative

Under the no-action alternative, the amendment would be denied and the project would be operated under the terms and conditions of the existing license, with no increase in nameplate capacity, hydraulic capacity, or energy production.

G. CONCLUSION

GRDA's request to amend the license would result in only minor changes to the licensed project and, in most cases, would not increase the project's impact on the environment. We, therefore, recommend that the license for the Pensacola Hydroelectric Project be amended as proposed, and conclude that approval of the proposed amendment with the staff recommendations would not constitute a major federal action significantly affecting the quality of the human environment.

H. LITERATURE CITED

Energy Information Administration. 1995. Supplement to the Annual Energy Outlook, End-Use Energy Prices: Reference Case, Source: Electric Utilities - Natural Gas, Page 138, Table 19.

EPRI (Electric Power Research Institute). 1990. Utility Options for Meeting Dissolved Oxygen Limits for Hydroelectric Power Plant Discharges. EPRI Research Project 2694-8. 414 pp + Appendices.

FERC (Federal Energy Regulatory Commission). 1992. Pensacola Hydroelectric Project Environmental Assessment. FERC No. 1494-002.

Fisher, W.L. and A.V. Zale. 1990. Effects of the Pensacola Hydropower Project on the Fishery Resource of the Grand River. Component E. Effects of Lake Level Fluctuations Resulting from Power Generation on Littoral Nursery Habitats. Final Report to the Grand River Dam Authority. Oklahoma Cooperative Fish & Wildlife Research Unit. Stillwater, OK. 31 pp.

Fisher. 1990. Component C. Effects on Fisheries of Establishment of the Riverine Environment in the Headwaters of Lake Hudson. 10 pp.

GRDA (Grand River Dam Authority). 1995. Application for Amendment of License. March 12, 1996.

Sorenson, K.M. 1990. Entrainment Susceptibilities of Fishes Inhabiting the Lower Portion of Grand Lake, Oklahoma. MS Thesis. Oklahoma State University. 55 pp.

I. LIST OF PREPARERS

R. Fletcher - FERC Task Monitor

P. Weslowski - Stone & Webster, Deputy Project Manager/Cultural Resources (M.P.A. Public Administration - 20 years experience)

S. Conant - Stone & Webster, Recreation Planning (M.A. Urban Affairs - 19 years experience)

J. Downing - Stone & Webster, Aquatic Ecologist/Fisheries Biologist (M.S. Biometrics - 19 years experience)

E. Kurkoski - Stone & Webster, Civil Engineering (B.S. Civil Engineering - 25 years experience)

P. Martin - Stone & Webster, Wildlife & Ecology (M.S. Zoology - 10 years experience)

77 FERC ¶ 61,251

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: Elizabeth Anne Moler, Chair;
Vicky A. Bailey, James J. Hoecker,
William L. Massey, and Donald F. Santa, Jr.

Grand River Dam Authority) Project No. 1494-123

ORDER AMENDING LICENSE

(Issued December 3, 1996)

On April 23, 1996, the Grand River Dam Authority (Grand River) filed an application to amend Article 401 of its license to modify the operating rule curve at the Pensacola Project No. 1494, located on the Grand/Neosho River in northeastern Oklahoma. 1/ The rule curve sets forth the target elevations for the project reservoir for different seasons of the year. The purpose of the modified rule curve would be to allow Grand River to manage the reservoir elevations to better accommodate run-off from spring flows, to increase flood storage capacity, and to enhance recreational use during the peak recreation season. For the reasons described below, we grant the application.

BACKGROUND

On April 24, 1992, Grand River received a new license to continue operating the 86.9-megawatt Pensacola Project. 2/ The project, which operates in a peaking mode, includes a 5,920-foot-long, 147-foot-high dam; a reservoir (Grand Lake O' the Cherokees, or Grand Lake); a powerhouse at the base of the dam; and a 1.5-mile tailrace and spillway channel in the riverbed below the dam.

Grand Lake has a surface area of 46,500 acres and a storage capacity of 1,680,000 acre-feet at a surface elevation of 745 feet PD. 3/ The lake is primarily used for flood control and power generation. The flood storage is provided between elevations 745 feet and 755 feet PD. Whenever the reservoir

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1/ The upper reach of the river above Grand Lake is called the Neosho River, and below the Pensacola Dam, the Grand River; thus, the river is sometimes referred to as the Grand/Neosho River.

2/ 59 FERC ¶ 62,073.

3/ PD (Pensacola Datum) is 1.07 feet higher than NGVD (National Geodetic Vertical Datum), which is a national standard for measuring elevations above sea level.

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elevation is within the limits of the flood pool, the U.S. Army Corps of Engineers (Corps) directs the water releases from the dam under the terms of a 1992 Letter of Understanding and Water Control Agreement between the Corps and Grand River. 4/

Article 401 of the Pensacola Project's new license 5/ provides that, except as necessary for the Corps to provide flood control protection, Grand River will maintain the following target reservoir surface elevations:

Period	Reservoir Elevation, feet PD
Apr 16 - May 31	Raise elevation from 742 to 745
Jun 01 - Jul 05	Maintain elevation at 745
Jul 06 - Jul 15	Lower elevation from 745 to 743
Jul 16 - Jul 31	Maintain elevation at 743
Aug 01 - Aug 14	Lower elevation from 743 to 741
Aug 15 - Oct 15	Maintain elevation at 741
Oct 16 - Oct 31	Raise elevation from 741 to 742
Nov 01 - Apr 15	Maintain elevation at 742

This rule curve inundates approximately 3,250 acres of shore zone between elevations 742 and 745 from mid-April until mid-July and then exposes that acreage the rest of the year, when it revegetates naturally, providing increased density and diversity of vegetation in the mudflats, and a food source for waterfowl. The rule curve increases fish nursery habitat when this shore zone is inundated in the spring and early summer, and stabilizes the water level during that period for the benefit of spawning crappie and black bass. Furthermore, in the late summer, the current rule curve exposes approximately 1,000 acres of mudflats between elevations 741 and 742 for two months, when Grand River plants Japanese millet, pursuant to the requirements of Article 404 of the license. 6/ The seeded mudflats are then inundated to elevation 742 in late October, and, if the millet grows to maturity before being killed by winter frosts, will provide mature seed heads as a food source for waterfowl, as well as habitat for invertebrates that are consumed by waterfowl.

4/ Section 7 of the Flood Control Act of 1944 (Pub. L. No. 78-534, 58 Stat. 890, 33 U.S.C. § 709) directs the Secretary of the Army to prescribe regulations for the use of storage allocation for flood control or navigation at all reservoirs constructed wholly or in part with federal funds. A federal grant provided a substantial part of the funding for the construction of the Pensacola Project.

5/ 59 FERC at p. 63,228.

6/ 59 FERC at p. 63,229.

A series of floods occurred along the Grand/Neosho River between September 1992 and July 1995. 7/ In June 1993, the Grand/Neosho River Committee was formed to address the effects of flooding on recreational use of Grand Lake and on shoreline property, as well other issues concerning the Grand/Neosho River Basin. 8/ The Committee included representatives of various towns and counties along the Grand/Neosho River, several chambers of commerce, state resource agencies from both Kansas and Oklahoma, the Kansas-Oklahoma Flood Control Alliance, the Neosho Basin Advisory Committee, and various lakeshore landowners associations. The Final Report of the Committee, issued on February 15, 1996, recommended the changes to the rule curve for the Pensacola Project that Grand River proposes in this proceeding. 9/

PROPOSED RULE CURVE

Grand River proposes to modify the present rule curve as follows:

(1) to better accommodate run-off from spring flows, delay the spring rise from elevation 742 feet to 745 feet by two weeks, from April 16 to May 1;

(2) to allow better flood management, set the rule curve's maximum water surface elevation (which is in summer) at 744 feet PD instead of 745 feet; and

(3) to benefit the recreational boating season, delay the draw-down from elevation 744 feet to 743 feet by about three weeks, from July 6 to August 1, and the draw-down from elevation 743 feet to 741 feet by about two weeks, from August 1 to August 16.

7/ According to a complaint filed in state court against Grand River in 1994, five floods occurred from September 1992 through September 1993, and two more floods occurred in April 1994. Dalrymple, et al. v. Grand River Dam Authority (Oklahoma District Court, Ottawa County, Sept. 23, 1994). An April 1, 1996 filing with the Commission by the Kansas-Oklahoma Flood Control Alliance described 14 periods of flooding upstream of the Pensacola Project between November 1992 and July 1995.

8/ The Committee was formed through the offices of members of the U.S. Congressional delegations from Kansas and Oklahoma.

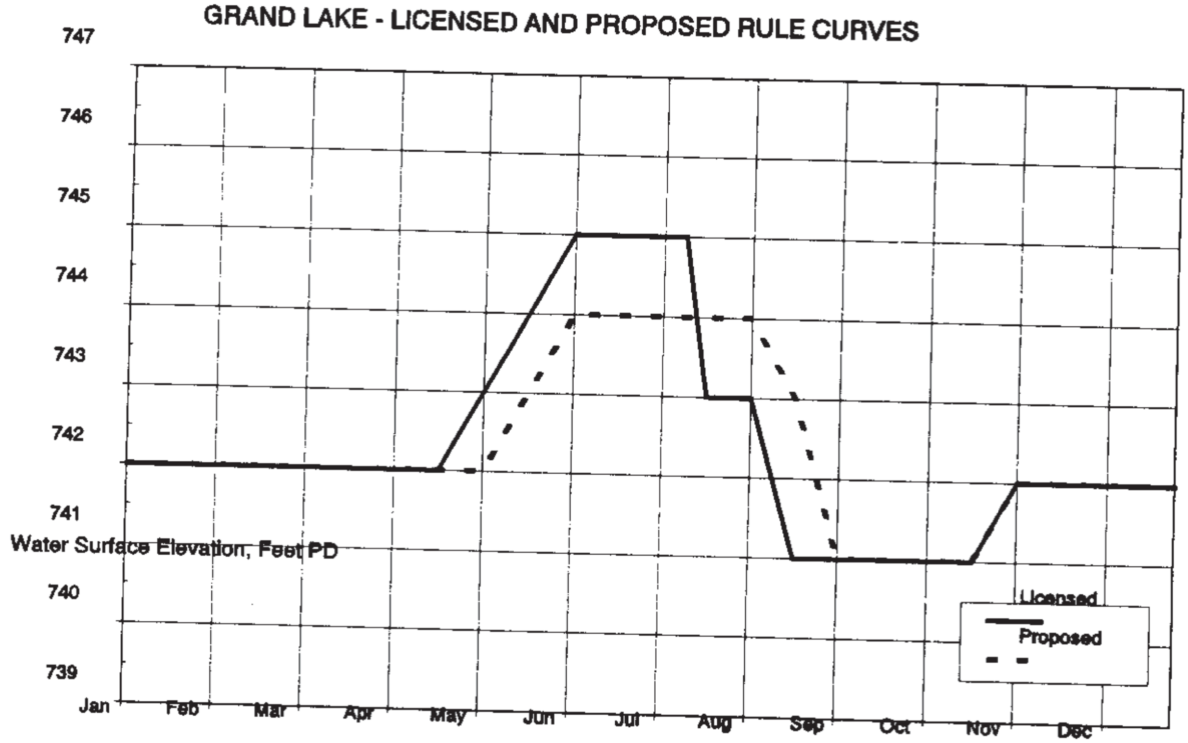
9/ The Committee report does not reflect any consideration of the effects of the proposed rule curve on bass nursery habitat or waterfowl.

The revised rule curve would be as follows:

Period	Reservoir Elevation, feet PD
May 01 - May 31	Raise elevation from 742 to 744
Jun 01 - Jul 31	Maintain elevation at 744
Aug 01 - Aug 15	Lower elevation from 744 to 743
Aug 16 - Aug 31	Lower elevation from 743 to 741
Sep 01 - Oct 15	Maintain elevation at 741
Oct 16 - Oct 31	Raise elevation from 741 to 742
Nov 01 - Apr 30	Maintain elevation at 742

Figure 1 is a graphical depiction of licensed and proposed rule curves.

FIGURE 1
GRAND LAKE - LICENSED AND PROPOSED RULE CURVES



On May 12, 1996, the Commission issued public notice of the proposed amendment. The Oklahoma Department of Wildlife Conservation (Oklahoma Wildlife) intervened opposing the amendment as premature, because of an ongoing Corps study of the effects of its flood control operations, and asserted that the proposed rule curve would adversely affect fish and wildlife resources and water quality. The U.S. Fish and Wildlife Service

(FWS) filed comments supporting the position of Oklahoma Wildlife.

Commission staff prepared an Environmental Assessment (EA) which addresses the environmental effects of the proposed rule curve and its potential effect on future flooding events. A Draft EA was issued August 9, 1996. Oklahoma Wildlife filed the only comments on the Draft EA. In its comments, Oklahoma Wildlife states that it takes exception to the finding the Draft EA that the licensee's proposal would not constitute a major federal action significantly affecting the quality of the human environment. Oklahoma Wildlife asserts that erosion between elevations 744 and 745 will increase under the proposed rule curve, at least until trees and shrubs become established in that shore zone. It also asserts that the increased rate of draw-down in the August will exacerbate turbidity. These comments are addressed in the Final EA, which is issued as an appendix to this order. 10/

ENVIRONMENTAL ANALYSIS

Flood Control

The Final EA concludes that the proposed change in the rule curve may slightly reduce the frequency of Grand Lake reaching the bottom of the flood pool, elevation 745 feet. The staff reviewed the daily inflow to the lake during the years 1984 to 1994 for the period April 15 through August 31, when there are differences between the current and proposed rule curves, and calculated the number of days the elevation would have exceeded 745 feet under the two rule curves. At no time during this period did the daily inflow exceed the capacity for release of such flows through the powerhouse and spill gates. The staff also analyzed the inflow data to determine how well the project could have maintained elevations below 745 feet using only generating capacity to pass inflows, which is the licensee's historical practice when lake elevations are below 745. The staff concluded that, under that release regime, the proposed rule curve would reduce by about 2.7 percent the number of days when lake elevation would exceed 745 feet during the spring period (April 15-May 31), 5.2 percent during the summer hold

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10/ The Commission found that the relicensing of the Pensacola Project in 1992, which dealt with the issue of the rule curve, along with many other issues, did not constitute a major federal action significantly affecting the quality of the human environment. 59 FERC ¶ 62,073 at p.63,259. This amendment, affecting the rule curve only, and only for a portion of the year, does not constitute an action having more significant effects than did the relicensing proceeding.

period (June 1-July 5), and 0.6 percent during the late summer decline period (July 6-August 31). 11/

The EA also examined the effects that the proposed rule curve might have had, as opposed to the existing rule curve, during the 14 flooding events identified by the Kansas-Oklahoma Flood Control Alliance in its April 1, 1996 filing. The staff found that the proposed rule curve would not have affected the ten flooding events between November 1992 and November 1994, because the lake elevations during those flooding events were already above 745 feet, and thus into the flood pool, during the periods when the proposed rule curve elevations are equal to or lower than the current rule curve elevations. However, during the four flood events of 1995, the peak elevations at the dam would have been about 1/3 foot lower under the proposed rule curve than under the current rule curve.

Recreation

Under the proposed rule curve, the spring raising of the lake level would be delayed by two weeks, and the lake elevation throughout the summer would be lower, both factors decreasing the boating capacity of the lake by 2.7 percent. 12/ On the other hand, the summer draw-down would be delayed, with the result that the lake would be up to two feet higher from mid-July to September 1 than under the current rule curve. This delay will increase the capacity of the lake to accommodate boats during peak recreational boating use by 4.7 percent. 13/

Fish and Wildlife Resources

Delaying the lake draw-down in August by two weeks shortens the growing season for the Japanese millet and significantly decreases the chances of producing millet with mature seed heads,

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11/ Specifically, if the current rule curve had been in effect from 1984 through 1994 (although a different curve was in effect prior to 1992), and inflows were released only through the powerhouse turbines, and not through spill gates, the lake elevation would have exceeded 745 feet on 636 days during the April 15 through August 31 periods of those 10 years. If the proposed rule curve had been in effect during those same periods, the lake elevation would have exceeded 745 feet on 598 days.

12/ EA at F.1.f. The relicensing EA anticipated the potential for Grand Lake to reach boating capacity during the term of the current license.

13 *Id.*

necessary as a food source to attract wintering waterfowl. 14/ The decreased growing season for the millet also decreases its usefulness as cover for waterfowl. On the other hand, the proposed rule curve would reduce the zone of fluctuation in lake elevation, which might benefit wetlands and improve conditions for vegetation along the shoreline, especially between elevations 744 and 745, and afford additional food and cover for waterfowl. However, this benefit would not offset the adverse impact on millet growing.

The delays in increasing lake elevation in the spring will not affect bass spawning habitat, but the lower elevation in the late spring and summer will decrease the available nursery habitat. Under the current rule curve, there would be approximately 3,250 acres of flooded shore zone available as nursery habitat for bass between elevations 742 and 745 feet. However, under the proposed rule curve, only about 2,000 acres, between elevations 742 to 744, of such nursery habitat would be available, a reduction of about 38 percent. Bass fingerlings need flooded vegetation, and the amount of such vegetation between elevations 742 and 743 feet is sparse, while the amount between elevations 744 and 745 feet is plentiful. 15/ In sum, the changes in the proposed rule curve would have a potential adverse impact on bass populations.

The EA also examined the possible effects of the proposed rule curve on endangered and threatened species in the area, and concluded that the lower elevation might improve conditions for the grey bat by reducing the frequency that their bat cave is flooded. Moreover, the proposed rule curve might benefit the Neosho madtom catfish population by limiting flood-related impacts on the known population site and on any potential habitat sites that are currently inundated by the 745-foot elevation. The EA found no potential adverse effects from the proposed rule curve on populations of bald eagles and Ozark cavefish. 16/

14/ Japanese millet requires 60 to 90 days from the time it is planted to produce mature seed heads. Under the proposed rule curve, the mudflats between elevations 741 and 742 feet are above water for only 45 days. Moreover, by delaying the draw-down and thus the planting for two weeks, the cooler weather may slow the growth of the seedlings, and the first frost may kill the millet before it fully matures andproduces seeds.

15/ EA at F.1.c (Fish Nursery Habitat).

16/ EA at F.1.e.

DISCUSSION

Delaying the raising of the lake level from 742 feet by two weeks from April 16 to May 1 and maintaining the lake at 744 feet rather than at 745 feet from June 1 to July 5, would provide additional flood storage capacity during those periods. Thus, we would expect the proposed rule curve to result in fewer, or at least less severe, flooding events around the lake shore and possibly upriver. Furthermore, the proposed rule curve would increase the lake's boating capacity during the season of peak recreational use, improve conditions for vegetation along the shoreline between elevations 744 and 745 feet, and improve conditions for the endangered gray bat.

The Corps has stated that there is insufficient data to determine the causes of the flooding upriver from the Pensacola Project. 17/ The Corps is currently conducting a study to evaluate the effects of flood control operations in the Grand/Neosho River Basin in Kansas, which is expected to be completed in December of this year. Furthermore, the Water Resources Development Act of 1996, signed by the President on October 12, 1996, directs the Secretary of the Army to complete within one year a study of flooding in the Grand/Neosho River Basin and tributaries in the vicinity of Pensacola Dam in northeast Oklahoma. 18/ The Act provides for a determination of the backwater effects of the operation of the Pensacola Dam, 19/ and of any adverse impacts on lands from such backwater effects, and authorizes the appropriation of up to $25 million for the study and acquisition of flowage easements or other interests in any adversely affected lands.

However, while we will not know what, if any, effects the facilities or operations of the Pensacola Project may have on the flooding on the Grand/Neosho River above Grand Lake until the Corps has completed its studies, we conclude that the value of potential added protection from flood damage from a modified rule curve outweighs the likely increment of adverse effects on

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17/ Statement of Col. Timothy Sanford (U.S. Army Corps of Engineers) for Congressional Field Hearing on the Grand Lake O' the Cherokees, Miami, Oklahoma (February 21, 1996).

18/ Pub. L. No. 104-303, § 560, 110 Stat. 3658 (1996).

19/ "Backwater effects" are the effects of water backing up a river and its tributaries during high flows because of the presence of an obstruction downstream, such as a dam. In essence, the water reaches elevations higher than it would if there were no downstream obstruction.

waterfowl and bass nursery habitat. 20/ Moreover, because the adverse effects should not be great, they can be offset with other appropriate mitigation measures. We will therefore approve Grand River's proposed amendments to its rule curve and require it to submit a plan to mitigate for the above-described anticipated adverse effects of the new rule curve on waterfowl and bass nursery habitat. 21/ However, we reserve the right to revise the rule curve if the results of the studies by the Corps indicate that the current rule curve has no significant adverse effects on flooding around and above Grand Lake.

The Commission orders:

(A) Article 401 of Grand River's license is amended by deleting paragraphs (1) through (6) and inserting the following:

Period	Reservoir Elevation, feet (Pensacola Datum)
May 01 - May 31	Raise elevation from 742 to 744
Jun 01 - Jul 31	Maintain elevation at 744
Aug 01 - Aug 15	Lower elevation from 744 to 743
Aug 16 - Aug 31	Lower elevation from 743 to 741
Sep 01 - Oct 15	Maintain elevation at 741
Oct 16 - Oct 31	Raise elevation from 741 to 742
Nov 01 - Apr 30	Maintain elevation at 742

The Commission reserves authority to reinstate the rule curve under the 1992 licensing order, after notice and opportunity for a hearing, if the results of studies of the Corps of Engineers indicate that the rule curve under that order has not significant adverse effect on flooding around and upriver from Grand Lake.

(B) Grand River's license is amended by adding the following article:

Article 411. Within 180 days from the issuance date of this order, the licensee shall file with the Commission for

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20/ The proposed rule curve represents a consensus of opinion among a broad range of affected interests. We don't know if the parties' positions on the rule curve we are approving today will change in light of the results of the Corps' studies.

21/ In view of the reduced likelihood of a successful growing season for Japanese millet under the rule curve we approve herein, Grand River's mitigation plan should consider whether continuing the millet planting program required by Article 404 is warranted.

approval a fish and waterfowl habitat management plan. The licensee shall develop the plan in consultation with the Oklahoma Department of Wildlife Conservation (Oklahoma Wildlife) and U.S. Fish and Wildlife Service (FWS). The plan must provide specific protection and enhancement measures for wintering waterfowl and bass nursery habitat. The plan should identify acreage either within project boundaries, or available through easement or acquisition, that would be managed to protect and enhance wintering waterfowl and bass nursery habitat. The amount of acreage identified in the plan should provide benefits to waterfowl and bass populations commensurate with the benefits lost by reducing the effectiveness of, or terminating, the millet seeding program, and eliminating 1,250 acres of existing bass nursery habitat. The plan must provide that any land acquired through easement or purchase would be included within the project boundary. The plan must include a schedule for the implementation of the plan, a monitoring program to determine the effectiveness of the plan, a schedule for filing the monitoring results with the Commission, and a cost estimate for the development, implementation, and operation of the plan.

The licensee must develop the plan in consultation with Oklahoma Wildlife and FWS, and allow them at least 30 days to comment on a draft of the plan before it is filed with the Commission. In its filing with the Commission, the licensee must include documentation of consultation with Oklahoma Wildlife and FWS before preparing the plan, copies of these agencies' comments on the draft plan, and, if any of the agencies' recommendations are not incorporated into the plan, explanations of the reasons.

The Commission reserves the right to require changes to the plan. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

By the Commission.

(S E A L)

Lois D. Cashell

Lois D. Cashell,
Secretary.

UNITED STATES OF AMERICA 103 FERC ¶ 62,102
FEDERAL ENERGY REGULATORY COMMISSION

Grand River Dam Authority Project No. 1494-215, 254

ORDER APPROVING FISH AND WATERFOWL HABITAT MANAGEMENT PLAN UNDER ARTICLE 411 AND DELETING ARTICLE 404

(Issued May 22, 2003)

On May 14, 2003, Grand River Dam Authority (GRDA) filed a Fish and Waterfowl Habitat Management Plan to satisfy the requirements of article 411 in its license for the Pensacola Project.[1] In the same filing, GRDA requested Commission approval to delete article 404 from its license. The project is located on the Grand/Neosho River in Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma. Grand Lake O' the Cherokees (Grand Lake) is the reservoir for the Pensacola Project.

BACKGROUND

In 1996, the Commission approved an application by GRDA to amend article 401 of its license which establishes the project's rule curve.[2] The rule curve, in turn, establishes target water elevations for Grand Lake throughout the year. The Commission approved GRDA's application because the new rule curve would enhance recreational boating and serve other project purposes. However, Commission staff anticipated that the new curve would negatively affect fish and waterfowl at the project.[3] To compensate for any negative effects to fish and waterfowl, the Commission added article 411 to the license requiring GRDA to file a Fish and Waterfowl Habitat Management Plan. In pertinent part, article 411 requires GRDA to:

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[1]Negotiations resulting in the final plan were lead by the Commission's Dispute Resolution Service.

[2]See Order Amending License dated December 3, 1996 at 77 FERC ¶ 61,251.

[3]Final Environmental Assessment, Application for Amendment of License to Modify Rule Curve, Pensacola Hydroelectric Project, FERC No. 1494-123, Oklahoma, dated December 3, 1996. This document can be obtained from the Commission's public files for this project.

> . . . provide specific protection and enhancement measures for wintering waterfowl and bass nursery habitat. The plan should identify acreage either within project boundaries or available through easement or acquisition that would be managed to protect and enhance wintering waterfowl and bass populations commensurate with the benefits lost by reducing the effectiveness of, or terminating, the Japanese millet seeding program and eliminating 1,250 acres of existing bass nursery habitat. . .

GRDA's FISH AND WATERFOWL HABITAT MANAGEMENT PLAN

GRDA proposes to establish a fish and wildlife mitigation fund (Mitigation Fund) and a fish and wildlife technical committee (Technical Committee) to administer the fund. The general purpose of the Mitigation Fund and Technical Committee is to fund, design, implement, and evaluate projects that would protect, mitigate, and enhance fish and wildlife resources at the project. The type of projects that may be funded through the plan include: seeding millet or other grains for waterfowl; planting aquatic/wetland vegetation; installing fish habitat structures; installing waterfowl/bird nesting structures; stabilizing shorelines to protect fish and wildlife habitat; establishing shoreline buffer zones; planting riparian vegetation; enhancing terrestrial habitat; acquiring lands for fish and wildlife purposes; wetland development and enhancement; and support facilities such as nursery ponds for an aquatic planting program.

Mitigation Fund

GRDA would make an initial contribution of $260,000 into the Mitigation Fund within 30 days of any Commission order approving the Fish and Waterfowl Habitat Management Plan. Beginning in 2004, GRDA would contribute $100,000 to the Mitigation Fund by March 31 each year for the term of the license and for any subsequent annual licenses. GRDA would maintain the Mitigation Fund; keep the fund in an interest bearing account and; adjust its annual contribution each year by the Consumer Price Index.

Technical Committee

GRDA would establish a Technical Committee to administer the Mitigation Fund composed of the following entities: GRDA, Oklahoma Department of Wildlife Conservation (ODWC), U.S. Fish and Wildlife Service (FWS), Oklahoma Water Resources Board, U.S. Army Corps of Engineers, U.S. Geological Survey's Oklahoma Cooperative Fish and Wildlife Research Unit, and Oklahoma State University. Each of these organizations has agreed to provide representatives to the Technical Committee with technical expertise in fish and wildlife resources. The Technical Committee would meet at least twice a year and would establish its own administrative procedures for selecting a chairman, voting, replacing an organization that can no longer participate, and any other matters to ensure the effective operation of the committee. When disputes arise, the Technical Committee would follow the dispute resolution procedures contained in the plan before filing a dispute for Commission resolution.

Monitoring, Adaptive Management, and Reporting

All funded projects would be monitored and/or evaluated, as appropriate, to determine their success. The Technical Committee would use monitoring results to adaptively manage the use of mitigation funds, deciding which projects should be continued, modified, or terminated. To keep the Commission informed, GRDA would file a written report with the Commission by April 30 each year describing deposits, expenditures, available funds, and accrued interest from the previous year as well as completed, proposed, and ongoing projects. Reports would contain minutes from Technical Committee meetings held the previous year. GRDA would submit reports to the Technical Committee for its review and comment prior to filing reports with the Commission. All comments provided by Technical Committee members would be appended to the reports.

GRDA's REQUEST TO DELETE ARTICLE 404

Article 404 requires GRDA to annually seed 1,000 acres of mudflats around Grand Lake's shorelines with Japanese millet or a similar grain. Exactly how GRDA performs this seeding is specified by its Mudflat Seeding Plan originally approved in 1993 and later amended in 1997.[4] In its Fish and Waterfowl Habitat Management Plan, GRDA proposes to continue seeding 1,000 acres of mudflats each year, but decisions on exactly how to seed the millet would be made by the Technical Committee taking into account lake levels, river flows, drought and other environmental conditions each year. At its annual meetings, the Technical Committee would decide where and how to seed millet; whether seeding should be reduced; and whether seeding should be deferred altogether based on prevailing conditions. Should millet seeding be reduced or deferred

[4]See Order Approving and Modifying Mudflat Seeding Plan issued September 6, 1994 at 68 FERC ¶ 62,213 and Order Approving Amendment to Mudflat Seeding Plan and Requiring New Fish and Waterfowl Habitat Management Plan issued August 8, 1997 at 80 FERC ¶ 62,120.

in any given year, the plan requires GRDA to contribute that portion of unused funds needed to seed millet to the Mitigation Fund by September 30 of that year.

In light of its proposal to move the requirements of article 404 into the Fish and Waterfowl Habitat Management Plan and to adaptively manage the Japanese millet seeding program through the Technical Committee, GRDA asks the Commission to delete article 404 from its license.

CONSULTATION

Article 411 requires GRDA to consult with the ODWC and FWS prior to developing its Fish and Waterfowl Habitat Management Plan. GRDA consulted with these agencies and the other members of the proposed Technical Committee and all entities support the plan as documented in the following letters filed with the plan:

Entity	Date of Letter
Oklahoma Department of Wildlife Conservation	April 22, 2003
U.S. Fish and Wildlife Service	April 17, 2003
Oklahoma Water Resources Board	April 21, 2003
U.S. Geological Survey, Oklahoma Cooperative Fish and Wildlife Research Unit	April 18, 2003
Oklahoma State University	April 21, 2003

DISCUSSION AND CONCLUSION

GRDA has worked extensively with ODWC, FWS, and the other members of the proposed Technical Committee to develop a plan which all parties agree adequately mitigates any negative fish and waterfowl effects from changing the project's rule curve in 1996. The plan establishes a Mitigation Fund and Technical Committee to fund, design, implement, and evaluate projects that would protect, mitigate, and enhance fish and wildlife resources at the project. Commission staff agree with GRDA and the other members of the Technical Committee that the plan adequately mitigates any such negative effects. The plan should be approved.

GRDA's plan incorporates the requirements of article 404 which requires GRDA to annually seed 1,000 acres of mudflats along Grand Lake's shoreline with Japanese millet. Incorporating these requirements enables the Technical Committee to adaptively manage this program leaving GRDA and the Technical Committee free to decide when and how to seed millet each year based on prevailing conditions at Grand Lake like weather, lake levels, and river flows. Millet seeding was not successful in several years, in part, because article 404 and the Mudflat Seeding Plan does not allow GRDA to alter or defer seeding based on such conditions.[5] Moving the requirements of article 404 to the Fish and Waterfowl Habitat Management Plan gives GRDA and the Technical Committee more flexibility to manage the program and should improve the program's long-term chances of success. Therefore, article 404 should be deleted from the license.

The Director orders:

(A) Grand River Dam Authority's Fish and Waterfowl Habitat Management Plan filed May 14, 2003 is approved.

(B) Article 404 in the license is deleted.

(C) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 CFR § 385.713.

George H. Taylor
Chief, Biological Resources Branch
Division of Hydropower Administration
and Compliance

[5] See GRDA's mudflat seeding reports for 1994 through 2000 filed with the Commission.

ATTACHMENT D. PENSACOLA PROJECT FLOW DURATION CURVES

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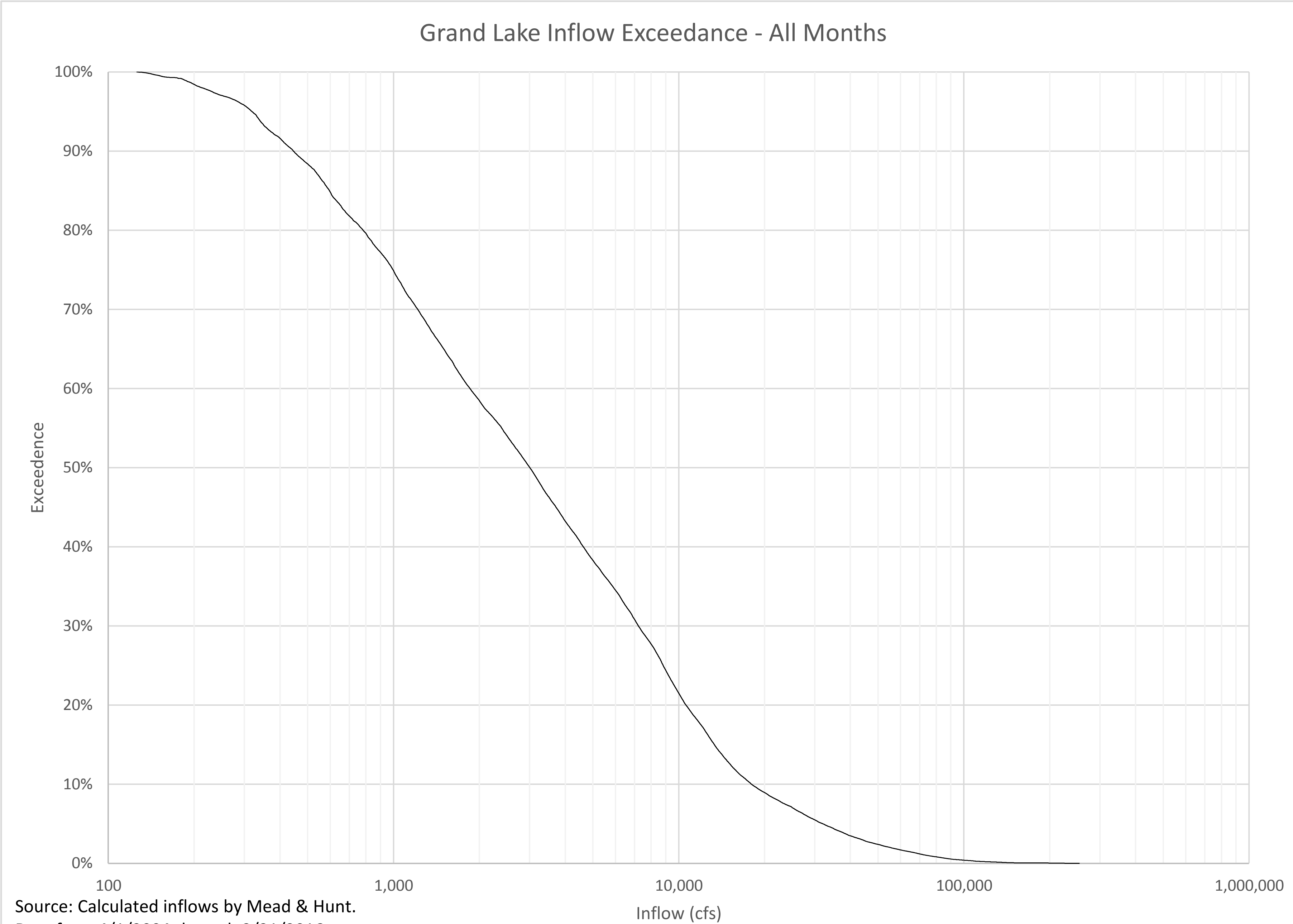
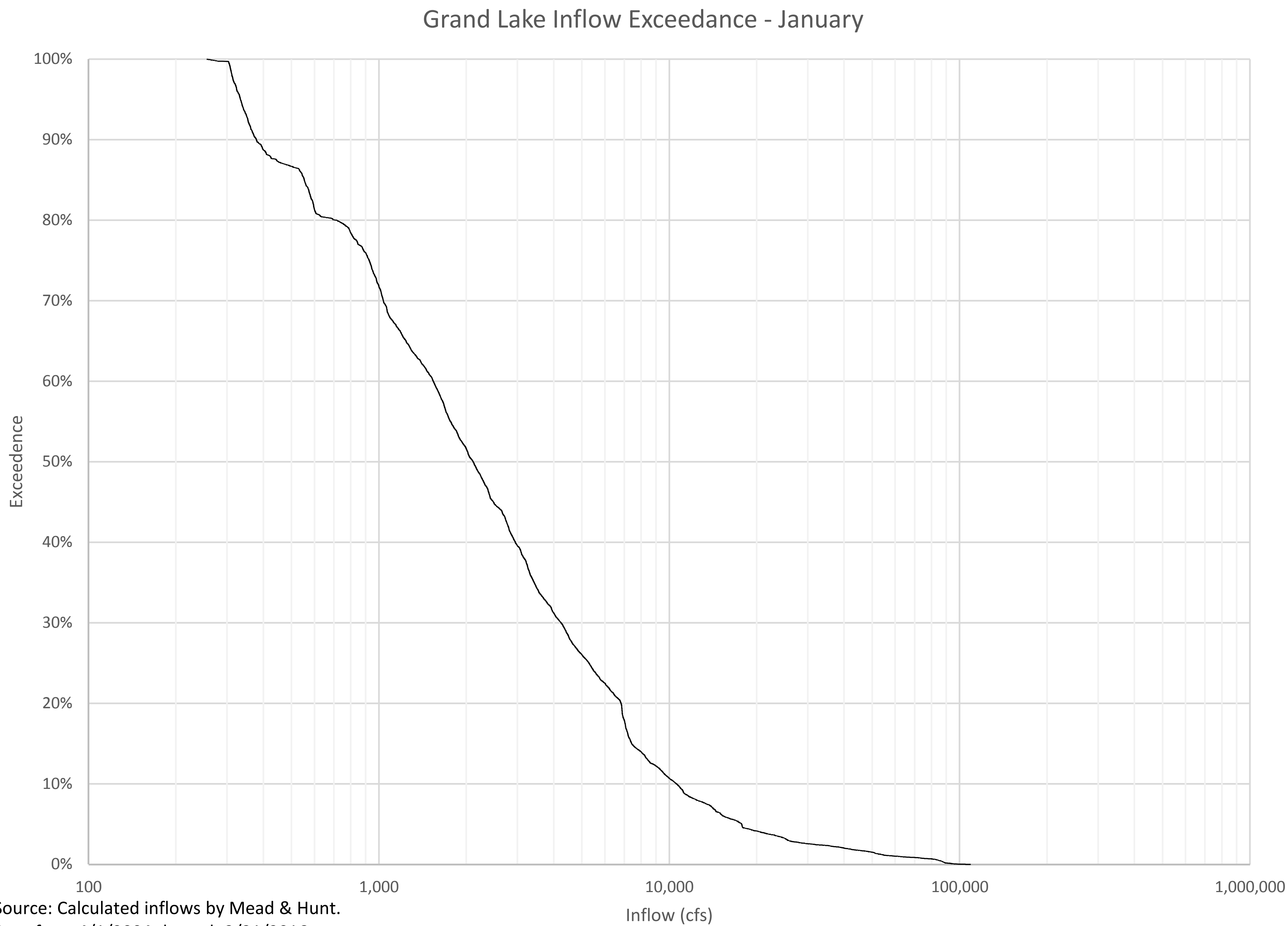
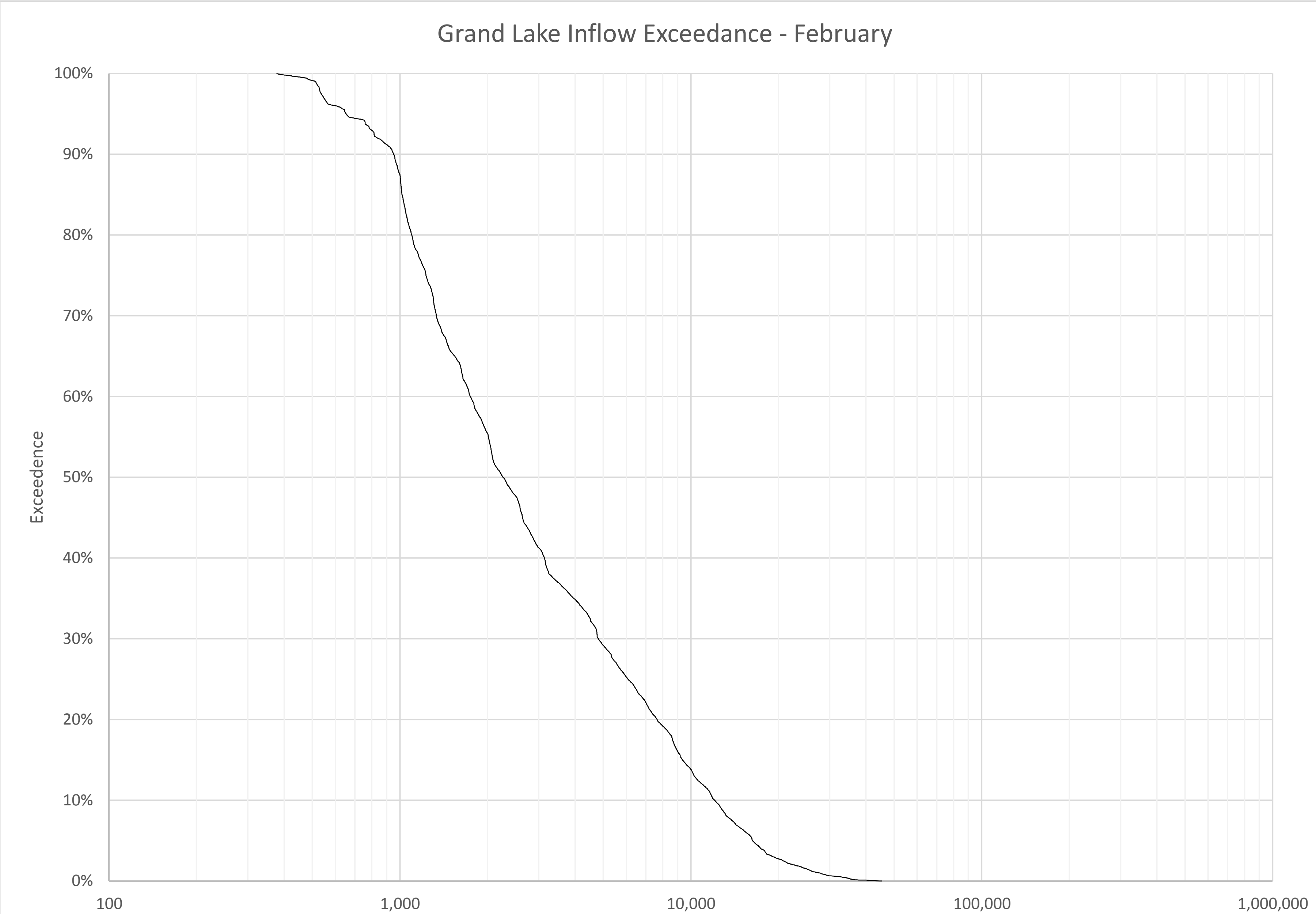


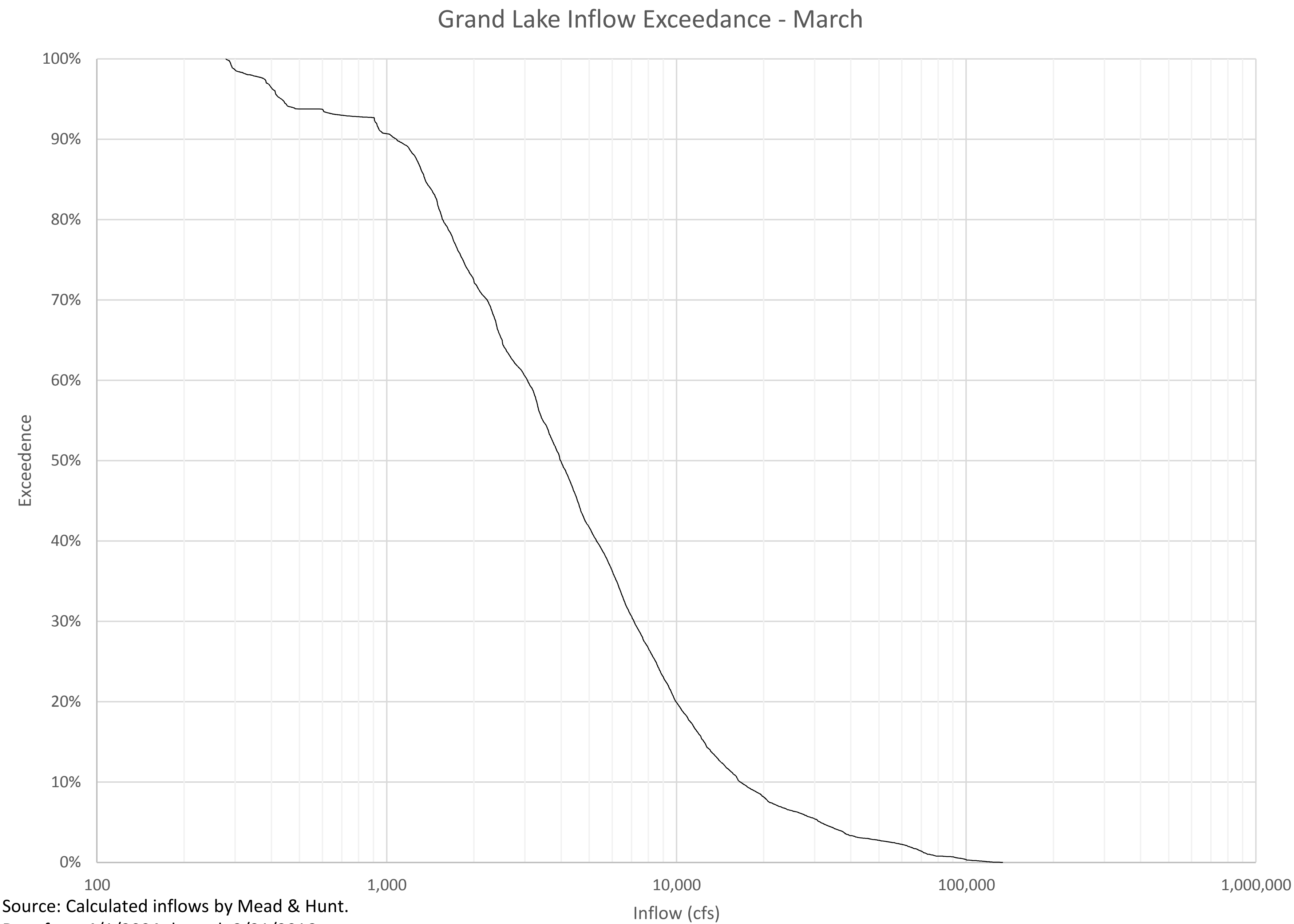
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



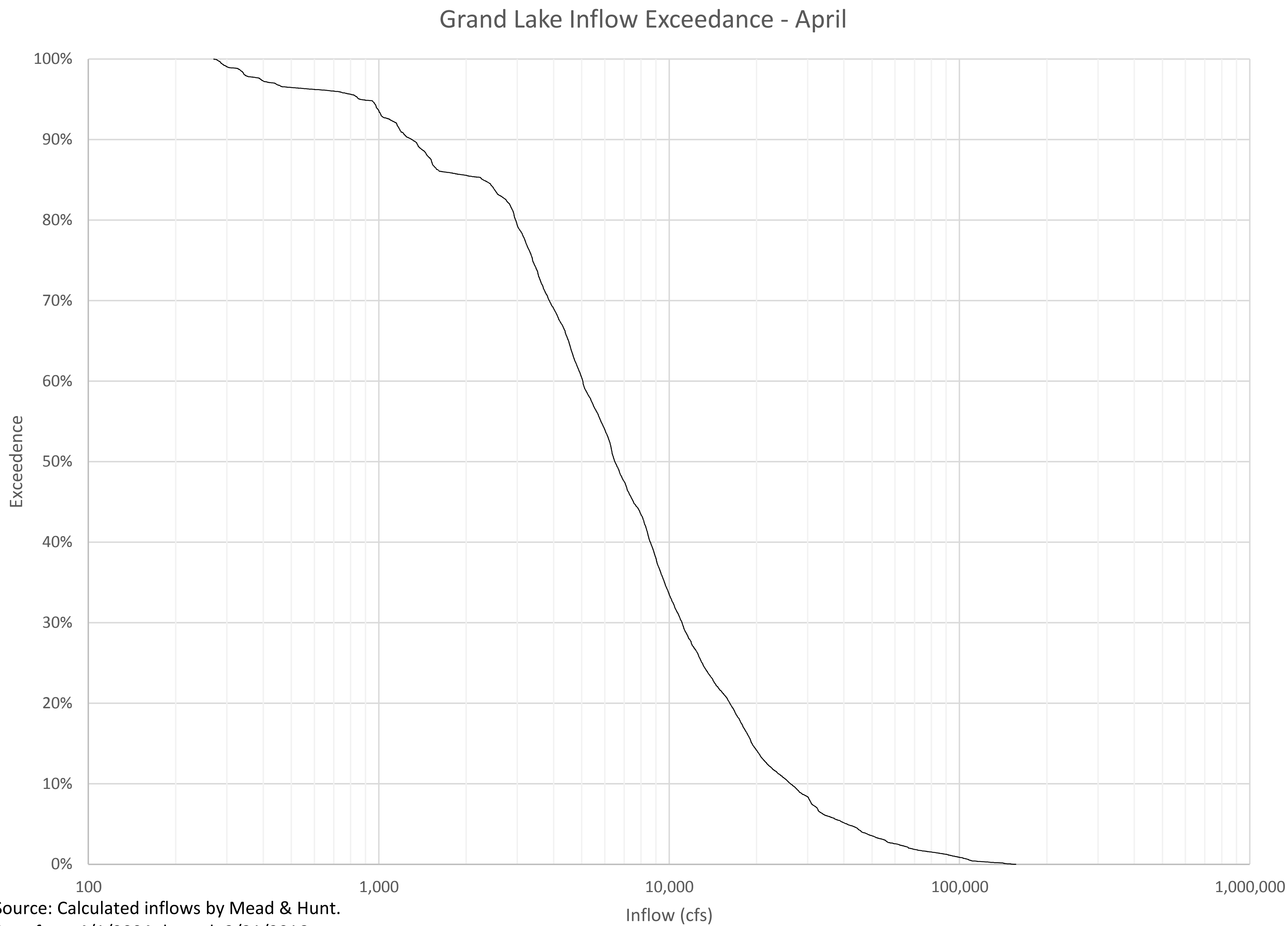
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



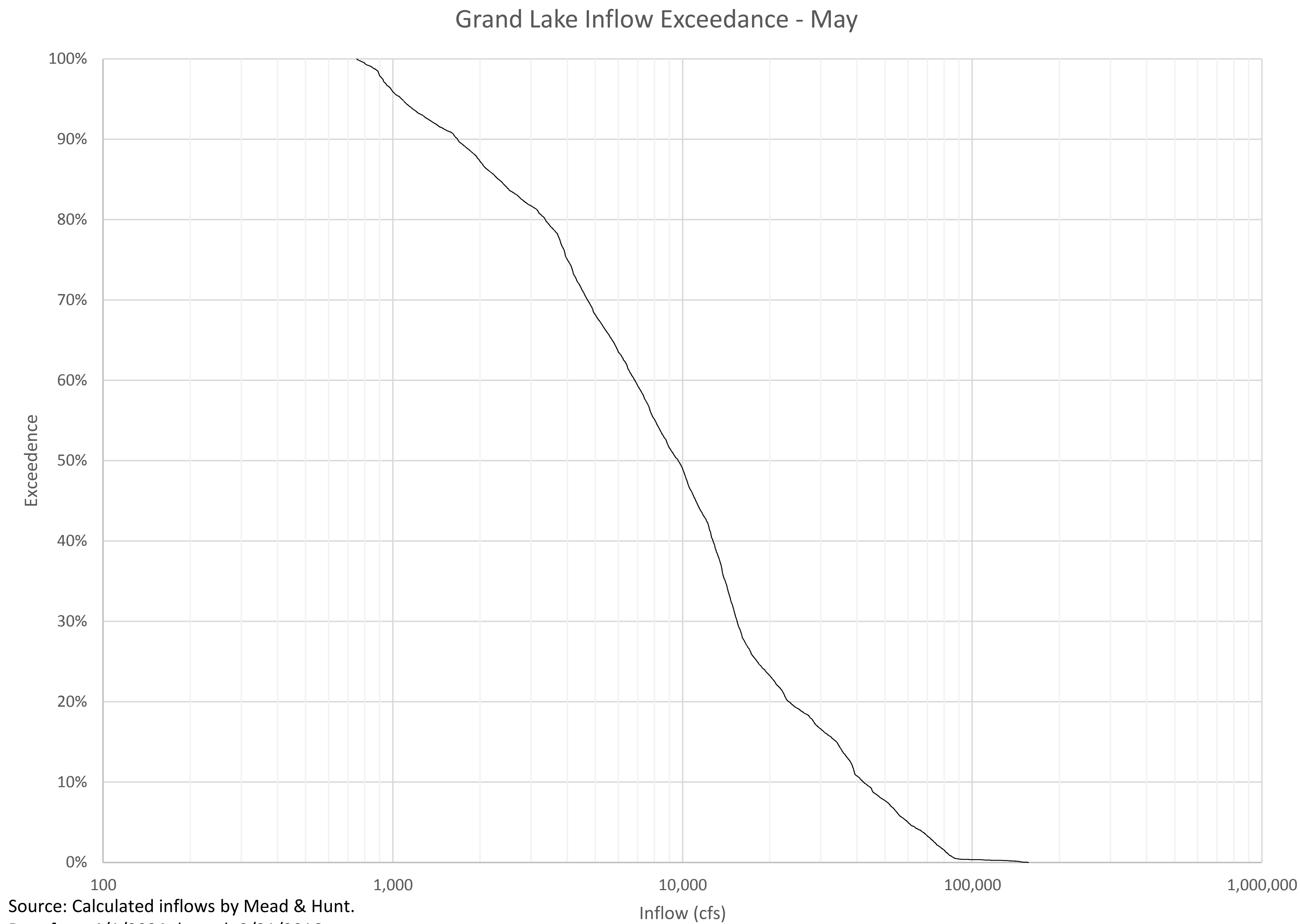
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



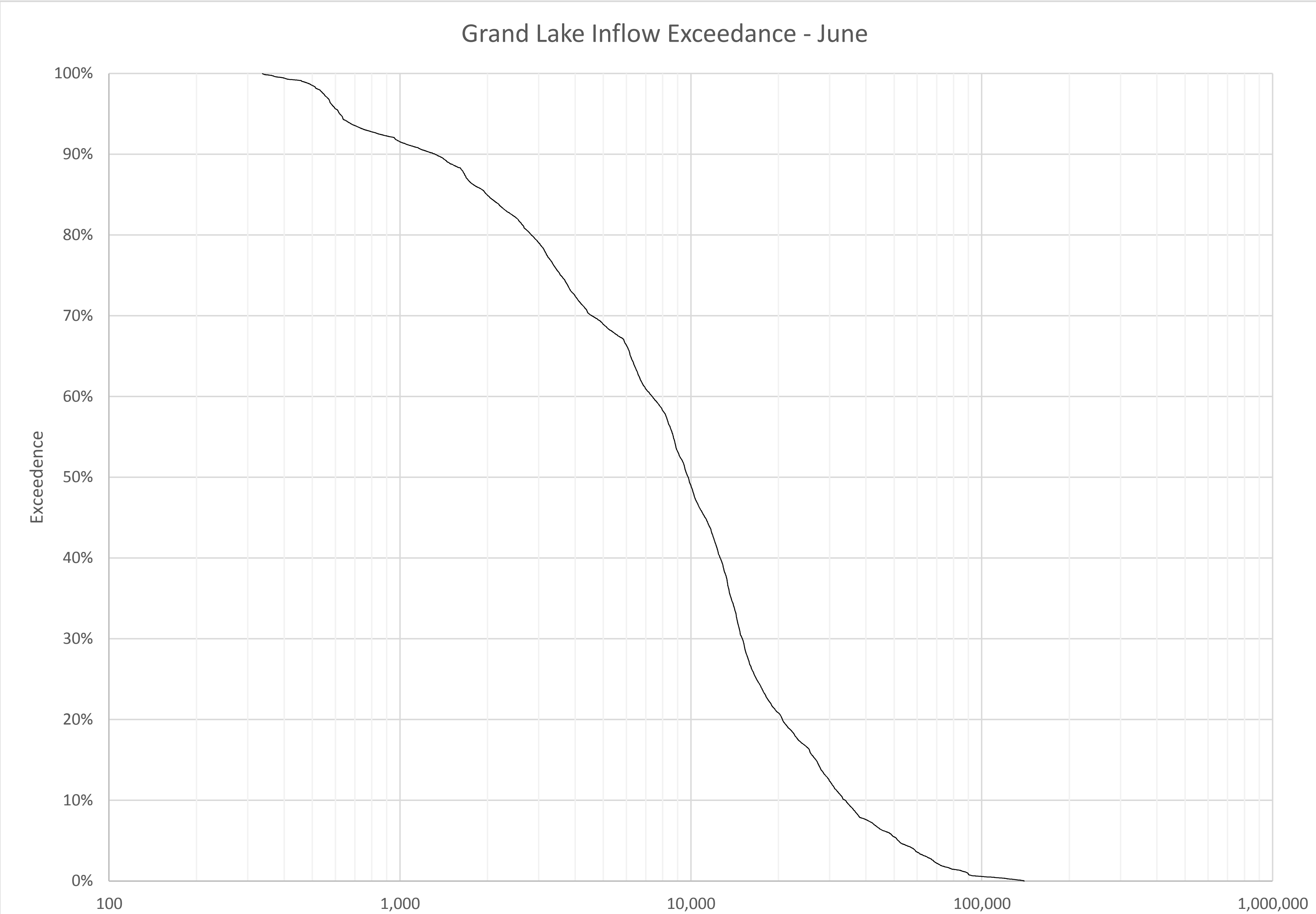
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



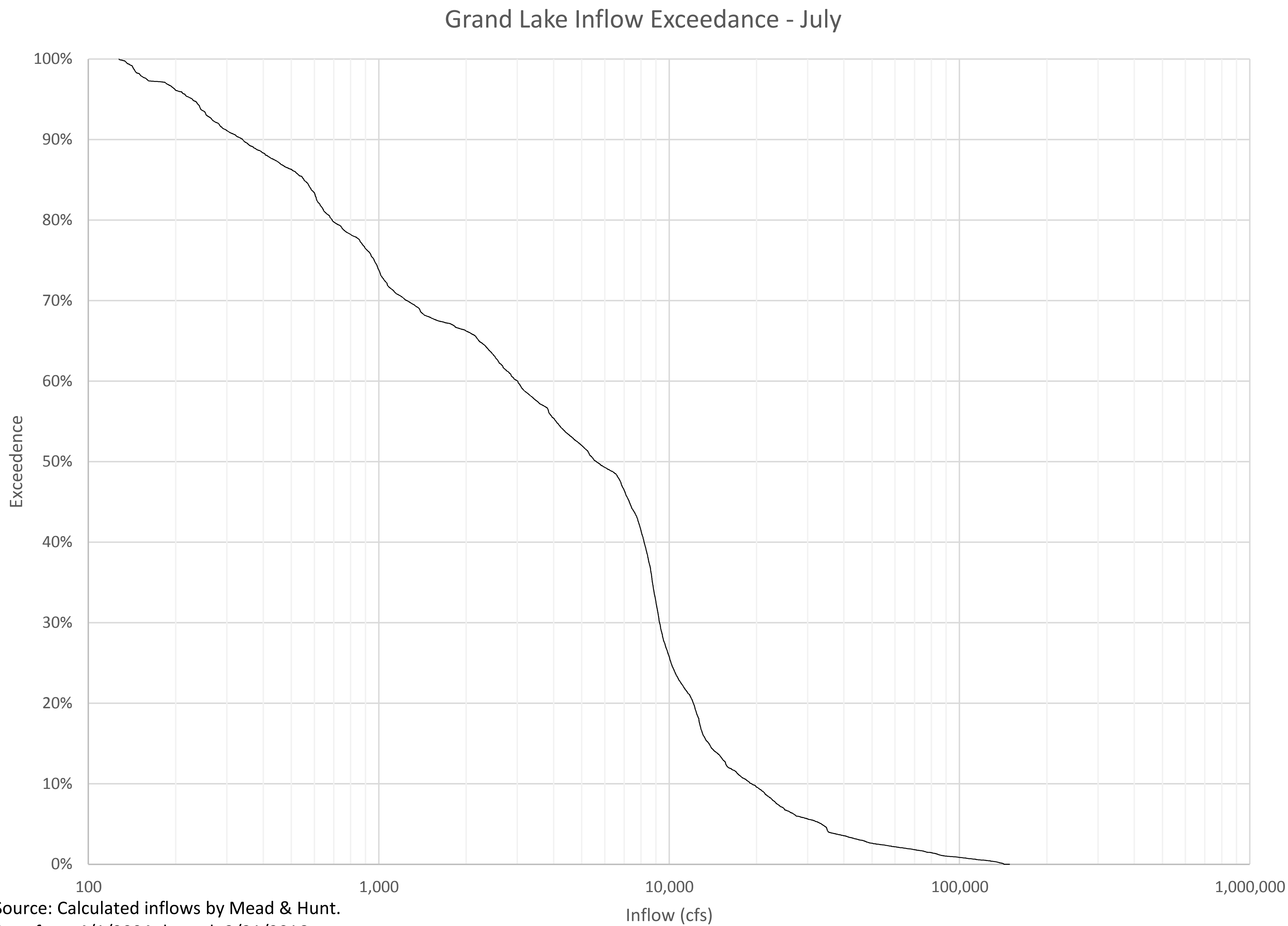
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



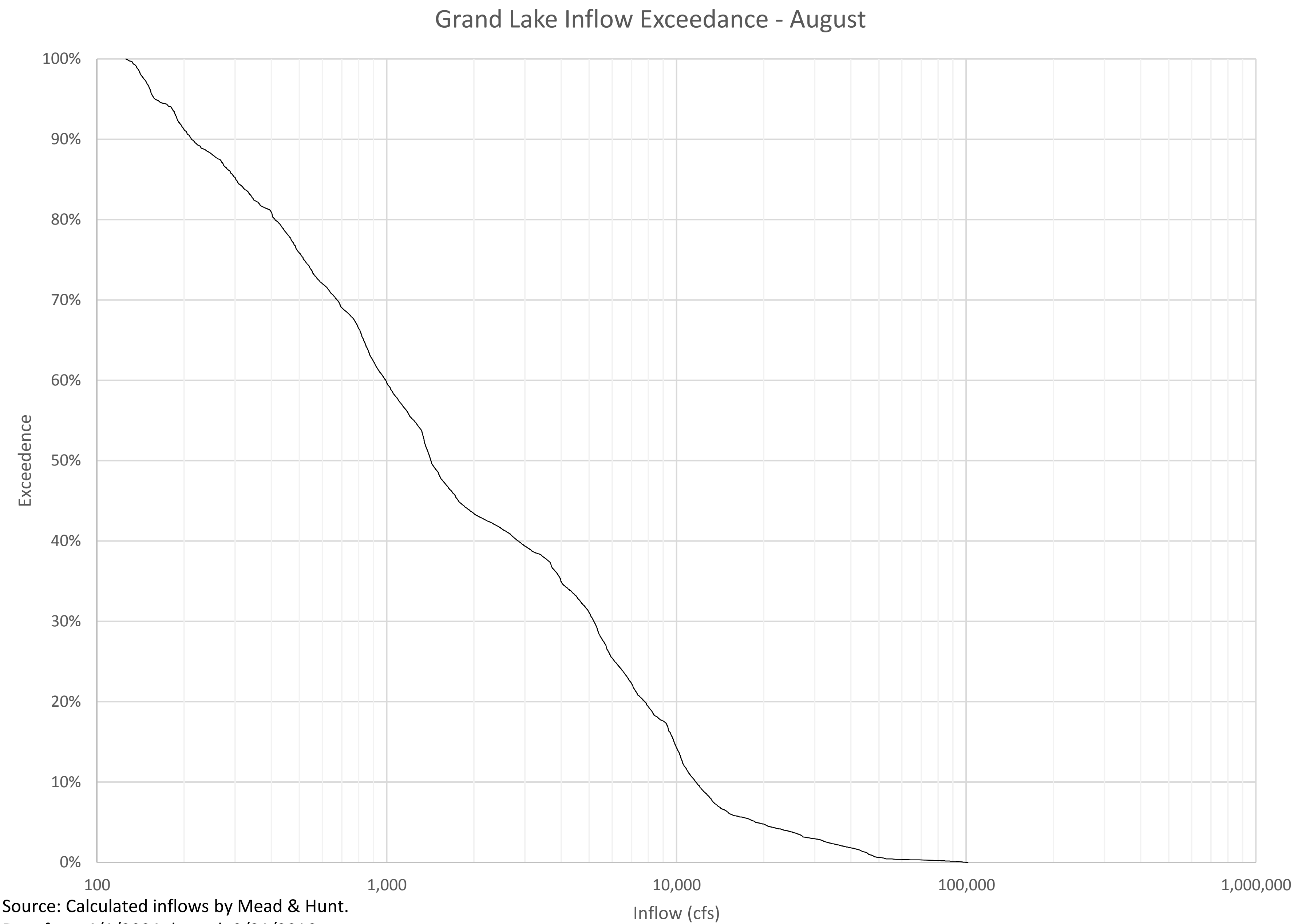
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



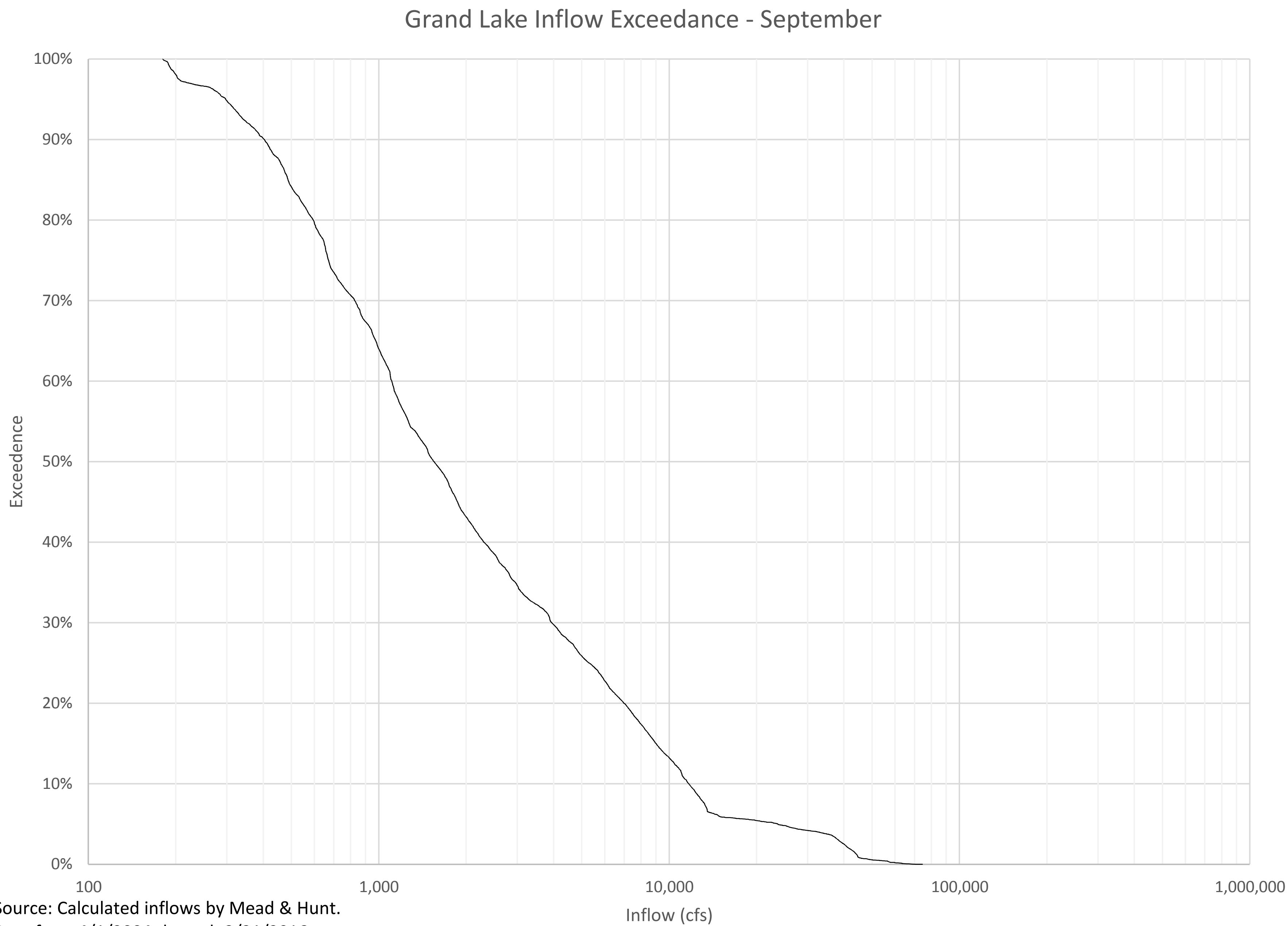
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



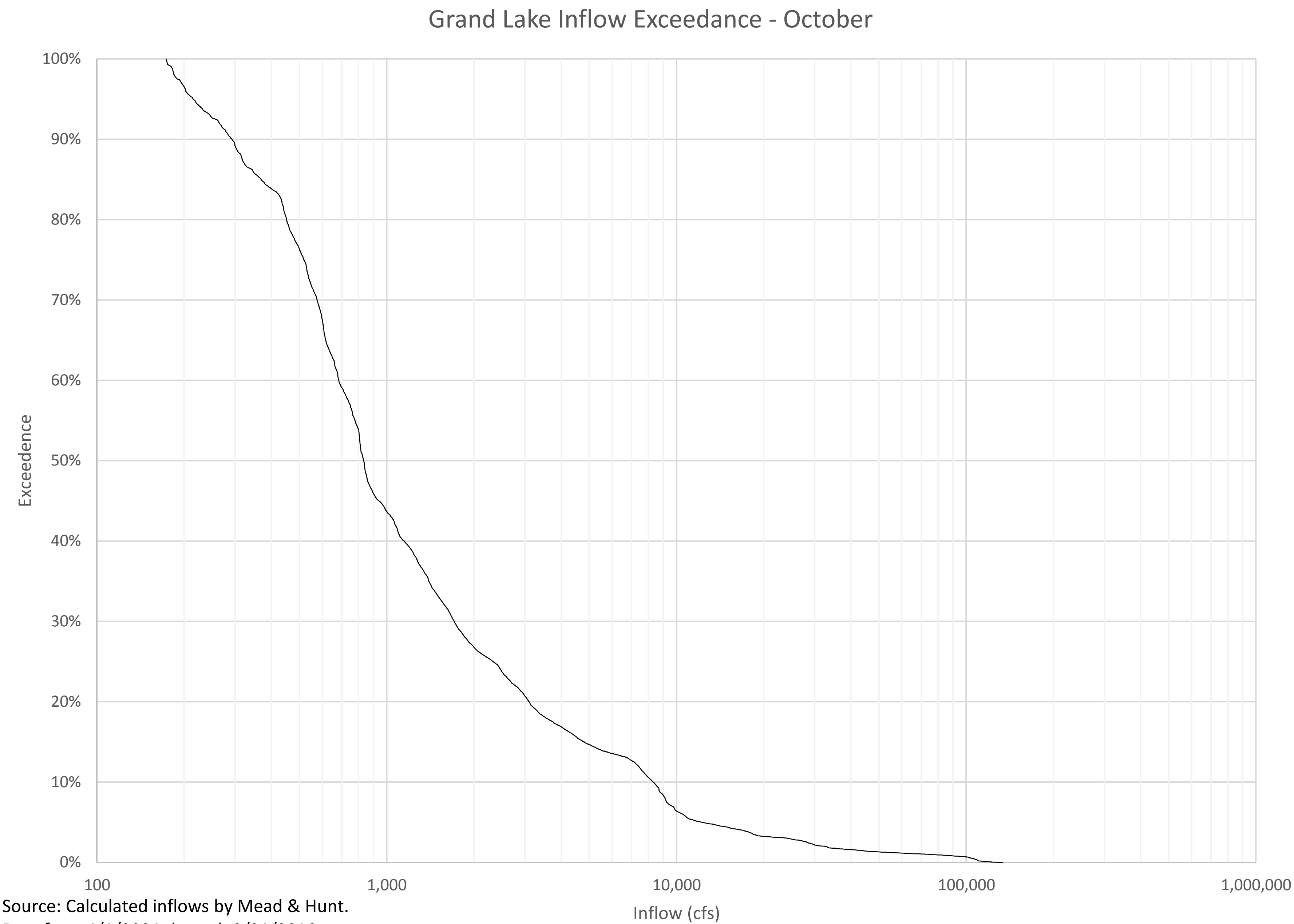
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



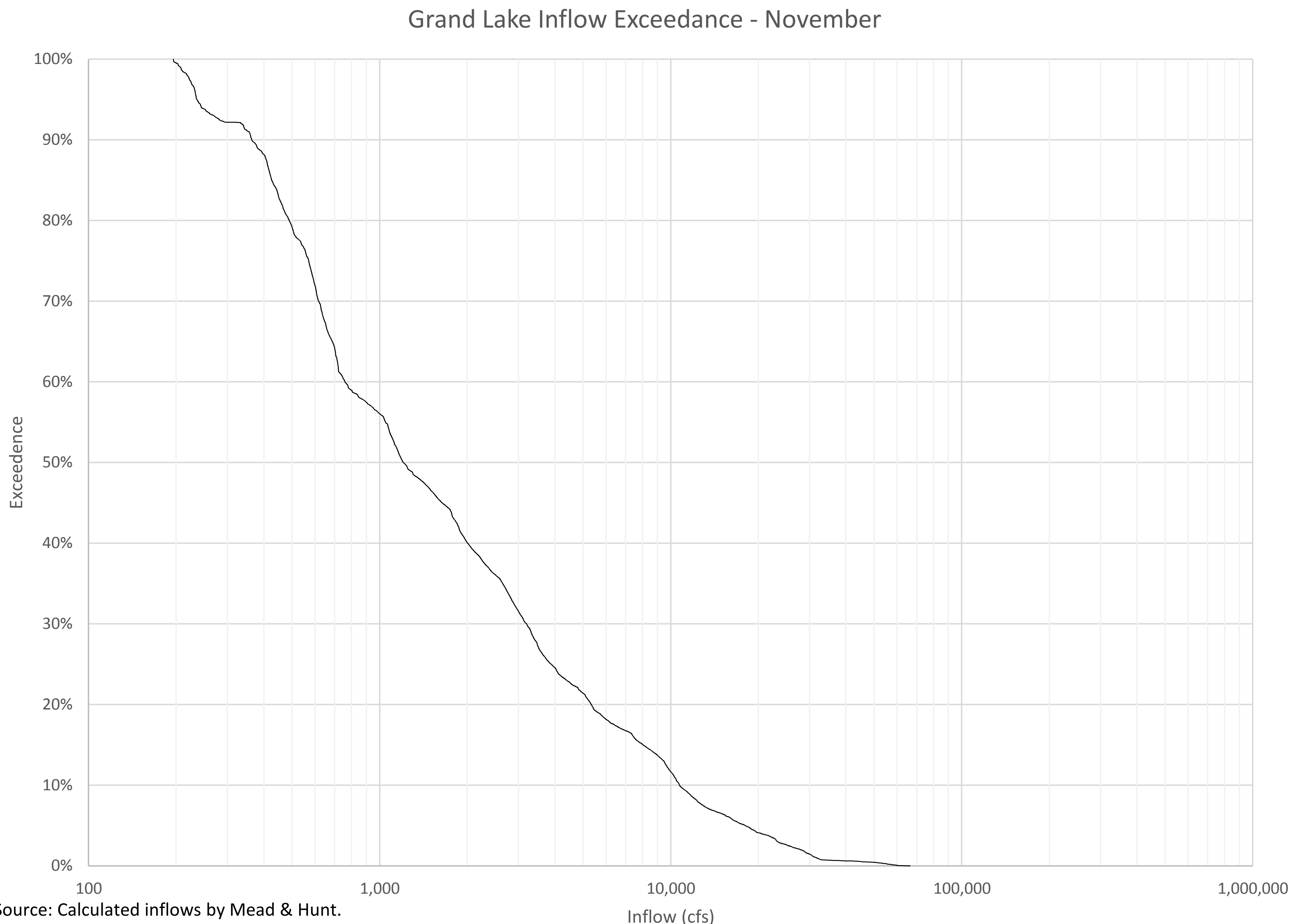
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



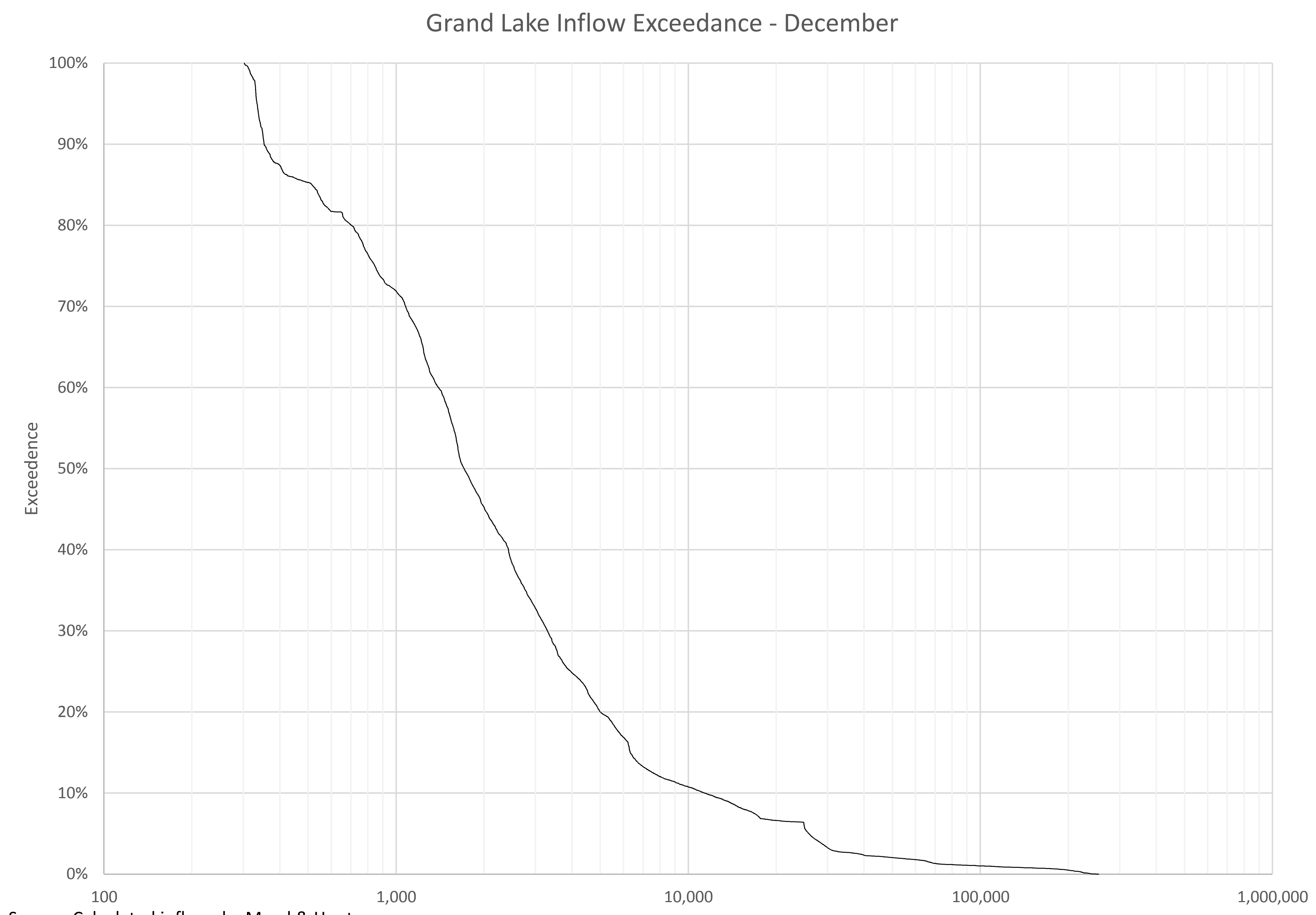
Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.



Source: Calculated inflows by Mead & Hunt.
Data from 4/1/2004 through 3/31/2016.

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ATTACHMENT E. WATER QUALITY MONITORING RESULTS

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Attachment E

Penasacola Hydroelectric Project Water Quality Monitoring Program
Average Profiles of Selected Parameters in Lower, Middle, and Upper Grand Lake, 2011 - 2016
<u>Temperature</u>

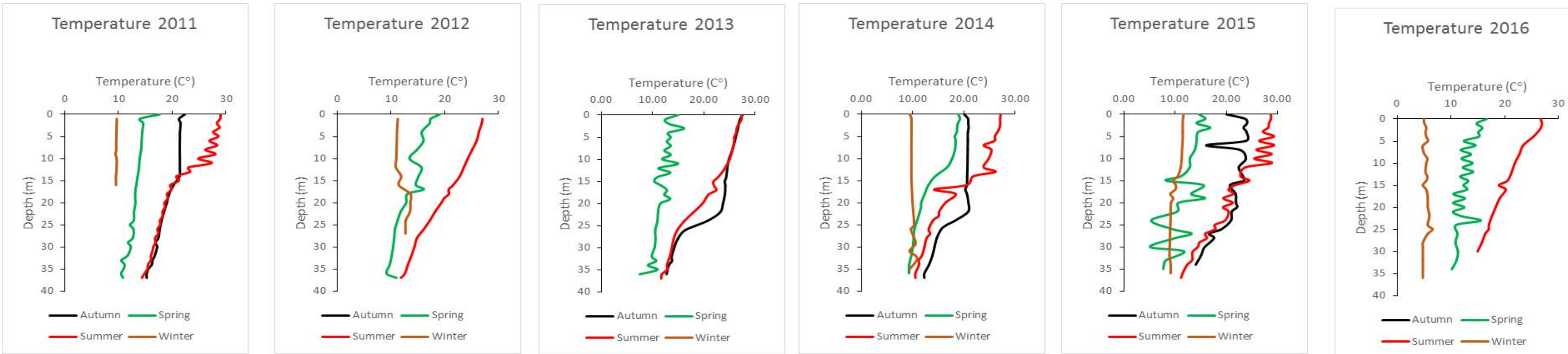

Figure 1. Average temperatures in Lower Grand Lake, 2011-2016.

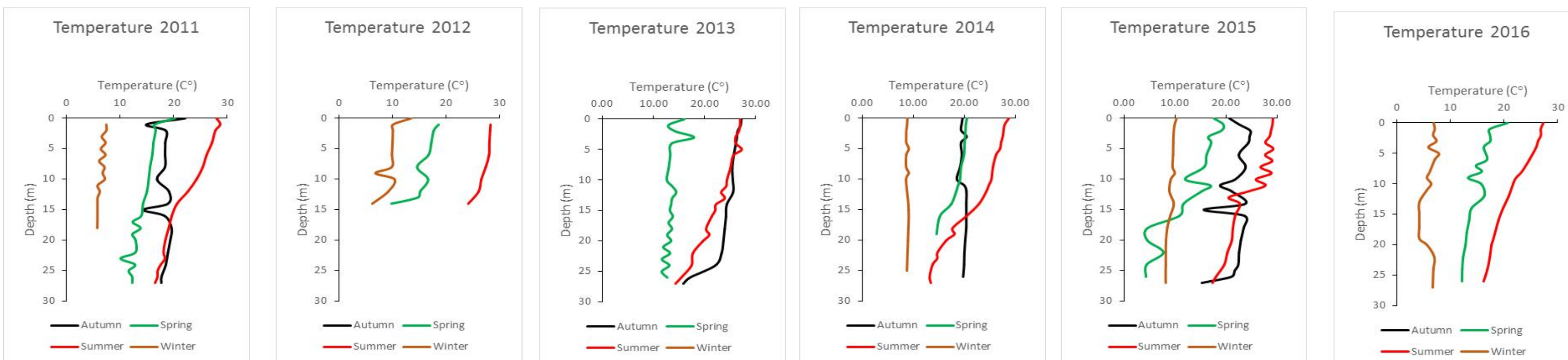

Figure 2. Average temperatures in MIddle Grand Lake, 2011-2016.

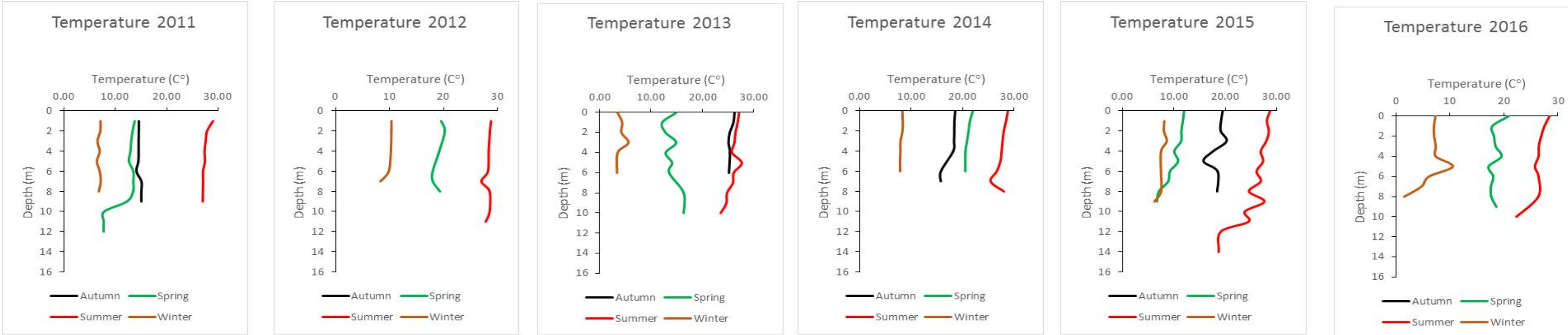

Figure 3. Average temperatures in Upper Grand Lake, 2011-2016.

Dissolved Oxygen

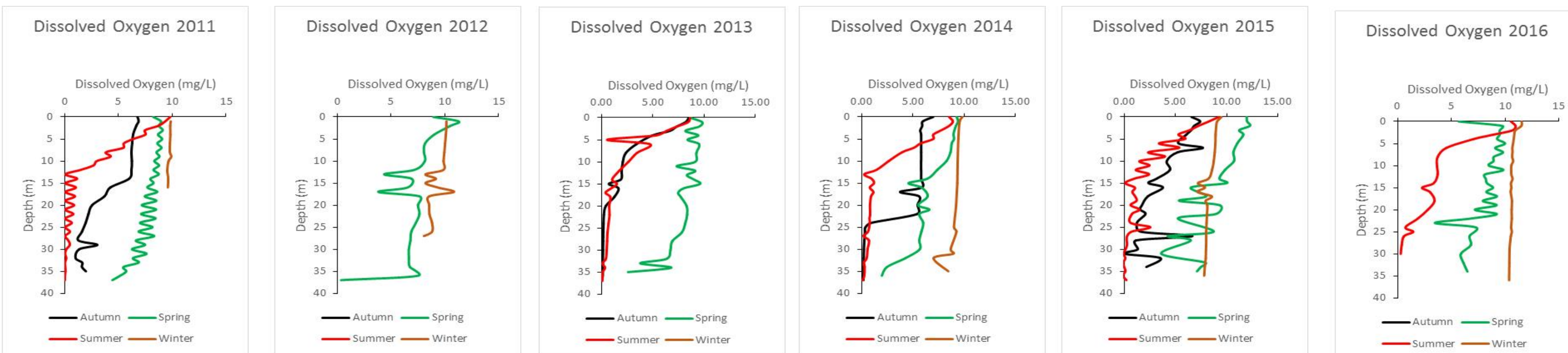

Figure 4. Average DO in Lower Grand Lake, 2011-2016.

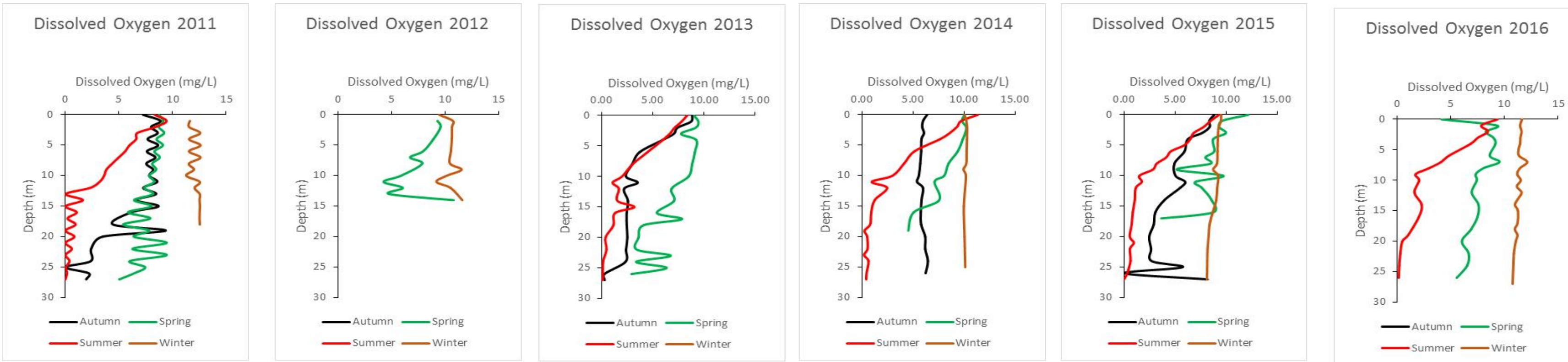

Figure 5. Average DO in Middle Grand Lake, 2011-2016.

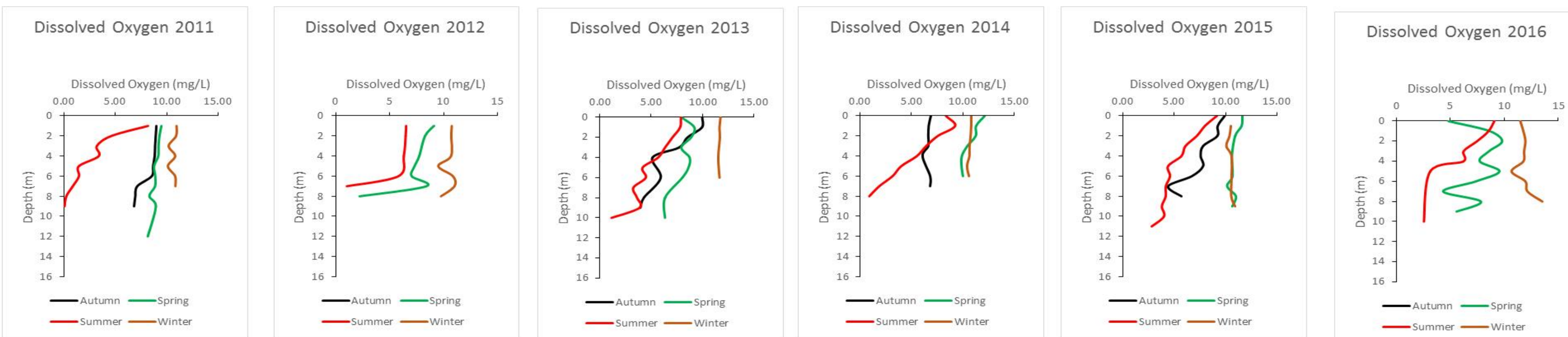

Figure 6. Average DO in Upper Grand Lake, 2011-2016.

pH

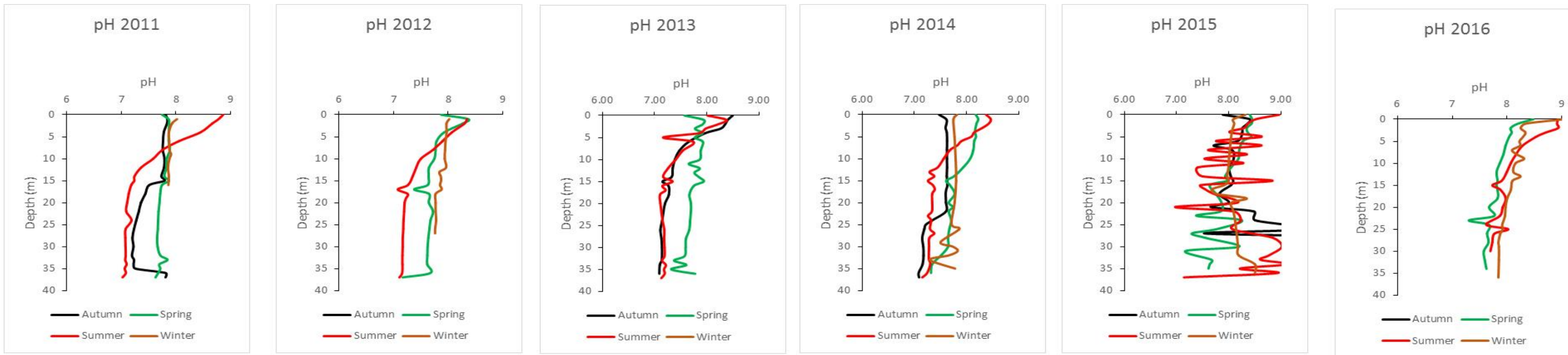

Figure 7. Average pH in Lower Grand Lake, 2011-2016.

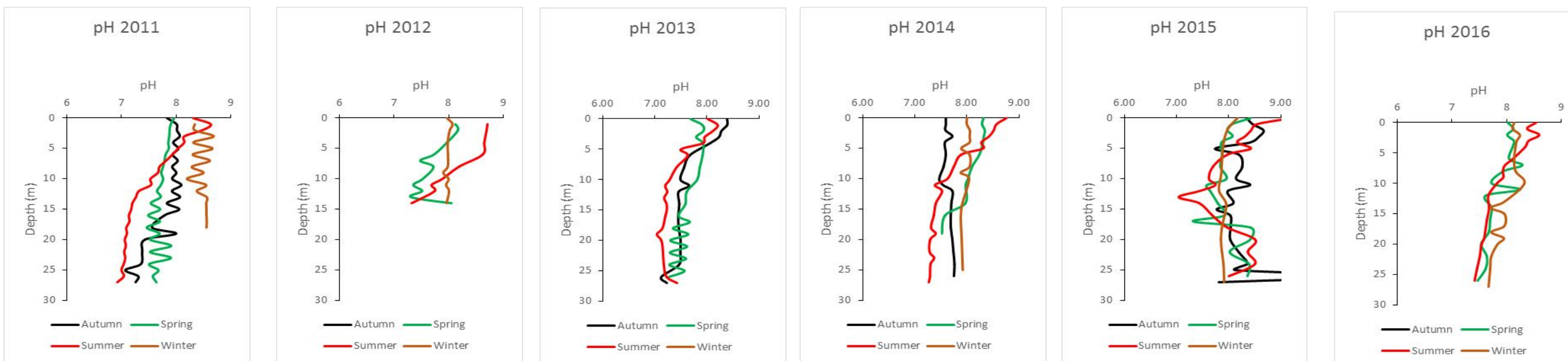

Figure 8. Average pH in Middle Grand Lake, 2011-2016.

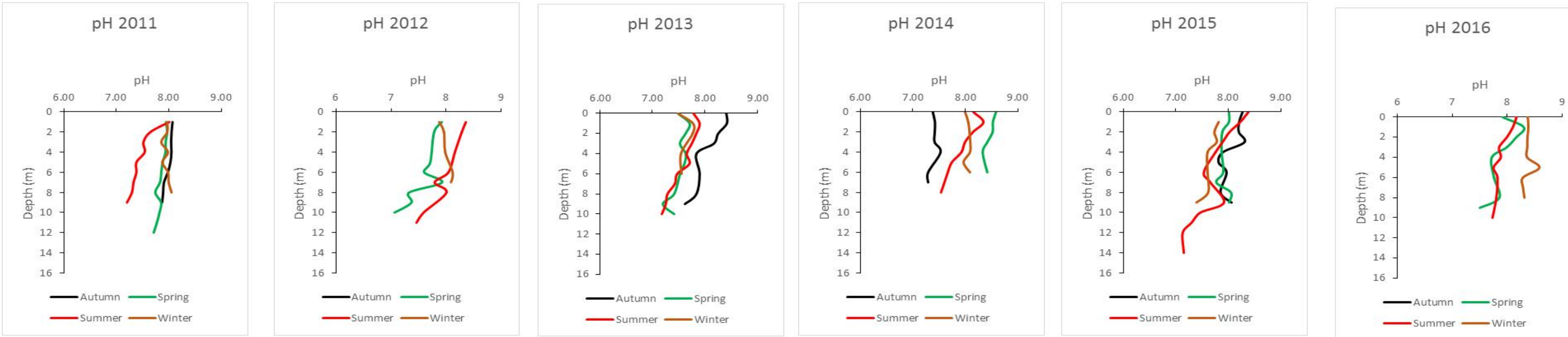

Figure 9. Average pH in Upper Grand Lake, 2011-2016.

Conductivity

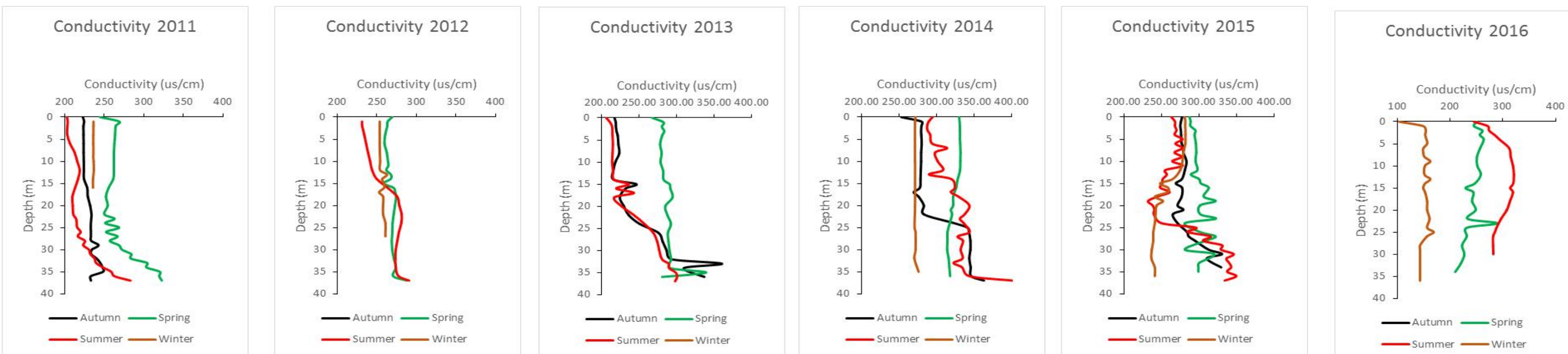

Figure 10. Average conductivity in Lower Grand Lake, 2011-2016.

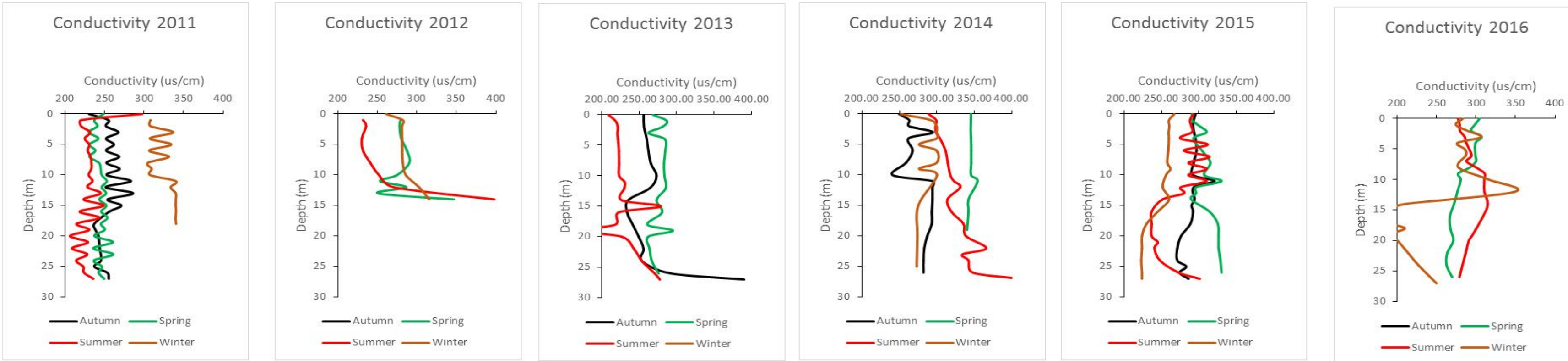

Figure 11. Average conductivity in Middle Grand Lake, 2011-2016.

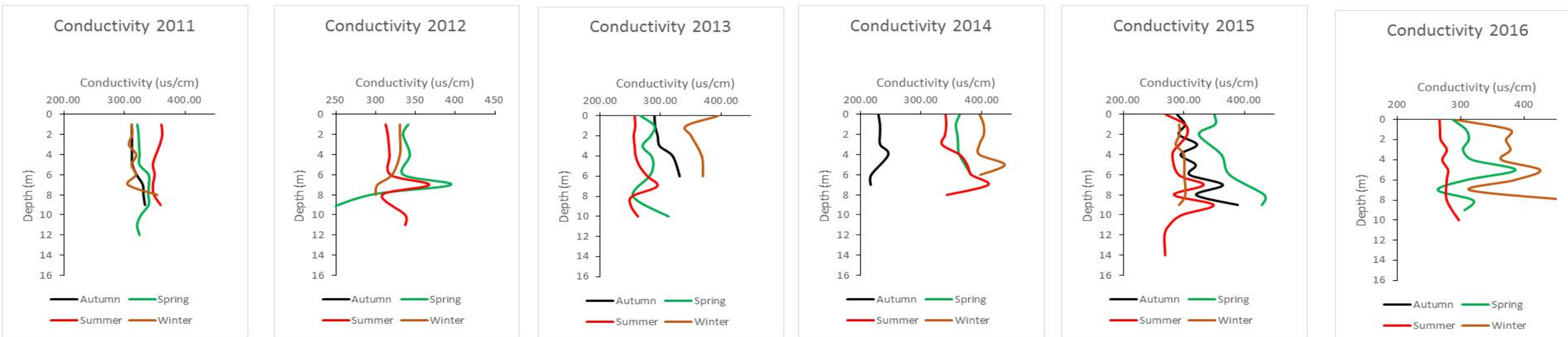

Figure 12. Average conductivity in Upper Grand Lake, 2011-2016.

Cholorophyl-a

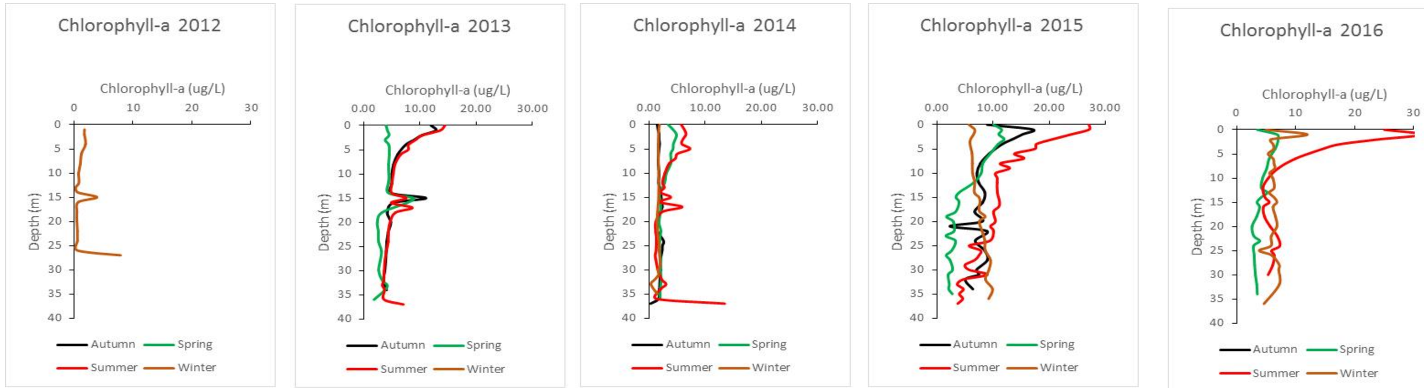

Figure 13. Average chlorophyl-a concentrations in Lower Grand Lake, 2012-2016 (no data for 2011).

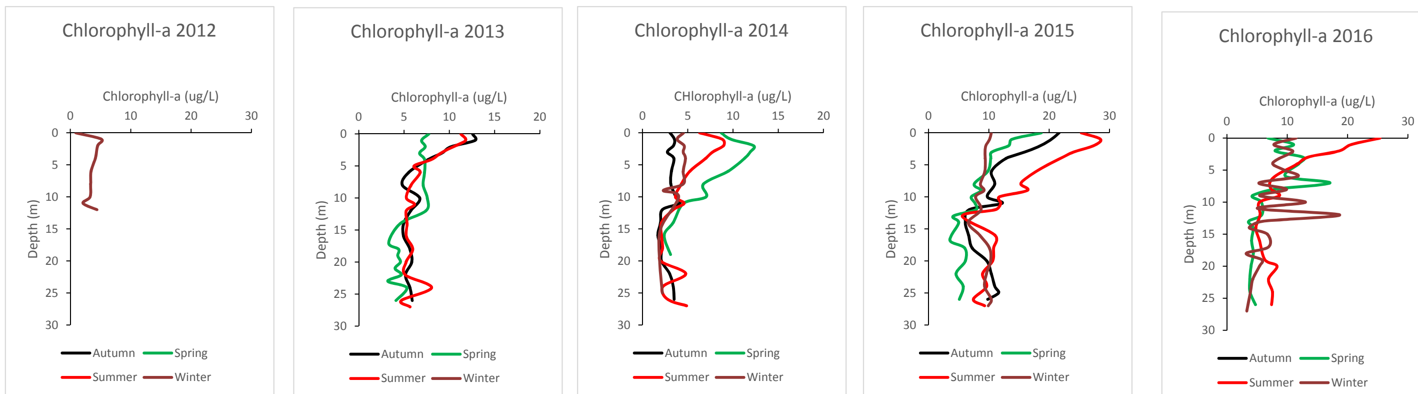

Figure 14. Average chlorophyl-a concentrations in Middle Grand Lake, 2012-2016 (no data for 2011).

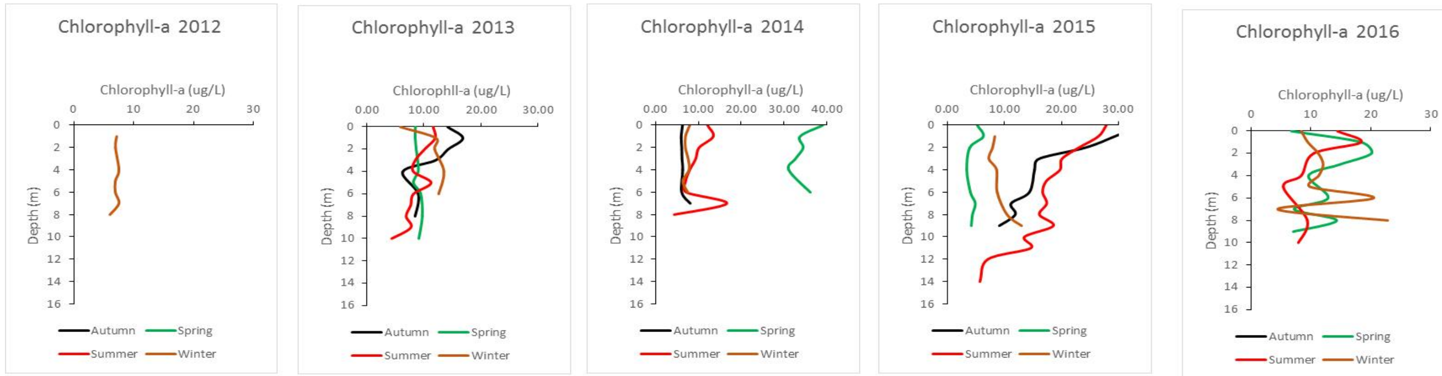

Figure 15. Average chlorophyl-a concentrations in Upper Grand Lake, 2012-2016 (no data for 2011).

ATTACHMENT F. PLANT SPECIES OCCURRING IN THE PROJECT VICINITY

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Attachment F

Vascular Plants of Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma (OBS, accessed May 6, 2016).

Family	Genus	Species	Common Name
Acanthaceae	*Dicliptera*	*brachiata*	branched foldwing
Acanthaceae	*Justicia*	*americana*	American water-willow
Acanthaceae	*Ruellia*	*humilis*	fringeleaf wild petunia
Acanthaceae	*Ruellia*	*pedunculata*	stalked wild petunia
Acanthaceae	*Ruellia*	*strepens*	limestone wild petunia
Acanthaceae	*Ruellia*	*caroliniesis*	Carolina wild petunia
Aceraceae	*Acer*	*negundo*	boxelder
Aceraceae	*Acer*	*rubrum*	red maple
Aceraceae	*Acer*	*saccharum*	sugar maple
Aceraceae	*Acer*	*saccharinum*	silver maple
Acoraceae	*Acorus*	*calamus*	calamus
Agavaceae	*Manfreda*	*virginica*	false aloe
Agavaceae	*Yucca*	*glauca*	soapweed yucca
Alismataceae	*Alisma*	*subcordatum*	American water plantain
Alismataceae	*Sagittaria*		arrowhead
Alismataceae	*Sagittaria*	*brevirostra*	shortbeak arrowhead
Alismataceae	*Sagittaria*	*calycina*	hooded arrowhead
Alismataceae	*Sagittaria*	*latifolia*	broadleaf arrowhead
Alismataceae	*Sagittaria*	*platyphylla*	delta arrowhead
Alismataceae	*Sagittaria*	*ambigua*	Kansas arrowhead
Amaranthaceae	*Amaranthus*	*albus*	prostrate pigweed
Amaranthaceae	*Amaranthus*	*hybridus*	slim amaranth
Amaranthaceae	*Amaranthus*	*spinosus*	spiny amaranth
Amaranthaceae	*Amaranthus*	*tuberculatus*	roughfruit amaranth
Amaranthaceae	*Iresine*	*rhizomatosa*	Juda's bush
Amaranthaceae	*Amaranthus*	*rudis*	tall amaranth
Anacardiaceae	*Rhus*	*aromatica*	fragrant sumac
Anacardiaceae	*Rhus*	*copallinum*	flameleaf sumac/winged sumac
Anacardiaceae	*Rhus*	*glabra*	smooth sumac
Anacardiaceae	*Rhus*	*lanceolata*	prairie sumac
Anacardiaceae	*Toxicodendron*	*radicans*	eastern poison ivy
Anacardiaceae	*Toxicodendron*	*rydbergii*	western poison ivy
Anacardiaceae	*Cotinus*	*obovatus*	American smoketree
Anacardiaceae	*Rhus*	*trilobata*	skunkbush sumac
Anacardiaceae	*Toxicodendron*		poison oak
Annonaceae	*Asimina*	*triloba*	pawpaw
Apiaceae	*Angelica*	*venenosa*	hairy angelica
Apiaceae	*Chaerophyllum*	*procumbens*	spreading chervil
Apiaceae	*Chaerophyllum*	*tainturieri*	hairyfruit chervil
Apiaceae	*Cicuta*	*maculata*	spotted water hemlock
Apiaceae	*Conium*	*maculatum*	poison hemlock

Family	Genus	Species	Common Name
Apiaceae	*Cryptotaenia*	*canadensis*	Canadian honewort
Apiaceae	*Daucus*	*carota*	Queen Anne's lace
Apiaceae	*Daucus*	*pusillus*	American wild carrot
Apiaceae	*Eryngium*	*yuccifolium*	button eryngo
Apiaceae	*Osmorhiza*	*longistylis*	longstyle sweetroot
Apiaceae	*Polytaenia*	*nuttallii*	Nuttall's prairie parsley
Apiaceae	*Ptilimnium*	*capillaceum*	herbwilliam
Apiaceae	*Ptilimnium*	*nuttallii*	laceflower
Apiaceae	*Sanicula*	*canadensis*	Canadian blacksnakeroot
Apiaceae	*Sanicula*	*odorata*	clustered blacksnakeroot
Apiaceae	*Thaspium*	*barbinode*	hairyjoint meadowparsnip
Apiaceae	*Thaspium*	*trifoliatum*	purple meadowparsnip
Apiaceae	*Torilis*	*arvensis*	spreading hedgeparsley
Apiaceae	*Torilis*	*japonica*	erect hedgeparsley
Apiaceae	*Zizia*	*aptera*	meadow zizia
Apiaceae	*Zizia*	*aurea*	golden zizia
Apiaceae	*Ammoselinum*	*butleri*	Butler's sandparsley
Apiaceae	*Anethum*	*graveolens*	dill
Apiaceae	*Erigenia*	*bulbosa*	harbinger of spring
Apiaceae	*Limnosciadium*	*pinnatum*	tansy dogshade
Apiaceae	*Spermolepis*	*divaricata*	roughfruit scaleseed
Apiaceae	*Taenidia*	*integerrima*	yellow pimpernel
Apiaceae	*Trepocarpus*	*aethusae*	whitenymph
Apiaceae	*Bifora*	*americana*	prairie bishop
Apiaceae	*Hydrocotyle*	*verticillata*	whorled marshpennywort
Apiaceae	*Oxypolis*	*rigidior*	stiff cowbane
Apiaceae	*Lomatium*	*foeniculaceum*	desert biscuitroot
Apiaceae	*Spermolepis*	*inermis*	Red River scaleseed
Apocynaceae	*Amsonia*	*illustris*	Ozark bluestar
Apocynaceae	*Amsonia*	*tabernaemontana*	eastern bluestar
Apocynaceae	*Apocynum*	*cannabinum*	Indianhemp
Apocynaceae	*Apocynum*	*xfloribundum*	
Apocynaceae	*Apocynum*	*androsaemifolium*	spreading dogbane
Aquifoliaceae	*Ilex*	*decidua*	possumhaw
Araceae	*Arisaema*	*dracontium*	green dragon
Araceae	*Arisaema*	*triphyllum*	Jack in the pulpit
Araliaceae	*Panax*	*quinquefolius*	American ginseng
Aristolochiaceae	*Asarum*	*canadense*	Canadian wildginger
Aristolochiaceae	*Aristolochia*	*serpentaria*	Virginia snakeroot
Aristolochiaceae	*Aristolochia*	*tomentosa*	woolly dutchman's pipe
Asclepiadaceae	*Asclepias*	*hirtella*	green milkweed
Asclepiadaceae	*Asclepias*	*incarnata*	swamp milkweed
Asclepiadaceae	*Asclepias*	*quadrifolia*	fourleaf milkweed
Asclepiadaceae	*Asclepias*	*sullivantii*	prairie milkweed
Asclepiadaceae	*Asclepias*	*tuberosa*	butterfly milkweed

Family	Genus	Species	Common Name
Asclepiadaceae	*Asclepias*	*verticillata*	whorled milkweed
Asclepiadaceae	*Asclepias*	*viridiflora*	green comet milkweed
Asclepiadaceae	*Asclepias*	*viridis*	green antelopehorn
Asclepiadaceae	*Cynanchum*	*laeve*	honeyvine
Asclepiadaceae	*Funastrum*	*crispum*	wavyleaf twinevine
Asclepiadaceae	*Matelea*	*gonocarpos*	angularfruit milkvine
Asclepiadaceae	*Asclepias*	*stenophylla*	slimleaf milkweed
Asclepiadaceae	*Matelea*	*baldwyniana*	Baldwin's milkvine
Asclepiadaceae	*Matelea*	*decipiens*	oldfield milkvine
Asclepiadaceae	*Asclepias*	*amplexicaulis*	clasping milkweed
Asclepiadaceae	*Asclepias*	*purpurascens*	purple milkweed
Asclepiadaceae	*Asclepias*	*syriaca*	common milkweed
Aspleniaceae	*Asplenium*	*platyneuron*	ebony spleenwort
Aspleniaceae	*Asplenium*	*resiliens*	blackstem spleenwort
Aspleniaceae	*Asplenium*	*rhizophyllum*	walking fern
Aspleniaceae	*Asplenium*	*trichomanes*	maidenhair spleenwort
Asteraceae	*Achillea*	*millefolium*	common yarrow/western yarrow
Asteraceae	*Ageratina*	*altissima*	white snakeroot
Asteraceae	*Ambrosia*	*artemisiifolia*	annual ragweed
Asteraceae	*Ambrosia*	*bidentata*	lanceleaf ragweed
Asteraceae	*Ambrosia*	*trifida*	Texan great ragweed
Asteraceae	*Antennaria*	*parlinii*	Parlin's pussytoes
Asteraceae	*Antennaria*	*plantaginifolia*	woman's tobacco
Asteraceae	*Anthemis*	*cotula*	stinking chamomile
Asteraceae	*Arctium*	*minus*	lesser burrdock
Asteraceae	*Arnoglossum*	*muehlenbergii*	great Indian plaintain
Asteraceae	*Arnoglossum*	*plantagineum*	groovestem Indian plaintain
Asteraceae	*Artemisia*	*annua*	sweet sagewort
Asteraceae	*Artemisia*	*ludoviciana*	white sagebrush
Asteraceae	*Berlandiera*	*pumila*	soft greeneyes
Asteraceae	*Bidens*	*aristosa*	bearded beggarticks
Asteraceae	*Bidens*	*bipinnata*	Spanish needles
Asteraceae	*Bidens*	*cernua*	nodding beggartick
Asteraceae	*Bidens*	*discoidea*	small beggarticks
Asteraceae	*Bidens*	*frondosa*	devil's beggartick
Asteraceae	*Brickellia*	*eupatorioides*	false boneset
Asteraceae	*Carduus*	*nutans*	nodding plumeless thistle
Asteraceae	*Centaurea*	*cyanus*	garden cornflower
Asteraceae	*Chrysopsis*	*pilosa*	soft goldenaster
Asteraceae	*Cichorium*	*intybus*	chicory
Asteraceae	*Cirsium*	*altissimum*	tall thistle
Asteraceae	*Cirsium*	*undulatum*	wavyleaf thistle
Asteraceae	*Cirsium*	*vulgare*	bull thistle
Asteraceae	*Conoclinium*	*coelestinum*	blue mistflower
Asteraceae	*Conyza*	*canadensis*	Canadian horseweed

Family	**Genus**	**Species**	**Common Name**
Asteraceae	*Coreopsis*	*grandiflora*	largeflower tickseed
Asteraceae	*Coreopsis*	*lanceolata*	lanceleaf tickseed
Asteraceae	*Coreopsis*	*palmata*	stiff tickseed
Asteraceae	*Coreopsis*	*pubescens*	star tickseed
Asteraceae	*Coreopsis*	*tinctoria*	golden tickseed
Asteraceae	*Coreopsis*	*tripteris*	tall tickseed
Asteraceae	*Cosmos*	*sulphureus*	sulphur cosmos
Asteraceae	*Echinacea*	*angustifolia*	blacksamson echinacea
Asteraceae	*Echinacea*	*atrorubens*	Topeka purple coneflower
Asteraceae	*Echinacea*	*pallida*	pale purple coneflower
Asteraceae	*Echinacea*	*purpurea*	eastern purple coneflower
Asteraceae	*Eclipta*	*prostrata*	false daisy
Asteraceae	*Elephantopus*	*carolinianus*	Carolina elephantsfoot
Asteraceae	*Erechtites*	*hieraciifolius*	American burnweed
Asteraceae	*Erigeron*	*annuus*	eastern daisy fleabane
Asteraceae	*Erigeron*	*philadelphicus*	Philadelphia fleabane
Asteraceae	*Erigeron*	*pulchellus*	robin's plantain
Asteraceae	*Erigeron*	*strigosus*	prairie fleabane/Beyrich's fleabane
Asteraceae	*Eupatorium*	*altissimum*	tall thoroughwort
Asteraceae	*Eupatorium*	*serotinum*	lateflowering thoroughwort
Asteraceae	*Eurybia*	*hemispherica*	southern prairie aster
Asteraceae	*Eurybia*	*paludosus*	southern swamp aster
Asteraceae	*Euthamia*	*gymnospermoides*	Texas goldentop
Asteraceae	*Eutrochium*	*purpureum*	sweetscented joe pye weed
Asteraceae	*Fleischmannia*	*incarnata*	pink thoroughwort
Asteraceae	*Gamochaeta*	*argyrinea*	silvery everlasting
Asteraceae	*Gamochaeta*	*purpurea*	spoonleaf purple everlasting
Asteraceae	*Grindelia*	*lanceolata*	narrowleaf gumweed
Asteraceae	*Helenium*	*amarum*	yellowdicks
Asteraceae	*Helenium*	*autumnale*	common sneezeweed
Asteraceae	*Helenium*	*flexuosum*	purplehead sneezeweed
Asteraceae	*Helianthus*	*decapetalus*	thinleaf sunflower
Asteraceae	*Helianthus*	*grosseserratus*	sawtooth sunflower
Asteraceae	*Helianthus*	*hirsutus*	hairy sunflower
Asteraceae	*Helianthus*	*mollis*	ashy sunflower
Asteraceae	*Helianthus*	*nuttallii*	Nuttall's sunflower
Asteraceae	*Helianthus*	*pauciflorus*	stiff sunflower
Asteraceae	*Helianthus*	*tuberosus*	Jerusalem artichoke
Asteraceae	*Heliopsis*	*helianthoides*	smooth oxeye
Asteraceae	*Hieracium*	*gronovii*	queendevil
Asteraceae	*Hieracium*	*longipilum*	hairy hawkweed
Asteraceae	*Hieracium*	*venosum*	rattlesnakeweed
Asteraceae	*Hymenopappus*	*scabiosaeus*	Carolina woollywhite
Asteraceae	*Ionactis*	*linariifolius*	flaxleaf whitetop aster
Asteraceae	*Iva*	*annua*	annual marshelder

Family	Genus	Species	Common Name
Asteraceae	*Krigia*	*biflora*	twoflower dwarfdandelion
Asteraceae	*Krigia*	*caespitosa*	weedy dwarfdandelion
Asteraceae	*Krigia*	*dandelion*	potato dwarfdandelion
Asteraceae	*Krigia*	*virginica*	Virginia dwarfdandelion
Asteraceae	*Krigia*	*wrightii*	Wright's dwarfdandelion
Asteraceae	*Lactuca*	*canadensis*	Canada lettuce
Asteraceae	*Lactuca*	*floridana*	woodland lettuce
Asteraceae	*Lactuca*	*serriola*	prickly lettuce
Asteraceae	*Leucanthemum*	*vulgare*	oxeye daisy
Asteraceae	*Liatris*	*pycnostachya*	prairie blazing star
Asteraceae	*Liatris*	*squarrosa*	scaly blazing star
Asteraceae	*Matricaria*	*discoidea*	disc mayweed
Asteraceae	*Packera*	*aurea*	golden ragwort
Asteraceae	*Packera*	*obovata*	roundleaf ragwort
Asteraceae	*Packera*	*plattensis*	prairie groundsel
Asteraceae	*Parthenium*	*integrifolium*	wild quinine
Asteraceae	*Pluchea*	*camphorata*	camphor pluchea
Asteraceae	*Pluchea*	*odorata*	sweetscent
Asteraceae	*Polymnia*	*canadensis*	whiteflower leafcup
Asteraceae	*Prenanthes*	*altissima*	tall rattlesnakeroot
Asteraceae	*Prenanthes*	*aspera*	rough rattlesnakeroot
Asteraceae	*Pseudognaphalium*	*obtusifolium*	rabbittobacco
Asteraceae	*Pyrrhopappus*	*carolinianus*	Carolina desert-chicory
Asteraceae	*Ratibida*	*columnifera*	upright prairie coneflower
Asteraceae	*Ratibida*	*pinnata*	pinnate prairie coneflower
Asteraceae	*Rudbeckia*	*fulgida*	orange coneflower
Asteraceae	*Rudbeckia*	*grandiflora*	rough coneflower
Asteraceae	*Rudbeckia*	*hirta*	blackeyed Susan
Asteraceae	*Rudbeckia*	*laciniata*	cutleaf coneflower
Asteraceae	*Rudbeckia*	*triloba*	browneyed Susan
Asteraceae	*Silphium*	*integrifolium*	wholeleaf rosinweed
Asteraceae	*Silphium*	*laciniatum*	compassplant
Asteraceae	*Silphium*	*perfoliatum*	cup plant
Asteraceae	*Silphium*	*radula*	roughstem rosinweed
Asteraceae	*Smallanthus*	*uvedalius*	hairy leafcup
Asteraceae	*Solidago*	*arguta*	Boott's goldenrod/Atlantic goldenrod
Asteraceae	*Solidago*	*caesia*	wreath goldenrod
Asteraceae	*Solidago*	*canadensis*	shorthair goldenrod/Canada goldenrod
Asteraceae	*Solidago*	*hispida*	hairy goldenrod
Asteraceae	*Solidago*	*missouriensis*	Missouri goldenrod
Asteraceae	*Solidago*	*nemoralis*	gray goldenrod
Asteraceae	*Solidago*	*petiolaris*	downy ragged goldenrod
Asteraceae	*Solidago*	*radula*	western rough goldenrod
Asteraceae	*Solidago*	*speciosa*	showy goldenrod
Asteraceae	*Solidago*	*ulmifolia*	elmleaf goldenrod

Family	Genus	Species	Common Name
Asteraceae	*Sonchus*	*asper*	spiny sowthistle
Asteraceae	*Symphyotrichum*	*anomalum*	manyray aster
Asteraceae	*Symphyotrichum*	*drummondii*	Drummond's aster
Asteraceae	*Symphyotrichum*	*ericoides*	white heath aster
Asteraceae	*Symphyotrichum*	*laeve*	smooth blue aster
Asteraceae	*Symphyotrichum*	*lanceolatum*	white panicle aster
Asteraceae	*Symphyotrichum*	*lateriflorum*	calico aster
Asteraceae	*Symphyotrichum*	*oblongifolium*	aromatic aster
Asteraceae	*Symphyotrichum*	*ontarione*	bottomland aster
Asteraceae	*Symphyotrichum*	*oolentangiense*	skyblue aster
Asteraceae	*Symphyotrichum*	*patens*	late purple aster
Asteraceae	*Symphyotrichum*	*pilosum*	hairy white oldfield aster
Asteraceae	*Symphyotrichum*	*praealtum*	willowleaf aster
Asteraceae	*Symphyotrichum*	*turbinellum*	smooth violet prairie aster
Asteraceae	*Tanacetum*	*vulgare*	common tansy
Asteraceae	*Thelesperma*	*ambiguum*	Colorado greenthread
Asteraceae	*Tragopogon*		goatsbeard
Asteraceae	*Verbesina*	*alternifolia*	wingstem
Asteraceae	*Verbesina*	*helianthoides*	gravelweed
Asteraceae	*Verbesina*	*virginica*	white crownbeard
Asteraceae	*Vernonia*	*arkansana*	Arkansas ironweed
Asteraceae	*Vernonia*	*baldwinii*	Baldwin's ironweed/interior ironweed
Asteraceae	*Vernonia*	*gigantea*	giant ironweed
Asteraceae	*Vernonia*	*missurica*	Missouri ironweed
Asteraceae	*Xanthium*	*strumarium*	rough cockleburr
Asteraceae	*Amphiachyris*	*dracunculoides*	prairie broomweed
Asteraceae	*Astranthium*	*integrifolium*	entireleaf western daisy
Asteraceae	*Boltonia*	*asteroides*	entireleaf western daisy
Asteraceae	*Centaurea*	*americana*	white doll's daisy/Arkansas leastdaisy
Asteraceae	*Chaetopappa*	*asteroides*	American star-thistle
Asteraceae	*Cirsium*	*carolinianum*	soft thistle
Asteraceae	*Crepis*	*pulchra*	smallflower hawksbeard
Asteraceae	*Dracopis*	*amplexicaulis*	clasping coneflower
Asteraceae	*Erigeron*	*tenuis*	slenderleaf fleabane
Asteraceae	*Gaillardia*	*aestivalis*	lanceleaf blanketflower
Asteraceae	*Gaillardia*	*pulchella*	firewheel
Asteraceae	*Gamochaeta*	*falcata*	narrowleaf purple everlasting
Asteraceae	*Helianthus*	*X laetiflorus*	cheerful sunflower
Asteraceae	*Heterotheca*	*subaxillaris*	camphorweed
Asteraceae	*Lactuca*	*ludoviciana*	biannual lettuce
Asteraceae	*Lactuca*	*tatarica*	blue lettuce
Asteraceae	*Liatris*	*aspera*	tall blazing star
Asteraceae	*Liatris*	*punctata*	dotted blazing star
Asteraceae	*Oligoneuron*	*rigidum*	stiff goldenrod
Asteraceae	*Packera*	*glabella*	butterweed

Family	Genus	Species	Common Name
Asteraceae	*Plectocephalus*	*americanus*	
Asteraceae	*Pyrrhopappus*	*grandiflorus*	tuberous desert-chicory
Asteraceae	*Pyrrhopappus*	*pauciflorus*	smallflower desert-chicory
Asteraceae	*Solidago*	*gigantea*	giant goldenrod
Asteraceae	*Solidago*	*ludoviciana*	Louisiana goldenrod
Asteraceae	*Solidago*	*odora*	anisescented goldenrod
Asteraceae	*Taraxacum*	*officinale*	common dandelion
Asteraceae	*Tragopogon*	*dubius*	yellow salsify
Asteraceae	*Verbesina*	*encelioides*	golden crownbeard
Asteraceae	*Antennaria*	*neglecta*	field pussytoes
Asteraceae	*Arnoglossum*	*atriplicifolium*	pale Indian plaintain
Asteraceae	*Boltonia*	*diffusa*	smallhead doll's daisy
Asteraceae	*Coreopsis*	*verticillata*	whorled tickseed
Asteraceae	*Helianthus*	*annuus*	common sunflower
Asteraceae	*Helianthus*	*petiolaris*	prairie sunflower
Asteraceae	*Helianthus*	*salicifolius*	willowleaf sunflower
Asteraceae	*Helianthus*	*X doronicoides*	
Asteraceae	*Heterotheca*	*villosa*	hairy goldenaster
Asteraceae	*Iva*	*angustifolia*	narrowleaf marshelder
Asteraceae	*Krigia*	*occidentalis*	western dwarfdandelion
Asteraceae	*Rudbeckia*	*subtomentosa*	sweet coneflower
Asteraceae	*Vernonia*	*noveboracensis*	New York ironweed
Asteraceae	*Ambrosia*	*psilostachya*	Cuman ragweed
Asteraceae	*Eupatorium*	*perfoliatum*	common boneset
Asteraceae	*Gutierrezia*	*sarothrae*	broom snakeweed
Asteraceae	*Packera*	*tampicana*	Great Plains ragwort
Asteraceae	*Tetraneuris*	*linearifolia*	fineleaf fournerved daisy
Balsaminaceae	*Impatiens*	*capensis*	jewelweed
Balsaminaceae	*Impatiens*	*pallida*	pale touch-me-not
Berberidaceae	*Podophyllum*	*peltatum*	mayapple
Betulaceae	*Alnus*	*serrulata*	hazel alder
Betulaceae	*Betula*	*nigra*	river birch
Betulaceae	*Corylus*	*americana*	American hazelnut
Betulaceae	*Ostrya*		hophornbean
Betulaceae	*Ostrya*	*virginiana*	hophornbeam
Bignoniaceae	*Campsis*	*radicans*	trumpet creeper
Bignoniaceae	*Catalpa*	*bignonioides*	southern catalpa
Bignoniaceae	*Catalpa*	*speciosa*	northern catalpa
Boraginaceae	*Buglossoides*	*arvensis*	corn gromwell
Boraginaceae	*Hackelia*	*virginiana*	beggarslice
Boraginaceae	*Heliotropium*	*indicum*	Indian heliotrope
Boraginaceae	*Lithospermum*	*canescens*	hoary puccoon
Boraginaceae	*Lithospermum*	*caroliniense*	Carolina puccoon
Boraginaceae	*Myosotis*	*verna*	spring forget-me-not
Boraginaceae	*Heliotropium*	*tenellum*	pasture heliotrope

Family	**Genus**	**Species**	**Common Name**
Boraginaceae	*Lithospermum*	*incisum*	narrowleaf stoneseed
Boraginaceae	*Onosmodium*	*bejariense*	
Boraginaceae	*Onosmodium*	*molle*	softhair marbleseed/western marbleseed
Brassicaceae	*Alliaria*	*petiolata*	garlic mustard
Brassicaceae	*Arabis*	*canadensis*	sicklepod
Brassicaceae	*Arabis*	*laevigata*	smooth rockcress
Brassicaceae	*Arabis*	*missouriensis*	green rockcress
Brassicaceae	*Barbarea*	*vulgaris*	garden yellowrocket
Brassicaceae	*Brassica*	*nigra*	black mustard
Brassicaceae	*Brassica*	*rapa*	field mustard
Brassicaceae	*Camelina*	*microcarpa*	littlepod false flax
Brassicaceae	*Capsella*	*bursa-pastoris*	shepherd's purse
Brassicaceae	*Cardamine*	*bulbosa*	bulbous bittercress
Brassicaceae	*Cardamine*	*concatenata*	cutleaf toothwort
Brassicaceae	*Cardamine*	*parviflora*	sand bittercress
Brassicaceae	*Cardamine*	*pensylvanica*	Pennsylvania bittercress
Brassicaceae	*Draba*	*brachycarpa*	shortpod draba
Brassicaceae	*Draba*	*reptans*	Carolina draba
Brassicaceae	*Iodanthus*	*pinnatifidus*	purplerocket
Brassicaceae	*Lepidium*	*densiflorum*	common pepperweed
Brassicaceae	*Lepidium*	*virginicum*	Virginia pepperweed
Brassicaceae	*Lesquerella*	*gordonii*	Gordon's bladderpod
Brassicaceae	*Rorippa*	*nasturtium-aquaticum*	watercress
Brassicaceae	*Rorippa*	*palustris*	bog yellowcress/Fernald's yellowcress
Brassicaceae	*Rorippa*	*sessiliflora*	stalkless yellowcress
Brassicaceae	*Selenia*	*aurea*	golden selenia
Brassicaceae	*Sibara*	*virginica*	Virginia winged rockcress
Brassicaceae	*Sisymbrium*	*officinale*	hedgemustard
Brassicaceae	*Draba*	*cuneifolia*	wedgeleaf draba
Brassicaceae	*Rorippa*	*islandica*	northern marsh yellowcress
Buddlejaceae	*Polypremum*	*procumbens*	juniper leaf
Cactaceae	*Opuntia*	*macrorhiza*	twistspine pricklypear
Cactaceae	*Opuntia*	*humifusa*	devil's-tongue
Callitrichaceae	*Callitriche*	*heterophylla*	twoheaded water-starwort
Campanulaceae	*Campanulastrum*	*americanum*	American bellflower
Campanulaceae	*Lobelia*	*appendiculata*	pale lobelia
Campanulaceae	*Lobelia*	*cardinalis*	cardinalflower
Campanulaceae	*Lobelia*	*inflata*	Indian-tobacco
Campanulaceae	*Lobelia*	*siphilitica*	great blue lobelia
Campanulaceae	*Lobelia*	*spicata*	palespike lobelia
Campanulaceae	*Triodanis*	*biflora*	small Venus' looking-glass
Campanulaceae	*Triodanis*	*lamprosperma*	prairie Venus' looking-glass
Campanulaceae	*Triodanis*	*leptocarpa*	slimpod Venus' looking-glass
Campanulaceae	*Triodanis*	*perfoliata*	clasping Venus' looking-glass
Cannabaceae	*Humulus*	*lupulus*	common hop

Family	**Genus**	**Species**	**Common Name**
Capparaceae	*Cleome*	*hassleriana*	pink queen
Capparaceae	*Polanisia*	*dodecandra*	sandyseed clammyweed/redwhisker clammyweed
Capparaceae	*Cleome*	*serrulata*	Rocky Mountain beeplant
Caprifoliaceae	*Lonicera*	*flava*	yellow honeysuckle
Caprifoliaceae	*Lonicera*	*japonica*	Japanese honeysuckle
Caprifoliaceae	*Lonicera*	*sempervirens*	trumpet honeysuckle
Caprifoliaceae	*Sambucus*	*nigra*	common elderberry
Caprifoliaceae	*Symphoricarpos*		snowberry
Caprifoliaceae	*Symphoricarpos*	*orbiculatus*	coralberry
Caprifoliaceae	*Triosteum*	*aurantiacum*	orangefruit horse-gentian
Caprifoliaceae	*Triosteum*	*perfoliatum*	feverwort
Caprifoliaceae	*Viburnum*	*prunifolium*	blackhaw
Caprifoliaceae	*Viburnum*	*rufidulum*	rusty blackhaw
Caprifoliaceae	*Viburnum*	*rafinesquianum*	downy arrowwood
Caryophyllaceae	*Agrostemma*	*githago*	common corncockle
Caryophyllaceae	*Arenaria*	*serpyllifolia*	thymeleaf sandwort
Caryophyllaceae	*Cerastium*	*brachypetalum*	gray chickweed
Caryophyllaceae	*Cerastium*	*brachypodum*	shortstalk chickweed
Caryophyllaceae	*Cerastium*	*fontanum*	big chickweed
Caryophyllaceae	*Cerastium*	*glomeratum*	sticky chickweed
Caryophyllaceae	*Dianthus*	*armeria*	Deptford pink
Caryophyllaceae	*Minuartia*	*muscorum*	Dixie stitchwort
Caryophyllaceae	*Minuartia*	*patula*	pitcher's stitchwort
Caryophyllaceae	*Paronychia*	*fastigiata*	hairy forked nailwort
Caryophyllaceae	*Sagina*	*decumbens*	trailing pearlwort
Caryophyllaceae	*Saponaria*	*officinalis*	bouncingbet
Caryophyllaceae	*Scleranthus*	*annuus*	German knotgrass
Caryophyllaceae	*Silene*	*antirrhina*	sleepy silene
Caryophyllaceae	*Silene*	*regia*	royal catchfly
Caryophyllaceae	*Silene*	*stellata*	widowsfrill
Caryophyllaceae	*Silene*	*virginica*	fire pink
Caryophyllaceae	*Stellaria*	*media*	common chickweed
Caryophyllaceae	*Cerastium*	*pumilum*	European chickweed
Caryophyllaceae	*Minuartia*	*drummondii*	Drummond's stitchwort
Caryophyllaceae	*Minuartia*	*michauxii*	Michaux's stichwort/Texas stitchwort
Celastraceae	*Celastrus*	*scandens*	American bittersweet
Celastraceae	*Euonymus*	*atropurpurea*	eastern wahoo
Ceratophyllaceae	*Ceratophyllum*	*demersum*	coon's tail
Chenopodiaceae	*Chenopodium*	*album*	lambsquarters
Chenopodiaceae	*Chenopodium*	*ambrosioides*	Mexican tea
Chenopodiaceae	*Chenopodium*	*pratericola*	desert goosefoot
Chenopodiaceae	*Chenopodium*	*pumilio*	clammy goosefoot
Chenopodiaceae	*Chenopodium*	*simplex*	mapleleaf goosefoot
Chenopodiaceae	*Chenopodium*	*standleyanum*	Standley's goosefoot

Family	Genus	Species	Common Name
Chenopodiaceae	*Chenopodium*	*berlandieri*	pitseed goosefoot
Chenopodiaceae	*Monolepis*	*nuttalliana*	Nuttall's povertyweed
Cistaceae	*Lechea*	*mucronata*	hairy pinweed
Cistaceae	*Lechea*	*tenuifolia*	narrowleaf pinweed
Clusiaceae	*Hypericum*	*drummondii*	nits and lice
Clusiaceae	*Hypericum*	*gentianoides*	orangegrass
Clusiaceae	*Hypericum*	*hypericoides*	St. Andrew's cross
Clusiaceae	*Hypericum*	*mutilum*	dwarf St. Johnswort
Clusiaceae	*Hypericum*	*perforatum*	common St. Johnswort
Clusiaceae	*Hypericum*	*prolificum*	shrubby St. Johnswort
Clusiaceae	*Hypericum*	*pseudomaculatum*	false spotted St. Johnswort
Clusiaceae	*Hypericum*	*punctatum*	spotted St. Johnswort
Clusiaceae	*Hypericum*	*sphaerocarpum*	roundseed St. Johnswort
Commelinaceae	*Commelina*	*communis*	Asiatic dayflower
Commelinaceae	*Commelina*	*erecta*	whitemouth dayflower
Commelinaceae	*Commelina*	*virginica*	Virginia dayflower
Commelinaceae	*Tradescantia*	*ernestiana*	Ernest's spiderwort
Commelinaceae	*Tradescantia*	*hirsutiflora*	hairyflower spiderwort
Commelinaceae	*Tradescantia*	*ohiensis*	bluejacket
Commelinaceae	*Tradescantia*	*ozarkana*	Ozark spiderwort
Commelinaceae	*Commelina*	*diffusa*	climbing dayflower
Commelinaceae	*Tradescantia*	*occidentalis*	prairie spiderwort
Convolvulaceae	*Convolvulus*	*arvensis*	field bindweed
Convolvulaceae	*Convolvulus*	*sepium*	hedge false bindweed
Convolvulaceae	*Ipomoea*	*coccinea*	redstar
Convolvulaceae	*Ipomoea*	*hederacea*	ivyleaf morning-glory
Convolvulaceae	*Ipomoea*	*lacunosa*	whitestar
Convolvulaceae	*Ipomoea*	*pandurata*	man of the earth
Convolvulaceae	*Ipomoea*	*purpurea*	tall morning-glory
Convolvulaceae	*Calystegia*	*silvatica*	shortstalk false bindweed
Convolvulaceae	*Evolvulus*	*nuttallianus*	shaggy dwarf morning-glory
Convolvulaceae	*Ipomoea*	*leptophylla*	bush morning-glory
Cornaceae	*Cornus*	*drummondii*	roughleaf dogwood
Cornaceae	*Cornus*	*florida*	flowering dogwood
Cornaceae	*Cornus*	*obliqua*	silky dogwood
Crassulaceae	*Penthorum*	*sedoides*	ditch stonecrop
Crassulaceae	*Sedum*	*nuttallianum*	yellow stonecrop
Crassulaceae	*Sedum*	*pulchellum*	widowscross
Cucurbitaceae	*Cayaponia*	*quinqueloba*	fivelobe cucumber
Cucurbitaceae	*Cucurbita*	*foetidissima*	Missouri gourd
Cucurbitaceae	*Melothria*	*pendula*	Guadeloupe cucumber
Cucurbitaceae	*Sicyos*	*angulatus*	oneseed burr cucumber
Cupressaceae	*Juniperus*	*virginiana*	eastern redcedar
Cupressaceae	*Juniperus*	*ashei*	Ashe's juniper
Cuscutaceae	*Cuscuta*	*compacta*	compact dodder

Family	Genus	Species	Common Name
Cuscutaceae	*Cuscuta*	*cuspidata*	cusp dodder
Cuscutaceae	*Cuscuta*	*glomerata*	rope dodder
Cuscutaceae	*Cuscuta*	*gronovii*	scaldweed
Cuscutaceae	*Cuscuta*	*obtusiflora*	Peruvian dodder
Cuscutaceae	*Cuscuta*	*pentagona*	fiveangled dodder/bushclover dodder
Cuscutaceae	*Cuscuta*	*polygonorum*	smartweed dodder
Cyperaceae	*Bulbostylis*	*capillaris*	densetuft hairsedge
Cyperaceae	*Carex*	*amphibola*	eastern narrowleaf sedge
Cyperaceae	*Carex*	*annectens*	yellowfruit sedge
Cyperaceae	*Carex*	*aureolensis*	goldenfruit sedge
Cyperaceae	*Carex*	*austrina*	southern sedge
Cyperaceae	*Carex*	*blanda*	eastern woodland sedge
Cyperaceae	*Carex*	*brevior*	shortbeak sedge
Cyperaceae	*Carex*	*bushii*	Bush's sedge
Cyperaceae	*Carex*	*cephalophora*	oval-leaf sedge
Cyperaceae	*Carex*	*complanata*	hirsute sedge
Cyperaceae	*Carex*	*crawei*	Crawe's sedge
Cyperaceae	*Carex*	*davisii*	Davis' sedge
Cyperaceae	*Carex*	*frankii*	Frank's sedge
Cyperaceae	*Carex*	*granularis*	limestone meadow sedge
Cyperaceae	*Carex*	*hirsutella*	fuzzy wuzzy sedge
Cyperaceae	*Carex*	*jamesii*	James' sedge
Cyperaceae	*Carex*	*leavenworthii*	Leavenworth's sedge
Cyperaceae	*Carex*	*louisianica*	Louisiana sedge
Cyperaceae	*Carex*	*lupuliformis*	false hop sedge
Cyperaceae	*Carex*	*lupulina*	hop sedge
Cyperaceae	*Carex*	*lurida*	shallow sedge
Cyperaceae	*Carex*	*meadii*	Mead's sedge
Cyperaceae	*Carex*	*molestiformis*	frightful sedge
Cyperaceae	*Carex*	*muehlenbergii*	Muhlenberg's sedge
Cyperaceae	*Carex*	*oklahomensis*	Oklahoma sedge
Cyperaceae	*Carex*	*oligocarpa*	richwoods sedge
Cyperaceae	*Carex*	*opaca*	Bicknell's sedge
Cyperaceae	*Carex*	*radiata*	eastern star sedge
Cyperaceae	*Carex*	*reniformis*	kidneyshape sedge
Cyperaceae	*Carex*	*retroflexa*	reflexed sedge
Cyperaceae	*Carex*	*tribuloides*	blunt broom sedge
Cyperaceae	*Carex*	*vulpinoidea*	fox sedge
Cyperaceae	*Cyperus*	*acuminatus*	tapertip flatsedge
Cyperaceae	*Cyperus*	*bipartitus*	slender flatsedge
Cyperaceae	*Cyperus*	*echinatus*	globe flatsedge
Cyperaceae	*Cyperus*	*esculentus*	chufa flatsedge
Cyperaceae	*Cyperus*	*flavescens*	yellow flatsedge
Cyperaceae	*Cyperus*	*lancastriensis*	manyflower flatsedge
Cyperaceae	*Cyperus*	*lupulinus*	Great Plains flatsedge

Family	Genus	Species	Common Name
Cyperaceae	*Cyperus*	*pseudovegetus*	marsh flatsedge
Cyperaceae	*Cyperus*	*retroflexus*	oneflower flatsedge
Cyperaceae	*Cyperus*	*strigosus*	strawcolored flatsedge
Cyperaceae	*Cyperus*	*surinamensis*	tropical flatsedge
Cyperaceae	*Eleocharis*	*engelmannii*	Engelmann's spikerush
Cyperaceae	*Eleocharis*	*obtusa*	blunt spikerush
Cyperaceae	*Eleocharis*	*palustris*	common spikerush
Cyperaceae	*Eleocharis*	*quadrangulata*	squarestem spikerush
Cyperaceae	*Eleocharis*	*tenuis*	slender spikerush
Cyperaceae	*Fimbristylis*	*annua*	annual fimbry
Cyperaceae	*Fimbristylis*	*autumnalis*	slender fimbry
Cyperaceae	*Fimbristylis*	*puberula*	hairy fimbry
Cyperaceae	*Fimbristylis*	*spadicea*	
Cyperaceae	*Fimbristylis*	*vahlii*	Vahl's fimbry
Cyperaceae	*Kyllinga*	*pumila*	low spikesedge
Cyperaceae	*Luzula*	*campestris*	field woodrush
Cyperaceae	*Rhynchospora*	*recognita*	globe beaksedge
Cyperaceae	*Schoenoplectus*	*californicus*	California bulrush
Cyperaceae	*Schoenoplectus*	*heterochaetus*	slender bulrush
Cyperaceae	*Scirpus*	*atrovirens*	green bulrush
Cyperaceae	*Scleria*	*ciliata*	fringed nutrush
Cyperaceae	*Scleria*	*pauciflora*	fewflower nutrush/Carolina nutrush
Cyperaceae	*Scleria*	*triglomerata*	whip nutrush
Cyperaceae	*Carex*	*aggregata*	glomerate sedge
Cyperaceae	*Carex*	*albicans*	whitetinge sedge
Cyperaceae	*Carex*	*bicknellii*	Bicknell's sedge
Cyperaceae	*Carex*	*festucacea*	fescue sedge
Cyperaceae	*Carex*	*fissa*	hammock sedge
Cyperaceae	*Carex*	*gravida*	heavy sedge
Cyperaceae	*Carex*	*microdonta*	littletooth sedge
Cyperaceae	*Carex*	*shinnersii*	Shinner's sedge
Cyperaceae	*Cyperus*	*odoratus*	fragrant flatsedge
Cyperaceae	*Eleocharis*	*lanceolata*	daggerleaf spikerush
Cyperaceae	*Eleocharis*	*radicans*	rooted spikerush
Cyperaceae	*Schoenoplectus*	*americanus*	chairmaker's bulrush
Cyperaceae	*Schoenoplectus*	*pungens*	common threesquare
Cyperaceae	*Schoenoplectus*	*tabernaemontani*	softstem bulrush
Cyperaceae	*Scirpus*	*lineatus*	rusty bulrush, drooping bulrush
Cyperaceae	*Carex*	*diandra*	lesser panicled sedge
Cyperaceae	*Carex*	*gracilescens*	slender looseleaf sedge
Cyperaceae	*Carex*	*grayi*	Gray's sedge
Cyperaceae	*Carex*	*hyalinolepis*	shoreline sedge
Cyperaceae	*Carex*	*scoparia*	broom sedge
Cyperaceae	*Carex*	*shortiana*	Short's sedge
Cyperaceae	*Cyperus*	*erythrorhizos*	redroot flatsedge

Family	Genus	Species	Common Name
Cyperaceae	*Cyperus*	*schweinitzii*	Schweinitz's flatsedge
Cyperaceae	*Cyperus*	*setigerus*	lean flatsedge
Cyperaceae	*Cyperus*	*squarrosus*	bearded flatsedge
Cyperaceae	*Eleocharis*	*acicularis*	needle spikerush
Cyperaceae	*Eleocharis*	*erythropoda*	bald spikerush
Cyperaceae	*Eleocharis*	*montevidensis*	sand spikerush
Cyperaceae	*Eleocharis*	*parvula*	dwarf spikerush
Cyperaceae	*Fimbristylis*	*dichotoma*	
Cyperaceae	*Isolepis*	*carinata*	keeled bulrush
Cyperaceae	*Scirpus*	*pendulus*	rufous bulrush
Cyperaceae	*Carex*	*hystericina*	bottlebrush sedge
Cyperaceae	*Carex*	*pellita*	woolly sedge
Cyperaceae	*Carex*	*squarrosa*	squarrose sedge
Cyperaceae	*Carex*	*umbellata*	parasol sedge
Cyperaceae	*Scirpus*	*georgianus*	Georgia bulrush
Dennstaedtiaceae	*Pteridium*	*aquilinum*	western brackenfern
Dioscoreaceae	*Dioscorea*	*oppositifolia*	Chinese yam
Dioscoreaceae	*Dioscorea*	*quaternata*	fourleaf yam
Dioscoreaceae	*Dioscorea*	*villosa*	wild yam
Dipsacaceae	*Dipsacus*	*fullonum*	Fuller's teasel
Droseraceae	*Drosera*	*brevifolia*	dwarf sundew
Dryopteridaceae	*Dryopteris*	*marginalis*	marginal woodfern
Dryopteridaceae	*Polystichum*	*acrostichoides*	Christmas fern
Ebenaceae	*Diospyros*	*virginiana*	common persimmon
Equisetaceae	*Equisetum*	*hyemale*	scouringrush horsetail
Equisetaceae	*Equisetum*	*X ferrissii*	
Ericaceae	*Rhododendron*	*canescens*	mountain azalea
Ericaceae	*Rhododendron*	*prinophyllum*	early azalea
Ericaceae	*Vaccinium*	*arboreum*	farkleberry
Ericaceae	*Vaccinium*	*pallidum*	Blue Ridge blueberry
Ericaceae	*Vaccinium*	*stamineum*	deerberry
Ericaceae	*Vaccinium*	*virgatum*	smallflower blueberry
Euphorbiaceae	*Acalypha*	*gracilens*	slender threeseed mercury
Euphorbiaceae	*Acalypha*	*monococca*	slender threeseed mercury
Euphorbiaceae	*Acalypha*	*rhomboidea*	Virginia threeseed mercury
Euphorbiaceae	*Acalypha*	*virginica*	Virginia threeseed mercury
Euphorbiaceae	*Chamaesyce*	*maculata*	spotted sandmat
Euphorbiaceae	*Chamaesyce*	*nutans*	eyebane
Euphorbiaceae	*Croton*	*capitatus*	hogwort
Euphorbiaceae	*Croton*	*glandulosus*	vente conmigo
Euphorbiaceae	*Croton*	*michauxii*	Michaux's croton
Euphorbiaceae	*Croton*	*monanthogynus*	prairie tea
Euphorbiaceae	*Euphorbia*	*commutata*	tinted woodland spurge
Euphorbiaceae	*Euphorbia*	*corollata*	flowering spurge
Euphorbiaceae	*Euphorbia*	*dentata*	toothed spurge

Family	Genus	Species	Common Name
Euphorbiaceae	*Euphorbia*	*spathulata*	warty spurge
Euphorbiaceae	*Phyllanthus*	*caroliniensis*	Carolina leaf-flower
Euphorbiaceae	*Tragia*	*ramosa*	branched noseburn
Euphorbiaceae	*Tragia*	*urticifolia*	nettleleaf noseburn
Euphorbiaceae	*Acalypha*	*ostryifolia*	pineland threeseed mercury
Euphorbiaceae	*Chamaesyce*	*serpens*	matted sandmat
Euphorbiaceae	*Croton*	*lindheimerianus*	threeseed croton
Euphorbiaceae	*Euphorbia*	*cyathophora*	fire on the mountain
Euphorbiaceae	*Euphorbia*	*davidii*	David's spurge
Euphorbiaceae	*Euphorbia*	*heterophylla*	Mexican fireplant
Euphorbiaceae	*Tragia*	*nepetifolia*	catnip noseburn
Euphorbiaceae	*Chamaesyce*	*humistrata*	spreading sandmat
Euphorbiaceae	*Chamaesyce*	*missurica*	prairie sandmat
Euphorbiaceae	*Euphorbia*	*marginata*	snow on the mountain
Euphorbiaceae	*Tragia*	*betonicifolia*	betonyleaf noseburn
Fabaceae	*Amorpha*	*canescens*	leadplant
Fabaceae	*Amorpha*	*fruticosa*	desert false indigo
Fabaceae	*Amphicarpaea*	*bracteata*	American hogpeanut
Fabaceae	*Apios*	*americana*	groundnut
Fabaceae	*Astragalus*	*canadensis*	Canadian milkvetch
Fabaceae	*Astragalus*	*crassicarpus*	groundplum milkvetch
Fabaceae	*Baptisia*	*alba*	largeleaf wild indigo
Fabaceae	*Baptisia*	*bracteata*	longbract wild indigo
Fabaceae	*Centrosema*	*virginianum*	spurred butterfly pea
Fabaceae	*Cercis*	*canadensis*	eastern redbud
Fabaceae	*Chamaecrista*	*fasciculata*	sleepingplant
Fabaceae	*Chamaecrista*	*nictitans*	partridge pea
Fabaceae	*Cladrastis*	*kentukea*	Kentucky yellowwood
Fabaceae	*Clitoria*	*mariana*	Atlantic pigeonwings
Fabaceae	*Crotalaria*	*sagittalis*	arrowhead rattlebox
Fabaceae	*Dalea*	*candida*	white prairie clover
Fabaceae	*Dalea*	*purpurea*	violet prairie clover
Fabaceae	*Desmanthus*	*illinoensis*	prairie bundleflower
Fabaceae	*Desmodium*	*canadense*	showy ticktrefoil
Fabaceae	*Desmodium*	*canescens*	hoary ticktrefoil
Fabaceae	*Desmodium*	*cuspidatum*	largebract ticktrefoil
Fabaceae	*Desmodium*	*glabellum*	Dillenius' ticktrefoil
Fabaceae	*Desmodium*	*glutinosum*	pointedleaf ticktrefoil
Fabaceae	*Desmodium*	*marilandicum*	smooth small-leaf ticktrefoil
Fabaceae	*Desmodium*	*nudiflorum*	nakedflower ticktrefoil
Fabaceae	*Desmodium*	*obtusum*	stiff ticktrefoil
Fabaceae	*Desmodium*	*paniculatum*	panicledleaf ticktrefoil
Fabaceae	*Desmodium*	*perplexum*	perplexed ticktrefoil
Fabaceae	*Desmodium*	*rotundifolium*	prostrate ticktrefoil
Fabaceae	*Desmodium*	*viridiflorum*	velvetleaf ticktrefoil

Family	Genus	Species	Common Name
Fabaceae	*Galactia*	*regularis*	eastern milkpea
Fabaceae	*Galactia*	*volubilis*	downy milkpea
Fabaceae	*Gleditsia*	*triacanthos*	honeylocust
Fabaceae	*Kummerowia*	*stipulacea*	Korean clover
Fabaceae	*Kummerowia*	*striata*	Japanese clover
Fabaceae	*Lathyrus*	*hirsutus*	Caley pea
Fabaceae	*Lespedeza*	*hirta*	hairy lespedeza
Fabaceae	*Lespedeza*	*procumbens*	trailing lespedeza
Fabaceae	*Lespedeza*	*repens*	creeping lespedeza
Fabaceae	*Lespedeza*	*stuevei*	tall lespedeza
Fabaceae	*Lespedeza*	*violacea*	violet lespedeza
Fabaceae	*Lespedeza*	*virginica*	slender lespedeza
Fabaceae	*Medicago*	*lupulina*	black medick
Fabaceae	*Melilotus*	*alba*	white sweet clover
Fabaceae	*Mimosa*	*microphylla*	sensitive plant
Fabaceae	*Mimosa*	*nuttallii*	Nuttall's sensitive-briar
Fabaceae	*Orbexilum*	*pedunculatum*	Sampson's snakeroot
Fabaceae	*Pediomelum*	*tenuiflorum*	
Fabaceae	*Phaseolus*	*polystachios*	thicket bean
Fabaceae	*Pueraria*	*montana*	kudzu
Fabaceae	*Rhynchosia*	*latifolia*	prairie snoutbean
Fabaceae	*Robinia*	*pseudoacacia*	black locust
Fabaceae	*Securigera*	*varia*	
Fabaceae	*Senna*	*marilandica*	Maryland senna
Fabaceae	*Strophostyles*	*leiosperma*	slickseed fuzzybean
Fabaceae	*Stylosanthes*	*biflora*	sidebeak pencilflower
Fabaceae	*Tephrosia*	*virginiana*	Virginia tephrosia
Fabaceae	*Trifolium*	*arvense*	rabbitfoot clover
Fabaceae	*Trifolium*	*campestre*	field clover
Fabaceae	*Trifolium*	*incarnatum*	crimson clover
Fabaceae	*Trifolium*	*pratense*	red clover
Fabaceae	*Trifolium*	*reflexum*	buffalo clover
Fabaceae	*Trifolium*	*repens*	white clover
Fabaceae	*Vicia*	*americana*	American vetch
Fabaceae	*Vicia*	*caroliniana*	Carolina vetch
Fabaceae	*Vicia*	*minutiflora*	pygmyflower vetch
Fabaceae	*Acacia*	*angustissima*	prairie acacia
Fabaceae	*Amorpha*	*laevigata*	smooth false indigo
Fabaceae	*Astragalus*	*nuttallianus*	smallflowered milkvetch
Fabaceae	*Baptisia*	*australis*	blue wild indigo
Fabaceae	*Dalea*	*multiflora*	roundhead prairie clover
Fabaceae	*Desmodium*	*pauciflorum*	fewflower ticktrefoil
Fabaceae	*Desmodium*	*sessilifolium*	sessileleaf ticktrefoil
Fabaceae	*Gymnocladus*	*dioicus*	Kentucky coffeetree
Fabaceae	*Indigofera*	*miniata*	coastal indigo

Family	Genus	Species	Common Name
Fabaceae	*Lathyrus*	*latifolius*	perennial pea
Fabaceae	*Lespedeza*	*capitata*	roundhead lespedeza
Fabaceae	*Lespedeza*	*X neglecta*	
Fabaceae	*Melilotus*	*officinalis*	yellow sweetclover
Fabaceae	*Neptunia*	*lutea*	yellow puff
Fabaceae	*Psoralidium*	*tenuiflorum*	slimflower scurfpea
Fabaceae	*Sesbania*	*herbacea*	bigpod sesbania
Fabaceae	*Strophostyles*	*helvola*	amberique-bean
Fabaceae	*Trifolium*	*carolinianum*	Carolina clover
Fabaceae	*Trifolium*	*dubium*	suckling clover
Fabaceae	*Vicia*	*ludoviciana*	Leavenworth's vetch/Louisiana vetch
Fabaceae	*Vicia*	*sativa*	garden vetch
Fabaceae	*Albizia*	*julibrissin*	silktree
Fabaceae	*Desmodium*	*laevigatum*	smooth ticktrefoil
Fabaceae	*Lespedeza*	*cuneata*	Chinese lespedeza
Fabaceae	*Lespedeza*	*thunbergii*	Thunberg's lespedeza
Fabaceae	*Lespedeza*	*X simulata*	
Fabaceae	*Strophostyles*	*umbellata*	pink fuzzybean
Fabaceae	*Trifolium*	*hybridum*	alsike clover
Fabaceae	*Astragalus*	*plattensis*	Platte River milkvetch
Fabaceae	*Baptisia*	*alba*	white wild indigo
Fagaceae	*Castanea*	*pumila*	Ozark chinkapin
Fagaceae	*Quercus*	*alba*	white oak
Fagaceae	*Quercus*	*falcata*	southern red oak
Fagaceae	*Quercus*	*macrocarpa*	bur oak
Fagaceae	*Quercus*	*marilandica*	blackjack oak
Fagaceae	*Quercus*	*muehlenbergii*	chinkapin oak
Fagaceae	*Quercus*	*rubra*	northern red oak
Fagaceae	*Quercus*	*shumardii*	Shumard's oak
Fagaceae	*Quercus*	*stellata*	post oak
Fagaceae	*Quercus*	*velutina*	black oak
Fagaceae	*Quercus*	*palustris*	pin oak
Fagaceae	*Quercus*	*xbushii*	
Fagaceae	*Quercus*	*shumardii*	Schneck oak/Shumard oak
Fumariaceae	*Corydalis*	*crystallina*	mealy fumewort
Fumariaceae	*Corydalis*	*flavula*	yellow fumewort
Fumariaceae	*Dicentra*	*cucullaria*	dutchman's breeches
Fumariaceae	*Corydalis*	*curvisiliqua*	curvepod fumewort
Fumariaceae	*Corydalis*	*micrantha*	smallflower fumewort
Gentianaceae	*Gentiana*	*alba*	plain gentian
Gentianaceae	*Gentiana*	*puberulenta*	downy gentian
Gentianaceae	*Sabatia*	*angularis*	rosepink
Gentianaceae	*Sabatia*	*campestris*	Texas star
Gentianaceae	*Sabatia*	*stellaris*	rose of Plymouth
Gentianaceae	*Sabatia*		rose gentian

Family	Genus	Species	Common Name
Geraniaceae	*Geranium*	*carolinianum*	Carolina geranium
Geraniaceae	*Geranium*	*maculatum*	spotted geranium
Geraniaceae	*Geranium*	*molle*	dovefoot geranium
Geraniaceae	*Geranium*	*pusillum*	small geranium
Geraniaceae	*Erodium*	*cicutarium*	redstem stork's bill
Grossulariaceae	*Ribes*	*missouriense*	Missouri gooseberry
Grossulariaceae	*Ribes*	*aureum*	golden currant
Haloragaceae	*Myriophyllum*	*aquaticum*	parrot feather watermilfoil
Haloragaceae	*Myriophyllum*	*heterophyllum*	twoleaf watermilfoil
Haloragaceae	*Myriophyllum*	*pinnatum*	cutleaf watermilfoil
Hamamelidaceae	*Hamamelis*	*vernalis*	Ozark witchhazel
Hippocastanaceae	*Aesculus*	*glabra*	Ohio buckeye
Hydrangeaceae	*Hydrangea*	*arborescens*	wild hydrangea
Hydrangeaceae	*Hydrangea*	*cinerea*	ashy hydrangea
Hydrocharitaceae	*Elodea*	*nuttallii*	western waterweed
Hydrophyllaceae	*Ellisia*	*nyctelea*	Aunt Lucy
Hydrophyllaceae	*Hydrophyllum*	*virginianum*	Shawnee salad
Hydrophyllaceae	*Phacelia*	*hirsuta*	fuzzy phacelia
Hydrophyllaceae	*Phacelia*	*strictiflora*	prairie phacelia
Hydrophyllaceae	*Phacelia*	*gilioides*	Brand's phacelia
Iridaceae	*Sisyrinchium*	*angustifolium*	narrowleaf blue-eyed grass
Iridaceae	*Sisyrinchium*	*campestre*	prairie blue-eyed grass
Iridaceae	*Belamcanda*	*chinensis*	blackberry lily
Iridaceae	*Sisyrinchium*	*bushii*	
Iridaceae	*Sisyrinchium*	*langloisii*	roadside blue-eyed grass
Iridaceae	*Iris*	*virginica*	Shreve's iris
Isoetaceae	*Isoetes*	*butleri*	limestone quillwort
Isoetaceae	*Isoetes*	*melanopoda*	blackfoot quillwort
Juglandaceae	*Carya*	*alba*	mockernut hickory
Juglandaceae	*Carya*	*cordiformis*	bitternut hickory
Juglandaceae	*Carya*	*illinoinensis*	pecan
Juglandaceae	*Carya*	*laciniosa*	shellbark hickory
Juglandaceae	*Carya*	*ovalis*	red hickory
Juglandaceae	*Carya*	*texana*	black hickory
Juglandaceae	*Juglans*	*nigra*	black walnut
Juncaceae	*Juncus*	*acuminatus*	tapertip rush
Juncaceae	*Juncus*	*biflorus*	bog rush
Juncaceae	*Juncus*	*brachycarpus*	whiteroot rush
Juncaceae	*Juncus*	*diffusissimus*	slimpod rush
Juncaceae	*Juncus*	*effusus*	common rush/lamp rush
Juncaceae	*Juncus*	*interior*	inland rush
Juncaceae	*Juncus*	*marginatus*	grassleaf rush
Juncaceae	*Juncus*	*tenuis*	poverty rush
Juncaceae	*Luzula*	*bulbosa*	bulbous woodrush
Juncaceae	*Juncus*	*scirpoides*	needlepod rush

Family	**Genus**	**Species**	**Common Name**
Juncaceae	*Juncus*	*torreyi*	Torrey's rush
Juncaceae	*Luzula*	*echinata*	hedgehog woodrush
Juncaceae	*Juncus*	*nodatus*	stout rush
Lamiaceae	*Agastache*	*nepetoides*	yellow giant hyssop
Lamiaceae	*Cunila*	*origanoides*	common dittany
Lamiaceae	*Glechoma*	*hederacea*	ground ivy
Lamiaceae	*Hedeoma*	*hispida*	rough false pennyroyal
Lamiaceae	*Hedeoma*	*pulegioides*	American false pennyroyal
Lamiaceae	*Lamium*	*amplexicaule*	henbit deadnettle
Lamiaceae	*Lamium*	*purpureum*	purple deadnettle
Lamiaceae	*Leonurus*	*cardiaca*	common motherwort
Lamiaceae	*Leonurus*	*sibiricus*	honeyweed
Lamiaceae	*Lycopus*	*americanus*	American water horehound
Lamiaceae	*Lycopus*	*rubellus*	taperleaf water horehound
Lamiaceae	*Marrubium*	*vulgare*	horehound
Lamiaceae	*Monarda*	*bradburiana*	eastern beebalm
Lamiaceae	*Monarda*	*fistulosa*	wild bergamot
Lamiaceae	*Monarda*	*russeliana*	redpurple beebalm
Lamiaceae	*Nepeta*	*cataria*	catnip
Lamiaceae	*Perilla*	*frutescens*	beefsteakplant
Lamiaceae	*Physostegia*	*angustifolia*	narrowleaf false dragonhead
Lamiaceae	*Physostegia*	*virginiana*	obedient plant
Lamiaceae	*Prunella*	*vulgaris*	common selfheal/lance selfheal
Lamiaceae	*Pycnanthemum*	*albescens*	whiteleaf mountainmint
Lamiaceae	*Pycnanthemum*	*tenuifolium*	narrowleaf mountainmint
Lamiaceae	*Salvia*	*azurea*	pitcher sage/azure blue sedge
Lamiaceae	*Salvia*	*lyrata*	lyreleaf sage
Lamiaceae	*Scutellaria*	*lateriflora*	blue skullcap
Lamiaceae	*Scutellaria*	*ovata*	heartleaf skullcap
Lamiaceae	*Scutellaria*	*parvula*	small skullcap
Lamiaceae	*Stachys*	*tenuifolia*	smooth hedgenettle
Lamiaceae	*Teucrium*	*canadense*	Canada germander
Lamiaceae	*Blephilia*	*ciliata*	downy pagoda-plant
Lamiaceae	*Blephilia*	*subnuda*	Cumberland pagoda-plant
Lamiaceae	*Melissa*	*officinalis*	common balm
Lamiaceae	*Mentha*	*spicata*	spearmint
Lamiaceae	*Mentha*	*X piperita*	peppermint
Lamiaceae	*Monarda*	*citriodora*	lemon beebalm
Lamiaceae	*Scutellaria*	*elliptica*	hairy skullcap
Lamiaceae	*Pycnanthemum*	*verticillatum*	whorled mountainmint
Lamiaceae	*Scutellaria*	*incana*	hoary skullcap
Lamiaceae	*Isanthus*	*brachiatus*	fluxweed
Lamiaceae	*Monarda*	*punctata*	spotted beebalm
Lauraceae	*Lindera*	*benzoin*	northern spicebush
Lauraceae	*Sassafras*	*albidum*	sassafras

Family	Genus	Species	Common Name
Lemnaceae	*Lemna*	*minor*	common duckweed
Lemnaceae	*Lemna*	*minuta*	least duckweed
Lemnaceae	*Spirodela*	*polyrrhiza*	common duckmeat
Lemnaceae	*Wolffia*	*columbiana*	Columbian watermeal
Lemnaceae	*Wolffia*	*brasiliensis*	Brazilian watermeal
Lentibulariaceae	*Utricularia*	*gibba*	humped bladderwort
Liliaceae	*Aletris*	*farinosa*	white colicroot
Liliaceae	*Aletris*	*lutea*	yellow colicroot
Liliaceae	*Allium*	*canadense*	meadow garlic
Liliaceae	*Allium*	*sativum*	cultivated garlic
Liliaceae	*Allium*	*vineale*	wild garlic/compact onion
Liliaceae	*Camassia*	*angusta*	prairie camas
Liliaceae	*Camassia*	*scilloides*	Atlantic camas
Liliaceae	*Erythronium*	*americanum*	dog tooth violet
Liliaceae	*Erythronium*	*mesochoreum*	midland fawnlily
Liliaceae	*Hypoxis*	*hirsuta*	common goldstar
Liliaceae	*Maianthemum*	*racemosum*	False Solomon's Seal
Liliaceae	*Nothoscordum*	*bivalve*	crowpoison
Liliaceae	*Ornithogalum*	*umbellatum*	sleepydick
Liliaceae	*Polygonatum*	*biflorum*	smooth Solomon's seal
Liliaceae	*Trillium*	*viride*	wood wakerobin
Liliaceae	*Trillium*	*viridescens*	tapertip wakerobin
Liliaceae	*Allium*	*drummondii*	Drummond's onion
Liliaceae	*Allium*	*stellatum*	autumn onion
Liliaceae	*Erythronium*	*albidum*	white fawnlily
Liliaceae	*Erythronium*	*rostratum*	yellow troutlily
Liliaceae	*Uvularia*	*grandiflora*	largeflower bellwort
Liliaceae	*Cooperia*	*drummondii*	evening rainlily
Linaceae	*Linum*	*medium*	stiff yellow flax
Linaceae	*Linum*	*sulcatum*	grooved flax
Linaceae	*Linum*	*berlandieri*	Berlandier's yellow flax
Loasaceae	*Mentzelia*	*oligosperma*	chickenthief
Lythraceae	*Ammannia*	*auriculata*	eared redstem
Lythraceae	*Ammannia*	*coccinea*	valley redstem
Lythraceae	*Cuphea*	*viscosissima*	blue waxweed
Lythraceae	*Lythrum*	*alatum*	winged lythrum
Lythraceae	*Rotala*	*ramosior*	lowland rotala
Lythraceae	*Lythrum*	*californicum*	California loosestrife
Magnoliaceae	*Liriodendron*	*tulipfera*	tulip tree
Malvaceae	*Abutilon*	*theophrasti*	velvetleaf
Malvaceae	*Callirhoe*	*alcaeoides*	light poppymallow
Malvaceae	*Callirhoe*	*digitata*	winecup
Malvaceae	*Hibiscus*	*laevis*	halberdleaf rosemallow
Malvaceae	*Hibiscus*	*lasiocarpos*	rosemallow
Malvaceae	*Malva*	*neglecta*	common mallow

Family	**Genus**	**Species**	**Common Name**
Malvaceae	*Sida*	*spinosa*	prickly fanpetals
Malvaceae	*Callirhoe*	*bushii*	Bush's poppymallow
Malvaceae	*Callirhoe*	*pedata*	palmleaf poppymallow
Malvaceae	*Hibiscus*	*moscheutos*	crimsoneyed rosemallow
Malvaceae	*Hibiscus*	*trionum*	flower of an hour
Marsileaceae	*Pilularia*	*americana*	American pillwort
Melastomataceae	*Rhexia*	*mariana*	Maryland meadowbeauty
Menispermaceae	*Calycocarpum*	*lyonii*	cupseed
Menispermaceae	*Cocculus*	*carolinus*	Carolina coralbead
Menispermaceae	*Menispermum*	*canadense*	common moonseed
Molluginaceae	*Mollugo*	*verticillata*	green carpetweed
Molluginaceae	*Glinus*	*lotoides*	lotus sweetjuice
Moraceae	*Fatoua*	*villosa*	hairy crabweed
Moraceae	*Morus*	*rubra*	red mulberry
Moraceae	*Morus*	*alba*	white mulberry
Moraceae	*Maclura*	*pomifera*	osage orange
Najadaceae	*Najas*	*guadalupensis*	southern waternymph
Nelumbonaceae	*Nelumbo*	*lutea*	American lotus
Nyctaginaceae	*Mirabilis*	*albida*	white four o'clock
Nyctaginaceae	*Mirabilis*	*nyctaginea*	heartleaf four o'clock
Nyctaginaceae	*Mirabilis*	*linearis*	narrowleaf four o'clock
Nymphaeaceae	*Nuphar*	*lutea*	yellow pond-lily
Nymphaeaceae	*Nymphaea*	*odorata*	American white waterlily
Nyssaceae	*Nyssa*	*sylvatica*	blackgum
Oleaceae	*Forestiera*	*acuminata*	eastern swampprivet
Oleaceae	*Fraxinus*	*americana*	white ash
Oleaceae	*Fraxinus*	*pennsylvanica*	green ash
Oleaceae	*Fraxinus*	*quadrangulata*	blue ash
Oleaceae	*Forestiera*	*pubescens*	stretchberry
Oleaceae	*Ligustrum*	*sinense*	Chinese privet
Onagraceae	*Gaura*	*filiformis*	
Onagraceae	*Gaura*	*longiflora*	longflower beeblossom
Onagraceae	*Ludwigia*	*alternifolia*	seedbox
Onagraceae	*Ludwigia*	*decurrens*	wingleaf primrose-willow
Onagraceae	*Ludwigia*	*palustris*	marsh seedbox
Onagraceae	*Ludwigia*	*peploides*	floating primrose-willow
Onagraceae	*Ludwigia*	*repens*	creeping primrose-willow
Onagraceae	*Oenothera*	*biennis*	common evening-primrose
Onagraceae	*Oenothera*	*fruticosa*	narrowleaf evening-primrose
Onagraceae	*Oenothera*	*laciniata*	cutleaf evening-primrose
Onagraceae	*Oenothera*	*linifolia*	threadleaf evening primrose
Onagraceae	*Oenothera*	*spachiana*	Spach's evening-primrose
Onagraceae	*Oenothera*	*speciosa*	pinkladies
Onagraceae	*Calylophus*	*serrulatus*	yellow sundrops
Onagraceae	*Gaura*	*triangulata*	prairie beeblossom

Family	Genus	Species	Common Name
Onagraceae	*Ludwigia*	*peploides*	floating primrose-willow
Onagraceae	*Oenothera*	*triloba*	stemless evening-primrose
Onagraceae	*Oenothera*	*villosa*	hairy evening-primrose
Onagraceae	*Circaea*	*lutetiana*	broadleaf enchanter's nightshade
Onagraceae	*Gaura*	*biennis*	biennial beeblossom
Onagraceae	*Oenothera*	*elata*	Hooker's evening-primrose
Onagraceae	*Oenothera*	*macrocarpa*	bigfruit evening-primrose
Onocleaceae	*Onoclea*	*sensibilis*	sensitive fern
Ophioglossaceae	*Botrychium*	*virginianum*	rattlesnake fern
Ophioglossaceae	*Ophioglossum*	*engelmannii*	limestone adderstongue
Ophioglossaceae	*Ophioglossum*	*vulgatum*	southern adderstongue
Orchidaceae	*Calopogon*	*oklahomensis*	Oklahoma grasspink
Orchidaceae	*Calopogon*	*tuberosus*	tuberous grasspink
Orchidaceae	*Corallorhiza*	*wisteriana*	spring coralroot
Orchidaceae	*Cypripedium*	*parviflorum*	lesser yellow lady's slipper
Orchidaceae	*Malaxis*	*unifolia*	green adder's-mouth orchid
Orchidaceae	*Platanthera*	*lacera*	green fringed orchid
Orchidaceae	*Spiranthes*	*cernua*	nodding ladies'-tresses
Orchidaceae	*Spiranthes*	*lacera*	northern slender ladies'-tresses
Orchidaceae	*Spiranthes*	*tuberosa*	little ladies'-tresses
Orchidaceae	*Spiranthes*	*vernalis*	spring ladies'-tresses
Orchidaceae	*Cypripedium*	*kentuckiense*	Kentucky lady's slipper
Orchidaceae	*Hexalectris*	*spicata*	spiked crested coralroot
Orchidaceae	*Platanthera*	*praeclara*	Great Plains white fringed orchid
Orobanchaceae	*Orobanche*	*uniflora*	oneflowered broomrape
Oxalidaceae	*Oxalis*	*corniculata*	creeping woodsorrel
Oxalidaceae	*Oxalis*	*dillenii*	slender yellow woodsorrel
Oxalidaceae	*Oxalis*	*stricta*	common yellow oxalis
Oxalidaceae	*Oxalis*	*violacea*	violet woodsorrel
Papaveraceae	*Sanguinaria*	*canadensis*	bloodroot
Papaveraceae	*Papaver*	*dubium*	blindeyes
Passifloraceae	*Passiflora*	*incarnata*	purple passionflower
Passifloraceae	*Passiflora*	*lutea*	yellow passionflower
Phytolaccaceae	*Phytolacca*	*americana*	American pokeweed
Phytolaccaceae	*Rivina*	*humilis*	rougeplant
Pinaceae	*Pinus*	*echinata*	shortleaf pine
Plantaginaceae	*Plantago*	*aristata*	largebracted plantain
Plantaginaceae	*Plantago*	*elongata*	prairie plantain
Plantaginaceae	*Plantago*	*lanceolata*	narrowleaf plantain
Plantaginaceae	*Plantago*	*major*	common plantain
Plantaginaceae	*Plantago*	*rugelii*	blackseed plantain
Plantaginaceae	*Plantago*	*virginica*	Virginia plantain
Plantaginaceae	*Plantago*	*patagonica*	woolly plantain
Plantaginaceae	*Plantago*	*rhodosperma*	redseed plantain
Plantaginaceae	*Plantago*	*pusilla*	dwarf plantain

Family	Genus	Species	Common Name
Platanaceae	*Platanus*	*occidentalis*	American sycamore
Poaceae	*Agrostis*	*gigantea*	redtop
Poaceae	*Agrostis*	*hyemalis*	winter bentgrass
Poaceae	*Agrostis*	*perennans*	upland bentgrass
Poaceae	*Aira*	*caryophyllea*	silver hairgrass
Poaceae	*Alopecurus*	*carolinianus*	Carolina foxtail
Poaceae	*Andropogon*	*gerardii*	big bluestem
Poaceae	*Andropogon*	*ternarius*	splitbeard bluestem
Poaceae	*Andropogon*	*virginicus*	broomsedge bluestem
Poaceae	*Aristida*	*dichotoma*	churchmouse threeawn
Poaceae	*Aristida*	*longespica*	slimspike threeawn
Poaceae	*Aristida*	*longispica*	slimspike threeawn
Poaceae	*Aristida*	*oligantha*	prairie threeawn
Poaceae	*Aristida*	*purpurascens*	arrowfeather threeawn
Poaceae	*Arundinaria*	*gigantea*	giant cane
Poaceae	*Brachyelytrum*	*erectum*	bearded shorthusk
Poaceae	*Bromus*	*commutatus*	meadow brome
Poaceae	*Bromus*	*hordeaceus*	soft brome
Poaceae	*Bromus*	*japonicus*	Japanese brome
Poaceae	*Bromus*	*pubescens*	hairy woodland brome
Poaceae	*Chasmanthium*	*latifolium*	Indian woodoats
Poaceae	*Dactylis*	*glomerata*	orchardgrass
Poaceae	*Danthonia*	*spicata*	poverty oatgrass
Poaceae	*Dichanthelium*	*acuminatum*	tapered rosette grass/western panicgrass/Lindheimer panicgrass
Poaceae	*Dichanthelium*	*boscii*	Bosc's panicgrass
Poaceae	*Dichanthelium*	*commutatum*	variable panicgrass
Poaceae	*Dichanthelium*	*depauperatum*	starved panicgrass
Poaceae	*Dichanthelium*	*dichotomum*	cypress panicgrass
Poaceae	*Dichanthelium*	*linearifolium*	slimleaf panicgrass
Poaceae	*Dichanthelium*	*malacophyllum*	softleaf rosette grass
Poaceae	*Dichanthelium*	*scoparium*	velvet panicum
Poaceae	*Dichanthelium*	*sphaerocarpon*	roundseed panicgrass
Poaceae	*Dichanthelium*	*villosissimum*	whitehair rosette grass
Poaceae	*Digitaria*	*ciliaris*	southern crabgrass
Poaceae	*Digitaria*	*cognata*	Carolina crabgrass
Poaceae	*Digitaria*	*ischaemum*	smooth crabgrass
Poaceae	*Digitaria*	*sanguinalis*	hairy crabgrass
Poaceae	*Dinebra*	*panicea*	
Poaceae	*Echinochloa*	*colona*	jungle rice
Poaceae	*Echinochloa*	*crus-galli*	barnyardgrass
Poaceae	*Echinochloa*	*muricata*	rough barnyardgrass
Poaceae	*Eleusine*	*indica*	Indian goosegrass
Poaceae	*Elymus*	*canadensis*	Canada wildrye
Poaceae	*Elymus*	*villosus*	hairy wildrye

Family	Genus	Species	Common Name
Poaceae	*Elymus*	*virginicus*	Virginia wildrye
Poaceae	*Eragrostis*	*cilianensis*	stinkgrass
Poaceae	*Eragrostis*	*hypnoides*	teal lovegrass
Poaceae	*Eragrostis*	*pectinacea*	tufted lovegrass
Poaceae	*Eragrostis*	*pilosa*	Indian lovegrass
Poaceae	*Festuca*	*paradoxa*	clustered fescue
Poaceae	*Festuca*	*subverticillata*	nodding fescue
Poaceae	*Glyceria*	*striata*	fowl mannagrass
Poaceae	*Holcus*	*lanatus*	common velvetgrass
Poaceae	*Hordeum*	*pusillum*	little barley
Poaceae	*Koeleria*	*macrantha*	prairie Junegrass
Poaceae	*Leersia*	*oryzoides*	rice cutgrass
Poaceae	*Leersia*	*virginica*	whitegrass
Poaceae	*Lolium*	*perenne*	Italian ryegrass
Poaceae	*Lolium*	*pratense*	meadow ryegrass
Poaceae	*Melica*	*nitens*	threeflower melicgrass
Poaceae	*Muhlenbergia*	*schreberi*	nimblewill
Poaceae	*Muhlenbergia*	*sobolifera*	rock muhly
Poaceae	*Panicum*	*anceps*	beaked panicgrass
Poaceae	*Panicum*	*capillare*	witchgrass
Poaceae	*Panicum*	*flexile*	wiry panicgrass
Poaceae	*Panicum*	*virgatum*	switchgrass
Poaceae	*Paspalum*	*floridanum*	Florida paspalum
Poaceae	*Pennisetum*	*glaucum*	pearl millet
Poaceae	*Phalaris*	*caroliniana*	Carolina canarygrass
Poaceae	*Poa*	*pratensis*	Kentucky bluegrass
Poaceae	*Poa*	*sylvestris*	woodland bluegrass
Poaceae	*Schizachyrium*	*scoparium*	little bluestem
Poaceae	*Setaria*	*parviflora*	marsh bristlegrass
Poaceae	*Setaria*	*viridis*	green bristlegrass
Poaceae	*Sorghastrum*	*nutans*	Indiangrass
Poaceae	*Sorghum*	*halepense*	Johnsongrass
Poaceae	*Sphenopholis*	*intermedia*	slender wedgescale
Poaceae	*Sphenopholis*	*obtusata*	prairie wedgescale
Poaceae	*Sporobolus*	*heterolepis*	prairie dropseed
Poaceae	*Sporobolus*	*vaginiflorus*	poverty dropseed
Poaceae	*Steinchisma*	*hians*	gaping grass
Poaceae	*Tridens*	*flavus*	purpletop tridens
Poaceae	*Tridens*	*muticus*	slim tridens
Poaceae	*Tridens*	*strictus*	longspike tridens
Poaceae	*Tripsacum*	*dactyloides*	eastern gamagrass
Poaceae	*Urochloa*	*platyphylla*	broadleaf signalgrass
Poaceae	*Vulpia*	*myuros*	rat-tail fescue
Poaceae	*Vulpia*	*octoflora*	sixweeks fescue
Poaceae	*Aegilops*	*cylindrica*	jointed goatgrass

Family	Genus	Species	Common Name
Poaceae	*Andropogon*	*glomeratus*	
Poaceae	*Bothriochloa*	*laguroides*	silver beardgrass
Poaceae	*Bothriochloa*	*saccharoides*	silver bluestem
Poaceae	*Bromus*	*catharticus*	rescuegrass
Poaceae	*Bromus*	*tectorum*	cheatgrass
Poaceae	*Cenchrus*	*longispinus*	mat sandbur
Poaceae	*Cenchrus*	*spinifex*	coastal sandbur
Poaceae	*Chloris*	*verticillata*	tumble windmill grass
Poaceae	*Chloris*	*virgata*	feather fingergrass
Poaceae	*Cinna*	*arundinacea*	sweet woodreed
Poaceae	*Coelorachis*	*cylindrica*	cylinder jointtail grass
Poaceae	*Cynodon*	*dactylon*	Bermudagrass
Poaceae	*Dichanthelium*	*oligosanthes*	Heller's rosette grass/Scribner's rosette grass
Poaceae	*Digitaria*	*filiformis*	slender crabgrass
Poaceae	*Eragrostis*	*barrelieri*	Mediterranean lovegrass
Poaceae	*Eragrostis*	*capillaris*	lace grass
Poaceae	*Eragrostis*	*curtipedicellata*	gummy lovegrass
Poaceae	*Eragrostis*	*intermedia*	plains lovegrass
Poaceae	*Eragrostis*	*spectabilis*	purple lovegrass
Poaceae	*Leptochloa*	*fusca*	bearded sprangletop
Poaceae	*Muhlenbergia*	*frondosa*	wirestem muhly
Poaceae	*Panicum*	*dichotomiflorum*	fall panicgrass
Poaceae	*Panicum*	*rigidulum*	redtop panicgrass
Poaceae	*Paspalum*	*fluitans*	horsetail paspalum
Poaceae	*Paspalum*	*pubiflorum*	hairyseed paspalum
Poaceae	*Paspalum*	*setaceum*	thin paspalum
Poaceae	*Poa*	*annua*	annual bluegrass
Poaceae	*Schedonorus*	*arundinaceus*	tall fescue
Poaceae	*Sporobolus*	*compositus*	composite dropseed/Drummond's dropseed
Poaceae	*Sporobolus*	*coromandelianus*	Madagascar dropseed
Poaceae	*Sporobolus*	*cryptandrus*	sand dropseed
Poaceae	*Agrostis*	*scabra*	rough bentgrass
Poaceae	*Andropogon*	*virginicus*	
Poaceae	*Bouteloua*	*curtipendula*	sideoats grama
Poaceae	*Bromus*	*secalinus*	rye brome
Poaceae	*Diarrhena*	*obovata*	obovate beakgrain
Poaceae	*Dinebra*	*panicea*	
Poaceae	*Elymus*	*hystrix*	eastern bottlebrush grass
Poaceae	*Eragrostis*	*hirsuta*	bigtop lovegrass
Poaceae	*Eragrostis*	*secundiflora*	red lovegrass
Poaceae	*Leptochloa*	*panicea*	mucronate sprangeltop
Poaceae	*Muhlenbergia*	*bushii*	nodding muhly
Poaceae	*Paspalum*	*dilatatum*	dallisgrass

Family	Genus	Species	Common Name
Poaceae	*Spartina*	*pectinata*	prairie cordgrass
Poaceae	*Sporobolus*	*clandestinus*	rough dropseed
Poaceae	*Triticum*	*aestivum*	common wheat
Poaceae	*Aira*	*elegans*	annual silver hairgrass
Poaceae	*Andropogon*	*hallii*	sand bluestem
Poaceae	*Dichanthelium*	*laxiflorum*	openflower rosette grass
Poaceae	*Dichanthelium*	*ovale*	eggleaf rosette grass
Poaceae	*Eragrostis*	*lugens*	morning lovegrass
Poaceae	*Paspalum*	*laeve*	field paspalum
Poaceae	*Schedonnardus*	*paniculatus*	tumblegrass
Poaceae	*Setaria*	*faberi*	Japanese bristlegrass
Polemoniaceae	*Phlox*	*divaricata*	wild blue phlox/Lapham's phlox
Polemoniaceae	*Phlox*	*pilosa*	downy phlox/Ozark phlox
Polemoniaceae	*Polemonium*	*reptans*	Greek valerian
Polemoniaceae	*Ipomopsis*	*aggregata*	scarlet gilia
Polemoniaceae	*Phlox*	*cuspidata*	pointed phlox
Polygalaceae	*Polygala*	*ambigua*	whorled milkwort
Polygalaceae	*Polygala*	*sanguinea*	purple milkwort
Polygalaceae	*Polygala*	*verticillata*	whorled milkwort
Polygalaceae	*Polygala*	*incarnata*	procession flower
Polygonaceae	*Eriogonum*	*longifolium*	longleaf buckwheat
Polygonaceae	*Polygonum*	*cespitosum*	Oriental lady's thumb
Polygonaceae	*Polygonum*	*hydropiper*	marshpepper knotweed
Polygonaceae	*Polygonum*	*hydropiperoides*	swamp smartweed
Polygonaceae	*Polygonum*	*lapathifolium*	curlytop knotweed
Polygonaceae	*Polygonum*	*pensylvanicum*	Pennsylvania smartweed
Polygonaceae	*Polygonum*	*persicaria*	spotted ladysthumb
Polygonaceae	*Polygonum*	*punctatum*	dotted smartweed
Polygonaceae	*Polygonum*	*ramosissimum*	bushy knotweed
Polygonaceae	*Polygonum*	*sagittatum*	arrowleaf tearthumb
Polygonaceae	*Polygonum*	*scandens*	climbing false buckwheat
Polygonaceae	*Polygonum*	*virginianum*	jumpseed
Polygonaceae	*Rumex*	*acetosella*	common sheep sorrel
Polygonaceae	*Rumex*	*altissimus*	pale dock
Polygonaceae	*Rumex*	*crispus*	curly dock
Polygonaceae	*Rumex*	*hastatulus*	heartwing sorrel
Polygonaceae	*Rumex*	*obtusifolius*	bitter dock
Polygonaceae	*Polygonum*	*aviculare*	prostrate knotweed
Polygonaceae	*Polygonum*	*buxiforme*	box knotweed
Polygonaceae	*Polygonum*	*convolvulus*	black bindweed
Polygonaceae	*Rumex*	*pulcher*	fiddle dock
Polygonaceae	*Polygonum*	*tenue*	pleatleaf knotweed
Polypodiaceae	*Pleopeltis*	*polypodioides*	resurrection fern
Pontederiaceae	*Heteranthera*	*dubia*	grassleaf mudplantain
Pontederiaceae	*Heteranthera*	*limosa*	blue mudplantain

Family	Genus	Species	Common Name
Pontederiaceae	*Pontederia*	*cordata*	pickerelweed
Portulacaceae	*Claytonia*	*virginica*	Virginia springbeauty
Portulacaceae	*Phemeranthus*	*parviflorus*	Flower-of-an-hour
Portulacaceae	*Portulaca*	*oleracea*	little hogweed
Potamogetonaceae	*Potamogeton*	*crispus*	curly pondweed
Potamogetonaceae	*Potamogeton*	*diversifolius*	waterthread pondweed
Potamogetonaceae	*Potamogeton*	*foliosus*	leafy pondweed
Potamogetonaceae	*Potamogeton*	*nodosus*	longleaf pondweed
Primulaceae	*Anagallis*	*arvensis*	scarlet pimpernel
Primulaceae	*Dodecatheon*	*meadia*	Shooting star
Primulaceae	*Lysimachia*	*lanceolata*	lanceleaf loosestrife
Primulaceae	*Samolus*	*valerandi*	seaside brookweed
Primulaceae	*Androsace*	*occidentalis*	western rockjasmine
Primulaceae	*Lysimachia*	*ciliata*	fringed loosestrife
Pteridaceae	*Adiantum*	*capillus-veneris*	common maidenhair
Pteridaceae	*Adiantum*	*pedatum*	northern maidenhair
Pteridaceae	*Argyrochosma*	*dealbata*	powdery false cloak fern
Pteridaceae	*Cheilanthes*	*lanosa*	hairy lipfern
Pteridaceae	*Cheilanthes*	*tomentosa*	woolly lipfern
Pteridaceae	*Myriopteris*	*alabamensis*	Alabama lipfern
Pteridaceae	*Myriopteris*	*lanosa*	hairy lipfern
Pteridaceae	*Pellaea*	*atropurpurea*	purple cliffbrake
Pteridaceae	*Cheilanthes*	*alabamensis*	Alabama lipfern
Pteridaceae	*Pellaea*	*wrightiana*	Wright's cliffbrake
Ranunculaceae	*Anemone*	*virginiana*	tall thimbleweed
Ranunculaceae	*Aquilegia*	*canadensis*	red columbine
Ranunculaceae	*Clematis*	*terniflora*	sweet autumn virginsbower
Ranunculaceae	*Clematis*	*versicolor*	pale leather flower
Ranunculaceae	*Delphinium*	*carolinianum*	Carolina larkspur
Ranunculaceae	*Delphinium*	*tricorne*	dwarf larkspur
Ranunculaceae	*Enemion*	*biternatum*	eastern false rue anemone
Ranunculaceae	*Myosurus*	*minumus*	tiny mousetail
Ranunculaceae	*Ranunculus*	*abortivus*	littleleaf buttercup
Ranunculaceae	*Ranunculus*	*fascicularis*	Early buttercup
Ranunculaceae	*Ranunculus*	*harveyi*	Harvey's buttercup
Ranunculaceae	*Ranunculus*	*hispidus*	bristly buttercup
Ranunculaceae	*Ranunculus*	*longirostris*	longbeak buttercup
Ranunculaceae	*Ranunculus*	*micranthus*	rock buttercup
Ranunculaceae	*Ranunculus*	*recurvatus*	blisterwort
Ranunculaceae	*Ranunculus*	*sardous*	hairy buttercup
Ranunculaceae	*Thalictrum*	*thalictroides*	rue anemone
Ranunculaceae	*Anemone*	*caroliniana*	Carolina anemone
Ranunculaceae	*Clematis*	*pitcheri*	bluebill
Ranunculaceae	*Consolida*	*ajacis*	doubtful knight's-spur
Ranunculaceae	*Ranunculus*	*macranthus*	large buttercup

Family	Genus	Species	Common Name
Ranunculaceae	*Thalictrum*	*dasycarpum*	purple meadow-rue
Ranunculaceae	*Thalictrum*	*dioicum*	early meadow-rue
Ranunculaceae	*Clematis*		leather flower
Ranunculaceae	*Thalictrum*	*revolutum*	waxyleaf meadow-rue
Rhamnaceae	*Ceanothus*	*americanus*	New Jersey tea
Rhamnaceae	*Ceanothus*	*herbaceus*	Jersey tea
Rhamnaceae	*Frangula*	*caroliniana*	Carolina buckthorn
Rosaceae	*Agrimonia*	*gryposepala*	tall hairy agrimony
Rosaceae	*Agrimonia*	*parviflora*	harvestlice
Rosaceae	*Agrimonia*	*pubescens*	soft agrimony
Rosaceae	*Agrimonia*	*rostellata*	beaked agrimony
Rosaceae	*Amelanchier*	*arborea*	common serviceberry/Alabama serviceberry
Rosaceae	*Aruncus*	*dioicus*	bride's feathers
Rosaceae	*Crataegus*	*crus-galli*	cockspur hawthorn
Rosaceae	*Crataegus*	*engelmannii*	Engelmann's hawthorn
Rosaceae	*Fragaria*	*virginiana*	Virginia strawberry
Rosaceae	*Geum*	*canadense*	white avens
Rosaceae	*Geum*	*vernum*	spring avens
Rosaceae	*Physocarpus*	*opulifolius*	Atlantic ninebark
Rosaceae	*Porteranthus*	*stipulatus*	Indian physic
Rosaceae	*Potentilla*	*recta*	sulphur cinquefoil
Rosaceae	*Potentilla*	*simplex*	common cinquefoil
Rosaceae	*Prunus*	*hortulana*	hortulan plum
Rosaceae	*Prunus*	*mexicana*	Mexican plum
Rosaceae	*Prunus*	*munsoniana*	wild goose plum
Rosaceae	*Prunus*	*serotina*	black cherry
Rosaceae	*Rosa*	*arkansana*	prairie rose
Rosaceae	*Rosa*	*carolina*	Carolina rose
Rosaceae	*Rosa*	*multiflora*	multiflora rose
Rosaceae	*Rosa*	*setigera*	climbing rose
Rosaceae	*Rubus*	*aboriginum*	garden dewberry
Rosaceae	*Rubus*	*allegheniensis*	Allegheny blackberry
Rosaceae	*Rubus*	*bifrons*	Himalayan berry
Rosaceae	*Rubus*	*bushii*	Bush's blackberry
Rosaceae	*Rubus*	*mollior*	softleaf blackberry
Rosaceae	*Rubus*	*occidentalis*	black raspberry
Rosaceae	*Rubus*	*oklahomus*	Oklahoma blackberry
Rosaceae	*Crataegus*	*mollis*	Arnold hawthorn
Rosaceae	*Crataegus*	*pruinosa*	waxyfruit hawthorn
Rosaceae	*Crataegus*	*viridis*	green hawthorn
Rosaceae	*Prunus*	*gracilis*	Oklahoma plum
Rosaceae	*Rosa*	*foliolosa*	white prairie rose
Rosaceae	*Rubus*	*argutus*	sawtooth blackberry
Rosaceae	*Rubus*	*trivialis*	southern dewberry

Family	Genus	Species	Common Name
Rosaceae	*Sanguisorba*	*annua*	prairie burnet
Rosaceae	*Crataegus*	*coccinioides*	Kansas hawthorn
Rosaceae	*Crataegus*	*intricata*	Copenhagen hawthorn
Rosaceae	*Malus*	*ioensis*	prairie crabapple
Rosaceae	*Potentilla*	*norvegica*	Norwegian cinquefoil
Rosaceae	*Prunus*	*americana*	American plum
Rosaceae	*Rubus*	*ostryafolius*	highbush blackberry
Rosaceae	*Prunus*	*angustifolia*	Chickasaw plum
Rubiaceae	*Cephalanthus*	*occidentalis*	common buttonbush
Rubiaceae	*Diodia*	*teres*	poorjoe
Rubiaceae	*Diodia*	*virginiana*	Virginia buttonweed
Rubiaceae	*Galium*	*aparine*	stickywilly
Rubiaceae	*Galium*	*arkansanum*	Arkansas bedstraw
Rubiaceae	*Galium*	*circaezans*	licorice bedstraw
Rubiaceae	*Galium*	*concinnum*	shining bedstraw
Rubiaceae	*Galium*	*obtusum*	bluntleaf bedstraw
Rubiaceae	*Galium*	*pilosum*	hairy bedstraw
Rubiaceae	*Galium*	*triflorum*	fragrant bedstraw
Rubiaceae	*Hedyotis*	*nigricans*	diamondflowers
Rubiaceae	*Houstonia*	*longifolia*	longleaf summer bluet
Rubiaceae	*Houstonia*	*purpurea*	Venus' pride
Rubiaceae	*Houstonia*	*pusilla*	tiny bluet
Rubiaceae	*Sherardia*	*arvensis*	blue fieldmadder
Rubiaceae	*Spermacoce*	*glabra*	smooth false buttonweed
Rubiaceae	*Stenaria*	*nigricans*	diamondflowers
Rubiaceae	*Cruciata*	*pedemontana*	piedmont bedstraw
Rubiaceae	*Galium*	*tinctorium*	stiff marsh bedstraw
Rubiaceae	*Galium*	*virgatum*	southwestern bedstraw
Rutaceae	*Ptelea*	*trifoliata*	common hoptree
Salicaceae	*Salix*	*caroliniana*	coastal plain willow
Salicaceae	*Salix*	*nigra*	black willow
Salicaceae	*Populus*	*deltoides*	eastern cottonwood
Salicaceae	*Salix*	*exigua*	sandbar willow
Salicaceae	*Salix*	*humilis*	prairie willow
Santalaceae	*Comandra*	*umbellata*	bastard toadflax
Sapindaceae	*Sapindus*	*saponaria*	western soapberry
Sapindaceae	*Cardiospermum*	*halicacabum*	love in a puff
Sapotaceae	*Sideroxylon*	*lanuginsoum*	gum bully
Saururaceae	*Saururus*	*cernuus*	lizard's tail
Saxifragaceae	*Heuchera*	*americana*	American alumroot
Saxifragaceae	*Saxifraga*	*palmeri*	Palmer's saxifrage
Saxifragaceae	*Saxifraga*	*texana*	Texas saxifrage
Saxifragaceae	*Heuchera*	*richardsonii*	Richardson's alumroot
Saxifragaceae	*Saxifraga*	*virginiensis*	early saxifrage
Scrophulariaceae	*Agalinis*	*fasciculata*	beach false foxglove

Family	Genus	Species	Common Name
Scrophulariaceae	*Agalinis*	*gattingeri*	roundstem false foxglove
Scrophulariaceae	*Agalinis*	*tenuifolia*	slenderleaf false foxglove
Scrophulariaceae	*Agalinis*	*viridis*	green false foxglove
Scrophulariaceae	*Aureolaria*	*grandiflora*	largeflower yellow false foxglove
Scrophulariaceae	*Aureolaria*	*pectinata*	combleaf yellow false foxglove
Scrophulariaceae	*Bacopa*	*rotundifolia*	disk waterhyssop
Scrophulariaceae	*Buchnera*	*americana*	American bluehearts
Scrophulariaceae	*Castilleja*	*coccinea*	scarlet Indian paintbrush
Scrophulariaceae	*Castilleja*	*indivisa*	entireleaf Indian paintbrush
Scrophulariaceae	*Collinsia*	*violacea*	violet blue eyed Mary
Scrophulariaceae	*Dasistoma*	*macrophylla*	mullein foxglove
Scrophulariaceae	*Gratiola*	*neglecta*	clammy hedgehyssop
Scrophulariaceae	*Gratiola*	*virginiana*	roundfruit hedgehyssop
Scrophulariaceae	*Kickxia*	*elatine*	sharpleaf cancerwort
Scrophulariaceae	*Leucospora*	*multifida*	narrowleaf paleseed
Scrophulariaceae	*Linaria*	*vulgaris*	butter and eggs
Scrophulariaceae	*Lindernia*	*dubia*	yellowseed false pimpernel
Scrophulariaceae	*Mimulus*	*alatus*	sharpwing monkeyflower
Scrophulariaceae	*Mimulus*	*ringens*	Allegheny monkeyflower
Scrophulariaceae	*Nuttallanthus*	*texanus*	Texas toadflax
Scrophulariaceae	*Pedicularis*	*canadensis*	Canadian lousewort
Scrophulariaceae	*Penstemon*	*digitalis*	talus slope penstemon
Scrophulariaceae	*Penstemon*	*tubiflorus*	white wand beardtongue
Scrophulariaceae	*Scrophularia*	*marilandica*	carpenter's square
Scrophulariaceae	*Verbascum*	*blattaria*	moth mullein
Scrophulariaceae	*Verbascum*	*thapsus*	common mullein
Scrophulariaceae	*Veronica*	*anagallis-aquatica*	water speedwell
Scrophulariaceae	*Veronica*	*arvensis*	corn speedwell
Scrophulariaceae	*Veronica*	*peregrina*	neckweed
Scrophulariaceae	*Veronica*	*persica*	birdeye speedwell
Scrophulariaceae	*Veronica*	*polita*	gray field speedwell
Scrophulariaceae	*Agalinis*	*heterophylla*	prairie false foxglove
Scrophulariaceae	*Castilleja*	*purpurea*	downy Indian paintbrush
Scrophulariaceae	*Mecardonia*	*acuminata*	axilflower
Scrophulariaceae	*Nuttallanthus*	*canadensis*	Canada toadflax
Scrophulariaceae	*Penstemon*	*arkansanus*	Arkansas beardtongue
Scrophulariaceae	*Veronica*	*peregrina*	neckweed/hairy purselane speedwell
Scrophulariaceae	*Scrophularia*	*lanceolata*	lanceleaf figwort
Scrophulariaceae	*Veronicastrum*	*virginicum*	Culver's root
Scrophulariaceae	*Agalinis*	*densiflora*	Osage false foxglove
Selaginellaceae	*Selaginella*	*eclipes*	hidden spikemoss
Simaroubaceae	*Ailanthus*	*altissima*	tree of heaven
Smilacaceae	*Smilax*	*bona-nox*	saw greenbrier
Smilacaceae	*Smilax*	*lasioneura*	Blue Ridge carrionflower
Smilacaceae	*Smilax*	*rotundifolia*	roundleaf greenbrier

Family	**Genus**	**Species**	**Common Name**
Smilacaceae	*Smilax*	*glauca*	cat greenbrier
Smilacaceae	*Smilax*	*herbacea*	smooth carrionflower
Smilacaceae	*Smilax*	*tamnoides*	bristly greenbrier
Solanaceae	*Datura*	*stramonium*	jimsonweed
Solanaceae	*Physalis*	*angulata*	cutleaf groundcherry
Solanaceae	*Physalis*	*heterophylla*	clammy groundcherry
Solanaceae	*Physalis*	*longifolia*	longleaf groundcherry
Solanaceae	*Physalis*	*pubescens*	husk tomato
Solanaceae	*Physalis*	*virginiana*	Virginia groundcherry
Solanaceae	*Solanum*	*americanum*	American black nightshade
Solanaceae	*Solanum*	*carolinense*	Carolina horsenettle
Solanaceae	*Solanum*	*elaeagnifolium*	silverleaf nightshade
Solanaceae	*Solanum*	*ptychanthum*	West Indian nightshade
Solanaceae	*Solanum*	*rostratum*	buffalobur nightshade
Solanaceae	*Physalis*	*viscosa*	starhair groundcherry
Solanaceae	*Solanum*	*ptycanthum*	West Indian nightshade
Solanaceae	*Solanum*	*dimidiatum*	western horsenettle
Sparganiaceae	*Sparganium*	*americanum*	American bur-reed
Sparganiaceae	*Sparganium*	*androcladum*	branched bur-reed
Sparganiaceae	*Sparganium*	*eurycarpum*	broadfruit bur-reed
Staphyleaceae	*Staphylea*	*trifolia*	American bladdernut
Tamaricaceae	*Tamarix*	*gallica*	salt cedar, French tamarisk
Tamaricaceae	*Tamarix*	*ramosissima*	saltcedar
Thelypteridaceae	*Phegopteris*	*hexagonoptera*	broad beechfern
Tiliaceae	*Tilia*	*americana*	American basswood/Carolina basswood
Typhaceae	*Typha*	*latifolia*	broadleaf cattail
Typhaceae	*Typha*	*angustifolia*	narrowleaf cattail
Typhaceae	*Typha*	*domingensis*	southern cattail
Ulmaceae	*Celtis*	*occidentalis*	common hackberry
Ulmaceae	*Celtis*	*tenuifolia*	dwarf hackberry
Ulmaceae	*Ulmus*	*alata*	winged elm
Ulmaceae	*Ulmus*	*americana*	American elm
Ulmaceae	*Ulmus*	*crassifolia*	cedar elm
Ulmaceae	*Ulmus*	*rubra*	slippery elm
Ulmaceae	*Celtis*	*laevigata*	sugarberry/netleaf hackberry
Ulmaceae	*Ulmus*	*pumila*	Siberian elm
Urticaceae	*Boehmeria*	*cylindrica*	smallspike false nettle
Urticaceae	*Parietaria*	*pensylvanica*	Pennsylvania pellitory
Urticaceae	*Pilea*	*pumila*	Canadian clearweed/Deam's clearweed
Urticaceae	*Urtica*	*chamaedryoides*	heartleaf nettle
Urticaceae	*Laportea*	*canadensis*	Canadian woodnettle
Urticaceae	*Urtica*	*dioica*	stinging nettle
Valerianaceae	*Valerianella*	*longiflora*	longtube cornsalad
Valerianaceae	*Valerianella*	*radiata*	beaked cornsalad
Valerianaceae	*Valerianella*	*ozarkana*	Benjamin Franklin bush

Family	Genus	Species	Common Name
Verbenaceae	*Glandularia*	*canadensis*	rose mock vervain
Verbenaceae	*Phyla*	*lanceolata*	lanceleaf fogfruit
Verbenaceae	*Phyla*	*nodiflora*	turkey tangle fogfruit
Verbenaceae	*Verbena*	*bracteata*	bigbract verbena
Verbenaceae	*Verbena*	*hastata*	swamp verbena
Verbenaceae	*Verbena*	*simplex*	narrowleaf vervain
Verbenaceae	*Verbena*	*stricta*	hoary verbena
Verbenaceae	*Verbena*	*urticifolia*	white vervain
Verbenaceae	*Phryma*	*leptostachya*	American lopseed
Verbenaceae	*Verbena*	*X moechina*	
Verbenaceae	*Verbena*	*X rydbergii*	
Violaceae	*Hybanthus*	*concolor*	eastern greenviolet
Violaceae	*Viola*	*bicolor*	field pansy
Violaceae	*Viola*	*pedata*	birdfoot violet
Violaceae	*Viola*	*pubescens*	downy yellow violet
Violaceae	*Viola*	*sagittata*	arrowleaf violet
Violaceae	*Viola*	*sororia*	common blue violet
Violaceae	*Viola*	*striata*	striped cream violet
Violaceae	*Viola*	*triloba*	
Violaceae	*Viola*	*affinis*	sand violet
Violaceae	*Viola*	*missouriensis*	Missouri violet
Violaceae	*Viola*	*pedatifida*	prairie violet
Violaceae	*Viola*	*x palmata*	early blue violet
Viscaceae	*Phoradendron*	*leucarpum*	oak mistletoe
Vitaceae	*Ampelopsis*	*arborea*	peppervine
Vitaceae	*Ampelopsis*	*cordata*	heartleaf peppervine
Vitaceae	*Cissus*	*trifoliata*	sorrelvine
Vitaceae	*Parthenocissus*	*quinquefolia*	Virginia creeper
Vitaceae	*Vitis*	*aestivalis*	summer grape
Vitaceae	*Vitis*	*vulpina*	frost grape
Vitaceae	*Vitis*	*aestivalis*	long grape
Vitaceae	*Vitis*	*cinerea*	graybark grape
Vitaceae	*Vitis*	*rupestris*	sand grape
Woodsiaceae	*Cystopteris*	*bulbifera*	bulblet bladderfern
Woodsiaceae	*Cystopteris*	*protrusa*	lowland bladderfern
Woodsiaceae	*Cystopteris*	*tennesseensis*	Tennessee bladderfern
Woodsiaceae	*Filix*	*fragilis*	brittle bladderfern
Woodsiaceae	*Woodsia*	*obtusa*	bluntlobe cliff fern
Zannichelliaceae	*Zannichellia*	*palustris*	horned pondweed

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ATTACHMENT G. BIRDS OCCURRING IN OKLAHOMA

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Attachment G
Birds Occurring in Oklahoma

ANSERIFORMES
Family **Anatidae**: Ducks, Geese, and Swans
1. **Dendrocygna autumnalis* (Linnaeus 1758). Black-bellied Whistling-Duck.
2. **Dendrocygna bicolor* (Vieillot 1816). Fulvous Whistling-Duck.
3. *Anser albifrons* (Scopoli 1769). Greater White-fronted Goose.
4. *Chen caerulescens* (Linnaeus 1758). Snow Goose.
5. *Chen rossii* (Cassin 1861). Ross's Goose.
6. *Branta bernicla* (Linnaeus 1758). Brant.
7. *Branta leucopsis* (Bechstein 1803). Barnacle Goose.
8. *Branta hutchinsii* (Richardson 1832). Cackling Goose.
9. *Branta canadensis* (Linnaeus 1758). Canada Goose.
10. [*Cygnus olor* (Gmelin 1789). Mute Swan.]
11. *Cygnus buccinator (*Richardson 1831). Trumpeter Swan.
12. *Cygnus columbianus* (Ord 1815). Tundra Swan.
13. *Aix sponsa* (Linnaeus 1758). Wood Duck.
14. *Anas strepera (*Linnaeus 1758). Gadwall.
15. **Anas penelope (*Linnaeus 1758). Eurasian Wigeon.
16. *Anas americana (*Gmelin 1789). American Wigeon.
17. *Anas rubripes (*Brewster 1902). American Black Duck.
18. *Anas platyrhynchos (*Linnaeus 1758). Mallard.
19. *Anas fulvigula (*Ridgway 1874). Mottled Duck.
20. *Anas discors (*Linnaeus 1766). Blue-winged Teal.
21. *Anas cyanoptera (*Vieillot 1816). Cinnamon Teal.
22. *Anas clypeata (*Linnaeus 1758). Northern Shoveler.
23. *Anas acuta (*Linnaeus 1758). Northern Pintail.
24. **Anas querquedula (*Linnaeus 1758). Garganey.
25. [*Anas formosa (*Georgi 1775). Baikal Teal.]
26. *Anas crecca (*Linnaeus 1758). Green-winged Teal.
27. *Aythya valisineria* (Wilson 1814). Canvasback.
28. *Aythya americana* (Eyton 1838). Redhead.
29. *Aythya collaris* (Donovan 1809). Ring-necked Duck.
30. *Aythya marila* (Linnaeus 1761). Greater Scaup.
31. *Aythya affinis* (Eyton 1838). Lesser Scaup.
32. *Melanitta perspicillata* (Linnaeus 1758). Surf Scoter.
33. *Melanitta fusca* (Linnaeus 1758). White-winged Scoter.
34. *Melanitta americana* (Swainson 1832). Black Scoter.
35. *Clangula hyemalis* (Linnaeus 1758). Long-tailed Duck.
36. *Bucephala albeola* (Linnaeus 1758). Bufflehead.
37. *Bucephala clangula* (Linnaeus 1758). Common Goldeneye.
38. *Bucephala islandica* (Gmelin 1789). Barrow's Goldeneye.

39. *Lophodytes cucullatus* (Linnaeus 1758). Hooded Merganser.
40. *Mergus merganser (*Linnaeus 1758). Common Merganser.
41. *Mergus serrator (*Linnaeus 1758). Red-breasted Merganser.
42. *Oxyura jamaicensis* (Gmelin 1789). Ruddy Duck.
GALLIFORMES
Family **Odontophoridae**: New World Quails
43. *Callipepla squamata* (Vigors 1830). Scaled Quail.
44. *Colinus virginianus* (Linnaeus 1758). Northern Bobwhite.
Family **Phasianidae**: Partridges, Grouse, Turkeys, and Old World Quail
45. *Phasianus colchicus (*Linnaeus 1758). Ring-necked Pheasant.
46. [*Centrocercus minimus* (Bradbury and Vehrencamp 1998). Gunnison Sage-Grouse.]
47. [*Tympanuchus phasianellus* (Linnaeus 1758). Sharp-tailed Grouse.]
48. *Tympanuchus cupido* (Linnaeus 1758). Greater Prairie-Chicken.
49. *Tympanuchus pallidicinctus* (Ridgway 1873). Lesser Prairie-Chicken.
50. *Meleagris gallopavo (*Linnaeus 1758). Wild Turkey.
GAVIIFORMES
Family **Gaviidae**: Loons
51. **Gavia stellata* (Pontoppidan 1763). Red-throated Loon.
52. **Gavia pacifica* (Lawrence 1858). Pacific Loon.
53. *Gavia immer* (Brünnich 1764). Common Loon.
54. **Gavia adamsii* (Gray 1859). Yellow-billed Loon.
PODICIPEDIFORMES
Family **Podicipedidae**: Grebes
55. **Tachybaptus dominicus* (Linnaeus 1766). Least Grebe.
56. *Podilymbus podiceps* (Linnaeus 1758). Pied-billed Grebe.
57. *Podiceps auritus* (Linnaeus 1758). Horned Grebe.
58. **Podiceps grisegena* (Boddaert 1783). Red-necked Grebe.
59. *Podiceps nigricollis (*Brehm 1831). Eared Grebe.
60. *Aechmophorus occidentalis* (Lawrence 1858). Western Grebe.
61. **Aechmophorus clarkii* (Lawrence 1858). Clark's Grebe.
CICONIIFORMES
Family **Ciconiidae**: Storks
62. **Jabiru mycteria* (Lichtenstein 1819). Jabiru.
63. *Mycteria americana (*Linnaeus 1758). Wood Stork.
SULIFORMES
Family **Fregatidae**: Frigatebirds
64. *Fregata magnificens (*Mathews 1914). Magnificent Frigatebird.
65. *Fregata minor* (Gmelin 1789). Great Frigatebird.
Family **Sulidae: Boobies and Gannets**
66. [*Morus bassanus* (Linnaeus 1758). Northern Gannet.]
Family **Phalacrocoracidae**: Cormorants.
67. *Phalacrocorax brasilianus* (Gmelin 1789). Neotropic Cormorant.
68. *Phalacrocorax auritus* (Lesson 1831). Double-crested Cormorant.

Family **Anhingidae**: Darters
69. *Anhinga anhinga* (Linnaeus 1766). Anhinga.
PELECANIFORMES
Family **Pelecanidae**: Pelicans
70. *Pelecanus erythrorhynchos (*Gmelin 1789). American White Pelican.
71. *Pelecanus occidentalis (*Linnaeus 1766). Brown Pelican.
Family **Ardeidae**: Herons, Bitterns, and Allies
72. *Botaurus lentiginosus* (Rackett 1813). American Bittern.
73. *Ixobrychus exilis* (Gmelin 1789). Least Bittern.
74. *Ardea herodias (*Linnaeus 1758). Great Blue Heron.
75. *Ardea alba (*Linnaeus 1758). Great Egret.
76. *Egretta thula* (Molina 1782). Snowy Egret.
77. *Egretta caerulea* (Linnaeus 1758). Little Blue Heron.
78. *Egretta tricolor* (Müller 1776). Tricolored Heron.
79. **Egretta rufescens* (Gmelin 1789). Reddish Egret.
80. *Bubulcus ibis* (Linnaeus 1758). Cattle Egret.
81. *Butorides virescens* (Linnaeus 1758). Green Heron.
82. *Nycticorax nycticorax* (Linnaeus 1758). Black-crowned Night-Heron.
83. *Nyctanassa violacea* (Linnaeus 1758). Yellow-crowned Night-Heron.
Family **Threskiornithidae**: Ibises and Spoonbills
84. *Eudocimus albus* (Linnaeus 1758). White Ibis.
85. *Plegadis falcinellus* (Linnaeus 1766). Glossy Ibis.
86. *Plegadis chihi* (Vieillot 1817). White-faced Ibis.
87. *Platalea ajaja (*Linnaeus 1758). Roseate Spoonbill.
ACCIPITRIFORMES
Family **Cathartidae**: New World Vultures
88. *Coragyps atratus* (Bechstein 1793). Black Vulture.
89. *Cathartes aura* (Linnaeus 1758). Turkey Vulture.
Family **Pandionidae**: Ospreys
90. *Pandion haliaetus* (Linnaeus 1758). Osprey.
Family **Accipitridae**: Hawks, Kites, Eagles, and Allies
91. *Elanoides forficatus* (Linnaeus 1758). Swallow-tailed Kite.
92. *Elanus leucurus* (Vieillot 1818). White-tailed Kite.
93. *Ictinia mississippiensis* (Wilson 1811). Mississippi Kite.
94. *Haliaeetus leucocephalus* (Linnaeus 1766). Bald Eagle.
95. *Circus cyaneus* (Linnaeus 1766). Northern Harrier.
96. *Accipiter striatus (*Vieillot 1808). Sharp-shinned Hawk.
97. *Accipiter cooperii* (Bonaparte 1828). Cooper's Hawk.
98. *Accipiter gentilis* (Linnaeus 1758). Northern Goshawk.
99. *Parabuteo unicinctus* (Temminck 1824). Harris's Hawk.
100. *Buteo lineatus* (Gmelin 1788). Red-shouldered Hawk.
101. *Buteo platypterus* (Vieillot 1823). Broad-winged Hawk.
102. [*Buteo nitidus* (Latham 1790). Gray Hawk.]

103. *Buteo swainsoni (*Bonaparte 1838). Swainson's Hawk.
104. *Buteo jamaicensis* (Gmelin 1788). Red-tailed Hawk.
105. *Buteo regalis* (Gray 1844). Ferruginous Hawk.
106. *Buteo lagopus* (Pontoppidan 1763). Rough-legged Hawk.
107. *Aquila chrysaetos* (Linnaeus 1758). Golden Eagle.
FALCONIFORMES
Family **Falconidae**: Caracaras and Falcons
108. **Caracara cheriway* (Jocquin 1784). Crested Caracara.
109. *Falco sparverius (*Linnaeus 1758). American Kestrel.
110. *Falco columbarius (*Linnaeus 1758). Merlin.
111. *Falco rusticolus (*Linnaeus 1758). Gyrfalcon.
112. *Falco peregrinus (*Tunstall 1771). Peregrine Falcon.
113. *Falco mexicanus (*Schlegel 1851). Prairie Falcon.
GRUIFORMES
Family **Rallidae**: Rails, Gallinules, and Coots
114. *Coturnicops noveboracensis* (Gmelin 1789). Yellow Rail.
115. *Laterallus jamaicensis* (Gmelin 1789). Black Rail.
116. *Rallus elegans (*Audubon 1834). King Rail.
117. *Rallus limicola (*Vieillot 1819). Virginia Rail.
118. *Porzana carolina* (Linnaeus 1758). Sora.
119. *Porphyrio martinica* (Linnaeus 1766). Purple Gallinule.
120. *Gallinula galeata* (Lichtenstein 1818). Common Gallinule.
121. *Fulica americana (*Gmelin 1789). American Coot.
Family **Gruidae**: Cranes
122. *Grus canadensis* (Linnaeus 1758). Sandhill Crane.
123. *Grus americana* (Linnaeus 1758). Whooping Crane.
CHARADRIIFORMES
Family **Charadriidae**: Lapwings and Plovers
124. *Pluvialis squatarola* (Linnaeus 1758). Black-bellied Plover.
125. *Pluvialis dominica* (Müller 1776). American Golden-Plover.
126. *Charadrius nivosus (*Cassin 1858). Snowy Plover.
127. **Charadrius wilsonia (*Ord 1814). Wilson's Plover.
128. *Charadrius semipalmatus (*Bonaparte 1825). Semipalmated Plover.
129. *Charadrius melodus (*Ord 1824). Piping Plover.
130. *Charadrius vociferus (*Linnaeus 1758). Killdeer.
131. *Charadrius montanus (*Townsend 1837). Mountain Plover.
Family **Recurvirostridae**: Stilts and Avocets
132. *Himantopus mexicanus* (Müller 1776). Black-necked Stilt.
133. *Recurvirostra americana (*Gmelin 1789). American Avocet.
Family **Scolopacidae**: Sandpipers, Phalaropes, and Allies
134. *Actitis macularius* (Linnaeus 1766). Spotted Sandpiper.
135. *Tringa solitaria (*Wilson 1813). Solitary Sandpiper.
136. *Tringa melanoleuca* (Gmelin 1789). Greater Yellowlegs.

137. *Tringa semipalmata* (Gmelin 1789). Willet.
138. *Tringa flavipes* (Gmelin 1789). Lesser Yellowlegs.
139. *Bartramia longicauda* (Bechstein 1812). Upland Sandpiper.
140. †*Numenius borealis* (Forster 1772). Eskimo Curlew.
141. *Numenius phaeopus* (Linnaeus 1758). Whimbrel.
142. *Numenius americanus (*Bechstein 1812). Long-billed Curlew.
143. *Limosa haemastica* (Linnaeus 1758). Hudsonian Godwit.
144. *Limosa fedoa* (Linnaeus 1758). Marbled Godwit.
145. *Arenaria interpres* (Linnaeus 1758). Ruddy Turnstone.
146. *Calidris canutus* (Linnaeus 1758). Red Knot.
147. *Calidris alba* (Pallas 1764). Sanderling.
148. *Calidris pusilla* (Linnaeus 1766). Semipalmated Sandpiper.
149. *Calidris mauri* (Cabanis 1857). Western Sandpiper.
150. *Calidris minutilla* (Vieillot 1819). Least Sandpiper.
151. *Calidris fuscicollis* (Vieillot 1819). White-rumped Sandpiper.
152. *Calidris bairdii* (Coues 1861). Baird's Sandpiper.
153. *Calidris melanotos* (Vieillot 1819). Pectoral Sandpiper.
154. **Calidris maritima* (Brünnich 1764). Purple Sandpiper.
155. *Calidris alpina* (Linnaeus 1758). Dunlin.
156. [*Calidris ferruginea* (Pontoppidan 1763). Curlew Sandpiper.]
157. *Calidris himantopus* (Bonaparte 1826). Stilt Sandpiper.
158. *Tryngites subruficollis* (Vieillot, 1819). Buff-breasted Sandpiper.
159. **Philomachus pugnax* (Linnaeus 1758). Ruff.
160. *Limnodromus griseus* (Gmelin 1789). Short-billed Dowitcher.
161. *Limnodromus scolopaceus* (Say 1823). Long-billed Dowitcher.
162. *Gallinago delicata* (Linnaeus 1758). Wilson's Snipe.
163. *Scolopax minor (*Gmelin 1789). American Woodcock.
164. *Phalaropus tricolor* (Vieillot 1819). Wilson's Phalarope.
165. *Phalaropus lobatus* (Linnaeus 1758). Red-necked Phalarope.
166. *Phalaropus fulicarius* (Linnaeus 1758). Red Phalarope.
Family **Laridae**: Skuas, Gulls, Terns, and Skimmers
167. *Rissa tridactyla* (Linnaeus 1758). Black-legged Kittiwake.
168. *Xema sabini* (Sabine 1819). Sabine's Gull.
169. *Chroicocephalus philadelphia* (Ord 1815). Bonaparte's Gull.
170. **Chroicocephalus ridibundus* (Linnaeus 1766). Black-headed Gull.
171. **Hydrocoloeus minutus* (Pallas 1776). Little Gull.
172. *Leucophaeus atricilla* (Linnaeus 1758). Laughing Gull.
173. *Leucophaeus pipixcan* (Wagler 1831). Franklin's Gull.
174. *Larus heermanni (*Cassin 1852). Heermann's Gull.
175. **Larus canus (*Linnaeus 1758). Mew Gull.
176. *Larus delawarensis (*Ord 1815). Ring-billed Gull.
177. *Larus californicus (*Lawrence 1854). California Gull.
178. *Larus argentatus (*Pontoppidan 1763). Herring Gull.

179. *Larus thayeri (*Brooks 1915). Thayer's Gull.
180. **Larus glaucoides (*Meyer 1822). Iceland Gull.
181. **Larus fuscus (*Linnaeus 1758). Lesser Black-backed Gull.
182. *Larus glaucescens (*Naumann 1840). Glaucous-winged Gull.
183. *Larus hyperboreus (*Gunnerus 1767). Glaucous Gull.
184. **Larus marinus (*Linnaeus 1758). Great Black-backed Gull.
185. **Onychoprion fuscatus* (Linnaeus 1766). Sooty Tern.
186. *Sternula antillarum (*Lesson 1847). Least Tern.
187. *Hydroprogne caspia* (Pallas 1770). Caspian Tern.
188. *Chlidonias niger* (Linnaeus 1758). Black Tern.
189. *Sterna hirundo (*Linnaeus 1758). Common Tern.
190. **Sterna paradisaea (*Pontoppidan 1763). Arctic Tern.
191. *Sterna forsteri (*Nuttall 1834). Forster's Tern.
192. **Thalasseus maximus* (Boddaert 1783). Royal Tern.
193. *Rynchops niger (*Linnaeus 1758). Black Skimmer.
Family **Stercorariidae:** Skuas and Jaegers
194. *Stercorarius pomarinus* (Temminck 1815). Pomarine Jaeger.
195. *Stercorarius parasiticus* (Linnaeus 1758). Parasitic Jaeger.
196. **Stercorarius longicaudus (*Vieillot 1819). Long-tailed Jaeger.
COLUMBIFORMES
Family **Columbidae**: Pigeons and Doves
197. *Columba livia (*Gmelin 1789). Rock Pigeon.
198. *Patagioenas fasciata (*Say 1823). Band-tailed Pigeon.
199. *Streptopelia decaocto* (Frivaldszky 1838). Eurasian Collared-Dove.
200. **Zenaida asiatica* (Linnaeus 1758). White-winged Dove.
201. *Zenaida macroura* (Linnaeus 1758). Mourning Dove.
202. †*Ectopistes migratorius* (Linnaeus 1766). Passenger Pigeon.
203. *Columbina inca* (Lesson 1847). Inca Dove.
204. *Columbina passerina* (Linnaeus 1758). Common Ground-Dove.
PSITTACIFORMES
Family **Psittacidae**: Lories, Parakeets, Macaws, and Parrots
205. [*Myiopsitta monachus* (Boddaert 1783). Monk Parakeet.]
206. †*Conuropsis carolinensis* (Linnaeus 1758). Carolina Parakeet.
CUCULIFORMES
Family **Cuculidae**: Cuckoos, Roadrunners, and Anis
207. *Coccyzus americanus* (Linnaeus 1758). Yellow-billed Cuckoo.
208. *Coccyzus erythropthalmus* (Wilson 1811). Black-billed Cuckoo.
209. *Geococcyx californianus* (Lesson 1829). Greater Roadrunner.
210. *Crotophaga sulcirostris (*Swainson 1827). Groove-billed Ani.
STRIGIFORMES
Family **Tytonidae**: Barn Owls
211. *Tyto alba* (Scopoli 1769). Barn Owl.

Family **Strigidae**: Typical Owls
212. *Megascops kennicottii* (Elliot 1867). Western Screech-Owl.
213. *Megascops asio* (Linnaeus 1758). Eastern Screech-Owl.
214. *Bubo virginianus* (Gmelin 1788). Great Horned Owl.
215. *Bubo scandiacus* (Linnaeus 1758). Snowy Owl.
216. *Athene cunicularia* (Molina 1782). Burrowing Owl.
217. *Strix varia (*Barton 1799). Barred Owl.
218. *Asio otus* (Linnaeus 1758). Long-eared Owl.
219. *Asio flammeus* (Pontoppidan 1763). Short-eared Owl.
220. *Aegolius acadicus* (Gmelin 1788). Northern Saw-whet Owl.
CAPRIMULGIFORMES
Family **Caprimulgidae**: Goatsuckers
221. *Chordeiles acutipennis* (Hermann 1783). Lesser Nighthawk.
222. *Chordeiles minor* (Forster 1771). Common Nighthawk.
223. *Phalaenoptilus nuttallii* (Audubon 1844). Common Poorwill.
224. *Caprimulgus carolinensis (*Gmelin 1789). Chuck-will's-widow.
225. *Caprimulgus vociferus (*Wilson 1812). Eastern Whip-poor-will.
APODIFORMES
Family **Apodidae**: Swifts
226. *Chaetura pelagica* (Linnaeus 1758). Chimney Swift.
227. [*Aeronautes saxatalis* (Woodhouse 1853). White-throated Swift.]
Family **Trochilidae**: Hummingbirds
228. **Colibri thalassinus* (Swainson 1827). Green Violetear.
229. **Cynanthus latirostris* Swainson 1827. Broad-billed Hummingbird.
230. *Archilochus colubris* (Linnaeus 1758). Ruby-throated Hummingbird.
231. *Archilochus alexandri* (Bourcier and Mulsant 1846). Black-chinned Hummingbird.
232. *Calypte anna* (Lesson 1829). Anna's Hummingbird.
233. **Stellula calliope* (Gould 1847). Calliope Hummingbird.
234. **Selasphorus platycercus* (Swainson 1827). Broad-tailed Hummingbird.
235. *Selasphorus rufus* (Gmelin 1788). Rufous Hummingbird.
CORACIIFORMES
Family **Alcedinidae**: Kingfishers
236. **Megaceryle torquata* (Linnaeus 1766). Ringed Kingfisher.
237. *Megaceryle alcyon* (Linnaeus 1758). Belted Kingfisher.
PICIFORMES
Family **Picidae**: Woodpeckers and Allies
238. *Melanerpes lewis* (Gray 1849). Lewis's Woodpecker.
239. *Melanerpes erythrocephalus* (Linnaeus 1758). Red-headed Woodpecker.
240. *Melanerpes formicivorus* (Swainson 1827). Acorn Woodpecker.
241. *Melaanerpes aurifrons* (Wagler 1829). Golden-fronted Woodpecker.
242. *Melanerpes carolinus* (Linnaeus 1758). Red-bellied Woodpecker.
243. *Sphyrapicus thyroideus* (Cassin 1852). Williamson's Sapsucker.
244. *Sphyrapicus varius* (Linnaeus 1766). Yellow-bellied Sapsucker.

245. *Sphyrapicus nuchalis (*Baird 1858). Red-naped Sapsucker.
246. *Picoides scalaris* (Wagler 1829). Ladder-backed Woodpecker.
247. *Picoides pubescens* (Linnaeus 1766). Downy Woodpecker.
248. *Picoides villosus* (Linnaeus 1766). Hairy Woodpecker.
249. *Picoides borealis* (Vieillot 1809). Red-cockaded Woodpecker.
250. *Colaptes auratus* (Linnaeus 1758). Northern Flicker.
251. *Dryocopus pileatus* (Linnaeus 1758). Pileated Woodpecker.
252. †*Campephilus principalis* (Linnaeus 1758). Ivory-billed Woodpecker.
PASSERIFORMES
Family **Tyrannidae**: Tyrant Flycatchers
253. *Contopus cooperi* (Nuttall 1831). Olive-sided Flycatcher.
254. *Contopus sordidulus (*Sclater 1859). Western Wood-Pewee.
255. *Contopus virens* (Linnaeus 1766). Eastern Wood-Pewee.
256. *Empidonax flaviventris* (Baird and Baird 1843). Yellow-bellied Flycatcher.
257. *Empidonax virescens* (Vieillot 1818). Acadian Flycatcher.
258. *Empidonax alnorum (*Brewster 1895). Alder Flycatcher.
259. *Empidonax traillii* (Audubon 1828). Willow Flycatcher.
260. *Empidonax minimus* (Baird and Baird 1843). Least Flycatcher.
261. *Empidonax hammondii* (Xántus de Vesey 1858). Hammond's Flycatcher.
262. [*Empidonax wrightii (*Baird 1858). Gray Flycatcher.]
263. *Empidonax oberholseri (*Phillips 1939). Dusky Flycatcher.
264. *Empidonax occidentalis* (Nelson 1897). Cordilleran Flycatcher.
265. **Sayornis nigricans* (Swainson 1827). Black Phoebe.
266. *Sayornis phoebe* (Latham 1790). Eastern Phoebe.
267. *Sayornis saya* (Bonaparte 1825). Say's Phoebe.
268. *Pyrocephalus rubinus* (Boddaert 1783). Vermilion Flycatcher.
269. [*Myiarchus tuberculifer* (d'Orbigny and Lafresnaye 1837). Dusky-capped Flycatcher.]
270. *Myiarchus cinerascens* (Lawrence 1851). Ash-throated Flycatcher.
271. *Myiarchus crinitus* (Linnaeus 1758). Great Crested Flycatcher.
272. **Pitangus sulphuratus* (Linnaeus 1766). Great Kiskadee.
273. *Tyrannus vociferans (*Swainson 1826). Cassin's Kingbird.
274. *Tyrannus verticalis (*Say 1823). Western Kingbird.
275. *Tyrannus tyrannus* (Linnaeus 1758). Eastern Kingbird.
276. *Tyrannus forficatus* (Gmelin 1789). Scissor-tailed Flycatcher.
Family **Laniidae**: Shrikes
277. *Lanius ludovicianus (*Linnaeus 1766). Loggerhead Shrike.
278. *Lanius excubitor (*Linnaeus 1758). Northern Shrike.
Family **Vireonidae**: Vireos
279. *Vireo griseus* (Boddaert 1783). White-eyed Vireo.
280. *Vireo bellii (*Audubon 1844). Bell's Vireo.
281. *Vireo atricapilla (*Woodhouse 1852). Black-capped Vireo.
282. *Vireo vicinior (*Coues 1866). Gray Vireo.
283. *Vireo flavifrons (*Vieillot 1808). Yellow-throated Vireo.

284. *Vireo plumbeus (*Coues 1866). Plumbeous Vireo.
285. *Vireo cassinii (*Xantus de Vasey). 1858. Cassin's Vireo.
286. *Vireo solitarius* (Wilson 1810). Blue-headed Vireo.
287. *Vireo gilvus* (Vieillot 1808). Warbling Vireo.
288. *Vireo philadelphicus* (Cassin 1851). Philadelphia Vireo.
289. *Vireo olivaceus* (Linnaeus 1766). Red-eyed Vireo.
Family **Corvidae**: Crows and Jays
290. [*Perisoreus canadensis* (Linnaeus 1766). Gray Jay.]
291. *Gymnorhinus cyanocephalus (*Wied 1841). Pinyon Jay.
292. *Cyanocitta stelleri* (Gmelin 1788). Steller's Jay.
293. *Cyanocitta cristata* (Linnaeus 1758). Blue Jay.
294. *Aphelocoma californica* (Vigors 1839). Western Scrub-Jay.
295. *Nucifraga columbiana* (Wilson 1811). Clark's Nutcracker.
296. *Pica hudsonia* (Sabine 1823). Black-billed Magpie.
297. *Corvus brachyrhynchos (*Brehm 1822). American Crow.
298. *Corvus ossifragus (*Wilson 1812). Fish Crow.
299. *Corvus cryptoleucus (*Couch 1854). Chihuahuan Raven.
300. *Corvus corax (*Linnaeus 1758). Common Raven.
Family **Alaudidae**: Larks
301. *Eremophila alpestris* (Linnaeus 1758). Horned Lark.
Family **Hirundinidae**: Swallows
302. *Progne subis* (Linnaeus 1758). Purple Martin.
303. *Tachycineta bicolor* (Vieillot 1808). Tree Swallow.
304. [*Tachycineta thalassina* (Swainson 1827). Violet-green Swallow.]
305. *Stelgidopteryx serripennis* (Audubon 1838). Northern Rough-winged Swallow.
306. *Riparia riparia* (Linnaeus 1758). Bank Swallow.
307. *Petrochelidon pyrrhonota* (Vieillot 1817). Cliff Swallow.
308. *Petrochelidon fulva* (Vieillot 1808). Cave Swallow.
309. *Hirundo rustica (*Linnaeus 1758). Barn Swallow.
Family **Paridae**: Chickadees and Titmice
310. *Poecile carolinensis* (Audubon 1834). Carolina Chickadee.
311. *Poecile atricapillus* (Linnaeus 1766). Black-capped Chickadee.
312. *Poecile gambeli* (Ridgway 1886). Mountain Chickadee.
313. *Baeolophus ridgwayi* (Richmond 1902). Juniper Titmouse.
314. *Baeolophus bicolor* (Linnaeus 1766). Tufted Titmouse.
315. *Baeolophus atricristatus* (Cassin 1850). Black-crested Titmouse.
Family **Remizidae**: Penduline Tits and Verdin
316. *Auriparus flaviceps* (Sundevall 1850). Verdin.
Family **Aegithalidae**: Long-tailed Tits and Bushtits
317. *Psaltriparus minimus* (Townsend 1837). Bushtit.
Family **Sittidae**: Nuthatches
318. *Sitta canadensis (*Linnaeus 1766). Red-breasted Nuthatch.
319. *Sitta carolinensis (*Latham 1790). White-breasted Nuthatch.

320. *Sitta pygmaea (*Vigors 1839). Pygmy Nuthatch.
321. *Sitta pusilla (*Latham 1790). Brown-headed Nuthatch.
Family **Certhiidae**: Creepers
322. *Certhia americana (*Bonaparte 1838). Brown Creeper.
Family **Troglodytidae**: Wrens
323. *Salpinctes obsoletus* (Say 1823). Rock Wren.
324. *Catherpes mexicanus* (Swainson 1829). Canyon Wren.
325. *Thryothorus ludovicianus* (Latham 1790). Carolina Wren.
326. *Thryomanes bewickii* (Audubon 1827). Bewick's Wren.
327. *Troglodytes aedon (*Vieillot 1809). House Wren.
328. *Troglodytes hiemalis (*Vieillot 1819). Winter Wren.
329. *Cistothorus platensis* (Latham 1790). Sedge Wren.
330. *Cistothorus palustris* (Wilson 1810). Marsh Wren.
Family **Polioptilidae**: Gnatcatchers and Gnatwrens
331. *Polioptila caerulea* (Linnaeus 1766). Blue-gray Gnatcatcher.
Family **Regulidae**: Kinglets
332. *Regulus satrapa (*Lichtenstein 1823). Golden-crowned Kinglet.
333. *Regulus calendula* (Linnaeus 1766). Ruby-crowned Kinglet.
Family **Turdidae**: Thrushes
334. *Sialia sialis* (Linnaeus 1758). Eastern Bluebird.
335. *Sialia mexicana (*Swainson 1832). Western Bluebird.
336. *Sialia currucoides* (Bechstein 1798). Mountain Bluebird.
337. *Myadestes townsendi* (Audubon 1838). Townsend's Solitaire.
338. *Catharus fuscescens* (Stephens 1817). Veery.
339. *Catharus minimus* (Lafresnaye 1848). Gray-cheeked Thrush.
340. *Catharus ustulatus* (Nuttall 1840). Swainson's Thrush.
341. *Catharus guttatus* (Pallas 1811). Hermit Thrush.
342. *Hylocichla mustelina* (Gmelin 1789). Wood Thrush.
343. *Turdus migratorius (*Linnaeus 1766). American Robin.
344. **Ixoreus naevius* (Gmelin 1789). Varied Thrush.
Family **Mimidae**: Mockingbirds and Thrashers
345. *Dumetella carolinensis* (Linnaeus 1766). Gray Catbird.
346. *Mimus polyglottos* (Linnaeus 1758). Northern Mockingbird.
347. *Oreoscoptes montanus* (Townsend 1837). Sage Thrasher.
348. *Toxostoma rufum* (Linnaeus 1758). Brown Thrasher.
349. *Toxostoma curvirostre* (Swainson 1827). Curve-billed Thrasher.
Family **Sturnidae**: Starlings
350. *Sturnus vulgaris (*Linnaeus 1758). European Starling.
Family **Motacillidae**: Wagtails and Pipits
351. *Anthus rubescens* (Tunstall 1771). American Pipit.
352. *Anthus spragueii* (Audubon 1844). Sprague's Pipit.
Family **Bombycillidae**: Waxwings
353. *Bombycilla garrulus* (Linnaeus 1758). Bohemian Waxwing.

354. *Bombycilla cedrorum (*Vieillot 1808). Cedar Waxwing.
Family **Ptilogonatidae**: Silky-Flycatchers
355. [*Phainopepla nitens* (Swainson 1838). Phainopepla.]
Family **Calcariidae**: Longspurs and Snow Buntings
356. *Calcarius lapponicus* (Linnaeus 1758). Lapland Longspur.
357. *Calcarius ornatus* (Townsend 1837). Chestnut-collared Longspur.
358. *Calcarius pictus* (Swainson 1832). Smith's Longspur.
359. *Rhynchophanes mccownii* (Lawrence 1851). McCown's Longspur.
360. *Plectrophenax nivalis* (Linnaeus 1758). Snow Bunting.
Family **Parulidae**: Wood-Warblers
361. *Seiurus aurocapilla* (Linnaeus 1766). Ovenbird.
362. *Helmitheros vermivorum* (Gmelin 1789). Worm-eating Warbler.
363. *Parkesia motacilla* (Vieillot 1809). Louisiana Waterthrush.
364. *Parkesia noveboracensis* (Gmelin 1789). Northern Waterthrush.
365. *Vermivora chrysoptera* (Linnaeus 1766). Golden-winged Warbler.
366. *Vermivora cyanoptera* (Olson and Reveal 2009). Blue-winged Warbler.
367. *Mniotilta varia* (Linnaeus 1766). Black-and-white Warbler.
368. *Protonotaria citrea* (Boddaert 1783). Prothonotary Warbler.
369. *Limnothlypis swainsonii* (Audubon 1834). Swainson's Warbler.
370. *Oreothlypis peregrina* (Wilson 1811). Tennessee Warbler.
371. *Oreothlypis celata* (Say 1823). Orange-crowned Warbler.
372. *Oreothlypis ruficapilla* (Wilson 1811). Nashville Warbler.
373. *Oreothlypis virginiae* (Baird 1860). Virginia's Warbler.
374. *Oporornis agilis* (Wilson 1812). Connecticut Warbler.
375. *Geothlypis tolmiei* (Townsend 1839). MacGillivray's Warbler.
376. *Geothlypis philadelphia* (Wilson 1810). Mourning Warbler.
377. *Geothlypis formosa* (Wilson 1811). Kentucky Warbler.
378. *Geothlypis trichas* (Linnaeus 1766). Common Yellowthroat.
379. *Setophaga citrina* (Boddaert 1783). Hooded Warbler.
380. *Setophaga ruticilla* (Linnaeus 1758). American Redstart.
381. *Setophaga tigrina* (Gmelin 1789). Cape May Warbler.
382. *Setophaga cerulea* (Wilson 1810). Cerulean Warbler.
383. *Setophaga americana* (Linnaeus 1758). Northern Parula.
384. *Setophaga magnolia* (Wilson 1811). Magnolia Warbler.
385. *Setophaga castanea* (Wilson 1810). Bay-breasted Warbler.
386. *Setophaga fusca* (Müller 1776). Blackburnian Warbler.
387. *Setophaga petechia* (Linnaeus 1766). Yellow Warbler.
388. *Setophaga pensylvanica* (Linnaeus 1766). Chestnut-sided Warbler.
389. *Setophaga striata* (Forster 1772). Blackpoll Warbler.
390. *Setophaga caerulescens* (Gmelin 1789). Black-throated Blue Warbler.
391. *Setophaga palmarum* (Gmelin 1789). Palm Warbler.
392. *Setophaga pinus* (Wilson 1811). Pine Warbler.
393. *Setophaga coronata* (Linnaeus 1766). Yellow-rumped Warbler.

394. *Setophaga dominica* (Linnaeus 1766). Yellow-throated Warbler.
395. *Setophaga discolor* (Vieillot 1809). Prairie Warbler.
396. [*Setophaga graciae* (Baird 1865). Grace's Warbler.]
397. *Setophaga nigrescens* (Townsend 1837). Black-throated Gray Warbler.
398. *Setophaga townsendi* (Townsend 1837). Townsend's Warbler.
399. *Setophaga virens* (Gmelin 1789). Black-throated Green Warbler.
400. *Cardellina canadensis* (Linnaeus 1766). Canada Warbler.
401. *Cardellina pusilla* (Wilson 1811). Wilson's Warbler.
402. *Icteria virens* (Linnaeus 1758). Yellow-breasted Chat.
Family **Emberizidae**: Emberizids
403. *Pipilo chlorurus* (Audubon 1839). Green-tailed Towhee.
404. *Pipilo maculatus (*Swainson 1827). Spotted Towhee.
405. *Pipilo erythrophthalmus* (Linnaeus 1758). Eastern Towhee.
406. *Aimophila ruficeps* (Cassin 1852). Rufous-crowned Sparrow.
407. *Melozone fusca* (Swainson 1827). Canyon Towhee.
408. *Peucaea cassinii* (Woodhouse 1852). Cassin's Sparrrow.
409. *Peucaea aestivalis* (Lichtenstein 1823). Bachman's Sparrow.
410. *Spizella arborea* (Wilson 1810). American Tree Sparrow.
411. *Spizella passerina* (Bechstein 1798). Chipping Sparrow.
412. *Spizella pallida* (Swainson 1832). Clay-colored Sparrow.
413. *Spizella breweri (*Cassin 1856). Brewer's Sparrow.
414. *Spizella pusilla* (Wilson 1810). Field Sparrow.
415. *Pooecetes gramineus* (Gmelin 1789). Vesper Sparrow.
416. *Chondestes grammacus* (Say 1823). Lark Sparrow.
417. *Amphispiza bilineata* (Cassin 1850). Black-throated Sparrow.
418. **Amphispiza belli* (Cassin 1850). Sage Sparrow.
419. *Calamospiza melanocorys* (Stejneger 1885). Lark Bunting.
420. *Passerculus sandwichensis* (Gmelin 1789). Savannah Sparrow.
421. *Ammodramus savannarum* (Gmelin 1789). Grasshopper Sparrow.
422. *Ammodramus bairdii* (Audubon 1844). Baird's Sparrow.
423. **Ammodramus henslowii* (Audubon 1829). Henslow's Sparrow.
424. *Ammodramus leconteii* (Audubon 1844). Le Conte's Sparrow.
425. *Ammodramus nelsoni* (Allen 1875). Nelson's Sparrow.
426. *Passerella iliaca* (Merrem 1786). Fox Sparrow.
427. *Melospiza melodia* (Wilson 1810). Song Sparrow.
428. *Melospiza lincolnii* (Audubon 1834). Lincoln's Sparrow.
429. *Melospiza georgiana* (Latham 1790). Swamp Sparrow.
430. *Zonotrichia albicollis* (Gmelin 1789). White-throated Sparrow.
431. *Zonotrichia querula* (Nuttall 1840). Harris's Sparrow.
432. *Zonotrichia leucophrys* (Forster 1772). White-crowned Sparrow.
433. *Junco hyemalis* (Linnaeus 1758). Dark-eyed Junco.
Family **Cardinalidae** Cardinals and Allies
434. **Piranga flava* (Vieillot 1822). Hepatic Tanager.

435. *Piranga rubra* (Linnaeus 1758). Summer Tanager.
436. *Piranga olivacea* (Gmelin 1789). Scarlet Tanager.
437. *Piranga ludoviciana* (Wilson 1811). Western Tanager.
438. *Cardinalis cardinalis* (Linnaeus 1758). Northern Cardinal.
439. **Cardinalis sinuatus* Bonaparte 1839. Pyrrhuloxia.
440. *Pheucticus ludovicianus* (Linnaeus 1766). Rose-breasted Grosbeak.
441. *Pheucticus melanocephalus* (Swainson 1827). Black-headed Grosbeak.
442. *Passerina caerulea* (Linnaeus 1758). Blue Grosbeak.
443. *Passerina amoena* (Say 1823). Lazuli Bunting.
444. *Passerina cyanea* (Linnaeus 1766). Indigo Bunting.
445. *Passerina ciris* (Linnaeus 1758). Painted Bunting.
446. *Spiza americana* (Gmelin 1789). Dickcissel.
Family **Icteridae**: Blackbirds
447. *Dolichonyx oryzivorus* (Linnaeus 1758). Bobolink.
448. *Agelaius phoeniceus* (Linnaeus 1766). Red-winged Blackbird.
449. *Sturnella magna* (Linnaeus 1758). Eastern Meadowlark.
450. *Sturnella neglecta (*Audubon 1844). Western Meadowlark.
451. *Xanthocephalus xanthocephalus* (Bonaparte 1826). Yellow-headed Blackbird.
452. *Euphagus carolinus* (Müller 1776). Rusty Blackbird.
453. *Euphagus cyanocephalus* (Wagler 1829). Brewer's Blackbird.
454. *Quiscalus quiscula* (Linnaeus 1758). Common Grackle.
455. *Quiscalus mexicanus* (Gmelin 1788). Great-tailed Grackle.
456. *Molothrus bonariensis* (Gmelin 1789). Shiny Cowbird.
457. *Molothrus aeneus* (Wagler 1829). Bronzed Cowbird.
458 *Molothrus ater* (Boddaert 1783). Brown-headed Cowbird.
459 *Icterus spurius* (Linnaeus 1766). Orchard Oriole.
460. *Icterus bullockii* (Swainson 1827). Bullock's Oriole.
461 *Icterus galbula* (Linnaeus 1758). Baltimore Oriole.
Family **Fringillidae**: Fringilline and Cardueline Finches and Allies
462. **Pinicola enucleator* (Linnaeus 1758). Pine Grosbeak.
463. *Carpodacus purpureus* (Gmelin 1789). Purple Finch.
464. *Carpodacus cassinii (*Baird 1854). Cassin's Finch.
465. *Carpodacus mexicanus* (Müller 1776). House Finch.
466. *Loxia curvirostra (*Linnaeus 1758). Red Crossbill.
467. *Loxia leucoptera (*Gmelin 1789). White-winged Crossbill.
468. *Acanthis flammea* (Linnaeus 1758). Common Redpoll.
469. *Spinus pinus* (Wilson 1810). Pine Siskin.
470. *Spinus psaltria* (Say 1823). Lesser Goldfinch.
471. *Spinus tristis* (Linnaeus 1758). American Goldfinch.
472. *Coccothraustes vespertinus* (Cooper 1825). Evening Grosbeak.

Family **Passeridae**: Old World Sparrows
473. *Passer domesticus* (Linnaeus 1758). House Sparrow.

*species documented with a recognizable photograph.
[ ] indicate species supported only by written documentation. The mute swan and Monk Parakeet also have brackets [ ] around their names due to unknown origin.
†extinct and possibly extinct species.

Adapted from:

OBRC (Oklahoma Bird Records Committee). 2011. The Oklahoma Ornithological Society Checklist of Oklahoma Birds, 4th edition. Oklahoma Ornithological Society, Norman, Oklahoma.

ATTACHMENT H. SPECIES OF GREATEST CONSERVATION NEED IN THE PENSACOLA PROJECT VICINITY

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Attachment H

Species of Greatest Conservation Need in the Pensacola Project Vicinity

Below are tables of Federal and State Listed Species, State Designated Species of Greatest Conservation Need, and State Rare and/or Vulnerable Plant Species potentially occurring in the project vicinity (ODWC 2015a, 2015b; ONHI 2016). Although there is no regulatory protection for species not listed under the Endangered Species Act (ESA) as threatened or endangered, the status of many native species is tracked because of their rarity and/or vulnerability. The State of Oklahoma currently lists 144 Species of Greatest Conservation Need (also includes federal threatened and endangered species) that potentially occur near the Project. The state lists species occurrence by ecoregion – Ozark east of Grand Lake and Tall Grass Prairie west of Grand Lake. The U.S. Fish and Wildlife Service (USFWS) lists species by county – Craig, Delaware, Mayes, and Ottawa that surround Grand Lake. In addition the Oklahoma Natural Heritage Inventory (ONHI), which tracks biodiversity world wide, lists four rare and/or vulnerable plants in the Project vicinity.

Table 1 Species of greatest conservation need in the Pensacola Project vicinity (ODWC 2015b and ODWC 2015c): x = occurs in ecoregion, St = state, F = federal, E = endangered, T = threatened, C= candidate.

Species		Ecoregion		
Scientific Name	**Common Name**	**Ozarks**	**Tallgrass Prairie**	**Listing**
Amphibians				
Lithobates areolatus	Crawfish frog	x	x	
Eurycea spelaea	Grotto salamander	x		
Eurycea tynerensis	Oklahoma salamander	x		
Cryptobranchus alleganiensis	Ozark salamander	x		
Ambystoma annulatum	Ringed salamander	x		
Birds				
Pluvialis dominica	American golden plover	x	x	
Scolopax minor	American woodcock	x	x	
Peucaea aestivalis	Backman's sparrow	x	x	
Haliaeetus leucocephalus	Bald eagle	x	x	
Tyto alba	Barn owl		x	
Vireo bellii	Bell's vireo	x	x	
Vermivora cyanoptera	Blue-winged warbler	x		
Sitta pusilla	Brown-headed nuthatch	x		
Calidris subruficollis	Buff-breasted sandpiper		x	
Aythya valisineria	Canvasback	x	x	
Setophaga cerulea	Cerulean warbler	x		
Tympanuchus cupido	Greater prairie chicken		x	
Zonotrichia querula	Harris's sparrow	x	x	
Ammodramus henslowii	Henslow's sparrow	x	x	

Species		Ecoregion		
Scientific Name	Common Name	Ozarks	Tallgrass Prairie	Listing
Setophaga citrina	Hooded warbler	x		
Limosa haemastica	Hudsonian godwit		x	
Sterna antillarum athalassos	Interior least tern		x	
Geothlypis formosa	Kentucky warbler	x	x	
Rallus elegans	King rail		x	
Ammodramus leconteii	LeConte's sparrow	x	x	
Aythya affinis	Lesser scaup	x	x	
Egretta caerulea	Little blue heron	x	x	
Lanius ludovicianus	Loggerhead shrike	x	x	
Parkesia motacilla	Louisiana waterthrush	x	x	
Ammodramus nelsoni	Nelson's sharp-tailed sparrow	x	x	
Colinus virginianus	Northern bobwhite	x	x	
Anas acuta	Northern pintail	x	x	
Passerina ciris	Painted bunting	x	x	
Falco peregrinus	Peregrine falcon		x	
Charadrius melodus	Piping plover	x	x	F-T
Falco mexicanus	Prairie falcon		x	
Setophaga discolor	Prairie warbler	x		
Protonotaria citrea	Prothonotary warbler	x	x	
Melanerpes erythrocephalus	Red-headed woodpecker	x	x	
Calidris canutus rufa	Rufa red knot			F-T
Euphagus carolinus	Rusty blackbird	x	x	
Asio flammeus	Short-eared owl	x	x	
Calcarius pictus	Smith's longspur	x	x	
Egretta thula	Snowy egret	x	x	
Tringa solitaria	Solitary sandpiper	x	x	
Anthus spragueii	Sprague's pipit		x	
Buteo swainsoni	Swainson's hawk		x	
Cygnus buccinator	Trumpeter swan	x	x	
Bartramia longicauda	Upland sandpiper	x	x	
Calidris mauri	Western sandpiper		x	
Antrostomus vociferus	Whip-poor-will	x		
Empidonax traillii	Willow flycatcher	x	x	
Phalaropus tricolor	Wilson's phalarope		x	
Helmitheros vermivorum	Worm-eating warbler	x		
Coturnicops noveboracensis	Yellow rail	x	x	
Fish				
Alosa alabamae	Alabama shad	x		
Etheostoma cragini	Arkansas darter	x	x	F-C
Ictiobus niger	Black buffalo		x	

Species		Ecoregion		
Scientific Name	**Common Name**	**Ozarks**	**Tallgrass Prairie**	**Listing**
Percina maculata	Blackside darter	x		St-T
Cycleptus elongatus	Blue sucker	x		
Cyprinella camura	Bluntface shiner	x	x	
Luxilus cardinalis	Cardinal shiner	x	x	
Notropis ortenburgeri	Kiamichi shiner		x	
Etheostoma microperca	Least darter	x		
Percina nasuta	Longnose darter	x		St-E
Noturus placidus	Neosho madtom		x	F-T
Amblyopsis rosae	Ozark cavefish	x		F-T
Notropis nubilus	Ozark minnow	x		
Polyodon spathula	Paddlefish	x	x	
Hybognathus placitus	Plains minnow		x	
Fundulus sciadicus	Plains topminnow	x		
Etheostoma whipplei	Redfin darter	x	x	
Nocomis asper	Redspot chub	x		
Percina shumardi	River darter	x		
Moxostoma macrolepidotum	Shorthead redhorse	x		
Scaphirhynchus platorynchus	Shovelnose sturgeon		x	
Ichthyomyzon gagei	Southern brook lamprey	x		
Cyprinella spiloptera	Spotfin shiner	x		
Etheostoma mihileze	Sunburst darter	x		
Notropis greenei	Wedgespot shiner	x		
Invertebrates				
Zonitoides kirbyi	Shadow gloss snail	x	x	
Catinella wandae	Slope ambersnail		x	
Neohelix lioderma	Tulsa whitelip snail		x	
Helicodiscus nummus	Wax coil snail		x	
Ellipsaria lineolata	Butterfly mussel		x	
Quadrula metanevra	Monkeyface mussel		x	
Lampsilis rafinesqueana	Neosho mucket	x	x	St-E, F-E
Ptychobranchus occidentalis	Ouachita kidneyshell	x	x	
Fusconaia ozarkensis	Ozark pigtoe	x		
Lampsilis cardium	Plain pocketbook	x	x	
Toxolasma lividus	Purple lilliput	x		
Quadrula cylindrica	Rabbitsfoot	x	x	F-T
Quadrula nodulata	Wartyback mussel		x	
Megalonaias nervosa	Washboard		x	
Cyprogenia aberti	Western fanshell		x	
Texella reyesi	Cave harvestman		x	
Bombus pensylvanicus	American bumble bee		x	

Species		Ecoregion		
Scientific Name	**Common Name**	**Ozarks**	**Tallgrass Prairie**	**Listing**
Nicrophorus americanus	American burying beetle	x	x	F-E
Atrytone arogos	Arogos (Iowa) skipper	x	x	
Problema byssus	Byssus skipper	x	x	
Hesperia attalus	Dotted skipper		x	
Amblyscirtes linda	Linda's roadside skipper	x	x	
Dromochorus belfragei	Loamy-ground tiger beetle		x	
Nixe flowersi (mayfly)	none	x		
Gomphus oklahomensis	Oklahoma clubtail	x		
Gomphus ozarkensis	Ozark clubtail	x		
Somatochlora ozarkensis	Ozark emerald	x		
Gryllotalpa Major	Prairie mole cricket	x	x	
Papaipema eryngi	Rattlesnake master borer moth	x		
Tricorythodes curvatus (mayfly)	none	x		
Trigenotyla blacki (cave obligate millipede)	none	x		
Caecidotea (eight cave spp.)	none			
Crangonyx forbesi	none	x		
Stygobromus bowmani	Bowman's cave amphipod	x		
Bactrurus hubrichti	Kansas well amphipod	x	x	
Stygobromus ozarkensis	Ozark cave amphipod	x		
Cambarus subterraneus	Delaware county cave crayfish	x		St-E
Orconectes (four crayfish spp.)	none	x		
Procambarus tenuis	none	x		
Mammals				
Reithrodontomys humulis	Eastern harvest mouse		x	
Spilogale putorius	Eastern spotted skunk	x	x	
Myotis grisescens	Gray bat	x		F-E
Myotis sodalis	Indiana bat	x		F-E
Mustela frenata	Long-tailed weasel	x		
Zapus hudsonius	Meadow jumping mouse		x	
Myotis septentrionalis	Northern long-eared bat	x	x	F-T
Plecotus townsendii ingens	Ozark big-eared bat	x		F-E
Sylvilagus aquaticus	Swamp rabbit	x	x	
Perimyotis subflavus	Tri-colored bat	x	x	
Reptiles				
Macrochelys temminckii	Alligator snapping turtle	x	x	
Pseudemys concinna concinna	Eastern river cooter	x	x	
Apalone mutica mutica	Midland smooth softshell		x	

Species		Ecoregion		
Scientific Name	**Common Name**	**Ozarks**	**Tallgrass Prairie**	**Listing**
Graptemys pseudogeographica kohnii	Mississippi map turtle	x	x	
Graptemys geographica	Northern map turtle	x		
Cemophora coccinea copei	Northern scarletsnake	x		
Graptemys ouachitensis	Ouachita map turtle	x	x	
Apalone spinifera	Spiny softshell turtle	x	x	
Phrynosoma cornutum	Texas horned lizard		x	
Crotalus atrox	Western diamondback rattlesnake	x		
Sistrurus catenatus tergeminus	Western massasauga		x	
Plants				
Platanthera praeclara	Western prairie-fringed orchid			F-T

Table 2 Rare and vulnerable plant species of Oklahoma potentially occurring in the Project vicinity, tracked by the Oklahoma Natural Heritage Inventory (ONHI undated).

Scientific Name	Common Name
Agalinis auriculata	Skinners foxglove
Tradescantia ozarkana	Ozark spiderwort
Carex fissa	Hammock sedge
Castanea pumila var. ozarkensis	Ozark chinquapin

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ATTACHMENT I. ARCHAEOLOGICAL AND HISTORIC RESOURCES WITHIN THE VICINITY OF THE PROJECT

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NOTE: Because of the potentially sensitive nature of information regarding archeological and historic sites containing cultural resources, the information contained in Attachment I is not being distributed to the general public. This information has been filed with the Federal Energy Regulatory Commission (FERC) separate from the Pre-Application Document with a Privileged designation. It may be obtained by request to Grand River Dam Authority or FERC, subject to confidentiality provisions.

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