



September 30, 2021

Via E-Filing

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

**Subject: Pensacola Hydroelectric Project (FERC Project No. 1494-438)  
Initial Study Report**

Dear Secretary Bose:

The Grand River Dam Authority (GRDA) hereby electronically files its Initial Study Report (ISR) pursuant to 18 C.F.R. § 5.15(c) for the relicensing of the Pensacola Hydroelectric Project (FERC No. 1494). The purpose of this ISR is to describe GRDA's overall progress in implementing its relicensing study plan and schedule and provides an explanation of variances from the study plans and schedules outlined in the Revised Study Plan (RSP), which was filed by GRDA in September 2018 and approved with Federal Energy Regulatory Commission (Commission) staff-recommended modifications in its November 8, 2018 study plan determination letter.

This ISR includes approved study plans (the Terrestrial Species of Concern Study and the Wetlands and Riparian Habitat Study), the six study plans approved with modifications (the Hydrologic and Hydraulic Modeling Study, the Sedimentation Study, the Aquatic Species of Concern Study, the Recreation Facilities Inventory and Use Study, the Cultural Resources Study, and the Socioeconomics Study), and the two Commission staff recommended studies (the Bathymetric Survey and the Infrastructure Study) for a total of 10 FERC Approved Study Plan Reports.

One of the ten studies, the Cultural Resources Studies, contain sensitive information; Therefore, pursuant to 18 CFR § 388.112(b) and 388.113(c)(1), GRDA accordingly requests designation and special treatment of the reports in their entirety as Privileged material by maintaining these reports in the Commission's non-public file.

Pursuant to 18 CFR § 5.15(c)(2), GRDA has scheduled an ISR meeting for Tuesday, October 12, Wednesday, October 13, and Thursday, October 14, 2021, beginning at 9:00 a.m. CDT. The meeting will be held virtually and is not open to the public due to Covid-19 concerns. An informal notification of the meeting location, time, and date was provided to the relicensing participants on record on August 31, 2021. The notice and agenda have been updated to include the virtual information. The agenda is enclosed as Appendix 1 of the ISR.

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Sincerely,

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Enclosure-ISR

cc: Distribution list (see attached)



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# GRAND RIVER DAM AUTHORITY

PENSACOLA HYDROELECTRIC PROJECT  
*FERC No. 1494*

INITIAL STUDY REPORT



September 30, 2021

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## TABLE OF CONTENTS

	Page
<b>1.0 General</b> .....	<b>1</b>
<b>2.0 Process and schedule overview</b> .....	<b>3</b>
2.1 Abeyance Period .....	3
2.2 Study Plan Development .....	4
2.3 Study Plan Determination .....	4
2.4 Modification of Relicensing Plan and Schedule .....	6
2.5 National Defense Authorization Act .....	6
2.6 Model Input Status Report .....	7
2.7 Study Reporting Timeline through USR Meeting .....	7
<b>3.0 Study Variances</b> .....	<b>9</b>
3.1 Study Variances .....	9
<b>4.0 Study Summaries</b> .....	<b>13</b>
4.1 Hydrologic and Hydraulic Study .....	13
4.1.1 Operations Model .....	14
4.1.2 Upstream Model .....	15
4.1.3 Downstream Model .....	16
4.2 Sedimentation Study .....	17
4.3 Aquatic Species of Concern .....	18
4.3.1 Neosho Mucket .....	19
4.3.2 Rabbitsfoot .....	19
4.3.3 Winged Mapleleaf .....	20
4.3.4 Neosho Madtom .....	20
4.3.5 Neosho Smallmouth Bass .....	21
4.3.6 Paddlefish .....	21
4.4 Terrestrial Species of Concern .....	23
4.4.1 American Burying Beetle Survey .....	23
4.4.2 Gray Bat Survey .....	24
4.5 Wetland and Riparian Habitat .....	25
4.6 Recreation Facilities Inventory and Use .....	26
4.7 Cultural Resources .....	26
4.7.1 Cultural Historic Investigation .....	27
4.7.2 Archaeological investigations in 2019 and 2020 .....	27
4.7.3 Archaeological investigations in 2020 and 2021 .....	28
4.7.4 Ethnography Study .....	29
4.8 Socioeconomics .....	30
4.9 Infrastructure .....	31

<b>5.0</b>	<b>USR Study Activities.....</b>	<b>32</b>
5.1	Hydrologic and Hydraulic Modeling .....	32
5.2	Sedimentation .....	32
5.3	Aquatic Species of Concern.....	32
5.3.1	Neosho Mucket Surveys .....	32
5.3.2	Neosho Madtom.....	33
5.4	Terrestrial Species of Concern .....	34
5.5	Wetland and Riparian Habitat .....	34
5.6	Recreation Facilities Inventory and Use .....	34
5.7	Cultural Resources.....	34
5.8	Socioeconomics .....	34
5.9	Infrastructure .....	34
<b>6.0</b>	<b>Requested Study Modifications AND REQUESTED NEW STUDIES.....</b>	<b>34</b>
6.1	Proposed Study Modifications .....	35
6.1.1	Aquatic Species of Concern.....	35
6.1.2	Terrestrial Species of Concern .....	36
6.1.3	Cultural Resources .....	36
6.1.4	Infrastructure .....	37
6.2	Requested New Studies .....	38
<b>7.0</b>	<b>Statement of License Application .....</b>	<b>38</b>
<b>8.0</b>	<b>References .....</b>	<b>39</b>

## Appendices

- Appendix 1: Virtual Meeting Agenda
- Appendix 2: Hydrologic and Hydraulic Study Reports
- Appendix 3: Bathymetry Study Report
- Appendix 4: Sedimentation Study Report
- Appendix 5: Aquatic Species of Concern Report
- Appendix 6: Terrestrial Species of Concern Report
- Appendix 7: Wetland and Riparian Habitat Report
- Appendix 8: Recreation Facilities Inventory and Use Report
- Appendix 9: Cultural Resources Reports
- Appendix 10: Socioeconomics Report
- Appendix 11: Infrastructure Report

## List of Tables

Table 1. Summary of studies included in this ISR .....	1
Table 2. Summary of Commission Staff Recommendations .....	4
Table 3. Reporting and review opportunities associated with the ISR and USR .....	8
Table 4. Study Variances .....	12
Table 5. Proposed Study Modifications .....	38

## List of Abbreviations and Terms

ABB	American Burying Beetle
APE	Area of Potential Effect
Commission	Federal Energy Regulatory Commission
CRWG	Cultural Resources Work Group
DLA	Draft License Application
DHM	Downstream Hydraulic Model
FERC	Federal Energy Regulatory Commission
FRM	Flood Routing Model
Grand Lake	Grand Lake O' the Cherokees
GRDA	Grand River Dam Authority
H&H Study	Hydrologic and Hydraulic Modeling Study
HEC	Hydrologic Engineering Center
ILP	Integrated Licensing Process
ISR	Initial Study Report
Kerr Dam	Robert S. Kerr Dam (Markham Ferry Hydroelectric Project)
Licensee	Grand River Dam Authority
MISR	Model Input Status Report
NDAA	National Defense Authorization Act for Fiscal Year 2020
NOI	Notice of Intent
NRHP	National Register of Historic Places
ODWC	Oklahoma Department of Wildlife Conservation
OM	Operations Model
PAD	Pre-Application Document
PD	Pensacola Datum
PLP	Preliminary Licensing Proposal
Project	Pensacola Hydroelectric Project
PSP	Proposed Study Plan
Qals	Quaternary landforms
RAS	River Analysis System
RM	River Mile
ROI	Region of Influence
RSP	Revised Study Plan
RWM	USACE'S RiverWare Model
SHPO	State Historic Preservation Officer
SPD	Study Plan Determination
STM	Sediment Transport Model
SWT	USACE Southwestern Division, Tulsa District
TCP	Traditional Cultural Properties
UHM	Upstream Hydrologic Model
USACE	United States Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
USR	Updated Study Report
WSEL	Water Surface Elevation



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## 1.0 GENERAL

This document presents Grand River Dam Authority's (GRDA's) Initial Study Report (ISR) for the Pensacola Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC or Commission) Project No. 1494. The ISR describes GRDA's overall progress in implementing its relicensing study plan and schedule, provides an explanation of variances, and proposes modifications from the study plans and schedules outlined in the Revised Study Plan (RSP), which was filed by GRDA in September 2018<sup>1</sup> and approved by FERC in its November 8, 2018<sup>2</sup>, study determination letter (FERC 2018) and further clarified in its January 23, 2019, Order on Request for Clarification and Rehearing (FERC 2019).

Appendices 2 through 11 of this ISR contain the individual reports for the ten studies identified in the RSP. A summary of the studies and the status of each is provided in **Table 1**<sup>3</sup>.

**Table 1. Summary of studies included in this ISR**

Study	Study Consultant(s)	Study Status
Hydrologic and Hydraulic Modeling	Mead & Hunt	Hydrologic and Hydraulic Model development and calibration with five historical and one synthetic model runs complete (with methodology variance).  For the updated Study Report (USR), update Operations Model without RiverWare constraints, update the operations model based upon comments, update Upstream Model based upon comments, update Downstream Model based upon comments, run proposed operation starting elevations for upstream and downstream model to determine anticipated future operations, provide Lentic and Lotic Maps for current and anticipated future operations (schedule variance), as needed, in the Aquatic Species of Concern, the Terrestrial Species of Concern, and the Wetland and Riparian Study.
Bathymetry	U.S. Geological Survey (USGS)	Study complete.
Sedimentation	Anchor QEA (Freshwater Engineering) and Simons and Associates	Sediment Transport Model development and field work complete.  Before December 31, 2021, complete model calibration (schedule variance).  For USR, describe observed or predicted effects of sedimentation due to anticipated future operations.

<sup>1</sup> GRDA's Revised Study Plan, P-1494-438, (September 24, 2018).

<sup>2</sup> Study Plan Determination, P-1494-438, (November 8, 2018).

<sup>3</sup> Modifications are being requested that could change the activities listed in this table.

<p>Aquatic Species of Concern<sup>4</sup></p>	<p>Olsson</p>	<p>Existing information evaluation complete.</p> <p>The assessment of potential impacts of anticipated future operations on paddlefish recruitment based on the area of lost spawning substrate during the paddlefish spawning period will be included in the USR (modification proposed).</p> <p>If necessary, the assessment of potential effects of anticipated future operations on sensitive life stages of the Neosho madtom, Neosho mucket, winged mapleleaf, and Neosho smallmouth bass will be included in the USR.</p>
<p>Terrestrial Species of Concern<sup>5</sup></p>	<p>Horizon Environmental Services</p>	<p>First season American Burying Beetle and Gray Bat Survey complete.</p> <p>Second set of survey results to be reported in USR (modification proposed).</p>
<p>Wetlands and Riparian Habitat</p>	<p>Horizon Environmental Services</p>	<p>Base mapping complete and wetlands have been identified and classified within the area that may be impacted by Project operations according to the H&amp;H Study.</p> <p>Changes in wetland inundation and wetland habitat due to anticipated future operations will be addressed in the USR.</p> <p>If it is determined Project operations are impacting wetlands, the accuracy of the base maps will be verified as necessary through ground-truthing.</p>
<p>Recreation Facilities Inventory and Use</p>	<p>Mead &amp; Hunt</p>	<p>Study complete.</p>
<p>Cultural Resources<sup>6</sup></p>	<p>Wood E&amp;I Solutions Algonquin Consultants, Inc.</p>	<p><b>Wood E&amp;I Solutions</b></p> <p>Archaeological surveys partially complete (with methodology and schedule variances).</p> <p>Complete reporting on archaeological reconnaissance on five sites not included in the ISR.</p> <p>Determine NRHP eligibility on recommended sites in consultation with CRWG.</p> <p>Complete reporting on the surveys of the remaining bluff areas not included in the ISR.</p> <p>Results of remaining 3 areas will be included in the USR.</p>

<sup>4</sup> Due to the sensitive nature of the RTE species information, the study reports will not be available to the public, rather, they will be filed with FERC as Privileged.

<sup>5</sup> Due to the sensitive nature of the RTE species information, the study reports will not be available to the public, rather, they will be filed with FERC as Privileged.

<sup>6</sup> Due to the sensitive nature of the cultural resource information, these study reports will not be available to the public, rather, they will be filed with FERC as Privileged. The report will be reviewed by the Cultural Resource Working Group (CRWG).

		<p><b>Algonquin Consultants, Inc.</b></p> <p>Continue with the Traditional Cultural Properties Inventory.</p>
Socioeconomics	Enercon	Study complete.
Infrastructure	Mead & Hunt	<p>Study completed with methodology variance explained in <b>Section 3.1</b>.</p> <p>Provide additional maps and tabular information based on any anticipated future operations (modification proposed).</p>

Each study report provides all information specified under FERC’s Integrated Licensing Process (ILP) requirements (18 CFR § 5.15) and is generally organized as follows:

- Introduction
- Study objectives
- Study area
- Methods
- Results
- Conclusions
- References
- Appendices

## 2.0 PROCESS AND SCHEDULE OVERVIEW

The current schedule in this integrated licensing process (ILP) began with the Notice of Intent to Relicense (NOI) being filed on February 1, 2017 and is expected to be completed when the current license expires on May 31, 2025. The following activities listed in chronological order have dictated the schedule following the filing of the NOI.

### 2.1 Abeyance Period

On February 15, 2017, Commission staff issued a letter order<sup>7</sup> holding the relicensing process in abeyance until the Commission acted on GRDA’s May 6, 2016, request to amend the project’s license<sup>8</sup>. The Commission issued an order amending the project license<sup>9</sup> on August 15, 2017, and on August 24, 2017, Commission staff issued a letter order<sup>10</sup> (Abeyance Order) that lifted the abeyance and provided an ILP process plan and schedule. As a result, the ILP process commenced on January 12, 2018, and the September 26, 2019, deadline for filing the ISR under 18 CFR § 5.15(c)(1) was established.

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<sup>7</sup> Letter Order Holding the Pensacola Project’s Pre-filing process in Abeyance (February 15, 2017).

<sup>8</sup> GRDA’s Application for Non-Capacity Related Amendment of License (May 6, 2016).

<sup>9</sup> Grand River Dam Authority, 160 FERC ¶ 61,001 (2017).

<sup>10</sup> Letter Order Lifting Abeyance and Providing a Revised ILP Process Plan and Schedule, P-1494-438, (August 24, 2017).

## 2.2 Study Plan Development

According to the Abeyance Order, the deadline for GRDA to file a Proposed Study Plan (PSP) under 18 CFR § 5.11(a) was established as April 27, 2018. On April 27, 2018, GRDA filed its PSP<sup>11</sup> with the Commission and hosted a meeting on the PSP according to 18 CFR § 5.8(b)(3)(viii) on May 30 and 31, 2018. Following the meeting, comments were received on the PSP under 18 CFR § 5.12. GRDA filed its Revised Study Plan (RSP) on September 24, 2018,<sup>12</sup> under 18 CFR § 5.13(a).

## 2.3 Study Plan Determination

As required under 18 CFR § 5.13(c), on November 8, 2018, within 30 days of the filing of the RSP, the Commission issued a Study Plan Determination<sup>13</sup> (SPD) approving the RSP with staff recommended modifications. The SPD made study recommendations outlined in **Table 2**.

**Table 2. Summary of Commission Staff Recommendations**

Study	Staff Recommendation(s)	Recommended Modification(s)
Hydrologic and Hydraulic Modeling	Approved with modifications	<ul style="list-style-type: none"> <li>• Increase range of inflow events and starting elevations.</li> <li>• Lotic and lentic mapping for anticipated future operations.</li> <li>• Update bathymetry.</li> <li>• Define material difference in Model Input Status Report.</li> <li>• Validate model with RiverWare.</li> <li>• Use Pensacola Datum.</li> <li>• Provide access to model.</li> </ul>
Sedimentation	Approved with modifications	<ul style="list-style-type: none"> <li>• Update bathymetry.</li> <li>• Create Sediment Transport Model.</li> <li>• Describe observed or predicted effects of sedimentation on the power pool.</li> <li>• Provide access to model.</li> </ul>
Aquatic Species of Concern	Approved with modifications	<ul style="list-style-type: none"> <li>• Estimate proportion of Neosho Smallmouth Bass spawning habitat affected by anticipated future operations by literature review in Item 1 and, if necessary, survey under Item 2.</li> <li>• Add Neosho Smallmouth Bass lentic and lotic paddlefish evaluation in Item 3.</li> <li>• Review of existing population density estimates in the Project vicinity for Neosho Mucket, Rabbitsfoot Mussel, Winged Mapleleaf Mussel, and Neosho Madtom.</li> <li>• If necessary, survey existing population to estimate density in the Project vicinity for Neosho Mucket, Rabbitsfoot Mussel, Winged Mapleleaf Mussel, and Neosho Madtom.</li> </ul>

<sup>11</sup> GRDA's Proposed Study Plan, P-1494-438, (April 27, 2018).

<sup>12</sup> GRDA's Revised Study Plan, P-1494-438, (September 24, 2018).

<sup>13</sup> Study Plan Determination, P-1494-438, (November 8, 2018).

Terrestrial Species of Concern	Approved	None
Wetlands and Riparian Habitat	Approved	None
Recreation Facilities Inventory and Use	Approved with modifications	<ul style="list-style-type: none"> <li>• Add Spring River, Council Cove, and Willow Park Survey Sites.</li> <li>• Add Wildlife Viewing as an option in question 10.</li> <li>• Add new question about hunting and wildlife viewing recreation activities participated in near Grand Lake in the past year.</li> <li>• Add rating scale to question 13.</li> </ul>
Cultural Resources	Approved with modifications to study plan	<ul style="list-style-type: none"> <li>• Consult with and request concurrence from the Oklahoma State Historic Preservation Officer (SHPO) and THPOs for tribes with lands within the Project boundary on the final Area of Potential Effect (APE).</li> <li>• Final APE should clearly identify the Project boundary, lands outside the Project boundary that are included in the APE, and the specific locations of any tribal trust lands that GRDA and Bureau of Indian Affairs determine are within the Project boundary.</li> <li>• For the Traditional Cultural Properties (TCP) Inventory, GRDA, to the best of its ability, should prepare a summary of study results to date to be filed with the USR, file individual TCP reports for each tribe upon their completion, and file a final comprehensive TCP report that contains the TCP results for all tribes with the final license application.</li> <li>• Obtain concurrence on survey methods with the SHPO.</li> <li>• Evaluate sites in Section 6.9 of the Pre-Application Document in consultation with the Cultural Resources Working Group.</li> <li>• Include a discussion of any project-related effects to identify TCPs during the TCP Inventory including, but not limited to effects associated with recreation in the cultural resources study report.</li> <li>• File sensitive cultural resources information as “privileged” on the Commission’s website.</li> <li>• Documentation on known sites of cultural property should not be shared with all tribes if the cultural property is traceable to a particular tribe or tribes.</li> </ul>
Socioeconomics	Approved with modifications	<ul style="list-style-type: none"> <li>• Include an appendix in the study report containing electronic copies of documents submitted by stakeholders and links to publicly accessible web sites containing such documents.</li> <li>• Include within the study report, a summary of the socioeconomic conditions in the four-county study area, but also tabular data on these conditions reported at the county and census tract level, where such data exist. The study report should clearly state which data source was used for each level of aggregation.</li> </ul>

<p>Infrastructure</p>	<p>Complete new study requirements</p>	<ul style="list-style-type: none"> <li>• In consultation with stakeholders, determine a list of infrastructure to be included in the Infrastructure Study.</li> <li>• Using H&amp;H output, determine the range of inflow conditions for which model results show Project operations and other purposes in combination with the USACE’S flood control operations are likely to have an effect on the frequency and depth of flooding.</li> <li>• Provide maps and table identifying the frequency and depth of flooding for each infrastructure item under existing operations and operations for other purposes.</li> <li>• Provide additional maps and tables based on any alternative operating scenarios proposed or developed through consultation.</li> </ul>
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## 2.4 Modification of Relicensing Plan and Schedule

On May 20, 2019, GRDA requested a modification of the relicensing plan and schedule. It amended its request on June 17, 2019. The modification was requested because of the unanticipated delays due to the abeyance process, the time required to update the bathymetric data, and the need for the updated bathymetric data before the Hydrologic and Hydraulic Model and the Sedimentation Model can be fully developed. On September 9, 2019, the Commission issued an order extending the license term and modifying the relicensing plan and schedule (Extension Order). The Extension Order waived the one-year requirement under 18 CFR § 5.14(c)(1) and established the deadline for submitting the ISR as September 30, 2021.

## 2.5 National Defense Authorization Act

On December 20, 2019, the 116<sup>th</sup> U.S. Congress approved the National Defense Authorization Act for Fiscal Year 2020 (NDAA), and it became law (Pub. L. No. 116-92).

In Title LXXVI, Subtitle B of the NDAA, Congress clarified regulatory oversight over water levels at Grand Lake, providing that:

“Except as may be required by the Secretary [of the Army] to carry out responsibilities under section 7 of the Flood Control Act of 1944 (33 U.S.C. 709), the Commission or any other Federal or State agency shall not include in any license for the project any condition or other requirement relating to—

- (i) surface elevations of the conservation pool; or
- (ii) the flood pool (except to the extent it references flood control requirements prescribed by the Secretary).”

The NDAA includes a narrow exception to this general prohibition on federal and state agencies, providing that the Project is to remain subject to FERC’s rules and regulations for project safety and protection of human health.

In clarifying regulatory oversight at Grand Lake, Congress in the NDAA confirms that the U.S. Army Corps of Engineers (USACE) has exclusive jurisdiction over flood control at Grand Lake, providing: “The Secretary [of the Army] shall have exclusive jurisdiction and responsibility for management of the flood

pool for flood control operations at Grand Lake O' the Cherokees.” In this regard, the NDAA expressly preserves USACE’s flood control authority under Flood Control Acts of 1938 and 1944, as well as USACE’s authorities and obligations to obtain property interests to carry out its obligations.

## 2.6 Model Input Status Report

As outlined in the RSP, confirmed in the SPD, and clarified in the Commission’s Order on Request for Clarification and Rehearing dated January 23, 2020<sup>14</sup>, a Model Input Status Report (MISR) was developed and provided to the relicensing participants on March 30, 2021. GRDA held a Technical Conference on April 21, 2021, to summarize the MISR and answer questions.

On June 23, 2021, the City of Miami, OK filed comments on the MISR with the Commission<sup>15</sup>. The City of Miami’s comments have been addressed in the UHM report contained in **Appendix 2**.

## 2.7 Study Reporting Timeline through USR Meeting

Following submittal of this ISR and consistent with requirements under 18 CFR § 5.15, GRDA will, within 15 days following the filing of this ISR, hold a meeting with agencies and other interested parties and Commission staff to discuss the 2021 study results reported in this ISR and plans for completing the study program. **GRDA has scheduled the ISR meeting for October 12 and 13, 2021 at 9:00 a.m. The meeting will be held virtually and is not open to the public due to Covid-19 concerns.**

Under 18 CFR § 5.15(c)(3), within 15 days following this meeting or by October 30, 2021, GRDA will file a meeting summary. Under 18 CFR § 5.15(c)(4), FERC staff or any agency and other interested party may file a disagreement concerning GRDA’s meeting summary within 30 days of its issuance or by November 29, 2021. This filing must set forth the basis of any disagreement with the material content of GRDA’s meeting summary and propose any desired alternative modifications to ongoing studies or new studies. Under 18 CFR § 5.15(c)(5), GRDA will then have 30 days to respond to any disagreements by December 29, 2021. Within 30 days of GRDA’s response or by January 28, 2022, under 18 CFR § 5.15(c)(6), any remaining disagreements will be resolved by the Commission, and the study plan will be amended as appropriate.

Under 18 CFR § 5.15(d), any proposal to modify an ongoing study must demonstrate that (1) the approved study was not conducted as described in the approved RSP or (2) the approved study was conducted under anomalous environmental conditions, or that environmental conditions have changed in a material way since the study plan’s approval.

Under 18 CFR § 5.15(e), any proposal for new information gathering or studies must include an appropriate statement explaining (1) any material changes in the law or regulations applicable to the information request, (2) why the study’s goals and objectives cannot be met via the approved study’s methodology, (3) why the request was not made earlier, (4) significant changes in the proposal or

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<sup>14</sup> Grand River Dam Authority, 170 FERC ¶ 61,027 (2020).

<sup>15</sup> Comments of Tetra Tech on Behalf of the City of Miami, Oklahoma (Corrected) on Mead & Hunt’s H&H Modeling Upstream Hydraulic Model Input Status Report on behalf of GRDA, June 23, 2021.



significant new information has become available that affects the study, and (5) why the study request meets the criteria of 18 CFR 5.9(b).

Following the Commission's resolution of any disagreements, the second study season will commence, and an updated study report (USR) will be filed with the Commission by September 20, 2022.

Following submittal of this USR and consistent with requirements under 18 CFR § 5.15(c)(2), GRDA will, within 15 days following the filing of the USR, hold a meeting with agencies and other interested parties and Commission staff to discuss the 2022 study results reported in the USR.

Under 18 CFR § 5.15(c)(3), within 15 days following this meeting or by October 30, 2022, GRDA will file a meeting summary. Under 18 CFR § 5.15(c)(4), FERC staff or any agency and other interested party may file a disagreement concerning GRDA's meeting summary within 30 days of its issuance or by November 29, 2022. This filing must set forth the basis of any disagreement with the material content of GRDA's meeting summary and propose any desired alternative modifications to ongoing studies or new studies. Under 18 CFR § 5.15(c)(5), GRDA will then have 30 days to respond to any disagreements by December 29, 2022. Within 30 days of GRDA's response or by January 28, 2023, under 18 CFR § 5.15(c)(6), any remaining disagreements will be resolved by the Commission, and the study plan will be amended as appropriate.

The proposed timeline for study reporting, i.e., the filing of the ISR and USR, as modified by the Extension Order is presented in **Table 3**.

**Table 3. Reporting and review opportunities associated with the ISR and USR**

<b>Activity or Information Sharing</b>	<b>Commission Deadline</b>
File ISR	September 30, 2021
Hold ISR meeting (meeting on study results and any proposals to modify study plan)	October 15, 2021
File Study Results Meeting Summary	October 30, 2021
File Meeting Summary Disagreements	November 29, 2021
File Responses to Disagreements	December 29, 2021
Commission Resolution of Disagreements	January 28, 2022
File USR	September 30, 2022
Hold USR meeting (meeting on study results and any proposals to modify study plan)	October 15, 2022
File USR Meeting Summary	October 30, 2022
File Meeting Summary Disagreements	November 29, 2022
File Responses to Disagreements	December 29, 2022
Commission Resolution of Disagreements	January 28, 2022

### 3.0 STUDY VARIANCES

Under 18 CFR § 5.15(c), the ISR must include “an explanation of any variance from the study plan and schedule.”

As noted in **Table 1**, study year 1 studies are complete except for a variance in the schedule for the Hydrologic and Hydraulic Modeling Study (H&H Study), the Sedimentation Study, and the Cultural Resources Study and variances in methodology for the H&H Study and Infrastructure Study. The individual variances from the approved study plans are outlined in **3.1**.

#### 3.1 Study Variances

##### Hydrologic and Hydraulic Modeling

The Hydrologic and Hydraulic Modeling (H&H) Study was completed in accordance with the RSP, as modified by the Commission staff in the SPD, except for two variances.

- 1) In the SPD, it was recommended the H&H Model be run with starting elevations ranging from a minimum of 734 feet Pensacola Datum (PD) to a maximum of 760 feet PD to match the maximum elevation of the existing flowage easement. GRDA varied from the recommendations in the SPD by substituting a maximum starting elevation for the preliminary model runs of 757 feet PD. The variance is necessary because the elevation of the crest of the dam is 757 feet PD.
- 2) In the SPD, Commission staff recommended the development of maps that clearly depict the boundary between lotic and lentic conditions under any proposed operating scenario be developed. The variance is necessary because any maps developed under the H&H Model are preliminary in nature and development of the maps for any proposed operation would be premature, until under 18 CFR § 5.15(c)(6), any remaining disagreements regarding the H&H Model that may arise are resolved by the Commission.

The H&H Study reports are available in **Appendix 2** and the report for the collection of updated bathymetry data to be utilized by both the H&H and the Sedimentation Studies is included in **Appendix 3**.

##### Sedimentation

The Sedimentation Study was completed in accordance with the RSP, as modified by the Commission staff in the SPD, except for one variance in schedule. During collection of additional field data as proposed in the RSP, the dominant sediment type was found to be cohesive (silt and clay) as opposed to being dominated by non-cohesive sediments such as gravel and sand. The schedule outlined in the SPD by Commission staff was based upon non-cohesive sediments being the dominant type.

Cohesive sediments are much more difficult to model and required the collection and analysis of core samples which were not part of the original study plan. The core sample collection and analysis were necessary to determine sediment movement properties of the dominant cohesive sediments for the model development.

Due to the additional field and desktop work required for cohesive sediments, a variance in the approved schedule is necessary to complete the model calibration after the ISR is required to be filed with the Commission. The ISR contains an interim study report that although explains the calibration methodology cannot include the full results of the calibration activity because it is currently ongoing. The interim study report is available in **Appendix 4** and GRDA plans to provide the full report and access to a calibrated model to all stakeholders by December 31, 2021. GRDA will schedule a virtual meeting with interested relicensing participants to present the calibration in January 2022.

#### **Aquatic Species of Concern**

The Aquatic Species of Concern Study was completed in accordance with the RSP, as modified by the Commission staff in the SPD. GRDA encountered no variances in completing this study. The study report is available in **Appendix 5**.

#### **Terrestrial Species of Concern**

The Terrestrial Species of Concern Study was completed in accordance with the RSP, as approved by the Commission staff in the SPD. GRDA encountered no variances in completing this study. The study report is available in **Appendix 6**.

#### **Wetland and Riparian Habitat**

The Wetland and Riparian Habitat Study was completed in accordance with the RSP, as approved by the Commission staff in the SPD. GRDA encountered no variances in completing this study. The study report is available in **Appendix 7**.

#### **Recreation Facilities Inventory and Use**

The Recreation Facilities Inventory and Use Study was completed in accordance with the RSP, as modified by the Commission staff in the SPD<sup>16</sup>. GRDA encountered no variances in completing this study. The study report is available in **Appendix 8**.

#### **Cultural Resources**

The Cultural Resources Study was completed in accordance with the RSP, as modified by the Commission staff in the SPD, except for three variances to methodology and schedule variances that were made in consultation with the Cultural Resources Work Group (CRWG) and accepted by the CRWG. The three methodology variances are outlined as follows:

- 1) In the RSP and SPD, field survey methods for Late Quarternary Landforms (Qals) are to follow the Osage Nation's Archaeological Block Survey Standards for conducting shovel test excavations to identify and delineate archaeological sites within the Project's APE. The standards entail adjusting the testing interval density based upon the size of the landform or parcel to be tested. Per the RSP, survey methods may be adjusted based upon in-field

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<sup>16</sup> The Commission Staff recommended a rating scale be added to Question 13. The rating scale that was added for question 13 provided a scale ranging from totally acceptable to totally unacceptable. It relies upon the comments provided by the recreation user to identify detail beyond the categories of safety, enjoyment, crowding, and overall experience. All comments provided by recreation users are organized by recreation site and listed in the report.

conditions as determined by the field director. During the survey efforts, adjustments based upon in-field conditions were made by the field director.

- 2) During the 2019-2020 field session, some of the Qal survey areas contained a thick veneer of alluvial sediments resulting from high flow events, such that the agreed-upon archaeological survey methods (pedestrian survey and STP excavations) were inadequate to determine if buried archaeological deposits were present. To efficiently assess these areas, additional field methods were proposed and accepted by the CRWG in June 2020. These methods included examination of soil profiles exposed in cutbanks, when available, and/or the excavation of auger tests to determine the depth of the modern soil deposits. If the deposits were found to be relatively shallow, and the historic surface could be reached via shovel testing, the standard methods for shovel test excavation were followed. If the deposits were found to extend beyond the depth of an average shovel test (more than 50 cm below surface), then the area was considered as “protected” with no adverse effects to any sites that may be present at depth and no further survey work was completed.
- 3) Although not specifically outlined in the RSP or the SPD, a bluff face visual inspection was initiated along 60.4 linear miles of bluff along the shoreline of Grand Lake that was classified as having high potential for possible rockshelters or caves. These areas of sheer bluff face were visually inspected via a boat survey for the presence of possible previously unrecorded rockshelters that may have been utilized by Pre-Contact peoples. This visual inspection was completed, but not reported in the ISR. It will be outlined as part of additional study reports to be part of the USR process.

The four schedule variances are outlined as follows:

- 1) Complete archaeological reconnaissance reporting on five sites unable to be included in the ISR.
- 2) Determine eligibility on remaining recommended site and include in the ISR.
- 3) Continue with Ethnography Study for traditional cultural properties.
- 4) Complete survey of remaining 3 areas unable to be included in the ISR.

The study reports have been filed as separate privileged documents but are to be incorporated into this document as **Appendix 9**.

### **Socioeconomics**

The Socioeconomic Study was completed in accordance with the RSP, as modified by the Commission staff in the SPD. GRDA encountered no variances in completing this study. The study report is available in **Appendix 10**.

### **Infrastructure**

The Infrastructure Study was completed in accordance with RSP, as modified by the Commission staff in the SPD, except for one variance.

- 1) In the SPD, Commission staff recommended analysis of infrastructure that could be affected under Project operations including operations during flood control. Since the SPD was issued (November 8, 2018), the NDAA became law on December 20, 2019. Section 7612(c) of the NDAA confirms that the Secretary of the Army has exclusive jurisdiction and responsibility for management of the flood pool for flood control operations. Therefore, effects on infrastructure for starting elevations higher than the upper elevation of the conservation pool (745 feet PD), were not evaluated as part of the study. In addition, the H&H Study has concluded the initial starting elevation has an immaterial impact on upstream inundation.

The study report is available in **Appendix 11**.

The complete list of study variances is outlined in **Table 4**.

**Table 4. Study Variances**

Study	Variance(s)
Hydrologic and Hydraulic Modeling	Starting elevation for the preliminary model runs of 757 feet PD. Provide Lentic and Lotic maps in the USR.
Sedimentation	Calibration will be complete by December 31, 2021.
Aquatic Species of Concern	None
Terrestrial Species of Concern	None
Wetland and Riparian Habitat	None
Recreation Facilities Inventory and Use	None
Cultural Resources	Complete archaeological reconnaissance reporting on five sites unable to be included in the ISR. Determine NRHP eligibility on recommended sites in consultation with CRWG. Complete the reporting of the surveys on the remaining bluff areas unable to be included in the ISR. Continue with Ethnography Study for traditional cultural properties. Results of remaining three areas will be included in the USR. Adjust the testing interval density for Late Quarternary landforms based upon in-field conditions as determined by the field director. Adjust the survey methods for buried archaeological deposits in Late Quarternary landforms.
Socioeconomics	None
Infrastructure	Limit starting elevation of reservoir to a maximum elevation of 745 feet PD.

## 4.0 STUDY SUMMARIES

### 4.1 Hydrologic and Hydraulic Study

The H&H Study was included as a study in the relicensing process because Project operations influence water levels both upstream and downstream of the Pensacola Dam. The H&H Study is intended to quantify the influences and improve the understanding of the magnitude, duration, and frequency of influences. Also, it should identify operational sources of such influences and assist in analyzing resource-level effects that could be associated with the influences. The H&H Study will also help identify changes in areas that are inundated, if any, that may be associated with any changes to current operations that may be proposed by GRDA.

An H&H Study was first proposed by GRDA as part of the Pre-Application Document (PAD).

The Commission Staff requested a “Flooding and Sedimentation Study” which became the H&H Study in their Study Request Letter dated March 13, 2018<sup>17</sup>. Their reasoning for requesting the study is best outlined in their stated nexus which was as follows:

“GRDA does not propose any changes in current operation. However, upstream flooding has been an ongoing issue in the project area. Information gathered through this study would allow stakeholders to develop an understanding of the interactions between project operation and flooding, the specific factors or project elements that can influence flooding, and associated effects on other resources...” The collection of data from this study would provide the basis for potential license requirements pertaining to project operational constraints and/or environmental measures necessary to protect, mitigate for, or enhance aquatic, terrestrial, recreation, and cultural resources around the project. This information would also be important in determining whether the current project boundary is appropriate.”

The RSP states the nexus for H&H Study as the following:

“Project operation influences water levels of the Grand/Neosho River, as well as some tributaries, both upstream and downstream of Pensacola Dam. The H&H Study will help quantify these influences; improve understanding of the magnitude, duration, and frequency of such influences; identify the operational sources of such influences (e.g., hydroelectric operations or USACE flood control operations); and assist in analyzing resource-level effects that could be associated with these influences. The H&H Study will also help identify changes in areas inundated, if any, that may be associated with any changes to current operations that may be proposed by GRDA as part of the relicensing effort.”

The study plan was first presented in the PSP, modified based upon relicensing participant comments for the RSP, and again modified per Commission Staff recommendations provided in the SPD.

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<sup>17</sup> Staff Comments on the Pre-Application Document and Study Request for the Pensacola Hydroelectric Project, P-1494-438, (March 13, 2018).

The H&H Study has two main areas:

- 1) To determine the effect of initial water surface elevations (WSELs) on the extent of inundation upstream of Pensacola Dam.
- 2) To provide lentic and lotic maps for WSELs of 742-, 743-, 744-, and 745-foot PD at the Pensacola Dam to be used for the analysis in the Aquatic Species of Concern, the Terrestrial Species of Concern, and the Wetland and Riparian Studies, should GRDA anticipate any changes to Project operations.

The H&H Study is divided into three separate study efforts, the Operations Model (OM), the upstream study, and the downstream study. The Operations Model provides input to the upstream and downstream studies.

#### **4.1.1 Operations Model**

United States Army Corps of Engineers' (USACE's) RiverWare (RWM) period-of-record model is a tool used by USACE Southwestern Division, Tulsa District (SWT) to simulate reservoir operations on the Arkansas River system upstream of United States Geological Survey (USGS) gage number 07250500 at Van Buren, Arkansas, including the Project. This model uses a daily time step and includes over 30 reservoirs.

A Flood Routing Model (FRM) was developed to replicate, as closely as possible, the Project flow routing decisions in the USACE RWM period-of-record model as an input to the OM required for the upstream and downstream study efforts. The FRM is needed to investigate hypothetical design events and alternative operating scenarios that would be difficult and time-consuming to program into the RWM. The FRM includes three reservoirs (Pensacola, Kerr, and Fort Gibson), which operate as a subsystem for flow routing, and uses daily time steps like the RWM.

The OM simulates flow routing, hydropower scheduling, and other constraints on an hourly time step to support the Project relicensing effort. Because electricity prices vary widely within a day, hourly time steps provide improved accuracy for hydropower operations simulation. Output from the FRM – most importantly the average daily total discharge – is used as an input to the OM. The OM seeks to optimize the hydropower generation revenue at each facility while simultaneously satisfying various physical and operational constraints, including the flow routing decisions based on the RWM model as simulated in the FRM. The OM includes Pensacola Dam and Kerr Dam (Markham Ferry Hydroelectric Project), which is downstream of Pensacola Dam. Both Pensacola Dam and Kerr Dam are owned and operated by GRDA, and flow routing decisions at both projects are regulated by USACE under certain conditions.

The FRM and OM have been validated against the RWM using the common metrics of the Coefficient of Determination and the Nash-Sutcliffe Efficiency to evaluate modeled total discharge and elevation.

There are some limitations with the OM in its current state. It is currently designed to use the RWM to confirm the results of the H&H Model effort. These limitations are due to ramping rate

restrictions, turbine shutoff compensation, and flood routing model stage matching. The OM will be improved, and the revised OM will be included in the USR. Such minor changes in the OM and incorporated into the UHM and DHM could impact the lotic and lentic mapping efforts.

The study report is available in **Appendix 2**.

#### **4.1.2 Upstream Model**

The Hydrologic Engineering Center River Analysis System (HEC-RAS) model, previously developed by Tetra Tech, was used as the base for the Upstream Hydrologic Model (UHM) development. A detailed review of Tetra Tech's Model identified ways in which the model should be improved. The Tetra Tech Model was transformed into the UHM by updating the version of HEC-RAS from a beta version to a full release version, modifying the geometry to contain larger flood events and to improve model stability and accuracy, updating bridge geometry, adding the Spring River and the Elk River, replacing the reservoir bathymetry to reflect newly surveyed conditions, and by using computational parameters recommended by the HEC-RAS development team. This resulted in an improved hydraulic model of Grand Lake and the river system upstream of Pensacola Dam.

The UHM was calibrated using measured data, including United States Geological Survey (USGS) gage elevations, high water marks, and recorded data from loggers installed by the project team. Six historical events were used to calibrate the model. Manning's n-values were adjusted until simulated water surface elevations reasonably matched measured data. Flow roughness factors were used to fine-tune the model.

A flood frequency analysis was performed for the study area using data from USACE. Data from 1940 (dam construction date) to 2019 (latest available data at time of data delivery from USACE) were used and a graphical frequency analysis of peak inflows was performed. The analysis estimated a 100-year event flow at Pensacola Dam of approximately 300,000 cubic feet per second (cfs). The largest events of recent record did not meet or exceed the 100-year event threshold at Pensacola Dam. The July 2007 event was scaled so the peak flow at Pensacola Dam approximately matched the estimated 100-year event, with a daily inflow volume to Pensacola Dam that approximately matched the results of a statistical analysis of historical inflow volumes.

The calibrated UHM was used to analyze five historical inflow events and one synthetic event with a range of starting pool elevations at Pensacola Dam. Maximum water surface elevation (WSEL) values and inundation extents were extracted from HEC-RAS and analyzed.

The results of the UHM demonstrate that the initial stage at Pensacola Dam has an immaterial impact on upstream WSELs and inundation. Only a different inflow event caused an appreciable difference in maximum WSEL and maximum inundation extent. The differences in WSEL and inundation extent due to the size of the inflow event were an order of magnitude greater than the differences in WSEL and inundation extent due to the initial stage at Pensacola Dam. Any changes to the OM or the UHM as a result of stakeholder comments are not expected to result in a different conclusion for the UHM. Such minor changes in the OM, UHM, and DHM could impact



the lotic and lentic mapping efforts needed to evaluate any changes to Project operations that GRDA may decide to implement.

The study report is available in **Appendix 2**.

#### **4.1.3 Downstream Model**

The Downstream Hydraulic Model (DHM) was developed using a one-dimensional (1D) HEC-RAS Model extending from just downstream of Pensacola Dam and through Lake Hudson to the Robert S. Kerr Dam, where flood control operations are also regulated by USACE. The model geometry was developed from the best available topographic and bathymetric data. Bridge structures within the model were represented based on record drawings obtained from various agencies. The model was calibrated to four historical events based on measurements at the USGS stream gage near Langley, OK (USGS Gage No. 07190500) and observed WSEL at Kerr Dam.

The calibrated HEC-RAS Model was used to analyze a range of operating conditions at Pensacola Dam utilizing results from the OM. Six historical flow events and one synthetic event were analyzed for a range of starting pool elevations at Pensacola Dam. Inflows to Lake Hudson for the synthetic 100-year event were derived from a statistical analysis of historical inflow volumes. Maximum WSEL values and inundation extents were extracted from HEC-RAS and analyzed.

The results of the DHM demonstrate that initial stages at the Project have an impact on downstream WSELs and out-of-bank inundation. As the analysis shows, downstream WSELs, stages at Kerr Dam, and inundation extents are dependent on the magnitude and volume of releases from the Project, which in turn are dependent on initial stage at the Project. Out-of-bank inundation downstream of the Project is the result of spillway releases which are directed by the USACE. Under authority of Section 7 of the 1944 Flood Control Act, the Tulsa District of the USACE is responsible for prescribing and directing the flood control operations of the Project. The USACE is also responsible for directing spillway releases in accordance with the procedures for system balancing of flood storage outlined in the Arkansas River Basin Water Control Master Manual. This authority is reinforced by Section 7612 (c) of the National Defense Authorization Act (NDAA) of Fiscal Year 2020 which states that "The Secretary [of the Army] shall have exclusive jurisdiction and responsibility for management of the flood pool for flood control operations at Grand Lake O' the Cherokees."

Use of the DHM to analyze different operational scenarios for the Project is entirely dependent on results from the OM due to the relatively flat gradient along Lake Hudson. As discussed in the study report for the OM, there are currently some known limitations and planned improvements for the next phase of the study. Following these improvements, more consistent predictions of peak stages versus initial stages are expected.

The OM, UHM, DHM are available in **Appendix 2**. The report for the updated bathymetry is available in **Appendix 3**.

## 4.2 Sedimentation Study

The Commission Staff originally requested a “Flooding and Sedimentation Study” which became the H&H Study in their Study Request Letter dated March 13, 2018. Their reasoning for requesting the study is best outlined in their stated nexus which was as follows:

“GRDA does not propose any changes in current operation. However, upstream flooding has been an ongoing issue in the project area. Information gathered through this study would allow stakeholders to develop an understanding of the interactions between project operation and flooding, the specific factors or project elements that can influence flooding, and associated effects on other resources...” The collection of data from this study would provide the basis for potential license requirements pertaining to project operational constraints and/or environmental measures necessary to protect, mitigate for, or enhance aquatic, terrestrial, recreation, and cultural resources around the project. This information would also be important in determining whether the current project boundary is appropriate.”

The study plan was proposed in the PSP, modified per relicensing participants’ comments for the RSP, and again modified per Commission Staff recommendations provided in the SPD.

A Sediment Transport Model (STM) using the HEC-RAS fluvial modeling software is currently in development for this study. Model development data ranges from topographic information to stream discharge volumes, water surface elevations, and sediment parameters both in the lake and streambeds and moving into the system through major tributaries. This data and other publicly available data sources have been gathered through desktop and field studies.

Sediment conditions within the basin were evaluated using grab samples to evaluate grain size distributions. Samples determined, in general, the streambeds consist of gravel with limited sand and the lake is primarily silt and clay. Due to the presence of cohesive material (silt and clay) in the lake, core samples were collected for SEDflume erosion analysis. The erosion analysis was used to determine parameters for sediment movement as part of model development.

Hydraulic calibration of the model is ongoing and consists of tuning roughness parameters to match measured peak WSELs for a range of flow events. Events which occurred between July 2007 and April 2017 are used for hydraulic calibration. Model tuning relies on adjusting hydraulic roughness coefficients and flow roughness factors. Calibration datasets include the USGS gages throughout the model domain, high water marks, and the water surface elevation monitoring stations. Model results show good agreement with the gaged locations.

Once the model is calibrated, the interim report included in **Appendix 4** will be updated. Results of the calibration will be included in the final study report. It is currently estimated that sediment transport calibration procedures will be finalized by the end of 2021. At that time, the STM inputs and outputs will be made available to relicensing participants for download from a protected cloud-based server.

The STM may be modified as necessary based upon relicensing participant comments. Once the STM is finalized, the STM will analyze the effects under the current operation and compare the results to the

anticipated future operations. The observed or predicted effects of sedimentation on the power pool will be described in the USR.

The interim study report is available in **Appendix 4**.

### **4.3 Aquatic Species of Concern**

The U.S. Fish and Wildlife Service (USFWS) originally requested in their letter dated March 12, 2018<sup>18</sup>, an “Inundation Study” which became in part the Aquatic Species of Concern Study. Their reasoning for requesting the study is best outlined in their stated goals and objectives where were as follows:

“The goals and objectives of this study are to determine the inundation effects of raising the target elevation to 745 feet.”

In the March 12, 2018 letter, the USFWS also states their resource management goals to which the inundation effects are to be evaluated for. They were stated as follows:

*“The Service has management goals for maintaining and enhancing habitat for federally-listed species and other trust resources. The Service has been involved in previous management of listed species, fisheries such as paddlefish, and wetlands in the project area and we see great potential for future management-related enhancements.”*

The Oklahoma Department of Wildlife Conservation (ODWC) originally requested a study to quantify the effects of increased water level within the Grand Lake O’ the Cherokees watershed, a study of the impacts of Grand Lake elevation manipulation on headwater river hydrology and paddlefish spawning/recruitment, and an impoundment fluctuation study. The requests were made in their letter dated March 13, 2018, to the Commission and became the Aquatic Species of Concern Study. Their reasonings for the study requests are all centered around identifying the potential effects on aquatic species (Neosho mucket, Neosho madtom, Neosho smallmouth bass, and paddlefish) by raising the target elevation to as high as 745 feet PD.

The study plan was not originally proposed in the PSP, but based upon relicensing participant comments, the proposed study was included in the RSP, and again modified per Commission Staff recommendations provided in the SPD.

The Aquatic Species of Concern Study gathers existing information on the potential species of concern and based on that existing information, identifies the species that are proposed for additional investigation needed to assess the effects of the Project, if any. The sensitive species reviewed as part of this study are the Neosho mucket, rabbitsfoot, winged mapleleaf, Neosho madtom, Neosho smallmouth bass, and paddlefish. A summary of the existing information for each species is outlined in the following sections.

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<sup>18</sup> Letter from Jonna E. Polk, Field Supervisor-USFWS to Kimberly Bose, Secretary-FERC, P-1494-438, (March 12, 2018).

#### 4.3.1 Neosho Mucket

The Neosho Mucket (*Lampsilis rafinesqueana*) is a freshwater mussel species endemic to the Arkansas River system with recorded distributions located within the Verdigris, Illinois, and Neosho River basins. Within the Pensacola Project basin, the Neosho, Spring, and Elk River all have documented populations. According to a 5-year status review by the USFWS, the most recent freshwater mussel surveys conducted in 2016-2017 indicate that no live Neosho Mucket specimens were located with the Project boundary or upstream of the area of probable effects on the Spring or Neosho River. These findings are consistent with other mussel surveys completed on the Spring and Neosho Rivers over the past 30 years. Therefore, on the Neosho and Spring Rivers we conclude that the Neosho Mucket is unlikely to occur.

On the Elk River, the current Project boundary overlaps about a one mile stretch of Critical Habitat NM2 which includes 20.3 rkm (12.6 rmi) of the Elk River from Missouri Highway 59 at Noel, McDonald County, Missouri, to the confluence of Buffalo Creek immediately downstream of the Oklahoma and Missouri State line, Delaware County, Oklahoma. The most recent survey on the Missouri side of the state line as well as other historic surveys indicate that a viable population of Neosho Mucket exists within this stretch of river, however no data could be located with respect to the density or distribution of the mussel on the Oklahoma state line or within Project boundary.

Given the presence of the host fish species, a nearby viable population, and high-quality potential habitat, additional survey work is being proposed for the next study period. The specifics of the proposed work are outlined in **Section 5.3.1**.

#### 4.3.2 Rabbitsfoot

The Rabbitsfoot (*Quadrula cylindrica cylindrica*) freshwater mussel is a historically widespread species with a range from the Lower Great Lakes to the Lower Mississippi River. Within the Arkansas River Basin, the Neosho and Spring Rivers are considered historical range. Within the study area, the most recent 5-year review indicated that in 2016-2017, surveys on the Neosho River 1.5 RM downstream of Miami to the Kansas State line did not locate any specimens. Similarly, surveys conducted in 2016-2017 on the Spring River from the confluence of the Neosho North did not locate any live specimens from the Oklahoma Portion of the Spring River. No data were located on the status of the Rabbitsfoot from recent or historical sources for the Elk River.

The rabbitsfoot is a freshwater mussel typically found in small-to-medium-sized rivers that have a moderate current and clear, relatively shallow water. It prefers river bottoms that are a mixture of sand and gravel substrates. The rabbitsfoot spawns from May to June. Three species of minnows have been determined to be suitable hosts for the rabbitsfoot larval stage: whitetail shiner, spotfin shiner, and bigeyed chub; however, it's possible that other cyprinid (species) may be suitable hosts. Records received from the OWRB, show none of the host species have been present at sampling events in the Neosho, Spring, and Elk Rivers draining into the Project area from 2003-2018.

Based on the literature and data available it is not likely that a population would occur within the study area and no further studies are recommended.

#### **4.3.3 Winged Mapleleaf**

The Winged Mapleleaf (*Quadrula fragosa*) has a historic range that spans the greater Mississippi basin. Current known locations for this species include locations in Missouri, Wisconsin, Arkansas, and Oklahoma. A 5-year review of the species completed in 2015 indicates this species is considered extirpated from the Neosho River and Spring River in Kansas and no known populations occur within the larger Grand Lake watershed or the Neosho River Basin. Historical and the most recent mussel surveys conducted on the Spring and Neosho Rivers have no record of this species and the species has not been documented on the Elk River based on our available data. Known host fish for this species include Channel Catfish (*Ictalurus punctatus*) and Blue Catfish (*Ictalurus furcatus*) both occur within the Project boundary.

Personal contact with the Sam Noble Museum, Oklahoma State invertebrate collection department and ODWC indicate that no specimens have been previously found within the Neosho, Spring, and Elk Rivers or surrounding drainages leading up to the reservoir. The only recognized population in Oklahoma is within the Little River which is 175 miles from the study area. It is not likely that there is a population within the study area and no further studies are recommended.

#### **4.3.4 Neosho Madtom**

The Neosho madtom is a small catfish commonly 1.75–2.75 inches long; the maximum is about 3 inches long. The density of Neosho madtom populations is much greater in the Neosho system (i.e., the Neosho and Cottonwood Rivers combined) than in the Spring River. Extant Oklahoma populations of the Neosho madtom are restricted to the Neosho River upstream from Grand Lake.

Neosho madtoms have been found in the highest numbers during daylight in riffles in late summer and early fall, after young of the year are estimated to have recruited to the population. Neosho madtoms prefer the interstitial spaces of unconsolidated pebbles and gravel, moderate-to-slow flows, and depths averaging 0.23 meters. Adults hide in the interstices of loose gravel riffles during the day and feed nocturnally on the aquatic insects. Young of the year are said to inhabit slower flowing waters downstream from riffles and use pools and backwaters as nursery areas.

Neosho madtoms have been found in the drainages of the Project area from 1969-2007. The last sampling attempts near the Project area occurred in 2016. The closest collection point within the Project was conducted in 1991.

It is proposed that sampling efforts take place within the Neosho River branch of the study area including sampling select locations upstream to determine habitat quality outside of the Project area. Determining habitat quality outside of the Project area will allow for appropriate mitigation if management practices limit suitable habitat within the study area. All previous madtom locations have been within this branch of the river and is the most likely area to have a stable population.

Additional details of the additional work are outlined in **Section 5.3.2**.

#### **4.3.5 Neosho Smallmouth Bass**

The Neosho smallmouth bass is a genetically distinct subspecies of smallmouth bass. The Neosho smallmouth bass is found in the western extent of the Ozark Highlands ecoregion and is known to occur in the Spring River, the Elk River, the Neosho River, Spavinaw Creek, Spring Creek, the Illinois River, Baron Fork, Sallisaw Creek, Lee Creek, Clear Creek, the Mulberry River, Big Piney Creek, and the Illinois Bayou.

The Neosho smallmouth bass is found in streams that have watersheds with coarse-textured soils within the Ozark and Boston Mountain ecoregions. Generally, the smallmouth bass is found in clear streams, but the Neosho smallmouth bass can persist in some streams that are often spring fed and have relatively high sediment loads. Though Neosho smallmouth bass are found in pool habitats, larger streams that have various channel units, including runs and riffles, are necessary for abundant populations.

Spawning habitat for the Neosho smallmouth bass consists of low-velocity, nearshore waters that are close to cover. The Neosho smallmouth bass also prefers to construct nests in areas that have fine sediment substrates and avoids areas that have thick layers of silts and clays. In years that have low stream flows, low water velocity at the nest site was found to be important for nest success. In years that have elevated discharge events, nest success was influenced by streamflow, temperature, and distance to shore.

Several records show that a smallmouth bass population is present within the drainages surrounding the Project, but during the sampling there was no determination that the Neosho subspecies was identified. It is likely that all records of smallmouth bass are not of the Neosho strain because the smallmouth bass that may occur within Grand Lake and the stretches of the Neosho, Spring, and Elk Rivers in Oklahoma are likely to be reservoir-strain fish. ODWC sampling efforts, which looked for both the Neosho and reservoir subspecies, did not detect the Neosho subspecies of the smallmouth bass within this Project or surrounding drainages. The latest surveys occurred in 2019.

The Neosho smallmouth bass has no state or federal listing and there is no need to collect any additional information to determine if there is an adverse effect upon the species.

Based on the data indicating that the Neosho smallmouth does not occur within the study area, GRDA proposes a modification to the RSP to eliminate any future work on the Neosho smallmouth bass in this relicensing process.

#### **4.3.6 Paddlefish**

Paddlefish are native to large rivers and lakes of the Mississippi River drainage and nearby gulf slope drainages. In Oklahoma, paddlefish were originally present in most large rivers of the Arkansas system (including the Neosho and Grand Rivers), the Little River, and the Red River.

Adult paddlefish inhabit deep slow-moving pools of large rivers and associated lakes and reservoirs. They typically inhabit areas with depths greater than 9.8 ft and current velocities

below 1.6 feet per second (ft/s) in reservoirs. Appropriate spawning habitats are more specific and require riverine habitats. Paddlefish spawning occurs in aggregations over hard substrates such as washed cobble within river environments. In Oklahoma, spawning peaks in late March and early April. Spawning appears to be episodic, often initiated by rising water levels and occurring during periods of high flow, and year-class recruitment is often highest in years that have extended high flow conditions during the spring spawning period. Paddlefish spawn demersal eggs that become adhesive upon fertilization and stick to the substrate. Hard substrates such as gravel and cobble are key to spawning success.

Previous research has quantified the amount of hard spawning substrates within the Neosho and Spring Rivers upstream of Grand Lake. This study compiled spawning substrate data and developed maps to evaluate the amount and spatial distribution of paddlefish spawning substrate within the area that may be impacted by Project operation.

At the maximum extent evaluated, a total of over 2,647 acres of potential habitat occurs, of which 1,701 acres (64 percent) consist of hard substrates presumably suitable for paddlefish spawning. Specifically, 997 acres of paddlefish spawning substrates (69 percent of available) were identified within the Neosho River and 704 acres (59 percent of available) were identified in the Spring River. The availability of hard substrates generally increases moving upstream from the river/reservoir interface. Within the Project boundary, 696 acres of paddlefish spawning substrate was identified within the Neosho River and 493 acres of spawning substrate was observed within the Spring River. Therefore, 70 percent of the available spawning substrate within the Neosho River falls within the Project boundary and 55 percent of the available spawning habitat in the Spring River falls within the Project boundary.

In the SPD, Commission staff recommended an assessment of potential effects on anticipated future operations on the spawning areas for paddlefish because increasing reservoir elevations would broaden and deepened the Grand Lake tributaries, slow water velocities, and deposition of soft, fine substrates to occur further upstream than currently occurs.

As stated in **Section 3.6.2** of the report, the availability of continuous high flows during spawning has a significant effect upon Paddlefish spawning success. The H&H Study has demonstrated Project operation (initial stage at Pensacola Dam) has an immaterial impact on upstream water surface elevations and consequently the hydraulic conditions which Paddlefish seek at upstream spawning sites during high inflow conditions.

Regardless of the anticipated future operation of the Project, the inflow events will continue to dominate the hydraulic conditions at the upstream spawning sites during high inflow events and dominate spawning success. Therefore, based upon the abundance of spawning habitat, the minimal impact of anticipated Project operations on upstream inundation, and the dominance of inflow events over successful paddlefish spawning, GRDA proposes a modification to the RSP to eliminate any future work on the paddlefish.

The study report is available in **Appendix 5**.

#### 4.4 Terrestrial Species of Concern

The USFWS originally requested in their letter dated March 12, 2018, an “Inundation Study” which became the Terrestrial Species of Concern Study. Their reasoning for requesting the study is best outlined in their stated goals and objectives which were as follows:

“The goals and objectives of this study are to determine the inundation effects of raising the target elevation to 745 feet.”

In the March 12, 2018 letter, the USFWS also states their resource management goals to which the inundation effects are to be evaluated for. They were stated as follows:

“The Service has management goals for maintaining and enhancing habitat for federally-listed species and other trust resources. The Service has been involved in previous management of listed species, fisheries such as paddlefish, and wetlands in the project area and we see great potential for future management-related enhancements.”

The study plan was not originally proposed in the PSP, but based upon relicensing participant comments, the proposed study was included in the RSP.

The Terrestrial Species of Concern Study gathers existing information on the potential species of concern and based on that existing information, identifies the species that are proposed for additional investigation needed to assess the effects of the Project, if any. The sensitive species reviewed as part of this study are the federally threatened American Burying Beetle (*Nicrophorus americanus*; ABB) and the federally endangered Gray Bat (*Myotis grisescens*). A summary of the existing information and proposed additional investigation for each species is outlined in the following sections.

##### 4.4.1 American Burying Beetle Survey

An initial presence/absence survey for the American Burying Beetle (ABB) was conducted to determine whether the ABB, a federally threatened species, may be present within the study area that may be impacted by Project operations according to the H&H Study. The area of potential impact is located within the ABB’s current range, but outside of any conservation priority area as defined by the USFWS.

On July 18, 2021, ABB Specialist Stephanie Rainwater (permit number TE-00284A) placed six (6) traps to cover a representative sample of all suitable habitat types within the area that may be impacted by Project operations.

The traps were designed, baited, and checked following the guidelines of the American Burying Beetle Range-wide Presence/Absence Survey Guidance. Trap locations were oriented in Delaware and Ottawa Counties only, but confirmed with Kevin Stubbs, USFWS National Species Lead via telephone conversation as sufficiently representative of the overall four county area.

The six traps were checked daily for a total of five nights with valid weather parameters and yielded no positive ABB findings. The survey effort concluded on July 23, 2021. The negative survey findings indicate that the ABB is not active within the study area.



The results of the H&H Study demonstrate that future operational changes that may be implemented by GRDA within the conservation pool of Grand Lake will not appreciably influence water levels beyond the current Project boundary (elevation of 750 feet Pensacola Datum). Thus, the areas that may be affected due to future operational changes are limited to a relatively narrow band of terrestrial habitat of a few feet of varying range from the shoreline.

The distance ABBs can travel and the limited terrestrial area potentially affected by anticipated future operations any ABBs captured could represent ABBs lured from the larger terrestrial area within the effective survey radius but outside of the area potentially affected by anticipated future operations and thus not representative of the species' actual habitat use or occupancy within the Project area as a whole. Positive ABB findings could thus incorrectly be identified as Project effects. Coupled with the negative findings of the 2021 ABB surveys, GRDA proposes a study modification to forego the second study period survey as the results would not be representative of Project effects.

#### **4.4.2 Gray Bat Survey**

This study was an assessment of species utilization of colonies of the federally endangered Gray Bat in caves DL-2 and DL-91, in Delaware County, Oklahoma. In Oklahoma, Gray Bats represent a contingent in North America that are year-round, obligate cave dwelling species.

Infrared-illuminated entrance and night vision optics were used to conduct non-intrusive exit surveys and population estimates of Gray Bat colonies exiting caves DL-2 and DL-91 in the 2021 summer maternity and post-maternity season. Such surveys are used to document habitation, assist in estimating colony size at the respective caves, and monitor movements of the colony during potential high water and flood events on Grand Lake.

Exit surveys were conducted at cave DL-2 on June 22, 2021, and the population was estimated to be 11,800. On June 24, 2021, and again on July 16, 2021, cave DL-91 was surveyed. The post-maternity colony population estimate at cave DL-91 during late summer 2021 was 20,440 and within the range of 10,000 to 29,905 bats (ave.=18,245) over the past decade.

Observations from previous exit surveys support historical evidence that during high water or flood events during the maternity season, a maternity colony of the endangered gray bat vacates cave DL-2 (Beaver Dam Cave) where the original exit lies below the flood pool elevation of Grand Lake. The maternity colony then migrates to an alternative cave.

The persistent threat of inundation increases the likelihood of "take" of adult females and young. Complete inundation of the cave passage of DL-2 occurs at about elevation 752 feet PD. When Grand Lake is at about elevation 751 feet PD, only about one foot of flyway exists between the top of the water in the cave and the rock ceiling of the flyway, forcing evacuation of the colony.

In October 2008, a small, high passage within cave DL-2 was identified and minimally excavated and enlarged. Enlarging this passage was suspected to provide an alternative escape route for exiting bats, particularly during high water. Additional excavation and enlargement of this

second-high passage was completed in October 2013. The length of the high passage was about 5m and was widened to about 0.40 meters wide by 0.50 meters tall.

An inspection of the passage following flood events since 2011 revealed scattered guano in the enlarged passage indicating use by bats. A post-inundation monitoring visits to the cave following a flood event in 2019 failed to give any indication that take had occurred as a result of inundation, and that the colony had successfully vacated to another location.

Management efforts at cave DL-91 over the past 40 years have improved the security and potential for the colony's persistence. The average post-maternity colony size illustrates relative consistency, ranging from 15,200 to 29,905 bats with an average colony size of 19,288 Gray Bats for the past 10 years.

If it is found anticipated future operations according to the H&H Study will impact cave DL-2, the success of enlarging the passage in cave DL-2 to provide an alternative escape route for exiting bats in avoiding take will again be reviewed in 2022.

The study report is available in **Appendix 6**.

#### **4.5 Wetland and Riparian Habitat**

The ODWC originally requested "Impoundment Fluctuation Studies" and "Wetland Documentation." The requests were made in their letter dated March 13, 2018, to the Commission and became the Wetland and Riparian Habitat Study. Their reasonings for the study requests are all centered around identifying the potential aerial extent of riparian habitat and potential aerial extent and change in type of wetland habitats by raising the target elevation to as high as 745 feet PD.

The study plan was not originally proposed in the PSP, but based upon relicensing participant comments, the proposed study was included in the RSP.

The purpose of the Wetland and Riparian Habitat Study is to quantify and refine the potential impacts associated with the proposed Operations of the Project (a potential raise in target elevation to as high as 745 feet PD or anticipated future operations). Base mapping was completed to identify, display, and describe the current composition of wetland communities within and adjacent to the area that may be impacted by anticipated future operations by relying on information in the H&H Study.

In the area studied, 54,980.72 acres of wetland habitat types and 4,236.06 acres of riparian habitat types were identified. Once the lentic and lotic maps according to anticipated future operations are developed through the H&H Study, the potential impacts of any anticipated future operations can be outlined in the USR.

The study report is available in **Appendix 7**.

#### **4.6 Recreation Facilities Inventory and Use**

A recreation inventory and use survey was first proposed by GRDA as part of the PAD. The study was refined based upon relicensing participant comments for the PSP, modified based upon relicensing participant comments for the RSP, and again modified per Commission Staff recommendations provided in the SPD.

During the months of May through September of 2020, a total of 30 recreation observation surveys were conducted on 20 separate recreation sites as outlined in the RSP and recommended in the SPD. In addition, bi-monthly surveys were completed along river channel sites below the Pensacola Dam.

The surveys included counting individuals and vehicles, classifying primary and secondary activities, and interviewing people at the sites. Photos were taken at recreation sites, which focused on the water level at boat ramps and typical activities.

During visitor interviews, participants were asked various questions based on their input for sites visited. If additional sites were visited in the Project area, other than the interview site location, the survey requested visitor input for each site visited.

During at least one site visit to the five FERC-approved recreation sites, state parks, and other public access sites, the condition of each recreation facility and its immediate vicinity were assessed, and an inventory of recreation enhancements was made.

Although there is a large amount of recreational use in the Project area, there are numerous non-commercial quality recreation access sites available around the Project shoreline. All but one recreation site has adequate capacity for the near future and this study did not identify a need for any additional access sites to be established as part of the relicensing process. It is recommended recreation use be surveyed every six years during the future license term to assure adequate recreation access is maintained during the term of the future license.

The study report is available in **Appendix 8**.

#### **4.7 Cultural Resources**

A cultural resources study was first proposed by GRDA as part of the PAD. The study was refined based upon relicensing participant requests for the PSP, modified based upon relicensing participant comments for the RSP, and again modified per Commission Staff recommendations provided in the SPD.

The Cultural Resources Study is composed of the following four study efforts:

- Cultural Historic Investigation
- Archaeological investigations in 2019 and 2020
- Archaeological investigations in 2020 and 2021
- Ethnography Study

The four study reports are incorporated as **Appendix 9** but have been filed with the Commission as privileged information.

#### **4.7.1 Cultural Historic Investigation**

The investigation was conducted to document and evaluate the potential effects of the operation of the Project on known historic resources, including the Pensacola Dam Historic District and the Splitlog Church. In addition, a resource survey was conducted for unknown above ground historic properties within the APE. The APE consists of areas within the current Project boundary and includes lands or properties outside the Project boundary where Project operations or Project-related recreation activities or other enhancements may cause changes in the character or use of historic properties. The survey was conducted, assessing any associated buildings or structures over 50 years old for their respective eligibility for listing on the National Register of Historic Places (NRHP). Identified historic resources were also evaluated for the potential effects from the renewal of the license for the Project.

The Pensacola Dam Historic District was established in 2003 when the Dam and its associated structures were determined eligible for the NRHP and listed at that time. The Splitlog Church was determined eligible for the NRHP and listed in 1972. The investigation has determined the renewal of the license for the Project has no adverse effect on the Pensacola Historic District or the Splitlog Church.

Two bridges, the Stepps Ford Bridge and the Spring River Bridge over SH 10, were previously recommended as eligible for listing on the NRHP. However, these two bridges have since been demolished and replaced with modern structures. An additional eighteen historic bridges were also identified within the APE. Of the eighteen bridges, thirteen had been previously surveyed, with the remaining five newly identified. However, all eighteen bridges were deemed not eligible for listing on the NRHP based on a lack of historic significance and/or material integrity, with six of the bridges recently replaced with modern structures. The investigation has determined the renewal of the license for the Project has no adverse effect on the twenty bridges identified.

#### **4.7.2 Archaeological investigations in 2019 and 2020.**

The 2019-2020 field season was divided into two distinct mobilizations with two distinct goals. During the first mobilization between November 5 and December 12, 2019, an archaeological reconnaissance was conducted on 34 previously recorded sites within and immediately adjacent to the Pensacola Project APE that were designated as “high priority” by members of the CRWG. In early 2020, four additional sites were added to the list of high priority sites requested for assessment by the CRWG, for a final priority site total of 38. The goal of the site reconnaissance efforts was to relocate the 38 sites and assess their current condition, integrity, and document ongoing disturbances. During the 2019-2020 field effort, the mapped locations of 37 of the 38 sites, totaling 239.1 acres, were visited. Findings from the reconnaissance investigations varied. Many sites were found to be completely inundated within the body of the reservoir. Some could not be accessed due to landowner restrictions or were found to be mis-plotted, while others necessitated systematic testing to establish condition and integrity. Of the revisited sites, seven sites were considered “potentially threatened” due to their locations, current condition, and/or other mitigating factors. Additional management actions were recommended for the seven sites.

The second mobilization of the 2019-2020 field season was conducted between February 19 and March 10, 2020 and consisted of the systematic archaeological survey of high-archaeological potential Qals previously identified in the Pre-Fieldwork Study commissioned by GRDA (Cerimele et al. 2019). The 29 Qals located within the Pensacola Project APE were determined by the CRWG to have high potential to retain intact archaeological deposits. Ten Qals were investigated during the winter 2020 field mobilization. The total acreage of the surveyed landforms was 838 acres (339.1 hectares). Eight previously unrecorded archaeological sites were identified, delineated, and fully documented. Three isolated finds were also recorded. Five of the newly recorded sites are recommended for additional archaeological investigations to determine eligibility to the NRHP. Two sites are also recommended for additional work to fully delineate the site boundaries beyond the Project APE.

#### **4.7.3 Archaeological investigations in 2020 and 2021**

The 2020-2021 field season (November 2020 to March 2021) builds upon the efforts reported in Volume I (Bissett et al. 2020). The total survey area for this project fell within the Pensacola Project APE. The 2020-2021 investigations consisted of relocating and assessing conditions at 11 previously recorded sites, surveying 16 Qals determined to have a high potential for cultural materials (Cerimele et al. 2019), and a visual inspection of exposed bluffs along the lake edge to identify potential rock shelters and caves. Additionally, one site outside of the Project APE was revisited at the request of the CRWG.

Archaeological reconnaissance was conducted on 11 previously recorded sites within and immediately adjacent to the Pensacola Project APE that were not revisited during the 2019-2020 field efforts. The goal of the site reconnaissance efforts was to relocate the sites and, if relocated, to assess their current condition, document ongoing disturbances, and assess integrity if possible. Five sites were not able to be reported on as part of this ISR. One site is a Cherokee cemetery that required a tribal monitor who could not attend due to Cherokee Nation Covid-19 protocols. One site was located within the protective buffer around an active bald eagle nest.

The locations of six of the 11 previously recorded sites investigated during the 2019-2020 season were visited during the current survey, but the sites could not be relocated. The remaining five of the 11 were relocated and assessed. Four are recommended as potentially eligible and require additional work to determine NRHP eligibility.

The second task of the 2020-2021 field season consisted of the systematic archaeological survey of previously identified Qals. Sixteen were surveyed in the 2020-2021 field season. Survey included pedestrian survey and shovel test excavations. Additionally, 13 islands were surveyed. In total, 2,108 acres were encompassed between the 16 Qals and 13 islands surveyed. Eleven new archaeological sites were identified and preliminarily evaluated. Three isolated finds were also recorded. Six of the newly recorded sites are recommended for additional archaeological investigations to determine eligibility to the NRHP.

The bluff face survey was based on the findings of the Pensacola Project Pre-Fieldwork Report that delineated 60.4 linear miles of high potential exposed bluff faces. Bluff areas are visually

inspected to identify potential rock shelters or caves that may contain archaeological deposits. Portions of three areas, and an additional 22 full areas, originally could not be reached by boat, but have been completed. The reports for the additional areas will be included in the USR.

The results of the 2020-2021 effort are contained in the Volume II report available in **Appendix 9**.

#### **4.7.4 Ethnography Study**

Multiple potential Traditional Cultural Properties (TCPs) and other cultural places have been identified, but the following key steps remain:

- Delineate the boundary of each potential TCP more definitively.
- Evaluate the integrity and significance of each potential TCP.
- Make a recommendation of eligibility to the National Register under one or more eligibility criteria, if applicable.
- Develop a TCP Inventory.

Dependent upon each Tribe's ability to participate, all this work will be conducted in the remaining months of 2021 and into 2022.

GRDA proposes to continue to complete the studies currently in progress within the APE. The results will be reported in agreement with the timing required for the USR.

The APE is currently defined in the RSP and confirmed in the SPD as:

"All lands within the FERC-approved project boundary (encompassing GRDA-owned lands and approximate elevation of 750 feet PD). The APE also includes lands or properties outside the project boundary where project operations or project-related recreation activities or other enhancements may cause changes in the character or use of historic properties, if any such properties exist."

APE is consistent with the requirements of section 106 and the definition of a project's APE provided at 36 CFR 800.16(d), which would encompass project-related effects both within and outside the Project boundary.

GRDA has been completing studies under this definition of the APE in the initial study period without the full understanding where project operations under high inflow conditions may cause changes to the character or use of historic properties.

In the RSP and confirmed by Commission Staff in SPD, after the initial study period, GRDA should consult with the CRWG to refine the APE, if necessary.

Since the initial establishment of the APE, the H&H Study concluded in the initial stage Pensacola Dam has an immaterial impact on upstream WSELs and inundation during flood frequencies. Only a different inflow event caused an appreciable difference in maximum WSEL and maximum inundation extent. The

differences in WSEL and inundation extent due to the size of the inflow event were an order of magnitude greater than the differences in WSEL and inundation extent due to the initial stage at Pensacola Dam.

The APE for studies needs to encompass project-related effects. The H&H Study has found change in inundation that occurs at higher inflow events under changing starting WSELs or anticipated future operations is immaterial to the inundation differences caused by the magnitude of the inflow event.

The only changes in inundation or impounded water caused by the anticipated future operations are restricted to the approximate elevation of the reservoir at the dam. Since the APE already encompasses land up to an approximate elevation of 750 feet PD and any anticipated future operations will not exceed 745 feet PD, the APE already encompasses all the areas where project operations have an effect.

Based upon the existing information there is no need to modify the APE for the Cultural Resources Study.

#### **4.8 Socioeconomics**

The study plan was proposed in the PSP, modified based upon relicensing participant comments for the RSP, and again modified per Commission Staff recommendations provided in the SPD.

The Socioeconomic Study presents information including land use patterns, population, and employment of the Project and the State of Oklahoma. The region of influence (ROI) for socioeconomic impacts are defined as Craig, Delaware, Mayes and Ottawa Counties, Oklahoma. Socioeconomic and demographic data establish baseline conditions consist of publicly available information about the ROI and, to provide perspective, the State of Oklahoma.

The population of the State of Oklahoma increased consistently between 2000 and 2020 and is 3,959,353 in the latest decennial census in 2020. The population in the ROI increased between 2000 and 2010 but decreased between 2010 and 2020 and is 123,835 in the latest decennial census in 2020. Oklahoma is expected to see a population increase up to 5,560,007 by 2075, with the population in the ROI expected to reach 198,444 for the same time period.

GRDA sent letters to various stakeholders, including local tribes, organizations, and businesses, in the ROI to request additional socioeconomic information. GRDA requested additional information on industry trends (e.g., goods and services, agricultural use), trends in land and resource values (e.g., hunting, fishing, ecotourism, outfitting, trapping, recreation, exploration, and mining activities), as well as other socioeconomic information that may be relevant to a socioeconomic analysis. Responses were received from eight stakeholders and are attached in the report.

The presence of the Project provides significant economic benefit to the economy in the ROI. 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. The H&H Study provides information to evaluate any reasonably foreseeable effect that has a reasonably close causal relationship to the Project operations and USACE flood control operations.

The cumulative socioeconomic impact analysis has concluded that the continued operation of the Pensacola Dam will result in continued significant economic benefits for the region.

The study report is available in **Appendix 10**.

#### **4.9 Infrastructure**

The study plan was not originally proposed by GRDA in the PSP or the RSP because GRDA wanted to assure there was a nexus for such a study. If a nexus was determined to exist through work on the H&H Study in the initial study period, the study information would be gathered and outlined in the application. However, per Commission Staff recommendations provided in the SPD the Infrastructure Study was completed in the initial study period as requested.

The Commission recommended an Infrastructure Study to determine a range of inflow conditions for which H&H Model results show Project operations may influence the frequency or depth of flooding. Specifically, the Commission requested maps and tables identifying the frequency and depth of inundation for each item of infrastructure.

The H&H Model of the area upstream of the Project along with a range of starting reservoir elevations and inflow events representing a range of flood frequencies were used for the study. Hydraulic results were extracted at infrastructure locations. Infrastructure locations were mapped, and tabular data of inundation depth were developed. The difference in depth between different starting reservoir elevations was also tabulated.

All appreciable increases in maximum inundation depth occur during high-flow conditions when the USACE controls the flood control operations under the Flood Control Act of 1944, except when the time of maximum inundation depth is solely a function of inflow event arrival time and not reservoir elevation.

The H&H Study concluded the initial stage at Pensacola Dam has an immaterial impact on upstream WSELs and inundation during flood frequencies. Only a different inflow event caused an appreciable difference in maximum WSEL and maximum inundation extent. The differences in WSEL and inundation extent due to the size of the inflow event were an order of magnitude greater than the differences in WSEL and inundation extent due to the initial stage at Pensacola Dam.

The WSEL operational effect findings of the H&H Study eliminates the original nexus where frequency and depth of flooding is influenced by Project operations (i.e., starting WSELs) during a range of inflow conditions used in the H&H Model. Therefore, additional work under the Infrastructure Study is no longer needed to inform the relicensing effort.

The study report is available in **Appendix 11**.



## 5.0 USR STUDY ACTIVITIES

The following activities will be completed in 2022 and the results will be reported as part of the USR. For the Aquatic Species of Concern, the Terrestrial Species of Concern, the Cultural Resources, and the Infrastructure Study, modifications are being requested that could change the activities listed in this section.

### 5.1 Hydrologic and Hydraulic Modeling

- Update Operations Model without RiverWare constraints and based upon comments.
- Update Upstream Model based upon comments.
- Update Downstream Model based upon comments.
- Run anticipated future operations for upstream and downstream model.
- Provide Lentic and Lotic Maps for current and anticipated future operations, as needed, in the Aquatic Species of Concern, the Terrestrial Species of Concern, and the Wetland and Riparian Study.

### 5.2 Sedimentation

- Update Sediment Transport Model based upon comments.
- Run Sediment Transport Model for current operation.
- Run Sediment Transport Model for anticipated future operations.
- Describe observed or predicted effects of sedimentation on the power pool.

### 5.3 Aquatic Species of Concern

Except for the following surveys, no additional surveys are planned for the Aquatic Species of Concern Study.

#### 5.3.1 Neosho Mucket Surveys

- The study area will consist of the Elk River from the Oklahoma/Missouri State line to the confluence of Buffalo Creek.
- Use a phased sampling design incorporating both Qualitative and Quantitative methods.
- Qualitative surveys will characterize the substrate, identify potential mussel beds, and potential presence of live mussels within the study area.
- A minimum search time of five person-hours (divided into five one person-hour searches) will be conducted within the delineated search area.
- If no live mussels are encountered after the first three one-person hour searches, surveys within this location will cease and it will be assumed no live mussels are present.
- At the end of each search period, collected mussels will be identified and enumerated.
- If no new species of mussels are collected during the fifth search period, the survey is complete.
- If at least one new mussel species is collected in the fifth search period, additional one person-hour search periods are required until no new species are collected.
- Visual, combined with tactile searching (hand-grubbing into the top 1-4 inches of substrate to increase detection of more-deeply buried mussels) will be used.

- Searchers will select a shoreline and begin searching from downstream to upstream moving back and forth across the stream, ensuring that all the delineated search area is sufficiently covered.
- If listed mussels are detected, initial surveys will immediately cease, and quantitative methods will commence.
- Quantitative surveys will involve sampling on mussel beds identified during qualitative surveys to quantify the mussel populations.
- Quantitative point sampling will be conducted on mussel beds by randomly selecting 0.25 m<sup>2</sup> quadrats plots within each bed.
- Systematic sampling will incorporate three random starts with 2 additional quadrats selected at 1-m intervals (9 quadrats per sample/site).
- Additional, randomly selected quadrat points will be available to replace locations that do not provide mussel habitat (e.g., too close to shore, water depth, poor substrate).
- Quantitative surveys will be performed by visual and tactile searches of randomly placed 0.25 m<sup>2</sup> quadrats placed at random locations as outlined above.
- Substrate within the quadrats will be excavated to a depth of 20 cm and sieved, as this increases the likelihood of detecting juvenile mussels.
- All live individuals will be identified, enumerated, and returned to the approximate location of collection.
- Shell material will also be collected and quantified during sampling from the stream and classified as fresh dead (FD; intact periostracum and lustrous nacre), weathered dead (WD; intact periostracum, weathered and chalky nacre), or subfossil (SF; shell chalky, no periostracum).
- The surveys will be conducted under the supervision of qualified personnel with appropriate licenses and knowledge of mussel survey methods and procedures for handling endangered mussel species.
- Estimated study cost is \$60,000.

### **5.3.2 Neosho Madtom**

- A 20-mile stretch of the river from HWY60 to the county border be assessed in locations that contain riffles and moderate to low-velocity gravel bar habitats. Fish sampling will be conducted between late summer and early fall at selected sites where riffles and gravel bars are identified via review of aerial imagery that are readily accessible public roads, bridges, or access points.
- Fish sampling will be conducted by kick-seining (4.6 m x 1.8 m seine with 3.2 mm mesh) by one or two individuals thoroughly disturbing the substrate beginning four meters upstream from a stationary seine and then kicking in a downstream direction to the seine's lead line.
- Kick-seining will start at the downstream end of a habitat and proceeded laterally and then upstream with multiple kick-seine efforts until all habitat less than one meter deep at a site had been sampled.
- All fishes captured will be identified to species, measured for total length (TL) to the nearest millimeter, counted, and then returned to the stream.
- Estimated study cost is \$50,000.

#### **5.4 Terrestrial Species of Concern**

- There are no activities planned for the ABB.
- Continue with the Gray Bat surveys.

#### **5.5 Wetland and Riparian Habitat**

- Once the lentic and lotic maps are produced by the H&H Study, changes in wetland inundation and riparian habitat due to anticipated future operations will be analyzed.
- If it is determined anticipated future operations are impacting wetlands, the accuracy of the base maps will be verified, as necessary, through ground-truthing.

#### **5.6 Recreation Facilities Inventory and Use**

There are no activities planned for this study.

#### **5.7 Cultural Resources**

- Report results of the archaeological reconnaissance on five sites not included in the ISR.
- Determine NRHP eligibility on recommended sites in consultation with CRWG.
- Report the results of the surveys on the remaining bluff areas not included in the ISR.
- Complete surveys and report the results of the remaining three (3) areas in the USR.
- Continue with TCP inventory.
- Continue to adjust the testing interval density for Qals based upon in-field conditions as necessary during remaining surveys using the adjusted survey methods for buried archaeological deposits.

#### **5.8 Socioeconomics**

There are no activities planned for this study.

#### **5.9 Infrastructure**

There are no activities planned for this study.

### **6.0 REQUESTED STUDY MODIFICATIONS AND REQUESTED NEW STUDIES**

Under 18 CFR § 5.15(d), any proposal to modify an ongoing study must demonstrate that the (1) approved study was not conducted as described in the approved RSP or (2) that it was conducted under anomalous environmental conditions, or that environmental conditions have changed in a material way since the study plan's approval.

Under 18 CFR § 5.15(e), any proposal for new information gathering or studies must include an appropriate statement explaining (1) any material changes in the law or regulations applicable to the information request, (2) why the study's goals and objectives cannot be met via the approved study's methodology, (3) why the request was not made earlier, (4) significant changes in the proposal or significant new information has become available that affects the study, and (5) why the study request meets the criteria of 18 CFR 5.9(b).

## **6.1 Proposed Study Modifications**

Based upon the study results of the studies conducted in the initial study period and contained in this document, GRDA is proposing several study modifications to the approved study plans that are outlined in the following sections. The proposed study modifications are also summarized in Table 5.

### **6.1.1 Aquatic Species of Concern**

#### **6.1.1.1 Neosho Smallmouth Bass**

Several records show that a smallmouth bass population is present within the drainages surrounding the Project, but during the sampling there was no determination that the Neosho subspecies was identified. It is likely that all records of smallmouth bass are not of the Neosho strain because the smallmouth bass that may occur within Grand Lake and the stretches of the Neosho, Spring, and Elk Rivers in Oklahoma are likely to be reservoir-strain fish. ODWCS sampling efforts, which looked for both the Neosho and reservoir subspecies, did not detect the Neosho subspecies of the smallmouth bass within this Project or surrounding drainages. The latest surveys occurred in 2019.

The Neosho smallmouth bass has no state or federal listing and there is no need to collect any detailed information to determine if there is an adverse effect upon the species.

The anticipated cost of additional work for the Neosho smallmouth bass is expected to be approximately \$100,000.

Based on the data indicating that the Neosho smallmouth bass does not occur within the study area and the benefit of the results of any additional work does not justify the anticipated cost, GRDA proposes a modification to the RSP to eliminate any future work on the Neosho smallmouth bass in this relicensing process.

#### **6.1.1.2 Paddlefish**

The background research completed in the initial study period shows the availability of continuous high flows during spawning has a significant effect upon Paddlefish spawning success. The H&H Study has demonstrated Project operation (initial stage at Pensacola Dam) has an immaterial impact on upstream water surface elevations and consequently the hydraulic conditions which Paddlefish seek at upstream spawning sites during high inflow conditions.

Regardless of the anticipated future operation of the Project, the inflow events will continue to dominate the hydraulic conditions at the upstream spawning sites during high inflow events and dominate spawning success.

There is an abundance of spawning habitat, anticipated Project operations have a minimal impact upon upstream inundation, the inflow events have dominance over successful paddlefish spawning, and the paddlefish fishery is healthy.

For the reasons stated, GRDA proposes a modification to the RSP to eliminate any future work on the paddlefish spawning habitat because unlike steady high inflow events, spawning habitat is not believed to be the limiting factor in paddlefish spawning success in the Project boundary.

### **6.1.2 Terrestrial Species of Concern**

The results of the H&H Study demonstrate that future operational changes that may be implemented by GRDA within the conservation pool of Grand Lake will not appreciably influence water levels beyond the current Project boundary (elevation of 750 feet Pensacola Datum). Thus, the areas that may be affected due to future operational changes are limited to a relatively narrow band of terrestrial habitat of a few feet of varying range from the shoreline.

The ABB will only use areas with a soil and/or leaf litter substrate and vegetated cover (as opposed to bare rocky or sandy shorelines) so suitable habitat within the Project boundary is limited. The effective survey radius for each trap is 0.5 mile (0.8 km) based on ABB mobility, size, recorded movement distances, and the distance from which ABBs can detect carrion (Guidance).

In Oklahoma, ABBs have been recorded to move approximately 10 km (6.2 miles) in 6 nights. With respect to these species' habits, traps would have to be placed within the narrow band of sparsely existing suitable habitat between the shoreline and the 750-foot elevation mark to cover the potentially affected area and due to the imprecise nature of the survey model, the majority of the effective radius would cover unsuitable habitat (water surface) and potentially preferable habitat outside of the APE (above 750-foot elevation).

The distance ABBs can travel and the limited terrestrial area potentially affected by anticipated future operations any ABBs captured indicate any ABBs lured from the larger terrestrial area within the effective survey radius but outside of the area potentially affected by anticipated future operations would not be representative of the species' actual habitat use or occupancy within Project area as a whole. Positive ABB findings could thus incorrectly be identified as Project effects. Coupled with the negative findings of the 2021 ABB surveys, GRDA proposes a study modification to forego the second study period survey as the results would not be representative of Project effects.

### **6.1.3 Cultural Resources**

Outlined in **Section 3.1**, the Cultural Resources Study, during the first study period, was conducted under two methodology variances that were developed in consultation and approved by the CRWG.

The first variance is a deviation from the Osage Nation's Archaeological Block Survey Standards for conducting shovel test excavations to identify and delineate archaeological sites within the Project's APE. During the survey efforts, adjustments based upon in-field conditions were made by the field director.

The second variance was for survey of Qal areas that contained a thick veneer of alluvial sediments, such that the original archaeological survey methods (pedestrian survey and STP

excavations) were inadequate to determine if buried archaeological deposits were present. To efficiently assess these areas, additional field methods including examination of soil profiles exposed in cutbanks, when available, and/or the excavation of auger tests to determine the depth of the modern soil deposits were implemented.

If the deposits were found to be relatively shallow, and the historic surface could be reached via shovel testing, the standard methods for shovel test excavation were followed. If the deposits were found to extend beyond the depth of an average shovel test (more than 50 cm below surface), then the area was considered as “protected” with no adverse effects to any sites that may be present at depth and no further survey work was completed.

Both above variances were developed in consultation with the CRWG and approved by the CRWG. As a result, GRDA proposes a study modification to continue to implement these methods during the second study period.

#### **6.1.4 Infrastructure**

The purpose of the Infrastructure Study is to determine a range of inflow conditions for which H&H model results show Project operations may influence the frequency or depth of flooding. Specifically, the Commission requested maps and tables identifying the frequency and depth of flooding for each item of infrastructure. The next step in the study is the analysis for anticipated future operations.

The H&H Study concluded that the initial stage at Pensacola Dam has an immaterial impact on upstream WSELs and inundation. Only a different inflow event caused an appreciable difference in maximum WSEL and maximum inundation extent. The differences in WSEL and inundation extent due to the size of the inflow event were an order of magnitude greater than the differences in WSEL and inundation extent due to the initial stage at Pensacola Dam.

The WSEL operational effect findings of the H&H Study weaken the original nexus of additional study work on the Infrastructure Study which was based upon the incorrect assumption WSEL operational changes under Project operations have an effect on inundation extent of infrastructure.

For the reasons stated, GRDA proposes a modification to the RSP to forego any future work on the Infrastructure Study.

**Table 5. Proposed Study Modifications**

<b>Study</b>	<b>Proposed Modification(s)</b>
Hydrologic and Hydraulic Modeling	None
Sedimentation	None
Aquatic Species of Concern	Forego surveys for paddlefish and Neosho smallmouth bass.
Terrestrial Species of Concern	Forego second study period surveys for ABBs.
Wetland and Riparian Habitat	None
Recreation Facilities Inventory and Use	None
Cultural Resources	Continue to adjust the testing interval density for Qals based upon in-field conditions as necessary during remaining surveys using the adjusted survey methods for buried archaeological deposits.
Socioeconomics	None
Infrastructure	Forego future work on study.

## 6.2 Requested New Studies

Based upon the study results of the studies conducted in the initial study period and contained in this document, GRDA is not proposing any new studies.

## 7.0 STATEMENT OF LICENSE APPLICATION

The relicensing studies addressed in the ISR and USR will provide the information necessary for determining and characterizing Project impacts and identifying appropriate protection, mitigation, and enhancement measures relevant to those impacts. An assessment of Project impacts will be presented in the Preliminary Licensing Proposal (PLP) or Draft License Application (DLA). The PLP or DLA will be filed with FERC no later than January 1, 2023<sup>19</sup> and will refine its presentation of information on impacts and its application. This includes PMEs, in the Final License Application, which must be filed no later than May 31, 2023.<sup>20</sup>

<sup>19</sup> Due no later than 150 days prior to deadline for filing of License Application (18 CFR §5.16(a)).

<sup>20</sup> Due no later than 2 years prior to license expiration (18 CFR § 5.17(a)).

## 8.0 REFERENCES

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**Appendix 1: Virtual Meeting Agenda**

**The Appendix has been eFiled as a separate file.**

**Appendix 2: Hydrologic and Hydraulic Study Reports**

**The Appendix has been eFiled as a separate file.**

**Appendix 3: Bathymetry Study Report**

**The Appendix has been eFiled as a separate file.**

**Appendix 4: Sedimentation Study Report**



**The Appendix has been eFiled as a separate file.**

**Appendix 5: Aquatic Species of Concern Report**

**The Appendix has been eFiled as a separate file.**

**Appendix 6: Terrestrial Species of Concern Report**

**The Appendix has been eFiled as a separate file.**

**Appendix 7: Wetland and Riparian Habitat Report**

**The Appendix has been eFiled as a separate file.**

**Appendix 8: Recreation Facilities Inventory and Use Report**



**The Appendix has been eFiled as a separate file.**

**Appendix 9: Cultural Resources Reports**

**The Appendix has been eFiled as a separate privileged file.**

**Appendix 10: Socioeconomic Report**

**The Appendix has been eFiled as a separate file.**

## **Appendix 11: Infrastructure Report**

**The Appendix has been eFiled as a separate file.**