July 2023

Response to Requests for Contaminated Sediment Transport Study for the Relicensing of the Pensacola Hydroelectric Project (FERC No. 1494)

Terms and Abbreviations

CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
City	City of Miami, Oklahoma
CoC	Contaminant of concern
Commission	Federal Energy Regulatory Commission
Corps	U.S. Army Corps of Engineers
CSTAG	Contaminated Sediments Technical Advisory Group
DHM	Downstream Hydraulic Model
EFDC	Environmental Fluid Dynamics Code
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
FRM	Flood Routing Model
FS	Feasibility study
Grand Lake	Grand Lake O' the Cherokees
GRDA	Grand River Dam Authority
H&H	Hydrologic and hydraulic
ILP	Integrated Licensing Process
ISR	Initial Study Report
LEAD	Local Environmental Action Demanded
LiDAR	Light Detection and Ranging
MISR	Model Input Status Report
MoDNR	Missouri Department of Natural Resources
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NOI	Notice of Intent
NPL	National Priorities List
ODEQ	Oklahoma Department of Environmental Quality
OM	Operations Model
OU	Operable Unit
PAD	Pre-Application Document
PD	Pensacola datum
Ppm	parts per million
PRP	Potentially responsible party
PSP	Proposed Study Plan

RM	River Mile
RSP	Revised Study Plan
SA1	Supplementary Analysis No. 1
SD	Scoping Document
SMD	Study Modification Determination
SPD	Study Plan Determination
SSL	Soil Screening Levels
TSMD	Tri-State Mining District
UHM	Upstream Hydraulic Model
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
USR	Updated Study Report
WSEL	Water surface elevations

Executive Summary

The existence of contaminated sediment from the U.S. Environmental Protection Agency's (EPA's) Tar Creek Superfund site and the larger Tri State Mining District (TSMD), which spans Kansas, Missouri, and Oklahoma, and its delivery of heavy metals to downstream areas has led to a request by certain participants in the ongoing Federal Energy Regulatory Commission (FERC or Commission) process for the relicensing of the Pensacola Hydroelectric Project (Project). These relicensing participants, the City of Miami, Oklahoma (City), and Local Environmental Action Demanded Agency, Inc. (LEAD) (collectively, Requestors), seek a determination from Commission staff that Grand River Dam Authority (GRDA), licensee of the Project, should conduct a study addressing contaminated sediment transport within the Project's Grand Lake O' the Cherokees (Grand Lake) and four tributaries near the City: the Neosho, Spring, and Elk rivers and Tar Creek.

On March 13, 2018, the City filed its proposed *Study Plan Request for Contaminated Sediment Transport Study* (Miami Proposed Study),[1] in which the City requested FERC to require GRDA to undertake a "comprehensive sediment transport analysis to assess the effect of increased flooding associated with Project operations on contaminated sediment deposition within the floodplains of the Neosho River, Tar Creek, and Lower Spring River in areas near Miami, OK."[2]

The overall goal of the Miami Proposed Study is to "determine Project impacts on flooding and toxic sediment deposition in the upper reaches of Grand Lake and the areas surrounding the Tar Creek, Neosho River, and Spring River tributaries, including in the vicinity of Miami."[3]

Next, in its comments filed on October 24, 2018, LEAD endorsed the Miami Proposed Study, but also proposed "a larger toxicity study to include a full sediment toxicity study of the lake that includes cores throughout the lake."[4] Contrary to FERC regulations, LEAD provided no study plan or other details regarding its proposed study.[5]

When FERC staff issued their initial *Study Plan Determination* (SPD) for the relicensing of the Project in 2018,[6] FERC staff did not approve the Contaminated Sediment Transport Study proposed by the Requestors because Requestors had not demonstrated a nexus between GRDA's Project operations under its FERC-issued license and contaminated sediment transport and deposition.

For a second time, after a several years of study and a renewed request by the Requestors, FERC staff did not approve the Contaminated Sediment Transport Study proposed by the Requestors when

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[1] FERC Accession No. 20180313-5162 at Attachment 9. For convenience, a copy of the Contaminated Sediment Transport Study appears in Exhibit 1 of this Response.
[2] Contaminated Sediment Transport Study proposal at 4.
[3] *Id.*
[4] FERC Accession No. 20181024-5063.
[5] 18 C.F.R. § 5.9(b).
[6] FERC Accession No. 20181108-3052.

FERC staff issued its *Determination for Study Modifications and New Studies for the Pensacola Hydroelectric Project* (2022 SMD) in 2022.[7] Once again, FERC staff deferred the decision because it was premature at that time to make a decision until the potential for Project operation to affect flooding, peak flows, and sediment transport in the project headwaters was determined.

For a third time, after another year of study and another renewed request by the Requestors, FERC staff did not approve the Contaminated Sediment Transport Study proposed by the Requestors when FERC staff issued their *Determination on Requests for Study Modifications and New Studies for the Pensacola Hydroelectric Project (2023 SMD)* in 2023.[8] FERC staff again deferred the decision because it was premature to make a decision until the potential for Project operation to affect flooding, peak flows, and sediment transport in the project headwaters was determined.

Unsurprisingly, after an initial request, two renewed requests, and three FERC staff decisions over the last five years, the requests for a Contaminated Sediment Transport Study have not been approved because the entire need for the study is contingent on the operations of the Project impacting flooding. The entire supposed need for this study is plainly stated in the Miami Proposed Study Plan objectives as follows:

> The goal of the proposed study is to determine Project impacts on flooding and toxic sediment deposition in the upper reaches of Grand Lake and the areas surrounding Tar Creek, Neosho River, and Spring River tributaries, including the vicinity of Miami.[9]

GRDA has now completed and filed the additional work required by FERC staff in their 2023 SMD. Concurrent with the filing of this Response to Requests for Contaminated Sediment Transport Study for the Relicensing of the Pensacola Hydroelectric Project (FERC No. 1494) (Response), GRDA has submitted *Supplementary Analysis No. 1, Hydrologic and Hydraulic Modeling: Fictional Scenarios in Which the U.S. Army Corps of Engineers Fails to Adhere to its Water Control Manual Until the Peak Inflow Reaches Pensacola Dam* (SA1), which brings to close the most comprehensive and detailed hydrologic and hydraulic (H&H) models ever constructed for the study area. Throughout development, the models were intensely peer reviewed and scrutinized by the City's experts and FERC staff. GRDA has also submitted an updated version of the *Sedimentation Study Report*, which brings the Sedimentation Study to close, and which also has been subject to intense scrutiny by relicensing participants for many years.

7 FERC Accession No. 20220224-3074.
8 FERC Accession No. 20230314-3035.
9 FERC Accession No. 20180313-5162 at Attachment 9, Section 2.1. For convenience, a copy of the Contaminated Sediment Transport Study appears in Exhibit 1 of this Response.

With the H&H Modeling Study and Sedimentation Study now final, FERC staff is now able to proceed with their determination on Requestors' Contaminated Sediment Transport Study according to the mandatory criteria for a study plan under 18 C.F.R. § 5.9(b).

In preparing this Response, GRDA completed a thorough review of the Contaminated Sediment Transport Study requests according to the Commission's regulatory requirements and has found the Requestors' proposed study plan fails to meet the mandatory criteria, and therefore must be rejected.

Over the past nearly 5 years, FERC staff has repeatedly and consistently indicated that the most important factor in determining whether a Contaminated Sediment Transport Study is needed is whether Project operations cause flooding in the upper reaches of the Spring and Neosho Rivers and Tar Creek. The studies completed in accordance with the FERC-approved study plan strongly demonstrate that Project operations do not cause flooding in upstream reaches of the Spring and Neosho Rivers. Thus, the Requestors' Contaminated Sediment Transport Study should be rejected on that basis alone. While the lack of a nexus between Project operations and upstream flooding is determinative in this matter, there are many other reasons warranting rejection of Requestors' proposed study. These reasons are summarized below and detailed in this Response:

1. <u>GRDA's Project Operations Do Not Cause Overbank Flooding Along Tar Creek or Along the Reaches of the Spring, Neosho, or Elk Rivers Within and in the Vicinity of the City of Miami (Criterion No. 5).</u>[10]
   GRDA's H&H Modeling and Sedimentation Study, which were conducted precisely as required by FERC staff —which fulfilled the requirements of the FERC-approved study plan—have proven that GRDA's Project operations do not cause flooding in areas where contamination is of concern. Proof that nature, not GRDA Project operations, causes flooding is bolstered by the chronological compendium of flooding in Historical Research Associates' *A History of Flooding, Flood Control, and Hydropower on the Neosho (Grand) River*, and GRDA's SA1, which presents the results of extreme, fictional scenarios in which the U.S. Army Corps of Engineers (Corps) fails to adhere to its Water Control Manual until the peak inflow reaches Pensacola Dam.

2. <u>Overbank Flooding Occurs Only During Natural Flooding Events when the Corps has Exclusive Jurisdiction over Project Operations (Criterion No. 5).</u>[11]
   Because FERC lacks authority to impose license conditions during the only periods in which overbank flooding occurs, results from the proposed Contaminated Sediment Transport Study will not produce information that would "inform the development of license requirements," as required by study Criterion No. 5. And because overbank flooding occurs during periods in

[10] See also Section 3.1 of this document.
[11] See also Section 3.2 of this document.

which the Corps has exclusive jurisdiction over Project operations, the proposed Contaminated Sediment Transport Study lacks any nexus between the Project's operations and the effects "of the resource to be studied," also in violation of study Criterion No. 5.

3. Because CERCLA Directs EPA —and *Only* EPA— to Address Tar Creek Superfund Site Remediation Efforts, Information Produced by the Proposed Study Will Not Inform License Conditions (Criterion No. 5).[12]

The Requestors' proposed Contaminated Sediment Transport Study seeks to infringe on EPA's statutory obligations under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Contrary to Requestors' efforts to draw FERC into the long-running program to clean up the Tar Creek Superfund Site, CERCLA authorizes EPA—not FERC—to identify potentially responsible parties (PRPs) and hold them accountable for the natural resource damages caused by their mining operations within the Tar Creek Superfund Site.

By requesting that FERC mandate the proposed Contaminated Sediment Transport Study, Requestors seek to have FERC infringe upon EPA's responsibilities for the Tar Creek Superfund Site under CERCLA.

The Requestors are naïve in assuming a change in Project's reservoir operations or Shoreline Management Plan will resolve the effects of contaminated sediment transport. Both common sense and the comprehensive scientific record demonstrate the only effective means of addressing the natural resources damage within the Tar Creek Superfund Site is to remove the source material.

4. Environmental and Health Effects of Contaminants Are Well Documented and Need No Further Study (Criterion No. 4).[13]

Toxicity testing by the U.S. Geological Survey (USGS) indicated that "…sediment samples collected from Grand Lake in October 2008 were not likely causing or substantially contributing to toxicity to sediment dwelling organisms."[14] Regarding human fish consumption, skinless fillet fish from mining mill ponds, the Neosho River, and Grand Lake are safe to eat. Skinless fillets are safe to eat from the Spring River except for non-game fish. Whole fish with skin and bones at some locations (a traditional cultural eating practice) elicits more nuance as far as consumption goes, which in effect is why Grand Lake and its tributaries are listed on the State 303d list for lead contamination.[15]

[12] See also Section 3.3 of this document.
[13] See also Section 3.4 of this document.
[14] Ingersoll et.al. 2009, at 3.
[15] Oklahoma Department of Environmental Quality (ODEQ), 2007.

Aquatic organisms in some of the more highly contaminated tributaries seem to be increasing in abundance. For example, in the ISR for aquatic species of concern,[16] GRDA documented that previous mussel surveys were unable to locate freshwater mussels in the Spring River in studies completed in the 1980s. However, recent surveys completed by EcoAnalysts[17] and GRDA[18] in the past 5 years have demonstrated that there is an ongoing recovery, regardless of dam operation as postulated by some stakeholders.

5. A Wealth of Existing Information is Already Available to Inform FERC's Cumulative Impacts Analysis of Contaminated Sediment Transport and Deposition (Criterion No. 4).[19]

Importantly, in its Scoping Document 2, FERC staff identified contaminated sediment transport as an issue that it will cumulatively analyze under the National Environmental Policy Act (NEPA). In completing this work, FERC staff can rely on a wealth of information to support its cumulative effects analysis. The contamination is spread across a vast area, spanning two EPA Regions, three states, numerous tribal jurisdictions, and various areas of academic inquiry. As a result, there are numerous repositories of information regarding contaminated sediments originating at the Tar Creek Superfund Site and broader TSMD, including numerous studies that are housed with the Tulsa United States Fish and Wildlife Services Oklahoma Ecological Services Field office website, the Oklahoma Department of Environmental Quality (ODEQ) website, and the EPA's website.

In addition, GRDA has identified several study reports that directly pertain to the Project and the issues raised by Requestors' proposed Contaminated Sediment Transport Study. The reports are identified in Section 3.5 along with links to the reports.

6. The City of Miami and Others Bear Significant Responsibility for the Spread of Contaminants (Criterion No. 5).[20]

Chat, mining waste originating in the Tar Creek Superfund Site and which is a major existing and past source of contamination, continues to be used for a variety of purposes. It was used under houses and businesses, to construct alleyways and driveways, as railroad ballast, as aggregate for asphalt and concrete, and in many other common uses for gravel. The past and ongoing sales of chat have been documented.

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[16] FERC Accession No. 20210930-5214.
[17] EcoAnalysts 2018.
[18] FERC Accession No. 20220930-5106, at Appendix 5.
[19] See also Section 3.5 of this document.
[20] See also Section 3.6 of this document.

The average lead level in Grand Lake sediment is 42 parts per million (ppm)[21] but 71% of the samples collected in the City Miami exceed 500 ppm[22] and are similar to lead levels immediately adjacent to chat piles within the EPA Superfund Site.[23] The source of contamination in Miami is not Grand Lake or Project operations. As explained in Section 2.3.1, chat was widely distributed and extensively used in Miami and other nearby towns. It is the dominant factor in the elevated lead issues in these locations.

GRDA does not question the critical importance of cleaning up the Tar Creek Superfund Site and addressing adverse effects to human health that have been caused by decades of mining activity. These are vital matters for our community to address.

By requesting the proposed Contaminated Sediment Transport Study, however, the City seeks to hold GRDA responsible for the spread of contamination to soils within and in the vicinity of the City, because of the Corps' Project operations during flood events that flow downriver and into the reservoir. However, as documented in this report, the distribution of chat in the City and other adjacent towns adds to the complexity of the contamination of the area and is the dominant cause of contamination, not flooding and deposition of contaminated sediment.

7. The Modeling Methodology Proposed in the Contaminated Sediment Transport Study is Not Generally Accepted in the Scientific Community (Criterion No. 6).[24]

The City's proposed methodology would add no value to the contamination remediation effort. There is no indication that the City's methodology would use contaminant levels as a calibration point. If the supposed primary output of the model—heavy metal sediment contamination—is not verified against field measurements, there can be no confidence in model results. What the City is proposing is a sediment transport model, which GRDA has already developed and documented in the Sedimentation Study Updated Study Report (USR). The City's sediment transport model would then be used to "predict" contaminant levels at a future date based on unspecified, subjective analysis with extremely uncertain results that would undercut any utility of the model.

The EPA's own expert group of individuals, the Contaminated Sediments Technical Advisory Group (CSTAG), created by the EPA in 2002, who are intimately familiar with both contaminant transport and fate models and the EPA Superfund program, suggested moving away from a modeling approach. CSTAG evaluated the subject of contaminated sediment, weighed the effort

[21] Fey et al. 2010.
[22] CH2M HILL 2001.
[23] U.S. Fish & Wildlife Service 2013.
[24] See also Section 3.7 of this document.

of model development against the possible benefits, and found that a modeling approach similar to that put forth by the Requestors was a poor use of limited resources. CSTAG's primary recommendation was to not pursue this type of modeling.[25]

8. <u>The Proposed Contaminated Sediment Transport Study Would Be Prohibitively Expensive, Delay the Relicensing Process, and Fail to Produce Any Reliable Results (Criterion No. 7).</u>[26]
Developing and documenting a defensible Contaminated Sediment Transport Study as requested is expected to cost close to $2,000,000. Through the expensive process, there is no guarantee this effort will produce a model that provides more confidence than simple field measurements as advocated by CSTAG.[27]

This is a significant cost in an already very expensive relicensing effort, where GRDA to-date has expended over $16,000,000 through the submittal of the Final License Application (FLA) and over $5,000,000 on the H&H Modeling and Sedimentation studies alone.

GRDA estimates that implementing this study would take at least two years to complete—particularly in light of the City's aggressive advocacy demonstrated during the ISR and USR phases of the prefiling Integrated Licensing Process (ILP). All the public benefits that will result from FERC's issuance of a new license will be significantly delayed by this study, if required.

As demonstrated by CSTAG's conclusions[28] when reviewing a modeling proposal similar to that of the City's Contaminated Sediment Transport Study proposal,[29] there is no reason to believe the results would be accurate enough to inform FERC's decision-making in this relicensing effort.

In sum, adopting the Requestors' proposed Contaminated Sediment Transport Study at this late stage of the relicensing effort—where all studies are now complete, and the FLA has been filed—would be highly disruptive and cause unreasonable delay. FERC staff should reject the proposed Contaminated Sediment Transport Study based on study Criterion No. 7's requirement to consider "level of effort and cost." Simply stated, this study would be inordinately expensive in a relicensing effort that has already significantly taxed GRDA's electric customers, significantly delaying the entire relicensing effort, and fail to provide meaningful data to inform an analysis of Project effects and mitigation measures—measures that, as described throughout this Response, the Commission has no authority to require.

Relying on FERC staff's prior responses to this long-standing study request, as well as the mandatory regulatory criteria governing FERC's determinations on study requests under 18 C.F.R. 5.9(b), this

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[25] CSTAG 2022.
[26] See also Section 3.8 of this document.
[27] CSTAG 2022.
[28] *Id.*
[29] FERC Accession No. 20180313-5162, at Attachment 9.

Response demonstrates that the proposed Contaminated Sediment Transport Study must be rejected by FERC. There is simply no rational justification for requiring this study.

1 Introduction

This Response to Requests for Contaminated Sediment Transport Study (Response) for the Pensacola Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC or Commission) Project No. 1494, presents the Grand River Dam Authority's (GRDA) response to the long-standing requests by the City of Miami, Oklahoma (City) and Local Environmental Action Demanded Agency, Inc. (LEAD) (collectively, Requestors) that FERC require GRDA to conduct studies of contaminated sediment transport to analyze how Project operations may alter the transport and deposition of contaminated sediments from the U.S. Environmental Protection Agency's (EPA's) Tar Creek Superfund Site. Relying on FERC staff's prior responses to this long-standing study request, as well as the regulatory criteria governing FERC's determinations on study requests,[30] this Response demonstrates that these proposed studies on contaminated sediment transport are unwarranted and must be rejected by FERC.

1.1 Project Description

The Project is located on the Grand Neosho River (Grand River) in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma (Figure 1.1-1). The Pensacola Dam is located at river mile (RM)[31] 77 on the Grand River and creates Grand Lake O' The Cherokees, also known as Grand Lake. The Project as licensed consists of: a) a reinforced-concrete dam with a multiple-arch section 4,284 feet long, a spillway 861 feet long containing twenty-one radial gates, a non-overflow gravity section 451 feet long, and two non-overflow abutments, comprising an overall length of 5,950 feet and a maximum height of 147 feet; b) a reinforced-concrete, gravity-type spillway section 886 feet long containing twenty-one radial gates and located about 1 mile east of the main dam; c) the Grand Lake reservoir, which has a surface area of approximately 45,200 acres and a storage capacity of 1,680,000 acre-feet at normal maximum water surface elevation (WSEL) of 745 feet Pensacola datum (PD),[32] below which is known as the conservation pool; d) six, 15-foot-diameter steel penstocks supplying flow to six turbines each rated at 17,446 kilowatts (kW) attached to six generators each rated at 24,000 kilovolt amp (kVA) or 21,600 kW, and one 3-foot-diameter penstock supplying flow to one turbine rated at 500 kW attached to an identically rated generator, located in a powerhouse immediately below the dam; e) a tailrace approximately 300 feet wide and a spillway channel approximately 850 feet wide, both about 1.5 miles long; and f) appurtenant facilities.

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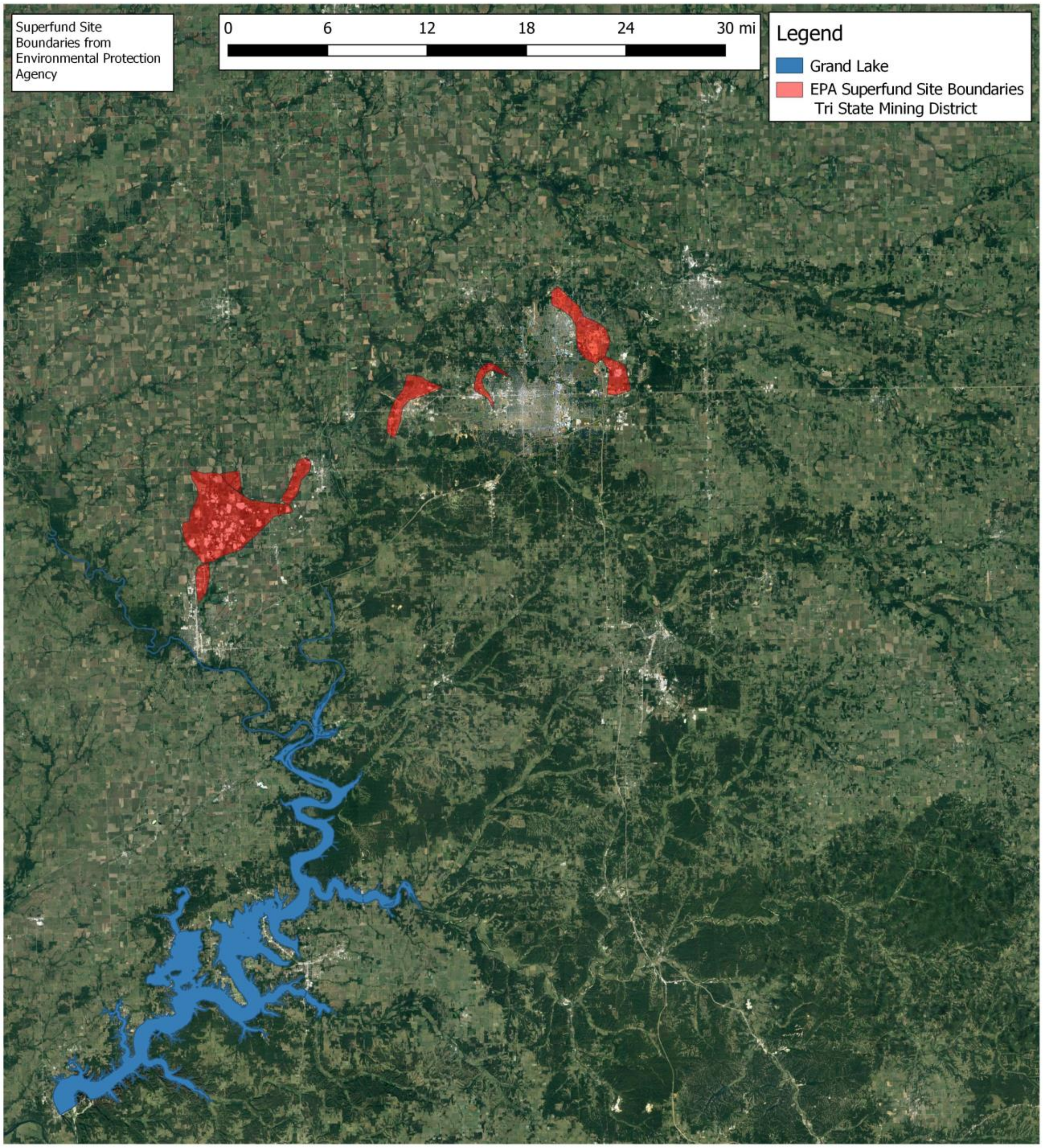
[30] 18 C.F.R. § 5.9(b).

[31] River miles in this document are based on a dataset created by USGS, November 14, 2016, NHD at 1:24,000 scale, unless otherwise noted.

[32] Unless otherwise noted, all elevations referenced are relative to PD. PD elevations can be converted to National Geodetic Vertical Datum of 1929 (NGVD) by adding 1.07 feet and to North American Vertical Datum of 1988 (NAVD) by adding 1.40 feet (for example, elevation 745 feet PD = 746.07 feet NGVD = 746.4 feet NAVD88). (http://ok.water.usgs.gov/projects/webmap/miami/datum.htm).

Figure 1.1-1
Location of EPA Superfund Sites Relative Grand Lake



The Project is owned and operated by GRDA, which is a non-appropriated agency of the State of Oklahoma, created by the Oklahoma legislature in 1935 to be a "conservation and reclamation district for the waters of the Grand River." As licensed by FERC, the Project serves multiple purposes, including hydropower generation, water supply, public recreation, and wildlife enhancement. As directed by Congress under section 7 of the Flood Control Act of 1944[33] and section 7612 of the National Defense Authorization Act for Fiscal Year 2020 (NDAA 2020),[34] the U.S. Army Corps of Engineers (Corps) has exclusive jurisdiction over Grand Lake for flood control purposes.

In addition, GRDA operates and maintains five FERC-approved recreation sites at the Project, consisting of: (1) Duck Creek Bridge Public Access Area; (2) Seaplane Base Public Access; (3) Monkey Island Public Boat Ramp; (4) Big Hollow Public Access; and (5) Wolf Creek Public Access. These facilities provide public access to Grand Lake for boating, fishing, and other recreational activities.

The Project Boundary is defined by a combination of a metes and bounds description and generally follows contour elevation 750 feet. It encompasses 53,965 acres, including the 45,200 acres of the Project reservoir (at the upper extent of the conservation pool of 745 feet PD). The Project Boundary encompasses all Project facilities and works, Project recreation areas, and a shoreline buffer around the entire reservoir (generally between 745 and 750 feet PD).

1.2 Treatment of Proposed Contaminated Sediment Transport Study in Relicensing Study Plan

FERC's relicensing of the Project began on February 1, 2017, when GRDA filed its Notice of Intent (NOI) to relicense the Project and Pre-Application Document (PAD). Following a brief abeyance period in the relicensing schedule, FERC on January 12, 2018, issued notice of the PAD and NOI and commencement of the relicensing pre-filing process. FERC's notice also requested that relicensing participants provide comments regarding the PAD and provide study requests. Concurrently, FERC issued Scoping Document 1 (SD1)[35] to outline the subject areas to be addressed in its environmental analysis of the Project pursuant to the National Environmental Policy Act (NEPA), followed by a series of public environmental scoping meetings.

1.2.1 Submittal of Proposed Contaminant Transport Studies

Following FERC's scoping meetings, federal and state regulators, Native American tribes, local governmental entities, interested members of the public, and other relicensing participants filed a total of 61 comment letters with FERC, in accordance with FERC's Integrated Licensing Process (ILP) regulations.[36] Comments received were a combination of general comments regarding the Project, comments on the PAD and SD1, and study requests. A total of 27 formal and individual study requests were made by relicensing participants and FERC staff.

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33 33 U.S.C. § 709.
34 Pub. L. No. 116-92, § 7612 (2019).
35 FERC Accession No. 20180112-3008.
36 18 C.F.R. § 5.9(a).

Among the 27 study requests submitted by relicensing participants were two proposed studies aimed at investigating how Project operations may alter the transport and deposition of contaminated sediments from the upstream Tri-State Mining District (TSMD), including EPA's Tar Creek Superfund Site, on lands within and in the vicinity of the City. First, on March 13, 2018, the City filed its proposed *Study Plan Request for Contaminated Sediment Transport Study* (Miami Proposed Study),[37] in which the City requested FERC to require GRDA to undertake a "comprehensive sediment transport analysis to assess the effect of increased flooding associated with Project operations on contaminated sediment deposition within the floodplains of the Neosho River, Tar Creek, and Lower Spring River in areas near Miami, OK."[38] The overall goal of the Miami Proposed Study is to "determine Project impacts on flooding and toxic sediment deposition in the upper reaches of Grand Lake and the areas surrounding the Tar Creek, Neosho River, and Spring River tributaries, including in the vicinity of Miami."[39] To achieve this goal, the Miami Proposed Study called for the development of several different models and related analyses:

- "Develop a comprehensive hydraulic model using existing and any required additional information to establish baseline flood inundation areas in the upper reaches of Grand Lake and in the vicinity of the City of Miami."[40] The City proposed that GRDA "use the Environmental Fluid Dynamics Model (EFDC) hydrodynamic and sediment transport modules, or another similar and appropriate model such as Delft3D, to simulate sediment movement in the Neosho River, Tar Creek, Spring River, and their floodplains."[41]
- "Specify toxins of concern and quantify toxicity of sediments from the Grand Lake tributaries of Tar Creek, Neosho River, and Spring River."[42]
- "Establish a baseline sediment transport model using existing and any required additional information."[43]
- "Estimate the change of toxic sediment deposition in the upper reaches of Grand Lake and in the vicinity of the City of Miami as a result of proposed operating scenarios."[44]
- "Estimate the future impacts of deposition of contaminated sediments near Miami and into Grand Lake over the duration of the license."[45]

Next, in its comments filed on October 24, 2018, LEAD endorsed the Miami Proposed Study, but also proposed "a larger toxicity study to include a full sediment toxicity study of the lake that includes

[37] FERC Accession No. 20180313-5162, at Attachment 9. For convenience, a copy of the Contaminated Sediment Transport Study appears in Exhibit 1 of this Response.
[38] Miami Proposed Study (Exhibit 1 of this response) at 4.
[39] *Id.*
[40] *Id.*
[41] *Id.* at 7.
[42] *Id.* at 4.
[43] *Id.*
[44] *Id.*
[45] *Id.*

cores throughout the lake."[46] Contrary to FERC regulations, LEAD provided no study plan or other details regarding its proposed study.[47]

1.2.2 GRDA Opposition to Proposed Contaminant Transport Studies

In both its Proposed Study Plan (PSP)[48] and Revised Study Plan (RSP),[49] GRDA opposed the proposed Contaminated Sediment Transport Study.[50] In the PSP, GRDA did not propose to conduct the proposed Contaminated Sediment Transport Study for several reasons:

- Citing Study Criterion No. 5, GRDA asserted that because "the Project is not at all responsible for the presence of any heavy metals in Tar Creek [...], this type of study would not 'inform the development of license requirements,' as required by FERC's ILP regulations."[51] GRDA's PSP cited other examples in which FERC did not require relicensing studies due to a lack of a causal relationship between the subject project and the presence of heavy metals.[52]
- GRDA cited extensive research conducted within TSMD and Grand Lake indicating that "no acute or chronic toxicity as a result of metals contamination within Grand Lake."[53]
- GRDA argued that because the EPA has an existing action plan in place to address damages to natural resources as a result of mining activities within TSMD under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), there is no need for FERC to address this matter in this relicensing process.[54]
- GRDA asserted that flooding events resulting in overbanking along Tar Creek are not "attributable to GRDA's operations under its license."[55]
- GRDA pointed out that to the extent information on contaminated sediment transport was needed for a cumulative effects analysis under NEPA, FERC could use a wealth of existing information to complete that analysis.[56]

In the RSP, GRDA raised these same objections to the proposed Contaminated Sediment Transport Study.[57]

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[46] FERC Accession No. 20181024-5063.
[47] 18 C.F.R. § 5.9(b).
[48] FERC Accession No. 20180427-5045.
[49] FERC Accession No. 20180924-5030.
[50] The Miami Proposed Study and LEAD's proposed additional "toxicity study" are hereinafter referred to collectively as the "Contaminated Sediment Transport Study."
[51] PSP at 36 (quoting 18 C.F.R. § 5.6(b)(5)).
[52] *Id.* (citing Study Plan Determination for the Toledo Bend Project at 17, Project No. P-2305 (issued Aug. 6, 2009) (rejecting the risk assessment study for the accumulation of Mercury and Sediment into the Toledo Bend Reservoir "[d]ue to the lack of a nexus between project operation and the resource to be studied")).
[53] *Id.*
[54] *Id.* at 37.
[55] *Id.*
[56] *Id.* (citing Council on Environmental Quality, *Considering Cumulative Effects Under the National Environmental Policy Act* at 3, 31 (1997)).
[57] RSP at 38-40.

1.2.3 FERC Study Plan Determination

FERC staff issued their *Study Plan Determination* (SPD) for the relicensing of the Project on November 8, 2018.[58] FERC's SPD approved a total of 9 studies, consisting of: (1) Hydrologic and Hydraulic (H&H) Modeling Study; (2) Sedimentation Study; (3) Aquatic Species of Concern Study; (4) Terrestrial Species of Concern Study; (5) Wetland and Riparian Habitat Study; (6) Recreation Facilities Inventory and Use Study; (7) Cultural Resources Study; (8) Socioeconomics Study; and (9) Infrastructure Study.

In the SPD, FERC staff did not approve the Contaminated Sediment Transport Study proposed by the Requestors because Requestors had not demonstrated a nexus between GRDA's Project operations under its FERC-issued license and contaminated sediment transport and deposition. FERC staff explained:

> Based on existing information, the degree to which the operation of the project affects contaminated sediment deposition is unclear. Above, we recommend H&H and sedimentation studies to evaluate the potential for project operation to affect flooding, peak flows, and sediment transport in the project headwaters. A finding from these modeling studies showing that flooding, influenced by project operation, contributes to sediment deposition in the overbank areas of the Grand Lake tributaries would demonstrate a possible nexus between project operation and effects of contaminated sediment transport (section 5.9(b)(5)). Such a finding could also indicate the possibility that a contaminated sediment transport study could inform a license requirement (section 5.9(b)(5)). However, until that connection is made, it is premature to require such a study.[59]

Thus, FERC staff deferred its determination on the proposed Contaminated Sediment Transport Study, indicating that if the H&H Modeling Study and Sedimentation Study demonstrate "that overbank flooding is influenced by project operation, additional information may be required to describe the effect of such flooding on soil chemistry and potential effects on plants and wildlife."[60]

[58] FERC Accession No. 20181108-3052.
[59] *Id.* at B-38.
[60] *Id.*

1.3 Initial Study Report and FERC Staff's Study Plan Modification Determination

1.3.1 GRDA Submission of Initial Study Report

On September 30, 2021, GRDA filed its Initial Study Report (ISR) with FERC, reporting on its progress in completing the FERC-approved study plan through the first several seasons of study.[61] The ISR contained a 513-page report (including all appendices) on the Upstream Hydraulic Model (UHM) component of the H&H Modeling Study. As summarized by GRDA:

> The results of the UHM demonstrate that the initial stage at Pensacola Dam has an immaterial impact on upstream WSEL 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.[62]

With regard to the Sedimentation Study, GRDA in the ISR included a 555-page (including all appendices) report on its progress of developing the FERC-required sediment transport model but reported that model development was a work-in-progress at the time of the ISR filing.[63]

1.3.2 Renewed Request for Contaminated Sediment Transport Study and GRDA Response

Following the ISR meetings held October 12-14, 2021, the City filed comments on the ISR on November 29, 2021.[64] The City's comments on the ISR renewed its request for the Contaminated Sediment Transport Study.[65]

GRDA filed its response to ISR comments on December 29, 2021.[66] In its response comments, GRDA objected to the proposed Contaminated Sediment Transport Study on the basis that the "nexus" required by FERC staff's SPD and the ILP regulations on study criteria,—i.e., that flooding, influenced

[61] FERC Accession No. 20210930-5214.
[62] *Id.* at 15-16.
[63] *Id.* at 17-18.
[64] FERC Accession No. 20211129-5213. LEAD did not file comments in response to the ISR.
[65] *Id.* at 18.
[66] FERC Accession No. 20211229-5048.

by Project operations, contributes to sediment deposition in the overbank areas of the Grand Lake tributaries—"has not been established."[67]

1.3.3 FERC Staff Study Modification Determination

On February 24, 2022, FERC staff issued its *Determination for Study Modifications and New Studies for the Pensacola Hydroelectric Project* (2022 SMD).[68] Based on comments raised by the City, FERC staff in its 2022 SMD approved several refinements to the H&H Modeling Study.[69] In addition, due to these approved changes, FERC staff determined that "GRDA's conclusion that project operations do not affect upstream flooding is premature."[70]

For these reasons, FERC staff once again deferred their determination on the proposed Contaminated Sediment Transport Study in their 2022 SMD, explaining:

> [T]he results of the H&H and Sedimentation Studies are necessary to evaluate the potential for project operation to affect flooding, peak flows, and sediment transport in the project headwaters. To date, these studies are incomplete and require modification as recommended in this SMD. Until those studies, including the modifications recommended in this SMD, are completed, it remains premature to make a determination on the need for the City's requested Contaminated Sediment Transport Study. Stakeholders will have the opportunity to request additional studies once GRDA has filed its [Updated Study Report] USR.[71]

1.4 Updated Study Report and FERC Staff's Study Plan Modification Determination

1.4.1 GRDA Submission of Updated Study Report

On September 30, 2022, GRDA filed its USR with FERC,[72] reporting on its progress in completing the FERC-approved study plan through the final season of study. The USR included reports of GRDA's progress in completing the FERC-approved study plan, including the changes approved by FERC staff to the H&H Modeling Study and Sedimentation Study following the ISR review process. The USR contained a 711-page (including all appendices) updated version of the UHM Report, which

[67] *Id.* at 53.
[68] FERC Accession No. 20220224-3074.
[69] *Id.* at B-12 to B-18. In a later determination, FERC staff approved proposed changes to the Sedimentation Study as well. FERC Accession No. 20220527-3022.
[70] 2022 SMD at B-13.
[71] *Id.* at C-1 to C-2.
[72] FERC Accession No. 20220930-5106.

comprehensively reported on the UHM component of the H&H Modeling Study. As stated in the Executive Summary of the UHM Report:

> The results of the UHM demonstrate that starting pool elevations at Pensacola Dam within GRDA's anticipated operational range have an immaterial impact on upstream WSELs, inundation, and duration for a range of inflow events. Compared to starting elevations within GRDA's anticipated operational range, only a different natural inflow event caused an appreciable difference in maximum WSEL, maximum inundation extent, or duration. The differences in WSEL, inundation extent, and duration due to the size of the natural inflow event were orders of magnitude greater than the differences in WSEL, inundation extent, and duration due to the initial stage at Pensacola Dam. The maximum impact of nature typically ranged from over 10 times to over 100 or even over 1,000 times the maximum simulated impact of GRDA's anticipated operational range.
>
> Even if extreme, hypothetical starting pool elevations outside GRDA's anticipated operational range are used, the maximum impact of nature is much greater than the maximum simulated impact of an extreme, hypothetical starting stage range of 23 feet. The impact of nature typically ranged from 2 times to 10 or even 100 times the impact of the extreme, hypothetical starting stage range.
>
> Comparing anticipated operations to baseline operations for a suite of simulations that spanned the FERC-requested range of starting pool elevations and inflow event magnitudes, the results of the UHM demonstrate that anticipated operations have an immaterial impact on upstream WSELs, inundation, and duration as compared to baseline operations.[73]

The USR also contained an updated, 971-page (including appendices) Sedimentation Study Report, which comprehensively reported on the Sedimentation Study implementation through the final study season. As stated in the Executive Summary of the Sedimentation Study Report:

> Model results were compared to determine the relative impacts of 50 years of sediment accumulation under expected loading, High Sedimentation versus Low Sedimentation rates, and Baseline versus Anticipated Operations. The results indicated that sediment loading, a natural phenomenon outside GRDA's control, generally has the largest impact on upstream water levels in

[73] UHM Report at vii-viii.

the Neosho River, overshadowing any impacts caused by Project operations. The impacts to water levels in the City of Miami for all evaluations are immaterial. Project operations, sediment loading, and future geometry show immaterial changes to water levels in the vicinity of the City. GRDA does not control the volume of incoming sediment, and the simulations indicate that, much like the findings of the Hydrologic and Hydraulic Study, nature dictates incoming sediment loads and therefore water levels in the study area, not Project operations.[74]

1.4.2 Renewed Requests for Contaminated Sediment Transport Study and GRDA Response

Undeterred by these conclusions of the USR, the Requestors continued to advocate for FERC staff's adoption of the proposed Contaminated Sediment Transport Study in their comments on the USR. In its comments on the USR, the City incorrectly stated that FERC had already "committed that it will study 'the effects of project operations on the transport and subsequent deposition of potentially contaminated sediment [...]"[75] The City also attempted to use GRDA's relicensing models to demonstrate that GRDA's Project operations have a backwater effect along Tar Creek, as well as along the Neosho and Spring Rivers.

In its comments on the USR, LEAD advocated that "FERC should complete a comprehensive heavy metal study on the sediments that the Dam's operations distribute in Grand Lake's watershed,"[76] including a "sediment transport model at higher water levels to determine the effect Dam operations have on redistributing toxic sediments."[77]

GRDA filed its response to USR comments on December 29, 2022.[78] In its response comments, GRDA once again objected to the proposed Contaminated Sediment Transport Study. In light of the significant new work completed on the H&H Modeling Study and Sedimentation Study during the final study season, GRDA opposed the proposed Contaminated Sediment Transport Study for the following reasons:

- The proposed Contaminated Sediment Transport Study lacks "'any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied.'

[74] Sedimentation Study Report at ES-3 to ES-4.

[75] FERC Accession No. 20221129-5184, at 20 (quoting Scoping Document 2 (SD2) for the Pensacola Hydroelectric Project at 8, FERC Accession No. 20180427-3008). At no place in SD2 did FERC staff express any commitment or intention to require the proposed Contaminated Sediment Transport Study. This proposed study is not listed among the Proposed Studies in SD2, and the City's incorrect statement is contradicted by the extensive record in this proceeding, summarized in this section, demonstrating FERC's consideration of this proposed study over the past 5 years.

[76] FERC Accession No. 20221129-5170, at 11.

[77] *Id.* at 12.

[78] FERC Accession No. 20221229-5237.

(Criterion 5)."[79] GRDA explained that "after four years of extensive study and modeling, the Commission-approved Study Plan has demonstrated that Project operations do not materially affect flows moving through the Project area from upstream locations, nor does the Project affect sedimentation."[80] GRDA also explained that "independent studies conducted by third parties also recognize that contamination of sediments is caused by parties other than GRDA."[81]

- The proposed Contaminated Sediment Transport Study "will not 'inform the development of license requirements' (Criterion 5)."[82] GRDA emphasized that "because the Project did not cause the release of contaminants from TSMD or materially contribute to their movement into and within the Project area, there is no basis for the Commission to fashion any license requirements to address this issue."[83] GRDA again cited other instances in FERC relicensing proceedings in which FERC has not required study of issues in which the licensee has no ability to mitigate effects.[84]
- GRDA once again opposed the Contaminated Sediment Transport Study because EPA—not FERC—has been delegated by Congress to oversee the EPA Superfund program under CERCLA, and that EPA has an existing and active action plan to address the concerns raised by the Requestors.[85]
- GRDA also cited numerous studies, performed by independent parties, concluding that there is no evidence of acute or chronic toxicity as a result of metals contamination within Grand Lake.[86]
- GRDA noted that FERC indicated in SD2 that it will analyze "the effects of project operations on the transport and subsequent deposition of potentially contaminated sediment,"[87] but asserted that FERC can rely on existing information to perform that analysis.[88]

1.4.3 FERC Staff Study Modification Determination

FERC staff issued their *Determination on Requests for Study Modifications and New Studies for the Pensacola Hydroelectric Project* (2023 SMD) on March 14, 2023.[89] In nearly all aspects, FERC staff in

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[79] *Id.* at 92 (quoting 18 C.F.R. § 5.9(b)(5)).
[80] *Id.*
[81] *Id.* (citing Andrews et al. 2009; Ingersoll et al. 2009, and Juracek and Becker 2009).
[82] *Id.* (quoting 18 C.F.R. § 5.9(b0(5)).
[83] *Id.*
[84] *Id.* at 93 (citing *First Light Hydro Generating Co.*, 162 FERC ¶ 61,235, at P 39 (2018); *Ga. Power Co.*, 111 FERC ¶ 61,433, at PP 36-46 (2005); Study Plan Determination for the Toledo Bend Project at 17, Project No. P-2305 (issued Aug. 6, 2009)).
[85] *Id.*
[86] *Id.*
[87] *Id.* (quoting SD2 at 8-9).
[88] *Id.* at 92-93 (citing *Natural Res. Defense Council v. Callaway*, 524 F.2d 79, 90 (2d Cir. 1975); *Eagle Crest Energy Co.*, 153 FERC ¶ 61,058 (2015).
[89] FERC Accession No. 20230314-3035.

the 2023 SMD accepted the FERC-approved study plan as complete. With regard to the H&H Modeling Study, FERC staff rejected nearly all criticisms advanced by the City, as follows:

- FERC staff rejected the City's request to change the UHM's 100-year event from the 308,000 cfs flow on the Neosho River, concluding: "The information in the record describing the calculation, results, and application of the 100-year flood estimate will support our hydrologic and hydraulic analysis. Therefore, we do not recommend that GRDA repeat its 100-year flood analysis or change its methodology."[90]
- FERC staff rejected the City's request for GRDA to analyze a wider range of operational alternatives, to encompass the range of physically feasible Project operations, determining: "GRDA has met the requirements of the approved study plan with respect to the modeling of a range of scenarios and reporting the results. The information provided is sufficient for an analysis of a realistic range of operational alternatives. Therefore, we do not recommend that GRDA be required to analyze a wider range of operational alternatives."[91]
- FERC staff rejected the City's request for GRDA to analyze pre-dam conditions at the Project, explaining: "The environmental baseline on relicensing is the environment as it exists at the time of relicensing, not pre-project conditions."[92]
- FERC staff rejected LEAD's request for the H&H Modeling Study to include a climate change impact study, determining: "Existing information and data sources are sufficient for this analysis. For example, GRDA has provided historic flood frequency data, which Commission staff can use to assess current trends in flood return frequencies to inform an evaluation of predicted climate change effects. Therefore, there is no need for a specific climate change impact study."[93]

FERC staff in its 2023 SMD did request GRDA to conduct some new analyses under the H&H Modeling Study, however. Although recognizing that GRDA's model runs were "[c]onsistent with the Corps' standard operating procedure for flood control as specified in the Corps' Water Control Manual for Pensacola Dam and Reservoir,"[94] and that GRDA's model "is consistent with [the] approach" recommended in the "HEC-RAS User's Manual, to start unsteady flow simulations prior to flood wave arrival at the upper boundary of the model,"[95] FERC staff recommended that GRDA conduct additional "extreme" scenarios in which "the initial starting elevation remains steady until the arrival of flood flows as recommended by the City."[96] In addition, FERC staff recommended that GRDA, in the 1D UHM, "revise the downstream boundary condition for Tar Creek at the Neosho River

[90] *Id.* at B-8 to B-9.
[91] *Id.* at B-9.
[92] *Id.* at B-14.
[93] *Id.* at B-15.
[94] *Id.* at B-7.
[95] *Id.* at B-8.
[96] *Id.*

confluence to reflect a flatter friction slope (if normal depth is used) or use a different downstream boundary condition, as appropriate," and to "correct the apparent and anomalous 10.5 foot difference in water surface elevations beginning at river mile 1.6."[97]

With regard to the Sedimentation Study, FERC staff again rejected nearly all modifications advanced by the City:

- FERC staff rejected the City's request for GRDA to modify the sediment rating curve.[98]
- FERC staff rejected the City's request for GRDA to change the method of sediment distribution.[99]
- FERC staff rejected the City's request for GRDA to run a sensitivity model analysis to multi-year climatic and runoff cycles, including a Monte Carlo-type analysis.[100]
- FERC staff rejected the City's request for GRDA to run the sediment transport model to represent a wider range of reservoir elevations, concluding that "GRDA reasonably followed the requirements of the approved study, including running the model at the required elevations."[101]
- FERC staff rejected the City's request for GRDA to analyze the potentially increased upstream flooding impacts of ongoing sedimentation dynamics in the tributaries above the sedimentation delta, such as channel and overbank deposition and natural levee building, concluding that "GRDA appropriately applied cross-section data from a range of sources and timeframes in model development and calibration and has analyzed the impacts of sedimentation dynamics in the tributaries on upstream flooding to a degree necessary to consider effects of project operation."[102]
- FERC staff rejected the City's request for GRDA to analyze the contribution of historical Project-caused sedimentation to current and future upstream flooding, concluding that "the Commission does not require applicants to study pre-project conditions or reconstruct pre-project conditions because that is not the baseline from which the Commission conducts its environmental analysis."[103]
- FERC staff rejected the U.S. Fish and Wildlife Service's request for GRDA to measure sediment deposition to verify the model projections and test for metals to determine if they are safe and appropriate for wildlife management, stating that "GRDA carried out the necessary sampling for the development and calibration of the hydraulic and sedimentation models,"[104]

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[97] *Id.* at B-11.
[98] *Id.* at B-21 to B-22.
[99] *Id.* at B-22.
[100] *Id.*
[101] *Id.* at B-23.
[102] *Id.* at B-24.
[103] *Id.* (citing *Conservation Law Foundation v. FERC*, 216 F.3d 41 (D. C. Cir. 2000); *Am. Rivers v. FERC*, 187 F.3d 1007, *amended and rehearing denied*, 201 F.3d 1186 (9th Cir. 1999)).
[104] *Id.* at B-25.

and therefore that GRDA is not "required to carry out any further measurements of sediment deposition."[105]

- FERC staff rejected the City's request for GRDA to modify other study reports (e.g., Aquatic Species of Concern Study, Terrestrial Species of Concern Study, Wetlands and Riparian Habitat Study, Infrastructure Study, and Socioeconomic Study) that rely on the Sedimentation Study, stating that "since none of the other studies rely on information from the Sedimentation Study, there is no need to modify them."[106]

Similar to the H&H Modeling Study, however, FERC staff did require additional, minor work on the Sedimentation Study as part of its 2023 SMD. In response to LEAD's request for GRDA to run the sediment transport model at higher water levels for purposes of determining effects of Project operations in the redistribution of toxic sediments, FERC staff directed GRDA to add a modeling run with a starting elevation level of 755 feet, explaining that such effort "would take little additional effort and could shed light on sedimentation processes associated with flood operations in the system."[107] In addition, FERC staff, in response to comments from the City, directed GRDA to "modify the [1D] UHM to correct the Tar Creek boundary condition and that the Sedimentation Study be revised by re-running the [sediment transport model] and updating the report as warranted to account for any changes that might result from the change in hydraulics."[108]

Because FERC staff in its 2023 SMD determined that the H&H Modeling Study and Sedimentation Study were not quite complete, as described above, they once again deferred decision on the proposed Contaminated Sediment Transport Study. FERC staff explained:

> [T]he results of the H&H and Sedimentation Studies are necessary to evaluate the potential for project operation to affect flooding, peak flows, and sediment transport in the project headwaters. These studies are nearly complete, but as recommended in this SMD, the [1D] UHM requires modification to revise the downstream boundary condition for Tar Creek at the Neosho River confluence. In addition, modifications to the sediment transport model are needed to account for the corrections to the [1D] UHM. Until the modifications recommended in this SMD are completed, it remains premature to make a determination on the need for the City's requested Contaminated Sediment Transport Study [...]. After that update is filed, a

[105] *Id.*
[106] *Id.*
[107] *Id.*
[108] *Id.* at B-23.

determination will be made on the Contaminated Sediment Transport Study.[109]

1.5 Submittal of Final Reports for H&H Modeling Study and Sedimentation Study

GRDA has now completed and filed the additional work required by FERC staff in their 2023 SMD. Concurrent with the filing of this Response, GRDA has submitted *Supplementary Analysis No. 1, Hydrologic and Hydraulic Modeling: Fictional Scenarios in Which the U.S. Army Corps of Engineers Fails to Adhere to its Water Control Manual Until the Peak Inflow Reaches Pensacola Dam* (SA1), which reports on the additional UHM modeling scenarios requested by FERC staff in the 2023 SMD. GRDA has also submitted an updated version of the *Sedimentation Study Report* to incorporate the final changes requested by FERC staff in the 2023 SMD.

With the H&H Modeling Study and Sedimentation Study now final, FERC staff is now able to proceed with their determination on Requestors' Contaminated Sediment Transport Study.

[109] *Id.* at C-3.

2 Overview of Contamination Related to the Tri-State Mining District

As FERC staff considers Requestors' proposed Contaminated Sediment Transport Study, a brief overview of the TSMD, including the Tar Creek EPA Superfund Site, is provided here. This overview includes a discussion of the history of the contamination, the response to the contamination, pathways of exposure to the contamination, an evaluation of the contamination, and recent information related to modeling approaches to understand the contamination. Although this overview is provided for contextual purposes, this information strongly demonstrates that FERC staff should deny the proposed Contaminated Sediment Transport Study. Not only do the now-final H&H Modeling Study and Sedimentation Study—as well as the report titled *A History of Flooding, Flood Control and Hydropower on the Neosho (Grand River)*[110]—strongly demonstrate that GRDA's Project operations do not cause overbank flooding along Tar Creek or along the reaches of the Spring River and Neosho River within and in the vicinity of the City of Miami, but the history and current cleanup status of the TSMD is highly complex, involving matters well beyond FERC's jurisdiction, and is a priority of the EPA—the federal agency charged by Congress under CERCLA to administer the Superfund program. There is no rational basis for FERC to become embroiled in this matter.

2.1 History of the Contamination

A discussion of contamination due to mining in the area is summarized in *Five-Year Review Report: Third Five-Year Review Report for the Tar Creek Superfund Site Ottawa County, Oklahoma*.[111] That report highlighted the historical lead and zinc mining that began in the early 1900s and the resulting pollution from the tailing ponds, chat piles, and abandoned mine shafts. Mining operations evolved over time, but the end results are similar.

> Lead and zinc mining activities first began at the site in the early 1900's. During the early mining period, most mining [in the TSMD] was conducted by small operators on 20 to 40 acre tracts. Each operator conducted their own mining, drilling, and milling activities (EPA, 1984). Mining activities occurred within a 50 to 150 [foot] thick ore bearing zone within the Boone Formation. The maximum depth of mining was approximately 385 feet below ground surface. Mining was accomplished using room and pillar techniques. To remove the ore, large rooms, some with ceilings as high as 100 feet, were connected by horizontal tunnels known as drifts. Pillars were left within the rooms to support the ceilings (EPA, 1994). The lead and zinc ores were milled

[110] FERC Accession No. 20230530-5192 at Appendix E-10.
[111] CH2M HILL, 2005.

> locally and generally sent to locations outside of Ottawa County for smelting.[112]
>
> [...]
>
> Rapid expansion of mining activities occurred during the 1920's, and mining activities reached their peak around 1925. Each mine holding usually had its own mill. During the 1930's, large central mills came into operation, and most mining operations ceased operating their own mills. During the peak of mining activities, 130,410 tons of lead and 749,254 tons of zinc were produced annually. Large scale underground mining activities ended in 1958 (Brown and Root, 1997). Smaller mining operations continued in the Picher Field through the 1960's, and all mining activities at the site ceased in the 1970's (EPA, 2000b).[113]

At about the time of the original development of the Pensacola Hydroelectric Project in the early 1940s, mining activities in the TSMD were decreasing. But they left a legacy of pollution in the region. That pollution affects groundwater, with approximately 100,000 acre-feet of potential storage in abandoned mines leaching acidified water and dissolved heavy metals. The groundwater eventually drains to surface streams, damaging sensitive ecosystems. There are also abandoned flotation ponds with fine sediments that are almost certainly contaminated. In 2005, there was an estimated 67 million tons of mine waste in chat piles spread throughout the area and concentrated in Picher and Cardin.

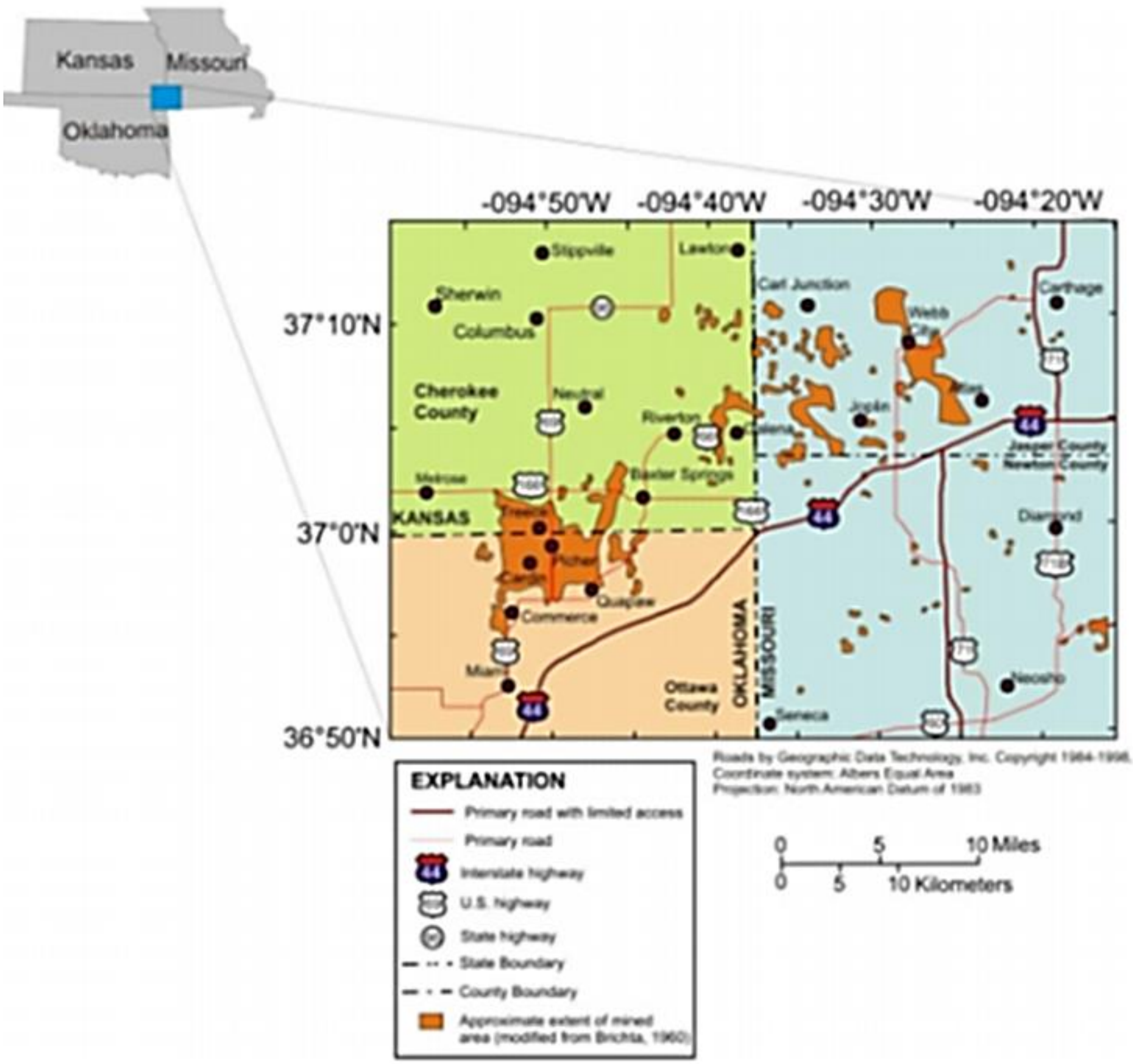
Contamination from the mining operations spread widely throughout the area by many different vectors. Processes that carry contaminants from the chat piles include wind, precipitation runoff, and, crucially, anthropogenic transport. The chat piles have been used "as a source material for the concrete and asphalt industries and as a gravel source. Other uses of the chat have included railroad ballast, sandblasting and sandbag sand, roadway, driveway, alleyway, and parking lot aggregate, general fill material in residential areas, and impact absorbing material in playgrounds."[114] The sales of this material played an important role in the local economy, and it is estimated that "less than 50 percent of the original volume of chat remains in the area."[115]

A map of the Tri-State Mining District is shown in Figure 2.1-1. The area of mining is in the southwest corner of Missouri, the southeast corner of Kansas, and the northeast corner of Oklahoma. Much of

[112] CH2M HILL, 2005.
[113] CH2M HILL, 2005.
[114] CH2M HILL, 2005.
[115] CH2M HILL, 2005.

the mining activity occurred in Oklahoma north of Miami in the vicinity of Cardin, Commerce, Picher, and Quapaw, Oklahoma, and in Treece, Kansas.

Figure 2.1-1
Location of Tri-State Mining District in Kansas, Missouri, and Oklahoma



2.2 History of Response to the Contamination

Indications from the Tar Creek area in 1940 suggested that any issues with the site were "not serious and could be handled by simple and inexpensive methods."[116] As samples were collected, Keheley notes, "[T]he degree of pollution was determined to be greater than anticipated." In 1980, the

[116] Keheley, 2002.

Governor of Oklahoma established the Tar Creek Task Force to focus attention on how to better deal with the contamination issue specifically in Tar Creek.[117] Since most of the mining operations had wound down in the 1940s and there were no longer responsible parties to address these complex issues, EPA designated Tar Creek and the adjacent mining area a Superfund site and placed it on the National Priorities List (NPL) in 1983.

CH2M HILL, which worked on the Tar Creek EPA Superfund Site for decades, noted that the cleanup costs for the Tar Creek component alone were so large that the entire national fund would have been depleted if all appropriate standards were followed, as assessed in 1984 and 2005. The massive costs associated with any engineering solution for surface water contamination in the Tar Creek Basin area would still be prohibitively high, and expenditures to meet those costs would drain the Fund.[118]

Due to the complexity and scope of contamination, an environmental triage/prioritization approach was undertaken which first focused on dealing with such items as the residential contamination caused by the direct use of mine wastes and groundwater/surface water contamination issues. This included ultimately buying out property owners in heavily contaminated areas who were affected by the direct placement of contaminated materials in construction and infrastructure projects on their property. The EPA Superfund process subdivided key components and issues at the site into Operable Units (OUs) to focus attention on key aspects of the contamination issue. CH2M HILL[119] summarized the thinking regarding the prioritization of where efforts should be focused for Tar Creek:

- "The Task Force identified the primary threat at the site as the potential for contamination of the Roubidoux Aquifer."[120]
- At the time the 1984 Record of Decision was signed, "the primary emphasis at the Tar Creek site was on ground water and surface water impacts related to the acid mine water." [121]
- "The first five-year review recommended that a second OU be designated at the site for the mining wastes. It was also recommended that studies be undertaken to determine the impacts of the chat piles and flotation ponds on human health and the environment." [122]

CH2M HILL[123] again reiterated that "it would still be cost prohibitive to institute additional engineering remedies to address environmental risks, and this cost would potentially drain the EPA's

[117] Keating, 2000.
[118] CH2M HILL, 2005.
[119] CH2M HILL, 2005.
[120] EPA, 1994.
[121] CH2M HILL, 2005.
[122] CH2M HILL, 2005.
[123] CH2M HILL, 2005.

Superfund and impact the EPA's ability to address other releases under CERCLA and the National Contingency Plan (NCP)."

Despite the early focus on dealing with the direct contamination of groundwater, surface water, and chat, these efforts have not been entirely successful. For example, CH2M HILL[124] stated in its third five-year review that the Roubidoux Aquifer may have been impacted by acid mine water. In other words, after approximately 25 years of effort, acid mine discharge had not been successfully contained. Progress has been made since the CH2M HILL report was published, but it is an ongoing process. This, along with associated costs discussed above, is likely the reason why fluvial transport of contaminated sediments was not a focus until the 2015 designation of OU5. Priority was instead placed on other issues for a period of 31 to 35 years (from the initial task force in 1980 and EPA involvement in 1983) until 2015 when OU5, focusing on sediment and surface water, was designated.

These early studies were the beginning of recognizing the seriousness of contamination related to mining in TSMD in general and Tar Creek in particular. An EPA summary documenting the progress made over the decades at the Tar Creek EPA Superfund Site highlighted "the relocation of communities most impacted by mining-related waste, the remediation of many chat bases and chat piles, the remediation of thousands of residential yards, the decline in blood lead levels in children, and the initiation of surface water and sediment investigations and human health risk assessments."[125] But, EPA also cautions that there continues to be significant work ahead, which will require millions of dollars and multiple decades.

In summary, EPA has responded to the contamination issue by systematically prioritizing and remediating individual hazards (Table 2.2-1), but the process is by no means complete.

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[124] CH2M HILL, 2005.
[125] EPA, 2019.

Table 2.2-1
Timeline for Operable Units at Tar Creek EPA Superfund Site

Operable Unit	Associated Dates
OU1 – Surface Water/Groundwater	Record of Decision – 1984
OU2 – Residential Areas	Record of Decision – 1997
OU3 – Eagle-Picher Office Complex – Abandoned Mining Chemicals	Removal Action – 2000
OU4 – Chat Piles, other Mine and Mill Waste, and Smelter Waste	Record of Decision – 2008
OU4 – Voluntary Buyout and Relocation Completed for Picher, Cardin, Hockerville, Oklahoma	2011
OU4 – Voluntary Buyout and Relocation Began and Was Completed for Community of Treece, Kansas	2012
OU4 – Oklahoma Department of Environmental Quality (ODEQ) Becomes Lead on Remedial Action for Non-Tribal Properties	2014
OU4 – Completed OU4 Remedial Action Optimization Report	2014
OU5 – Surface Water and Sediments; Begin Remedial Investigation and Human Health Risk Assessment (No Record of Decision issued)	2015

Source: EPA (2019)

2.3 Pathways of Exposure

There are multiple pathways of exposure by which contamination leaves the Tar Creek EPA Superfund Site and reaches adjacent or downstream areas:

1. **Anthropogenic distribution of chat**. One of the primary waste products of mining, chat is gravel and finer sized particles that was widely used as backfill under concrete slabs for businesses and residences as well as other residential uses and in alleyways, as railroad ballast, concrete and asphalt aggregate, and for other general purposes. Chat sales extended over decades, resulting in the widespread distribution of contaminated materials.
2. **Surface water**. Acidic mine drainage dissolves metals, and contaminated water leaves the site via surface drainage into Tar Creek and other small streams.
3. **Groundwater**. Acidic mine drainage dissolves metals and contaminated water leaves the site via groundwater movement.
4. **Wind**. Wind blows over the contaminated ground surface, including chat piles, and transports contaminated dust from the EPA Superfund Site to the land surface and into houses).
5. **Erosion/sediment transport**. Rainfall on the contaminated land surface and chat piles in the EPA Superfund Site can erode and transport sediment through the drainage system into Tar Creek and other streams. Some contaminated sediment is transported down Tar Creek into Grand Lake. This is distinct from surface water runoff because the metals and contaminants are not dissolved in the water and are instead attached to sediment particles.

6. **Direct physical movement of materials**. Excavation and transport by air (wind) and by water (surface and groundwater dissolution, sediment erosion and transport) have moved mine waste onto adjacent properties and downstream.

Each of these vectors of contamination have been or are being addressed through EPA's Superfund process, as discussed in Section 2.2.

2.3.1 Anthropogenic Distribution of Chat

Natural processes move contaminants, but they are not the only, or likely even the primary, means of chat distribution near the City. Human use of mine tailings has resulted in the spread of contaminated material throughout the City and the surrounding area. Chat has been used as fill for a variety of purposes from residential to industrial sites. These waste products have resulted in levels of lead and other heavy metals that are likely far greater than would have resulted from natural processes alone. As described in CH2M HILL's 2005 report,[126] mining produced three types of solid waste materials. From coarsest to finest, these are "development" rock, "chat," and "fines." Development is primarily coarser than gravel. Chat is primarily the size of gravel, and fines are the sediments often collected in flotation ponds.[127] This material was transported from storage piles off site for use as fill throughout the City and the surrounding area.

Keating stated that "many homes and businesses have been constructed using chat as backfill beneath floor slabs."[128] This is clearly a problem when addressing contaminated sediment in the Miami area. This material is not the result of stream-based sediment transport; it goes far beyond what Tar Creek is able to convey and instead is an issue of humans repurposing contaminated sediment throughout the City.

Initially used as fill, chat became a key part of "the foundations of schools and playgrounds, buildings and houses, driveways and streets."[129] Practically every construction material in Picher contains lead: "paint, roads, schools, hospitals, institutional builds of all kinds, people's homes, driveways, and sandboxes – everything." [130] As cited by several sources, [131] chat was widely used as a commercial product for residential, business, and municipal uses. That has spread contamination far and wide, exposing thousands to the adverse effects of lead and other dangerous minerals. This finding provides a whole new perspective on the issue of contamination in the vicinity of Tar Creek. CH2M HILL documented this vector of contamination in the City of Miami, describing the collection of 92 samples in Miami in conjunction with EPA during 2001. Their findings indicated that 65 sites (71%)

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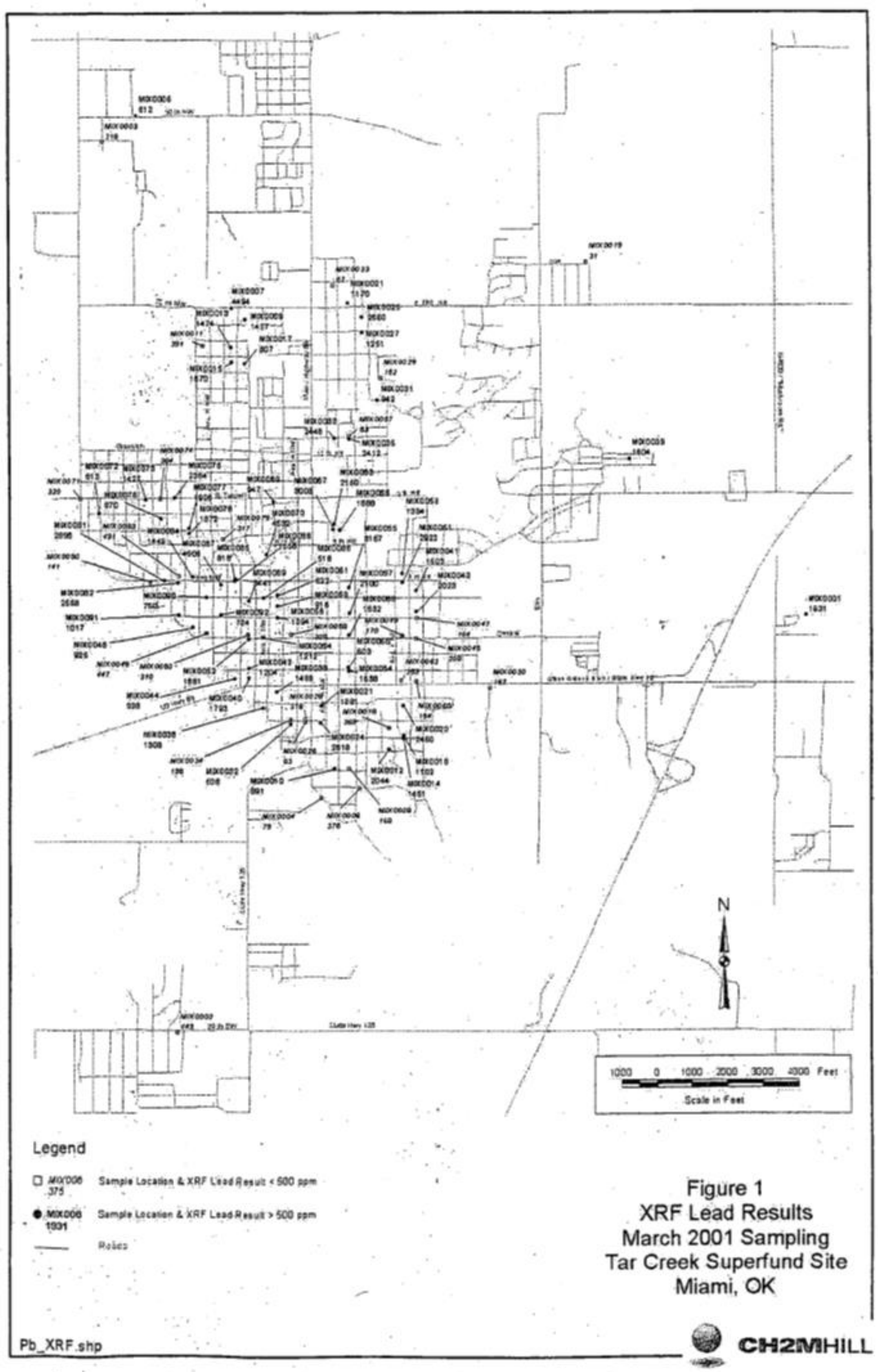
[126] CH2M HILL, 2005.
[127] EPA, 2000.
[128] Keating, 2000.
[129] Nirenberg, 2020.
[130] Nirenberg, 2020.
[131] Keating 2000, CH2M HILL 2005, Hayhow 2021, and others.

exceeded the 500 parts per million (ppm) action level for lead contamination established by EPA[132] and another 32 (35%) were above 1,500 ppm. Many of the sites were alleyways or streets, but some were at parks or recreational facilities in the City of Miami, including the municipal baseball field. Sampling locations and detailed results are shown in Figure 2.3-1.

[132] EPA, 1998.

Figure 2.3-1
Soil Sampling Locations in the Vicinity of Miami, Oklahoma during the 2001 CH2M HILL Study



As a point of comparison, lead levels were determined for soil samples taken near chat piles.[133] Figure 2.3-2 shows lead levels ranging from 424 to 2,315 ppm at various distances from chat piles. The lead levels adjacent to the chat piles in the EPA Superfund site are similar to lead levels in soils where chat was used in the City of Miami.

Figure 2.3-2
U.S. Fish & Wildlife Service Data on Lead Concentrations for Soil near Chat Piles in Tri State Mining District

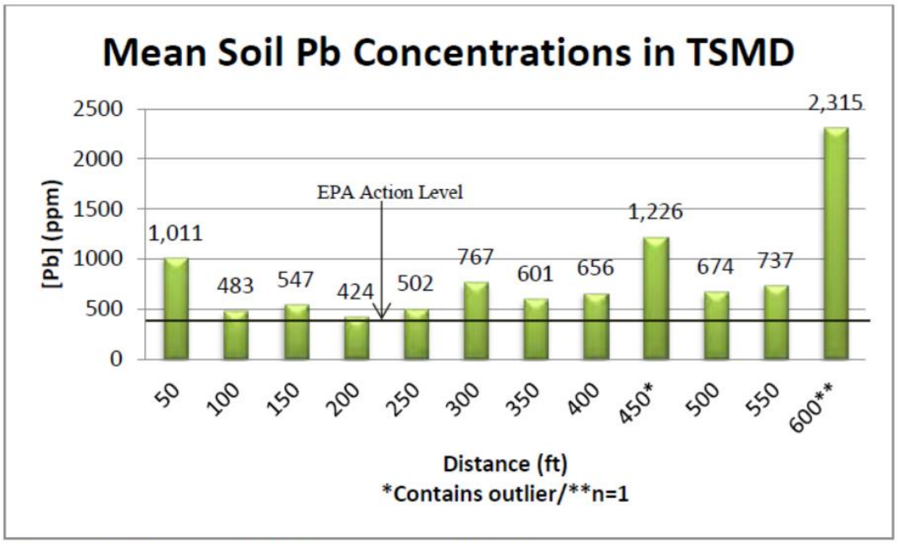


Figure 7. Mean Soil Pb Concentration by Distance. (Refer to Figure 5 for n at each distance.)

EPA[134] documented the sale and distribution of chat into recent years, with sales of chat planned to continue indefinitely into the future. EPA even entered into CERCLA administrative settlements with sellers, agreeing not to sue if specific conditions are met during sales of chat. Those conditions are laid out in the Chat Rule, 40 C.F.R. Part 278, and its preamble. Anthropogenic distribution of chat has clearly played a significant role in heavy metal contamination of sites within and around the City of Miami. But for the commercial, municipal, and residential use of chat for landscaping, gravel roads and alleyways, construction fill, railroads, asphalt and concrete pavement, and other uses, it is likely that the level of contamination in Miami would not have occurred via the water- or wind-related vectors.

2.3.2 Surface Water

CH2M HILL describes how the abandoned mines filled with groundwater to the point that it reached and exceeded the ground surface and began flowing as surface discharges into Tar Creek, killing

[133] U.S. Fish & Wildlife Service, 2013.
[134] EPA, 2008.

aquatic organisms and staining portions of the banks and bridges red due to ferric hydroxide deposition.[135]

Additional detailed discussion of the contaminated discharges from mine areas is found in Keheley,[136] which outlines the significant extent of contamination of surface water and its direct linkage to groundwater that had filled and was leaking from underground mines.

Clearly, widespread contamination has occurred via surface water drainage from mined areas into streams that received surface and groundwater drainage from mined areas.

2.3.3 Groundwater

Groundwater contamination was also studied by CH2M HILL.[137] Chemical processes between moisture and the minerals in the abandoned mine shafts lead to acidification of the water. The acidic water then dissolves heavy metals, which leach into groundwater. An estimated 100,000 acre-feet of acidified water dissolving minerals such as lead, zinc, cadmium, and iron moving as groundwater, leaking from 100,000 exploratory boreholes, and discharging into surface drainageways and streams is a significant source of contamination. Ongoing rainfall infiltrating into the ground and generally interacting with streams in the area provides an essentially continuous supply of water to be contaminated year after year.

2.3.4 Wind and Airborne Distribution

Water is one means of distribution for the EPA Superfund site contaminants, but a significant role is also played by wind. Several studies demonstrate the fact that fine particles from chat piles can be mobilized and transported by wind for quite some distance. Studies have shown that windborne material can travel more than 20 kilometers.[138] Li and McDonald-Gillespie showed that particulate matter containing high levels of lead could travel at least 100 miles from chat piles, with some Tar Creek EPA Superfund dust traveling as far as Tulsa.[139] These fine particles end up on the floodplain, on residential properties, and even in houses.[140]

Regarding windborne transport, Hayhow states, "these figures suggest that floodplain soils are dominated by wind transport of the fine chat" and goes on to say that "preliminary statistical analysis suggests that windborne transit represents a significant and continuing source of mobile metals and may contribute to the contamination of floodplain soils in hyperlocal ways." [141]

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[135] CH2M HILL, 2005.
[136] Keheley, 2002.
[137] CH2M HILL, 2005.
[138] Zota et al., 2009.
[139] Li and McDonald-Gillespie, 2020.
[140] Hayhow, 2021.
[141] Hayhow, 2021.

Windborne transport and inhalation of fine material is a well-documented public health problem. The windborne dust can be carried into homes, where it is inhaled or ingested. Zota et al. found that contaminated dust is particularly harmful for children because of their increased likelihood of contacting the material, their tendency to put their hands in their mouths, and their proximity to the ground. [142]

2.3.5 Erosion and Sediment Transport

Rainfall contributes to the movement of sediment from chat piles into surrounding areas. Chat piles are relatively tall and steep. When rain falls on them, some water infiltrates into the pile, dissolving heavy metals and other contaminants, while some flows down the piles as surficial runoff carrying sediment to Tar Creek and other streams and eventually into Grand Lake. The effect of erosion and sedimentation of small streams is discussed in the Executive Summary of Keating. [143] Keating cites Vitek, [144] Riley, [145] and Bollinger,[146] who analyzed drainage and flooding along Tar Creek. These studies found that mining disrupted the natural drainage system, resulting in decreased hydraulic efficiency and flooding—particularly when dikes and diversions were used to address water quality issues—and caused disruptions due to ground collapse and subsidence.

2.4 Level of Contamination in Upstream Rivers and Grand Lake

Garvin et al. assessed metal concentrations in streambeds and floodplain soils for streams in the Grand Lake watershed. Figure 2.4-1 shows the locations where samples were collected. [147]

[142] Zota et al., 2016.
[143] Keating, 2000.
[144] Vitek, 1983.
[145] Riley, 1983.
[146] Bollinger, 1983.
[147] Garvin et al., 2017.

Figure 2.4-1
Locations of Sediment Samples Tested for Metal Contamination by Garvin et al. (2017)

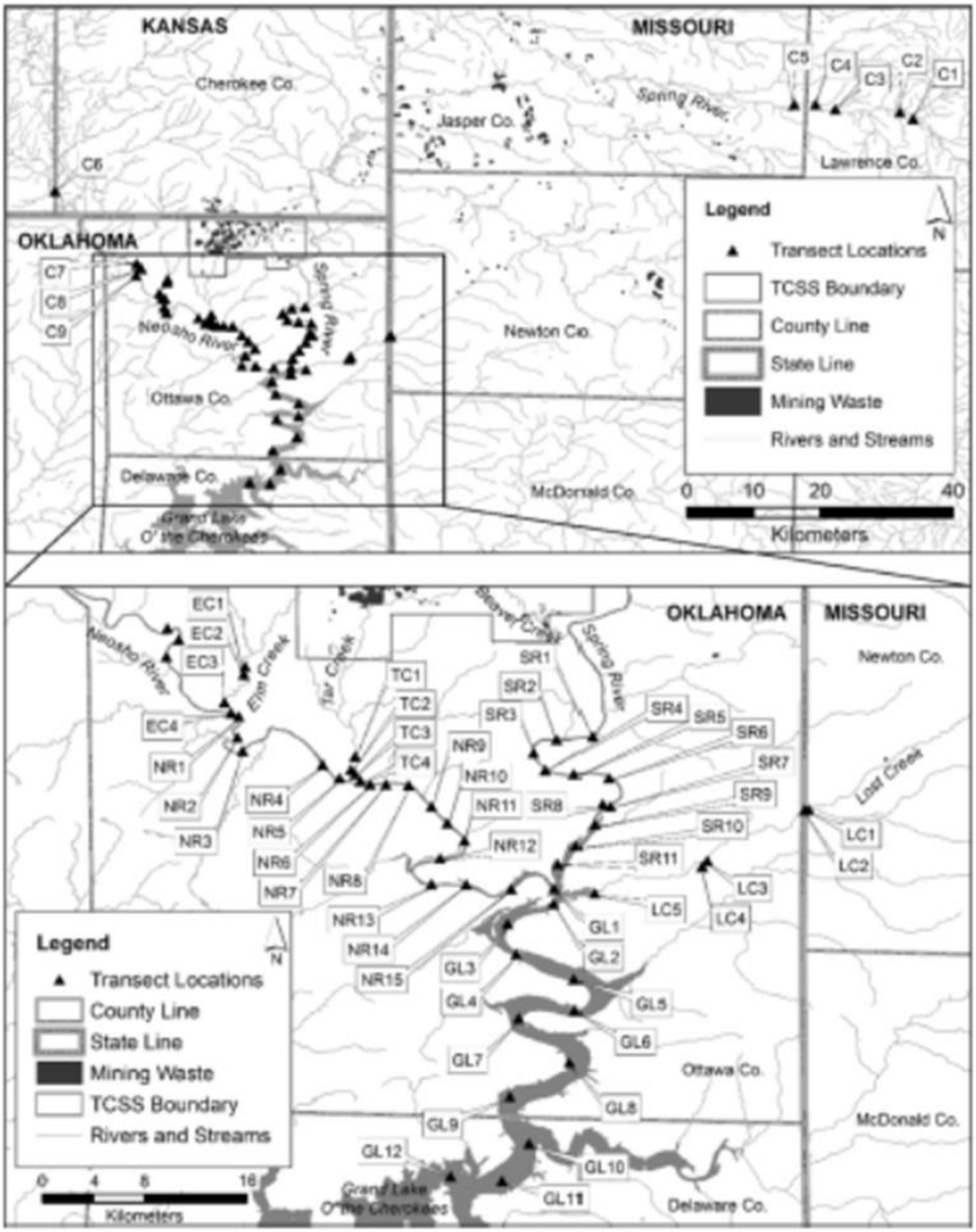

Fig. 1 Locations of sampled transects within the study area in relation to previously mined areas. Transect locations are named according to stream name and transect number. *C* Control, *EC* Elm Creek, *GL* Grand Lake, *LC* Lost Creek, *NR* Neosho River, *SR* Spring River, *TC* Tar Creek

Results of the analysis found that samples exceeded the high-risk threshold at 4 of the 11 locations in the Spring River and exceeded the low-risk threshold at another 4 of the 11 locations. All 4 of the Tar Creek bank samples exceeded the high-risk threshold, and the Neosho River samples were below the low-risk threshold at 15 locations, with only one sample exceeding that threshold. In contrast, all 11 samples in Grand Lake were below the low-risk threshold.[148] Sampling conducted by the U.S. Geological Survey (USGS) found that the average lead concentration from the bed of Grand Lake was 42 ppm, which is only 8.4% of the 500-ppm limit commonly used for lead.[149] Although Garvin et al.[150] focused on benthic organisms, their study recognized that, with respect to edible plants and fish that are used in traditional tribal culture, the consumption of traditional plants and whole fish (including bones, organs, and skin) as discussed in Garvin et al.[151] (unknown date) and Oklahoma DEQ[152], result in elevated levels of metals in blood tests. This is a result of poor control over contamination sources from EPA Superfund sites upstream.

2.5 Grand Lake's Contamination Dilution Effect

Grand Lake has received contamination for its entire existence, yet it remains the one bright spot in the entire contamination issue by remaining below the low-risk level threshold. Mining operations were slowing as Pensacola Dam was under construction in the early 1940s, but the resultant heavy metals were being transported downstream to the lake.

Grand Lake is not the source of contamination, but it has effectively absorbed significant abuse from upstream sources by providing a large volume of clean water and sediment to mix with contaminated inflows. Grand Lake's volume decreases levels of contamination to below low-risk threshold levels. The volume of contaminated water in the abandoned caverns was stated to be on the order of 100,000 acre-feet.[153] Some of this volume is continually leaking because of groundwater movement or leakage above the ground surface into local drainage routes and eventually into streams that drain into Grand Lake. The quantity of movement through the ground and via leakage is unknown but likely much less than 100,000 acre-feet a year. The storage volume of water in Grand Lake is approximately 1.5 million acre-feet. Thus, the quantity of water stored in Grand Lake is approximately 15 times larger than the volume of water in the abandoned mine caverns. Additional comparisons regarding water volume are made considering the relative magnitude of streamflow volumes from the various rivers into Grand Lake, as shown in Table 2.5-1.

[148] Garvin et al., 2017.
[149] Fey et al., 2010.
[150] Garvin et al., 2017.
[151] Garvin et al., u.d.
[152] Oklahoma DEQ, 2007.
[153] CH2M HILL, 2005.

Table 2.5-1
Summary of Average Annual Flow Volumes

Tributary	1940–2009 (acre-feet/year)	2009–2019 (acre-feet/year)	2020–2069 Anticipated Operation (acre-feet/year)	2020–2069 Baseline Operation (acre-feet/year)
Neosho River	2,764,104	3,121,744	3,028,352	3,028,352
Tar Creek	34,750	28,959	39,818	39,818
Spring River	1,601,414	1,928,647	1,828,740	1,828,740
Elk River	595,101	689,940	642,158	642,158

As these annual volumes of water from the various tributaries and the storage volume of Grand Lake clearly demonstrate, the contaminated volume of the abandoned mine caverns and potential seepage and leakage is significantly less than the volume of water flowing through the tributaries and stored in Grand Lake. This large differential is why water quality is significantly better in terms of reduced contamination in Grand Lake. This comparison extends to the realm of sediment. Based on regression analysis of suspended sediment data, sediment rating curves were developed and applied to the available flow data to compute the tonnage of sediment inflow into Grand Lake from the Neosho, Spring, and Elk rivers and from Tar Creek, as shown in Table 2.5-2. [154]

Table 2.5-2
Summary of Sediment Transport

Tributary	Total Sediment Transport (tons) 1940–2009	Total Sediment Transport (tons) 2009–2019	Total Sediment Transport (tons) 2020–2069
Neosho River	214,264,051	21,144,118	89,616,776
Tar Creek	864,297	19,702	122,593
Spring River	27,464,343	4,088,037	15,866,424
Elk River	57,766,979	1,432,848	3,535,827
Total	**300,359,670**	**26,684,705**	**109,141,619**

Source: Table 19[155]

The corresponding percentage contribution of sediment from each stream is presented in Table 2.5-3.

[154] Reproduced from Anchor QEA and Simons and Associates, 2022.
[155] Anchor QEA and Simons and Associates, 2022.

Table 2.5-3
Comparison of Sediment Percentage Contributions from Each Stream

Tributary	Percentage Sediment Transport 1940–2009 (%)	Percentage Sediment Transport 2009–2019 (%)	Percentage Sediment Transport 2020–2069 (%)
Neosho River	71.34	79.24	82.11
Tar Creek	0.29	0.07	0.11
Spring River	9.14	15.32	14.54
Elk River	19.23	5.37	3.24
Total	**100.00**	**100.00**	**100.00**
No. Years	69	11	50

The percentage contribution of Tar Creek to the overall sediment delivery to Grand Lake is miniscule, ranging from 0.07% to 0.29% of the overall sediment loading. To put this into perspective, assume that the threshold above which sediment is contaminated is X ppm and that Tar Creek sediment is at a level of 4 times larger than X (Table 2.5-4). Further, assume that the Neosho River sediment is 0.25X, Spring River is 1.0X and Elk River is 0.25 X. Based on the percentage contribution of the mixture from 2020 to 2069, sediment in Grand Lake is 0.363X, which is approximately 64% below the contamination level of X. If the levels of contamination remain as in the previous example but Tar Creek sediment is at 10.0X, the resulting level of contamination in Grand Lake would be 0.370X. If the contamination level in Tar Creek increases from 4 times the threshold level to 10 times that level, the resulting contamination in Grand Lake would increase from 0.363X to 0.370X, which remains well below the threshold level of X and represents a relatively small increase in overall contamination when these sources all mix in Grand Lake. Assuming Tar Creek contamination was reduced to X, the overall level of contamination in Grand Lake would be 0.36X. A change in contamination in Tar Creek from X to 10X results in just a change of 0.01X in Grand Lake. These examples demonstrate the significant level of buffering offered by the large volume of Grand Lake relative to Tar Creek inflows and show that contamination levels in Grand Lake are not sensitive to Tar Creek contamination.

Table 2.5-4
Resulting Contamination Level in Grand Lake for Hypothetic Levels in Tributaries

Tributary	Contamination Level	Contamination Level	Contamination Level
Neosho River	0.25X	0.25X	0.25X
Tar Creek	4.0X	10.0X	1.0X
Spring River	1.0X	1.0X	1.0X
Elk River	0.25X	0.25X	0.25X
Grand Lake	0.363X	0.370X	0.360X

2.6 EPA's Contaminated Sediments Technical Advisory Group

To aid its implementation of the Superfund program, in 2002 EPA created the Contaminated Sediments Technical Advisory Group (CSTAG) to advise EPA on large, complex, or controversial contaminated sediments sites. The CSTAG consists of a group of "site managers, scientists and engineers" from the EPA and the Corps "with expertise in sediment site characterization, remediation, and decision making." They also "have experience in model development, application, and use at sites. According to EPA, the CSTAG: [156]

- Assists in the management and implementation of nationally consistent sediment characterization and remedial actions across the EPA Office of Land and Emergency Management's remedial programs.
- Helps remedial project managers and on-scene coordinators appropriately investigate and manage sites in accordance with risk management principles.
- Promotes national consistency in the characterization and management of sediment sites by providing a forum for exchanging technical and policy information.
- Promotes the use of state-of-the-science tools and methods to characterize sites and help ensure the selection of cost-effective remedies that achieve long-term protection while minimizing short-term impacts.

EPA has engaged the CSTAG at the Tar Creek EPA Superfund Site for the express purpose of deciding how to analyze contaminated sediment issues. Very recently, CSTAG was asked to evaluate an approach that would use computer modeling of watershed hydraulics and sediment transport to better understand movement of contaminated sediment.[157] After considering this matter, CSTAG concluded as follows:

> CSTAG recognizes that some of these issues could well be clarified with additional input or discussion. However, at this juncture it is unclear whether this type of comprehensive modeling approach is even necessary or cost effective. The time and funding necessary for model development, data collection, parameterization, calibration, validation, and a host of possible iterations is high and will likely delay or preclude using the model to support an FS [feasibility study] and/or interim actions. As discussed in these recommendations, the region's focus should be on defining locations or media (bed/bank/groundwater) responsible for driving exposure and transport. New, existing, and ongoing sampling (e.g., the data gaps sampling and ORD/USGS monitoring) supplemented by additional focused characterization and loading studies could provide a faster, more versatile,

[156] EPA, 2022.
[157] CSTAG, 2022.

> and cost-effective approach to developing site decisions. Some degree of modeling may have utility, particularly if applied at a smaller scale on priority areas or deposits, but at this juncture, there does not seem to be significant alignment between site needs and model capabilities.[158]

CSTAG recommended against developing the proposed model and suggested that alternative empirical approaches, including data collection, geomorphic analysis, and mass-balance approaches, can achieve interim objectives "more accurately and cost-effectively." [159] This issue was discussed extensively in an April 2023 roundtable discussion that included the EPA, the U.S. Department of the Interior, HydroGeoLogic, the Kansas Department of Health and Environment, the Missouri Department of Health and Senior Services, Missouri Department of Natural Resources (MoDNR), MoDNR Superfund, the Missouri Fish and Wildlife Service, the Oklahoma DEQ, the Quapaw Nation, and the Tar Creek Trustee Council of Indian Tribes. The consensus of this group was agreement with CSTAG's concerns regarding modeling of contaminated sediment.

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[158] CSTAG, 2022.
[159] CSTAG, 2022.

3 FERC Staff Should Reject the Proposed Contaminated Sediment Transport Study

Under FERC's ILP regulations, any relicensing study adopted by FERC staff must meet the following criteria:

Criterion No. 1:	The proposed study plan must "[d]escribe the goals and objectives of each study proposal and the information to be obtained."[160]
Criterion No. 2:	The proposed study plan must, "[i]f applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied."[161]
Criterion No. 3:	"If the requestor is not a resource agency," the proposed study plan must "explain any relevant public interest considerations in regard to the proposed study."[162]
Criterion No. 4:	The proposed study plan must "[d]escribe existing information concerning the subject of the study proposal, and the need for additional information."[163]
Criterion No. 5:	The proposed study plan must "[e]xplain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements."[164]
Criterion No. 6:	The proposed study plan must "[e]xplain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge."[165]

[160] 18 C.F.R. § 5.9(b)(1).
[161] *Id.* § 5.9(b)(2).
[162] *Id.* § 5.9(b)(3).
[163] *Id.* § 5.9(b)(4).
[164] *Id.* § 5.9(b)(5).
[165] *Id.* § 5.9(b)(6).

Criterion No. 7: The proposed study plan must "[d]escribe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs."[166]

As detailed below, the Requestors' proposed Contaminated Sediment Transport Study fails to meet these mandatory criteria, and therefore must be rejected. As discussed more fully below, FERC staff has consistently indicated that the most important factor in determining whether a Contaminated Sediment Transport Study is needed is whether Project operations cause flooding in Tar Creek and the upper reaches of the Spring and Neosho Rivers. As discussed herein, the studies completed in accordance with the FERC-approved study plan strongly demonstrate that Pensacola Project operations do not cause flooding in Tar Creek or the upstream reaches of the Spring and Neosho rivers. Thus, the Requestors' Contaminated Sediment Transport Study should be rejected on that basis alone. Although the lack of a nexus between Project operations and upstream flooding is determinative in this matter, there are many other reasons, discussed in detail below, warranting rejection of Requestors' proposed study.

3.1 GRDA's Project Operations Do Not Cause Overbank Flooding Along Tar Creek or Along the Reaches of the Spring, Neosho, or Elk Rivers Within and in the Vicinity of the City of Miami (Criterion No. 5)

The now-final H&H Modeling and Sedimentation studies prove that GRDA's Project operations do not cause flooding in areas where contamination is of concern, namely along Tar Creek, along the Neosho River within and in the vicinity of Miami, and along the Spring River. Rather, flooding in these areas is a function of nature as floods accumulate in the 10,345 square mile watershed.[167] The City has documented its disagreement with GRDA's study conclusions and attempted to argue the need for a Contaminated Sediment Transport Study, but those arguments are based on assumptions and misrepresentation of GRDA's quantified study results, as discussed below.

Proof that nature, not GRDA Project operations, is the cause of flooding is further bolstered by two other ILP filings.

1. The compendium of historical flooding, documented in Historical Research Associates' *A History of Flooding, Flood Control, and Hydropower on the Neosho (Grand) River*, which was included in Appendix E-10 of GRDA's Final License Application (FLA).[168]

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[166] *Id.* § 5.9(b)(7).

[167] FERC Accession No. 20221229-5237, at 50.

[168] FERC Accession No. 20230530-5192. For convenience, a copy of the chronological compendium of historical flooding appears in Exhibit 2 of this Response.

2. GRDA's SA1, which presents the results of fictional scenarios in which the Corps fails to adhere to its Water Control Manual until the peak inflow reaches Pensacola Dam.[169]

Because Project operations do not cause flooding, the proposed Contaminated Sediment Transport Study lacks any nexus to the Project and should be rejected by FERC. These topics are discussed individually as follows.

3.1.1 GRDA's USR Demonstrated the Lack of Nexus

Beginning in 2018 after FERC staff issued their SPD[170] and culminating with this filing, GRDA has spent years developing the most comprehensive, robust, and reliable models of the study area that have ever been created. To date, GRDA has expended approximately $5,000,000 on the H&H Modeling and Sedimentation studies alone. GRDA used Tetra Tech's 2016 HEC-RAS model as a base and completely transformed the model by:

1. Updating the version of HEC-RAS from a beta version to a full release version,
2. Replacing the cross-sections of Grand Lake with a 2D flow area,
3. Expanding the 2D flow areas in the vicinity of Miami, Oklahoma to fully contain inundation from larger natural flood events,
4. Reviewing and adjusting all the cell centers within the 2D flow areas previously defined by Tetra Tech in accordance with published Corps guidance,[171]
5. Extending cross-sections to fully contain inundation from larger natural flood events,
6. Reviewing and adjusting the 1D/2D flow boundaries in accordance with published Corps guidance,[172]
7. Updating bridge geometries to reflect current conditions,
8. Reviewing and adjusting bank stations and ineffective flow areas in accordance with published Corps guidance,[173]
9. Adding the Elk River and Spring River to the model,
10. Incorporating new USGS Grand Lake bathymetry data into the model geometry, and
11. Adjusting computational parameters in accordance with published Corps guidance.[174]

This HEC-RAS model, the UHM, was used to simulate multiple inflow events in combination with a wide range of starting WSELs at Pensacola Dam, in accordance with FERC staff's SPD. To compute stage hydrographs at Pensacola Dam, GRDA developed a Flood Routing Model (FRM) and Operations Model (OM). In accordance with FERC staff's SPD, GRDA validated the FRM and OM

[169] SA1 filed concurrently with this Response.
[170] FERC Accession No. 20181108-3052.
[171] Corps, 2016a.
[172] Corps, 2016a; Corps, 2016b.
[173] Corps, 2016b.
[174] Corps, 2016a.

against the Corps' RiverWare model, which is used by the Tulsa District to simulate reservoir operations on the Arkansas River system. GRDA also validated the FRM and OM against two historical events recommended by FERC staff. The FRM and OM resolved the primary limitation of previous modeling efforts in the study area by Tetra Tech and others: GRDA's FRM and OM did not rely on a fundamentally unrealistic mass balance approach when computing stage hydrographs at Pensacola Dam[175]. Rather, the FRM and OM performed computational flood releases in accordance with the reservoir management rules defined in the Corps' RiverWare model.

In combination, the UHM, FRM, and OM represent the most comprehensive and detailed models ever constructed for the study area. And because these models have been intensely peer reviewed and scrutinized by the City's experts and FERC staff, they are highly reliable as analytical tools to demonstrate hydrologic and hydraulic processes in the Grand (Neosho) watershed. Model development milestones are as follows:

1. On March 30, 2021, GRDA filed its Model Input Status Report (MISR).[176] The MISR was accompanied by a public Technical Conference, held April 21, 2021.[177] The MISR and the Technical Conference focused on GRDA's model development. The City filed comments on GRDA's MISR on June 23, 2021.[178]
2. On September 30, 2021, GRDA filed its ISR.[179] The ISR addressed the City's comments on the MISR and completed the FERC-approved study plan through the first season of study. The ISR public meetings were held October 12-14, 2021.[180] The ISR and the public meetings included a comprehensive discussion of GRDA's model development and presented quantified study results. The City filed comments on GRDA's ISR on November 29, 2021.[181] On February 24, 2022, FERC staff issued their 2022 SMD.[182]
3. On September 30, 2022, GRDA filed its USR.[183] The USR included the changes approved by FERC staff following the ISR review process. The USR public meetings were held on October 12-13, 2022.[184] The USR and the public meetings included a comprehensive discussion of changes to the models, approved by FERC staff, and presented updated, quantified study results. The City filed comments on GRDA's USR on November 29, 2022.[185] On March 14, 2023, FERC staff issued their 2023 SMD.[186]

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[175] FERC Accession No. 20230530-5192, at E-114.
[176] FERC Accession No. 20210330-5359.
[177] FERC Accession No. 20210330-5334.
[178] FERC Accession No. 20210623-5075.
[179] FERC Accession No. 20210930-5214.
[180] FERC Accession No. 20211029-5103.
[181] FERC Accession No. 20211129-5213.
[182] FERC Accession No. 20220224-3074.
[183] FERC Accession No. 20220930-5106.
[184] FERC Accession No. 20221028-5112.
[185] FERC Accession No. 20221129-5184.
[186] FERC Accession No. 20230314-3035.

4. On July 24, 2023, concurrent with the filing of this Response, GRDA has submitted SA1, which reports on the additional UHM modeling scenarios requested by FERC staff in the 2023 SMD.

This robust process of years of peer review, scrutiny, public comment, and FERC staff determination have now culminated in these comprehensive and reliable models, which were used in accordance with FERC staff's SPD to determine the upstream impacts, if any, of GRDA's anticipated operations. The quantified results presented in GRDA's USR[187] demonstrated that starting elevations at Pensacola Dam have an immaterial impact on upstream WSELs, inundation, and duration for a range of inflow events. As stated in GRDA's H&H Modeling Study USR:

> Compared to starting elevations within GRDA's anticipated operational range, only natural inflows—and not Project operation—caused an appreciable difference in maximum WSEL, maximum inundation extent, or duration. The differences in WSEL, inundation extent, and duration due to the size of the natural inflow event were orders of magnitude greater than the differences in WSEL, inundation extent, and duration due to the initial stage at Pensacola Dam. The maximum impact of nature typically ranged from over 10 times to over 100 or even over 1,000 times the maximum simulated impact of GRDA's anticipated operations.[188]

GRDA's SA1, which reports on the additional UHM modeling scenarios required by FERC staff in the 2023 SMD, strengthened the conclusions of GRDA's USR:

> This new, quantified analysis resulted in the same conclusion presented in GRDA's USR: starting elevations at Pensacola Dam within GRDA's anticipated operational range have an immaterial impact on upstream WSELs, inundation, and duration of inundation for a range of inflow events.[189]
>
> [...]
>
> GRDA has now simulated scenarios specifically requested by the City of Miami after years of intense scrutiny, peer review, and multiple rounds of public comment. Even in these handpicked scenarios intended to test the limits of GRDA's modeling conclusions, the quantified results show that only natural inflows—and not Project operation—cause an appreciable difference in maximum WSEL, maximum inundation extent, or duration of inundation in the study area.[190]

[187] FERC Accession No. [20220930-5106](20220930-5106).
[188] UHM Report at 68.
[189] Concurrently filed SA1, at 36.
[190] *Id*.

Because FERC staff has consistently indicated that the most important factor in determining whether a Contaminated Sediment Transport Study is needed is whether Project operations cause flooding in the upper reaches of the study area, select results from GRDA's USR are presented. For starting WSELs at Pensacola Dam within GRDA's anticipated operational range:

1. On the Neosho River between RM 133 and 137, which represents the area within and in the vicinity of the City of Miami, the maximum simulated impact of GRDA's anticipated operational range is between 0.01 and 0.45 feet. In contrast, the maximum impact of nature in that same area is 31.88 feet.[191]

2. On the Spring River, the maximum simulated impact of GRDA's anticipated operational range is between 0.07 and 1.07 feet. In contrast, the maximum impact of nature on the Spring River is 36.78 feet.[192]

3. On Tar Creek, the maximum simulated impact of GRDA's anticipated operational range is between 0.01 and 0.35 feet. In contrast, the maximum impact of nature on Tar Creek is 32.15 feet.[193]

This information alone should be enough to prove the lack of nexus between Project operations and flooding. Yet the City refused to acknowledge this quantified conclusion, and in its response to GRDA's USR, the City renewed its request for a Contaminated Sediment Transport Study.[194]

3.1.2 The City Conflates Differences in Simulated WSEL with Backwater

To support the renewed request, the City first attempted to conflate a difference in simulated WSEL from a modification to the Tar Creek/Neosho River confluence with a "backwater effect",[195] that presumably the City attributes (incorrectly) to Project operations. GRDA has now filed the updated Sedimentation Study report, which includes simulation results from the modified confluence. While simulated WSELs on Tar Creek increased due to the reconfiguration of the confluence, the cause of flooding did not change and therefore the study conclusions did not change. As stated in GRDA's Sedimentation Study USR (July 24, 2023):

> Over a 50-year time period, there is virtually no increase to water levels in the City of Miami due to Project operations, and average water levels were shown to decrease during the July 2007 flow event under anticipated operations. Further, in the vicinity of Miami, the impacts due to sediment loading, Project operations, and expected future deposition produce only immaterial changes

[191] UHM Report at 43 (Table 21).
[192] *Id*. at 41 (Table 19).
[193] *Id*.
[194] FERC Accession No. 20221129-5184, at 20-23.
[195] *Id*. at 21.

> to water levels. Any meaningful increase in water levels due to sedimentation is further downstream and is primarily driven by the incoming sediment load.[196]

Because Project operations do not increase WSELs in the area of concern discussed in the City's filing, the City's claim that a Contaminated Sediment Transport Study is required because of a "backwater effect"[197] is incorrect and should be disregarded.

3.1.3 The City Shows No Nexus and Conflates Natural Flooding with Impacts of Project Operations

The City also attempted to show the need for a Contaminated Sediment Transport Study by conflating natural flooding with the impacts of Project operations. The City first discussed the Tar Creek sediment rating curve developed by GRDA. The City stated that metal contaminants would bind to fine sediments and "would be deposited anywhere flooded by Tar Creek."[198] The City claimed that "the [EPA] Superfund site's immense waste piles are located adjacent to, and in many cases within, the Tar Creek floodplain."[199] Later in its argument, the City discusses:

1. Absorption of metal to organic material in sediments,
2. Suspended sediment in the water column,
3. Sediment sampling in Tar Creek, and
4. Occurrence of metals in the environment.[200]

Yet, none of the City's discussion on these topics show a nexus between Project operations and flooding. The City operates on the assumption that flooding is Project-caused without providing proof and ignores the conclusions of the Sedimentation Study and the H&H Modeling Study. Because these studies proved that Project operations do not increase water levels in the area of concern, and because the City's discussion of contamination did not show a nexus with Project operations, the City has not shown a need for a Contaminated Sediment Transport Study.

3.1.4 The City Misrepresented GRDA's Modeling Results

The City also misrepresented GRDA's modeling results in an attempt to show an impact of Project operations on flooding. The City stated that "GRDA's own modeling shows that just the 1-year flood would inundate nearly 700 acres of land that would otherwise stay above water".[201] The City conveniently ignores that the majority of the 688 acres (the actual difference in computed area) that

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[196] Concurrently filed Grand Lake Sedimentation Study: Revised Updated Study Report at 237-238.
[197] *Id*.
[198] *Id*.
[199] *Id*.
[200] *Id*. at 22-23.
[201] *Id*. at 22.

would be "inundated" by a Project operational change is within the flood pool of Grand Lake. Along Tar Creek, the theoretical maximum difference in inundation area is only 11 acres. Along the Spring River, the maximum difference is 89 acres. Along the Neosho River in and around Miami, the maximum difference is 47 acres. These theoretical maximum differences in inundation area due to Project operations are all within GRDA's flowage easement and are dwarfed by the impact of nature, which is 1,064 acres along Tar Creek, 5,710 acres along the Spring River, and 2,952 acres along the Neosho River in and around Miami.

The City's misrepresentation of GRDA's quantified results continues:

> When looking at the historical range of reservoir operating levels, the modeled floods all show expanded flooding—due only to immediate project operational choices—of at least 1,500 acres, and as much as 16,000 acres.[202]

This statement is entirely untrue. The City calculates this 1,500-to-16,000-acre range using the values in Table 24 of GRDA's H&H Modeling Study USR.[203] This table does not include anything remotely close to "the historical range of reservoir operating levels" as claimed by the City. Rather, the table shows the smallest and largest inundation areas for a starting WSEL at Pensacola Dam ranging from 734 feet PD up to and including 757 feet PD. The crest elevation of the dam (757 feet PD) is not a historical operational level by any stretch of imagination. And while operations at 734 feet PD may have occurred decades ago, that WSEL is not within GRDA's currently licensed operational range nor is it part of GRDA's anticipated operational range.

The City also claims that "GRDA's modeling shows that different starting WSELs increase the duration of inundation for hours to days."[204] The City chooses to ignore GRDA's documentation of where the largest differences in duration of inundation occur. All differences in duration greater than 8 hours occur downstream of Miami and are not within the areas of contamination concern. For the City to claim, in support of a Contaminated Sediment Transport Study of Tar Creek, Spring River, and the Neosho River at and around Miami, that duration is increased by "days" when GRDA's USR explicitly states that duration differences in these areas do not exceed 8 hours, is a false claim. Furthermore, as stated in GRDA's H&H Modeling Study USR:

> The simulated duration differences due to a change in starting pool elevation within GRDA's anticipated operational range are orders of magnitude smaller than the duration differences that can be caused by nature.[205]

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[202] *Id.*
[203] FERC Accession No. 20220930-5106.
[204] FERC Accession No. 20221129-5184, at 22.
[205] FERC Accession No. 20220930-5106, UHM Report at 45-46.

Regarding duration of inundation, the impact of nature, as compared to the maximum simulated impact of GRDA's anticipated operational range, is 79 to 210 times greater along Tar Creek,[206] 14 to 115 times greater along the Spring River,[207] and 42 to 223 times greater along the Neosho in the vicinity of Miami.[208] The City ignores these quantified results in its request for a Contaminated Sediment Transport Study.

In summary, because the City's claims about inundated areas and durations of inundation are misrepresentations of the quantified results in GRDA's H&H Modeling Study USR, they should not be taken into consideration when determining if a Contaminated Sediment Transport Study is needed.

3.1.5 Substantial Flooding Has Always Occurred in the Areas of Concern Due to the Impact of Nature

Historical Research Associates' *A History of Flooding, Flood Control, and Hydropower on the Neosho (Grand) River* was included in Appendix E-10 of GRDA's FLA.[209] The report provided a comprehensive history of flooding upstream of Pensacola Dam. A long history of substantial, and even devastating, flooding along the Neosho River and its tributaries—prior to the creation of Pensacola Dam—is documented in the report. In the areas of concern, residents resigned themselves to coexisting with the cycle of flooding and drought after finding that the Neosho River and its tributaries flooded on a nearly annual basis. Sometimes, multiple flood events occurred in a single year. As one person explained, the area around Miami had "been inundated by every major flood on the Neosho River before [Pensacola Dam] was built."[210] Historical flooding unrelated to Pensacola Dam has not been limited to the Neosho River. There is documentation of major floods on the Spring River in 1905, 1912, 1920, 1941, 1943, 1993, and 2019[211] and there is documentation of major floods on Tar Creek in 1917, 1920, 1948, 1954, 1974, 1987, 1986, 1993, and 2007.[212] Based on the frequency of flooding since records began, flooding in the areas of concern likely occurred prior to the availability of preserved historical documentation.

Appendix B of Historical Research Associates' report presents a chronology of flooding in the Neosho River watershed. This compendium of historical flooding, which for convenience has been included in Exhibit B of this Response, proves that flooding has always occurred in the area,

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206 *Id*. at 46.
207 *Id*.
208 *Id*. at 47.
209 FERC Accession No. 20230530-5192.
210 A History of Flooding, Flood Control, and Hydropower on the Neosho (Grand) River, at 4. Quoting Walter C. Burnham to Douglas G. Wright, Administrator, July 28, 1947, Operation Grand River Dam Project, Grand River Dam Authority, Headquarters, Chouteau, OK (GRDA-HQ).
211 *Id*. at 4-14.
212 *Id*.

regardless of the presence of Pensacola Dam. Significant, even devasting flooding is a natural phenomenon that will continue to occur in and around Miami regardless of Project operations.

3.1.6 Extreme Scenarios Handpicked by the City Show Only Natural Inflows, not Operations, Flood the Area

FERC's 2023 SMD recommended that GRDA accommodate the City's November 29, 2022, request[213] to simulate fictional scenarios—i.e., operations that would never be implemented in the real world—in which the Corps fails to adhere to its Water Control Manual until the peak inflow reaches Pensacola Dam. In brief, these simulations imagine that the Corps would hold the elevation at Pensacola Dam steady at flood stage while the incoming flood passed the Corps-monitored upstream river gages near Commerce and Miami (which are 68 and 58 miles upstream of the dam, respectively) and continue to hold the elevation at Pensacola Dam steady at flood stage until the incoming flood reached Pensacola Dam.

In contrast to this fictional scenario, GRDA's USR simulations, as required by the FERC-approved study plan, performed Corps-directed flood releases in accordance with the reservoir management rules defined in the Corps' RiverWare model. FERC staff, of course, determined that GRDA's USR simulations were "consistent with the Corps' standard procedure for flood control as specified in the Corp's Water Control Manual for Pensacola Dam and Reservoir."[214] Staff recommended, however, that GRDA perform new simulations to accommodate the City's requests—even though FERC staff recognized that these simulations would present the "extreme" case.[215]

GRDA fulfilled FERC's recommendation and simulated fictional scenarios in which the Corps fails to adhere to its Water Control Manual until the peak inflow reaches Pensacola Dam. The modeling results were definitive: even in these extreme, fictional scenarios, the impact of nature far surpassed any impacts of Project operations by orders of magnitude. The findings of the analysis further solidified the conclusion of GRDA's USR. Even in scenarios handpicked by the City to lend support to its failed and debunked position regarding flooding causation, and which were intended to test the limits of GRDA's modeling conclusions—the quantified results showed that only natural inflows, and not Project operations, cause an appreciable difference in maximum WSEL, maximum inundation extent, or duration of inundation in the study area.

[213] FERC Accession No. 20221129-5184, at 8.
[214] FERC Accession No. 20230314-3035, at B-7.
[215] *Id*. at B-8.

3.1.7 Lack of Nexus Between Project Operations and Contaminated Sediment Transport

The City has continued to argue the need for a Contaminated Sediment Transport Study, despite its complete failure to demonstrate any nexus between Project operations and contaminated sediment transport. In contrast, GRDA's H&H Modeling and Sedimentation Studies, which were conducted precisely as required by FERC staff, have proven that GRDA's Project operations do not cause flooding in areas where contamination is of concern. Proof that nature, not GRDA Project operations, causes flooding is bolstered by the chronological compendium of flooding in Historical Research Associates' *A History of Flooding, Flood Control, and Hydropower on the Neosho (Grand) River*,[216] and GRDA's SA1, which presents the results of fictional scenarios in which the Corps fails to adhere to its Water Control Manual until the peak inflow reaches Pensacola Dam.

3.2 Overbank Flooding Occurs Only During Natural Flooding Events when the Corps has Exclusive Jurisdiction over Project Operations (Criterion No. 5)

The requested Contaminated Sediment Transport Study lacks "any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied."[217] As detailed in Section 3.1, after over four years of extensive study and modeling, the Commission-approved Study Plan has demonstrated that Project operations do not cause overbank flooding along Tar Creek, or along the Neosho and Spring rivers, in the vicinity of the City. For this reason alone, FERC staff should reject the proposed Contaminated Sediment Transport Study based on study Criterion No. 5.

In addition to this, the rather unique operational requirements of the Project present another basis for FERC staff to reject Requestors' proposed Contaminated Sediment Transport Study. In this regard, neither Requestor has ever alleged that overbank flooding occurs during normal flow conditions when GRDA has control of Project operations for hydropower and other public purposes (e.g., recreation and water supply). Rather, Requestors seem to concede, as they must, that overbank flooding occurs only during naturally occurring high-water events caused by natural precipitation in the basin.

This is an important distinction because during these high-flow events, the Corps—not FERC, and not GRDA—has exclusive jurisdiction over operations at the Project. Section 7 of the Flood Control Act of 1944 provides:

> It shall be the duty of the Secretary of the Army to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs

[216] For convenience, a copy of the chronological compendium of historical flooding appears in Exhibit 2 of this Response.
[217] 18 C.F.R. § 5.9(b).

> constructed wholly or in part with Federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations.[218]

Under the authority of Section 7, the Tulsa District of the Corps is solely responsible for flood control at the Project, including directing storage and spillway releases in accordance with the procedures for system balancing of flood storage as outlined by the Arkansas River Basin Water Control Master Manual.[219]

In addition, Congress in NDAA 2020 statutorily confirmed the Corps' exclusive jurisdiction over flood control, directing 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."[220]

Thus, even if Project operations result in an insignificant, *de minimis* contribution to upstream overbank flooding (which Requestors have not established, as explained in Section 3.1), that flooding occurs *only* when FERC lacks any authority to direct Project operations. Not only does NDAA 2020 designate the Corps as having exclusive authority over flood control operations, the statute prohibits FERC from regulating reservoir levels at Grand Lake:

> [T]he 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 [of the Army]).[221]

Because FERC lacks authority to impose license conditions during any period in which overbank flooding occurs, results from the proposed Contaminated Sediment Transport Study will not produce information that would "inform the development of license requirements," as required by Study Criterion No. 5.[222] And because overbank flooding occurs only during periods in which the Corps has exclusive jurisdiction over Project operations, the proposed Contaminated Sediment Transport Study lacks any nexus between the Project's Federal Power Act operations and the effects "of the resource to be studied," also in violation of Study Criterion No. 5.[223]

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[218] 33 U.S.C. § 709.
[219] Corps, 1980.
[220] Pub. L. No. 116-92, sec. 7612(c), 133 Stat.; 1198, 2313 (2019).
[221] *Id.* § 7612(b)(2)(A), 133 Stat. at 2312.
[222] 18 C.F.R. § 5.9(b)(5).
[223] *Id.*

For these reasons, FERC staff, based on Study Criterion No. 5, should reject the proposed Contaminated Sediment Transport Study.

3.3 Because CERCLA Directs EPA—and *Only* EPA—to Address Tar Creek Superfund Site Remediation Efforts, Information Produced by the Proposed Study Will Not Inform FERC License Conditions (Criterion No. 5)

In addition to ignoring the Corps' exclusive jurisdiction over flood control operations at the Project, Requestors' proposed Contaminated Sediment Transport Study seeks to infringe on EPA's statutory obligations under the Superfund program. Contrary to Requestors' efforts to draw FERC into the long-running program to clean up the TSMD, CERCLA authorizes EPA—not FERC—to identify Potentially Responsible Parties (PRPs) and hold them accountable for the natural resource damages caused by their mining operations within Tar Creek EPA Superfund Site. Among other things, EPA under CERCLA is responsible for:

- Seeking out those parties responsible for any release and assure their cooperation in the cleanup;
- Cleaning up orphan sites when PRPs cannot be identified or located, or when they fail to act;
- Enforcing private party cleanup through orders, consent decrees, and other settlements; and
- Recovering costs from financially viable individuals and companies once a response action has been completed.[224]

By requesting that FERC mandate the proposed Contaminated Sediment Transport Study, Requestors seek to have FERC infringe upon EPA's responsibilities for TSMD under CERCLA. For example, the City seeks to justify its proposed study because it:

> will inform the Commission which can mitigate Project impacts through changes to Project operations, such as the [Shoreline Management Plan] and Rule Curve, that may be required by FERC as a condition of relicensing.[225]

There are at least five major problems with the City's rationale:

- First, as discussed in Section 3.3, FERC lacks authority under NDAA 2020 to impose license conditions relating to reservoir levels. FERC cannot require any changes to the rule curve, as the City suggests.
- Second, CERCLA empowers EPA, not FERC, to decide on remediation efforts that are appropriate to address the contaminated site. Any remedial work along the shoreline that the

[224] 42 U.S.C. § 9604; *see generally Atlantic Richfield Co. v. Christian*, 140 S. Ct. 1335 (2020).

[225] FERC Accession No. 20180313-5162, Attachment 9 at 6. For convenience, a copy of the Contaminated Sediment Transport Study appears in Exhibit 1 of this Response.

City may believe is appropriate is a matter for EPA to decide. As the U.S. Supreme Court has instructed: "Once remedial study begins at a Superfund site, 'no potentially responsible party may undertake any remedial action' without EPA approval."[226] The U.S. Court of Appeals for the D.C. Circuit has echoed this principle, stating: "EPA's power to make decisions about whether and how to enforce [CERCLA] reasonably contemplates the agency developing a plan for achieving compliance that it deems best suited to the industrial landscape and technological obstacles presented."[227]

- Third, FERC has consistently declined to interfere with EPA's cleanup efforts under CERCLA, even at projects licensed under the Federal Power Act. In fact, earlier in this relicensing process, FERC staff rejected a request by LEAD for GRDA to dredge Grand Lake to reduce contaminated sediments, explaining that "staff does not intend to evaluate dredging of potentially contaminated sediments present in the lake. Any remedial measures would be the responsibility of the Environmental Protection Agency under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)."[228] Consistent with this approach, FERC in *Montana Power Co.* declined to move forward with the surrender proceeding for the Milltown Project, explaining: "Our disposition of a surrender application will be largely driven by EPA's decision under CERCLA on how best to deal with the contaminated sediments."[229] In *Clark Fork & Blackfoot, LLC*, which also involved the Milltown Project, FERC denied a license amendment application seeking approval to drawdown the project's reservoir, stating:

> EPA will implement, or direct the implementation of, all aspects of its [Final Plan for remediating the CERCLA site] and has effective regulatory control over all aspects of the project. It is entirely within EPA's discretion to determine when to begin activities under the Final Plan. Under these unique circumstances (i.e., a CERCLA site where the remediation plan provides for cessation of project generation and project removal), complete regulatory control transferred from the Commission to EPA when the Final Plan was adopted, and there is nothing left for the Commission to regulate.[230]

And in *Green Energy Storage Corp.*, FERC rescinded a preliminary permit for a project located at a CERCLA site, explaining: "[W]e do not think it is prudent to issue a permit for a site undergoing an indefinite cleanup process. The CERCLA investigation and remediation process

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[226] *Atlantic Richfield Co. v. Christian*, 140 S.Ct. 1335, 1342 (2020) (quoting 42 U.S.C. § 9622(e)(6)).
[227] *Assoc. of Irritated Residents v. EPA*, 494 F.3d 1027, 1036 (D.C. Cir. 2007).
[228] FERC Accession No. 20180427-3008), at 9.
[229] 91 FERC ¶ 61,280, at p. 61,994 (2000).
[230] 110 FERC ¶ 61,024, at P 16 (2005).

will take many years to complete, and our prior experience with Superfund sites is that they essentially preclude project development."[231]

- Fourth, the City's request suggests that GRDA should be considered a PRP, despite the fact that EPA has already identified PRPs in the CERCLA process for the TSMD and has not identified GRDA as a PRP. Thus, the City's request seeks to have FERC infringe on EPA's core statutory authority under CERCLA to identify PRPs and hold them (and not GRDA) responsible for their natural resources damages.
- Fifth, the City naively assumes that a change in Project's reservoir operations or Shoreline Management Plan will resolve the effects of contaminated sediment transport, when both common sense and the comprehensive scientific record developed by EPA over decades demonstrates that the only effective means of addressing the natural resources damages caused by mining activities within the Tar Creek EPA Superfund Site is to remove the source material—i.e., the chat piles and other mining waste. And FERC unquestionably lacks authority to impose any such requirement upon GRDA. In circumstances such as this—where the licensee has no ability to mitigate the identified issue—FERC has not required a study.[232]

For its part, LEAD attempts, in part, to justify the need for the proposed Contaminated Sediment Transport Study on the basis that "EPA and the Oklahoma Department of Environmental Quality conducted minimal cleanup and studies to mitigate contaminants from the Tar Creek Superfund Site,"[233] and that EPA's current cleanup efforts will take too long to complete.[234] Again, applicable precedent requires that these concerns are to be addressed with EPA directly, and not FERC.[235] But in any event, LEAD's concerns are misplaced, as demonstrated by EPA's 2019 summary of the progress it has made over the decades at the Tar Creek EPA Superfund Site:

> The Tar Creek [EPA] Superfund Site in Ottawa County, Oklahoma, is one of the largest and most complex cleanups in the United States. Substantial progress has been made since the Governor of Oklahoma established the Tar Creek Task Force in 1980, and EPA placed the Site on the NPL in 1983. Actions taken since the Site's listing include the relocation of communities most impacted by mining-related waste, the remediation of many chat bases and chat piles, the remediation of thousands of residential yards, the decline in blood lead levels in children, and the initiation of surface water and sediment investigations and human health risk assessments. Although significant progress has been made and is ongoing, substantial work is still

[231] 150 FERC ¶ 61,042, at P 8 (2015).

[232] *First Light Hydro Generating Co.*, 162 FERC ¶ 61,235, at P 39 (2018); *Ga. Power Co.*, 111 FERC ¶ 61,433, at PP 36-46 (2005); Study Plan Determination for the Toledo Bend Project at 17, Project No. P-2305 (issued Aug. 6, 2009)).

[233] FERC Accession No. 20221129-5184, at 13.

[234] FERC Accession No. 20181024-5063, at 2.

[235] *Assoc. of Irritated Residents v. EPA*, 494 F.3d 1027, 1036 (D.C. Cir. 2007).

> required to fully remediate the Site, which will take decades and multi-millions of dollars to complete.
>
> In 2017, the Site was placed on the EPA Administrator's Emphasis List of "[EPA] Superfund Sites Targeted for Immediate, Intense Action." In response, EPA, ODEQ, the Quapaw Nation and other partners are taking additional steps to identify opportunities that can accelerate cleanup and revitalize cleaned-up areas sooner. EPA and its remedial action partners are committed to new strategic approaches that can achieve this outcome. In addition to these ongoing remedial actions and related efforts, EPA is committed to cooperating and coordinating with state, community, tribal, university and federal partners to complete the investigation and decision-making process for impacted watersheds. Through dedication, teamwork, the planning process and a commitment to getting things done, EPA along with site partners and stakeholders have and will continue making great strides in cleaning up the Tar Creek [EPA] Superfund Site and making areas available for beneficial reuse.

In asserting that FERC staff should not require GRDA to conduct the proposed Contaminated Sediment Transport Study, GRDA clarifies that it does not question the critical importance of cleaning up the Tar Creek EPA Superfund Site and addressing adverse effects to human health that have been caused by decades of mining activity. These are vital matters for our community to address. However, Congress has directed that EPA administer these clean-up efforts and that PRPs be held accountable for the damages they caused. In this regard, FERC does not have authority to administer this program, and GRDA is not a PRP. Although GRDA is sympathetic to LEAD's concerns that the clean-up process has been prolonged, this is an immensely complex and expensive program—with EPA itself estimating that proper clean-up of the TSMD would bankrupt the entire Superfund program.

For these reasons, FERC staff, based on study Criterion No. 5, should reject the proposed Contaminated Sediment Transport Study.

3.4 Environmental and Health Effects of Contaminants Are Well Documented and Need No Further Study (Criterion No. 4)

In the five years since the City initially proposed the Contaminated Sediment Transport Study,[236] neither the City nor LEAD has put forth any evidence suggesting that contaminated sediments from

[236] FERC Accession No. 20180313-5162 at Attachment 9.

the TSMD cause any harm in the Project area.[237] Moreover, the health effects caused by contamination emanating from the TSMD have been extensively documented and continue to be studied by EPA under the auspices of the EPA Superfund program. For these reasons, study Criterion No. 4 precludes the need for the proposed study.[238]

Both Requestors attempt to justify the proposed Contaminated Sediment Transport Study on the basis that additional information is needed to understand the health effects associated with heavy metals deposition along Project shorelines. The City asserts:

> Investigating the impact of the Project on human health and environmental resources through increased flooding and deposition of contaminated sediments in Grand Lake and beyond the existing Project Boundary, including the vicinity of the City of Miami, is necessary to fulfill the Commission's responsibilities under NEPA. Ensuring that environmental measures and public health are considered following accepted scientific methods is essential to the Commission's public interest determination.[239]

Similarly, LEAD seeks the proposed Contaminated Sediment Transport Study "to fully characterize these [adverse health] risks so that FERC can evaluate solutions, including but not limited to reduced lake levels, during the relicensing process for the Dam."[240]

These study requests overlook the fact that the health effects of lead, zinc, and other contaminants originating at the TSMD have been studied extensively and are well understood. The effect that TSMD metals contamination has had on organisms is well documented through various studies over the years,[241] and the primary impacts have been observed upstream of the Project.

Contamination at the Pensacola Project has decreased since the 1980's, likely because of mine closure and cleanup initiatives lead by the EPA via the Superfund Program.[242] Sediments in the Neosho River and downstream of Tar Creek are in the low-risk category with respect to aquatic toxicity based on the site-specific sediment quality guidelines. Grand Lake sediments south of Twin Bridges are also in the low-risk category with respect to contaminant effects on aquatic life.[243]

EPA conducted a Phase 1 Study that evaluated overall toxicity in the area of the EPA Superfund site and concluded that there were no significant toxic effects upon sensitive species of small fish or

[237] *City of Centralia v. FERC*, 213 F.3d 742 (D.C. Cir. 2000) (overturning FERC's decision to require study of anadromous fish on the basis that the record was devoid of evidence indicating any harm to such species).
[238] 18 C.F.R. § 5.9(b)(4).
[239] Contaminated Sediment Transport Study at 4-5.
[240] FERC Accession No. 20221129-5170, at 13.
[241] McCormick 1985, OWRB and Oklahoma State University (OSU) 1995, MacDonald et al., 2010, and Morrison et.al., 2014.
[242] Juracek and Becker, 2009.
[243] Morrison et.al., 2018.

micro-crustaceans exposed to water samples collected from Grand Lake.[244] Furthermore, the study concluded that the contaminants of concern appear to be chemically bound to sediments since toxic concentrations of metals could not be extracted under conditions that occur naturally in the lake.[245]

In the EPA Phase 1 Study it was postulated that sediment disturbance could cause the release of toxic concentrations of metals.[246] Researchers found that under both disturbed and undisturbed conditions survival and biomass did not exhibit any significant differences between contaminated (Neosho and Spring rivers) and uncontaminated reference sites (Elk River).[247] In summary, past research spanning decades indicates no acute or chronic toxicity as a result of metals contamination in Grand Lake. The result of these studies is consistent with expectations based on Grand Lake water chemistry, including pH, hardness, and the presence of anoxic sediments; bioavailability of metals would be expected to be low.[248]

In addition, toxicity testing by USGS indicated that "…sediment samples collected from Grand Lake in October 2008 were not likely causing or substantially contributing to toxicity to sediment dwelling organisms."[249] Regarding human fish consumption, skinless fillet fish from mining mill ponds, the Neosho River, and Grand Lake are safe to eat. Skinless fillets are safe to eat from the Spring River except for non-game fish. Whole fish with skin and bones at some locations (a traditional cultural eating practice) elicits more nuance as far as consumption goes, which in effect is why Grand Lake and its tributaries are listed on the State 303d list for Lead contamination.[250]

Aquatic organisms in some of the more highly contaminated tributaries seem to be increasing in abundance. For example, in the ISR for aquatic species of concern,[251] GRDA documented that previous mussel surveys were unable to locate freshwater mussels in the Spring River in studies completed in the 1980s. However, recent surveys completed by EcoAnaysts[252] and GRDA[253] in the past five years have demonstrated that there is an ongoing recovery, regardless of dam operation as postulated by some stakeholders. In fact, there were more mussels found in the Spring River, which has documented effects of mining than in the Elk River, which has no effects of mining. Furthermore, the highest densities of mussels occurred in the Neosho River downstream of Tar Creek.

[244] OWRB and OSU, 1995.
[245] OWRB and OSU, 1995.
[246] OWRB and OSU, 1995.
[247] Morrison et.al., 2014.
[248] Atkinson et al., 2007.
[249] Ingersoll et.al., 2009, at 3.
[250] ODEQ, 2007.
[251] FERC Accession No. 20210930-5214.
[252] EcoAnalysts, 2018.
[253] FERC Accession No. 20220930-5106 at Appendix 5.

Because existing information extensively addresses the very information that Requestors seek from the proposed Contaminated Sediment Transport Study, FERC staff, based on Study Criterion No. 4, should reject the proposed study.

3.5 A Wealth of Existing Information is Already Available to Inform FERC's Cumulative Impacts Analysis of Contaminated Sediment Transport and Deposition (Criterion No. 4)

In their April 2018 Scoping Document 2 (SD2), FERC staff—at the request of Requestors and other relicensing participants—modified the geology and soils analysis "to include the effects of project operations on the transport and subsequent deposition of potentially contaminated sediment."[254] Importantly, FERC staff indicated its "intention to analyze the resource for cumulative effects."[255]

In reiterating its request for the proposed Sediment Transport Study as part of its USR comments, the City attempts to capitalize on this statement in SD2, incorrectly alleging that FERC had "committed that it will study 'the effects of project operations on the transport and subsequent deposition of potentially contaminated sediment [...]."[256] Not only did FERC staff *not* make the study commitment as alleged by the City, the fact that FERC staff *did* indicate that its analysis of contaminated sediment transport would be a cumulative effects assessment demonstrates that no study is needed. As the Council on Environment Quality (CEQ) has explained, a cumulative effects analysis need not include new study, but can be supported by "the best data we have."[257] CEQ goes on to explain: "Obtaining information on cumulative effects is often the biggest challenge [...] In some cases, federal agencies or the project proponent will have adequate data."[258] And consistent with applicable precedent,[259] FERC staff in this very proceeding has explained: "consistent with standard Commission practice, we do not require applicants to study pre-project conditions, *or conduct studies of other, non-project development activities' effects on cumulatively effected resources.*"[260]

To support its cumulative effects analysis of transport and subsequent deposition of potentially contaminated sediment, FERC staff can rely on a wealth of existing information. Due to the nature of contamination spread across a vast area—spanning two EPA Regions, three states, numerous tribal jurisdictions, and various areas of academic inquiry—there are numerous repositories of information regarding contaminated sediments originating at the Tar Creek EPA Superfund Site, including

[254] FERC Accession No. 20180427-3008, at 8.
[255] *Id.* at 8-9.
[256] FERC Accession No. 20221129-5184, at 20 (quoting SD2 for the Pensacola Hydroelectric Project at 8, FERC Accession No. 20180427-3008).
[257] CEQ, Considering Cumulative Effects Under the National Environmental Policy Act, at 3 (1997).
[258] *Id.* at 31.
[259] *Natural Res. Defense Council v. Callaway*, 524 F.2d 79, 90 (2d Cir. 1975); *Eagle Crest Energy Co.*, 153 FERC ¶ 61,058 (2015).
[260] FERC Accession No. 20220224-3074, at B-17.

numerous studies that are housed with the Tulsa U.S. Fish and Wildlife Services Oklahoma Ecological Services Field office website, the ODEQ website, and the EPA's website. For convenience, links to these repositories appear in Table 3.5-1.

Table 3.5-1
Data Sources Available for Contaminated Sediment Information

Entity	Hyperlink
UFWS Oklahoma Ecological Services Office	Contaminants | U.S. Fish & Wildlife Service (fws.gov)
Oklahoma Department of Environmental Quality	https://applications.deq.ok.gov/superfundweb/default.aspx?epaid=OKD980629844
EPA	https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.docdata&id=0601269
USGS	cerc.usgs.gov/orda_docs/CaseDetails?ID=907

Moreover, to aid FERC staff in completing this cumulative effects analysis, GRDA has identified several study reports that directly pertain to the Project and the issues raised by Requestors' proposed Contaminated Sediment Transport Study. These reports, together with a URL, appear in Table 3.5-2.

Table 3.5-2
Study Reports Pertaining to Project and Contaminated Sediments

Category	Title	Link	Notes
Reservoir Sediment	Occurrence and Trends of Selected Chemical Constituents in Bottom Sediment, Grand Lake O' the Cherokees, Northeast Oklahoma, 1940-2008	https://pubs.usgs.gov/sir/2009/5258/pdf/sir2009-5258.pdf	Study on the depositional patters of contaminants in Grand Lake
Reservoir Sediment	Geochemical Data for Core and Bottom-Sediment Samples Collected in 2007 from Grand Lake O' the Cherokees, Northeast Oklahoma	https://pubs.usgs.gov/of/2010/1298/downloads/OF10-1298.pdf	Study on the total geochemistry of sediments in grand lake.
Reservoir Sediment Aquatic Species	Distribution and Bioavailability of Trace Metals in Shallow Sediments	https://doi.org/10.1007/s00244-018-0559-1	Study on distribution of contaminants in Grand Lake and the toxicity of sediments during

Category	Title	Link	Notes
	from Grand Lake, Oklahoma		agitation to freshwater organisms
Aquatic Species	Toxicity assessment of sediments from the Grand Lake O' the Cherokees with the amphipod *Hyalella azteca*	https://www.cerc.usgs.gov/orda_docs/DocHandler.ashx?task=get&ID=985	USGS report on Sediment toxicity for Grand Lake
Reservoir Sediment Floodplain Soils Terrestrial Species Aquatic Species	Screening Level Assessment of Metal Concentrations in Streambed Sediments and Floodplain Soils within the Grand Lake Watershed in Northeastern Oklahoma, USA	https://doi.org/10.1007/s00244-017-0376-y	Heavy metals concentrations in river sediment, floodplain soils, with associated Eco Soil Screening Levels (SSLs) for plants and toxicity PECs
Floodplain Soils Terrestrial Resources Cultural Resources	Edible wild plants growing in contaminated floodplains: implications for the issuance of tribal consumption advisories within the Grand Lake watershed of northeastern Oklahoma, USA	https://doi.org/10.1007/s10653-017-9960-3	Edible plant metals concentrations and health risk assessment based of Tribal Lifeway
Reservoir Sediment	The depositional environment of zinc, lead, and cadmium in reservoir sediments	https://doi.org/10.1016/0043-1354(75)90060-3	Lake Fort Gibson Metals
Aquatic Species	Fish Consumption for the Tar Creek Area Including Grand Lake	https://www.deq.ok.gov/wp-content/uploads/land-division/TarCreekFishConsumptionBooklet.pdf	Booklet for general public on fish consumption
Aquatic Species	Fish Tissue Metals Analysis in the Tri-State Mining Area Follow-up Study	https://www.deq.ok.gov/wp-content/uploads/state-environmental-laboratory-services/2007TarCreekStudy.pdf	Report on fish metals concentrations
Human Health Risk Cultural Resources	Tar Creek Superfund Site Operable Unit 5. Human Health Risk Assessment.	FINAL HUMAN HEALTH RISK ASSESSMENT REPORT, VERSION 1.3, TAR CREEK OPERABLE UNIT 5 (epa.gov)	Human health risk assessment for OU5 including contaminants exposure based off a Tribal Lifeway Scenario,

Category	Title	Link	Notes
	Document Control No. 0079-02017		General Public Recreational Scenario, and Aquatic Worker Scenario

Because FERC staff has access to a wealth of existing information to support its cumulative effects analysis of transport and subsequent deposition of potentially contaminated sediment, FERC staff, based on Study Criterion No. 4, should reject the proposed Contaminated Sediment Transport Study.

3.6 The City of Miami and Others Bear Significant Responsibility for the Spread of Contaminants (Criterion No. 5)

By requesting the proposed Contaminated Sediment Transport Study, the City disingenuously seeks to hold GRDA responsible for the spread of contamination to soils in and in the vicinity of the City, alleging that such contamination is the result of Project operations during flood events that flow downriver and into the reservoir. But in fact, as documented in Section 2.3.1, the anthropogenic distribution of chat in the City and other adjacent towns is undoubtedly the dominant cause of contamination, not flooding and deposition of contaminated sediment.

Chat was and continues to be used for a variety of purposes.[261] It was used under houses and businesses, to construct alleyways and driveways, as railroad ballast, as aggregate for asphalt and concrete, and in many other common uses for gravel. The sale of chat for such purposes and its use continues to this day, as described in EPA (2008), where ongoing chat sales and distribution were documented along with CERCLA administrative agreements not to sue sellers if certain conditions were met (see Chat Rule, 40 C.F.R. Part 238 and its preamble).

Sediment samples were collected in Miami and tested for lead content.[262] The study showed that 65 of the 92 samples (71%) collected in the City were above the 500-ppm level for lead, and 32 (35%) had levels greater than 1,500 ppm. These are similar to lead levels found in close proximity to chat piles within the EPA Superfund site.[263] In contrast, lead levels in Grand Lake sediments averaged just 42 ppm[264] due to mixing and dilution when water from the Neosho, Spring, and Elk rivers and Tar Creek combine in the reservoir as discussed in Section 2.5.

It is abundantly clear that if the average lead level in Grand Lake sediment is 42 ppm but 71% of the samples collected in Miami exceed 500 ppm and are similar to lead levels adjacent to chat piles within the EPA Superfund site, the source of contamination in Miami is not Grand Lake or Project

[261] Keating, 2000; CH2M HILL, 2001.
[262] CH2M HILL, 2001.
[263] U.S. Fish & Wildlife Service, 2013.
[264] Fey et al., 2010.

operations. The fact that chat was widely distributed and extensively used in Miami and other nearby towns is undoubtedly the dominant factor in the elevated lead issues in these locations. The City of Miami and other towns have essentially converted themselves into the equivalent of EPA Superfund sites by their own actions allowing chat to be so widely used.

For these reasons, FERC staff should reject the proposed Contaminated Sediment Transport Study because Study Criterion No. 5 requires "nexus between project operations and effects."[265] In this case, any elevated levels of lead and zinc in Miami and other towns is attributable to the City's allowing contaminated materials to be widely used for infrastructure projects throughout its jurisdiction—and not to Project operations.

3.7 The Modeling Methodology Proposed in the Contaminated Sediment Transport Study is Not Generally Accepted in the Scientific Community (Criterion No. 6)

Requestors' proposed Contaminated Sediment Transport Study seeks an EFDC model calibrated with water and sediment samples. Terrain information would be developed from either existing survey data (LiDAR and/or bathymetry) and new surveys as needed. The model domain would include an apparent minimum 75 river miles between the Neosho and Spring rivers and Tar Creek.

3.7.1 The City's Proposed Methodologies are Fatally Flawed

The proposal has five stated goals:[266]

1. Develop a comprehensive hydraulic model using existing and any required additional information to establish baseline flood inundation areas in the upper reaches of Grand Lake and in the vicinity of the City of Miami.
2. Specify toxins of concern and quantify toxicity of sediments from the Grand Lake tributaries of Tar Creek, Neosho River, and Spring River.
3. Establish a baseline sediment transport model using existing and any required additional information.
4. Estimate the change of toxic sediment deposition in the upper reaches of Grand Lake and in the vicinity of the City of Miami as a result of proposed operating scenarios.
5. Estimate the future impacts of deposition of contaminated sediments near Miami and into Grand Lake over the duration of the license.

Several of the proposed study goals have already been met by the work performed by GRDA in the H&H and Sedimentation studies as part of the ongoing relicensing process (e.g., the goals to

[265] 18 C.F.R. § 5.9(b)(5).
[266] FERC Accession No. 20180313-5162 at Attachment 9. For convenience, a copy of the Contaminated Sediment Transport Study appears in Exhibit 1 of this Response.

develop a comprehensive hydraulic model, establish a baseline sediment transport model) or by the EPA as part of the Tar Creek EPA Superfund Site remediation efforts (e.g., the goal to specify toxins of concern and quantify toxicity of sediments). As written, the study neglects important information and as a result cannot complete the other goals (e.g., the goals to estimate changes in toxic sediment deposition, estimate future impacts of contaminated sediment deposition).

The most glaring problem with the City's proposed methodology is the calibration process. As stated in the City's proposal, "Sediment transport calibration is based on a comparison of model-predicted and observed suspended sediment concentrations, bed morphology changes, and net flux at selected locations." There is no indication that the City's proposed study plan would use contaminant levels as a calibration point. If the supposed primary output of the model (heavy metal sediment contamination) is not verified against field measurements, there can be no confidence in model results. What the City is proposing is a sediment transport model, which GRDA has already developed and documented in the Sedimentation Study Revised USR. The City's sediment transport model would then be used to "predict" contaminant levels at a future date based on unspecified, subjective analysis with extremely uncertain results that would undercut any utility of the model.[267]

The City's proposed methodology neglects overland transport of sediment due to stormwater runoff. Particularly given the magnitude of contamination resulting from use of chat throughout Miami,[268] this should be seen as a critical component of contaminated sediment transport evaluations in the area. Any evaluation of contaminated sediment transport intended to meet the City's stated goals of "Estimat[ing] the change of toxic sediment deposition in the upper reaches of Grand Lake and in the vicinity of the City of Miami as a result of proposed operating scenarios" and "Estimat[ing] the future impacts of deposition of contaminated sediments near Miami and into Grand Lake over the duration of the license" must include the transport of contaminants from the anthropogenic sources within Miami during precipitation events. These are some of the most dominant contaminant sources and are critical for assessing the impacts to human health and safety within the affected community (please see Section 3.6).

The City's proposed study also raises other concerns about its ability to evaluate sediment transport from the Tar Creek EPA Superfund Site and other TSMD locations. The proposal includes a statement that at least 30 grab samples will be collected from the approximately 75 miles of riverbeds in the study area, 15 of which will be used to evaluate critical shear stress using SEDflume. The City writes, "Since core data will not be collected in the field, grab sample data will be used to reconstruct cores for laboratory [SEDflume] testing." This statement again demonstrates the City's misunderstanding of

[267] At the time of the City's request for a Contaminated Sediment Transport Study in 2018, the completion of a sediment study incorporating a sediment transport model also requested by the City was being disputed by GRDA. Therefore, the City's request for a contaminated sediment transport model with its stated methodology being only a sediment transport model can be explained by GRDA's opposition to completing a sediment study that includes a sediment transport model at the time of the City's request.
[268] CH2M HILL, 2001.

cohesive material. Over time, cohesive sediment is compacted and develops more resistance to erosion. Once it has been disturbed, it no longer has the same level of cohesion within the soil matrix and cannot reasonably be used to assess critical shear stress, so SEDflume testing relies on undisturbed (or minimally disturbed) sediment core samples. The City's proposed testing clearly disturbs the matrix and renders any subsequent SEDflume analysis completely meaningless. This is especially concerning given that much of the sediment in the proposed study area consists of cohesive material (Revised USR, Section 2.3.2) with a wide range of critical shear stress values. Regardless, the limited samples for this analysis are insufficient to appropriately parameterize sediment conditions at the proposed geographic scale given the complexity of the transport processes involved and importance of high-resolution results to inform future remediation strategies.

The proposed study also neglects other key factors for characterizing the contamination stemming from past mining activities in the TSMD. As discussed previously, there does not appear to be any meaningful effort to establish model calibration and lend any credibility to their contaminant transport predictions. Even with contaminant testing of their proposed grab samples, the collected data are unlikely to have enough spatial density to fully characterize the large study area. Further, there is no indication that the City plans to evaluate and test for dissolved metals or simulate those as part of their study, which means cadmium and zinc (both contaminants of concern [CoCs] at the Tar Creek EPA Superfund site) are largely neglected. It also shows no plan to evaluate groundwater contamination that further drives ecological and human health concerns downstream of the TSMD. In sum, there appears to be relatively little field data to support development of a predictive toxicity assessment in the study area.

The City's proposed contaminated sediment transport model would add no value to the contamination remediation effort. There is no meaningful calibration plan for contaminant levels—the primary model output of interest—the proposal neglects key sources of contamination, and the field sampling plans are insufficient to provide the data needed to complete such a study. Contrary to Study Criterion No. 6, the plan does not meet current generally accepted practices.[269]

3.7.2 CSTAG Has Rejected a Modeling Approach That Is Substantially Identical to Requestors' Proposed Study

As noted in Section 2.6, CSTAG (2022) evaluated a proposed modeling approach showing nearly identical limitations as Requestors' proposed Contaminated Sediment Transport Study. The proposed modeling effort considered by CSTAG would have included large-scale "hydrodynamic, sediment transport, and contaminant transport" modeling throughout the TSMD using HEC-HMS and 1D HEC-RAS for the H&H analysis.

[269] 18 C.F.R. § 5.9(b)(6).

CSTAG had multiple concerns about the plan and its ability to provide useful information for site remediation efforts. Their primary concerns are summarized as follows:

1. **Calibration and validation data**. The proposed work is insufficient and would require significant additional efforts. As written, it would not include any information about metals, and with the proposed scope, CSTAG wrote, "The total uncertainty would be a minimum of two orders of magnitude and would completely engulf the relative differences between simulated remedial alternatives."
2. **Parameterization of contaminants of concern**. There was no indication they could be accurately parameterized for the model, particularly given the "magnitude of the site, complexity of the processes, and the need for precision in targeting areas and media," meaning that "modeling will be extremely challenging and have a high degree of uncertainty."
3. **Overland flow and lateral inflows**. These are important to include in such a model but would not be adequately represented by a proposed 1D model and none of the crucial groundwater inflow would be captured.
4. **Model domain**. The described model would encompass a large geographic region and require extensive information about bathymetry, soils, and geotechnical features throughout.
5. **Groundwater**. Groundwater is not included in the modeling efforts, which means the study would neglect many dissolved contaminants, including zinc and cadmium.
6. **Application to mitigation efforts**. The modeling efforts would result in very coarse identification of erosional or depositional reaches, which are not detailed enough to be useful in decision-making.

For these reasons, CSTAG (2022) recommended abandoning efforts to develop such a model.

CSTAG's analysis is particularly relevant to FERC staff's decision on Requestors' proposed Contaminated Sediment Transport Study. Many of the shortcomings of the CSTAG proposal are shared with Requestors' proposed study. CSTAG cited a nearly identical list of reasons, which describe a model that would take extensive effort and significant expense to develop, and which would still fail to demonstrate robust calibration, rely on limited field data, and neglect key sources of contamination. In short, the model would provide no useful data to inform future site remediation strategies.

Requestors' proposed model has many of the same shortcomings. The concerns given by CSTAG could equally be applied to Requestors' proposed Contaminated Sediment Transport Study in this relicensing effort:

1. **Calibration and validation data**. The proposal shows no effort to calibrate to contaminant levels or even gather information required to develop such a dataset.

2. **Parameterization of contaminants of concern**. There is no indication that the model would even attempt to accurately parameterize contaminants, so modeling will necessarily have a high degree of uncertainty.
3. **Overland flows**. Stormwater runoff is not included in the Requestors' assessment, despite considerable evidence that chat used for construction fill within the City is a significant source of contaminated sediments.[270]
4. **Model domain**. The model covers at least 75 miles of stream, and the described field effort is not sufficient to understand localized contaminant transport over the entire domain.
5. **Groundwater**. The Requestors' plan also does not include groundwater, despite it being a well-documented source of contamination that negatively impacts human health.
6. **Application to mitigation efforts**. The proposed model does not have the underlying dataset necessary to evaluate localized remediation strategies, especially if the goal is to evaluate contaminants that are not studied or evaluated in the proposal.

The EPA's own expert group of individuals, who are intimately familiar with both contaminant transport and fate models and the EPA Superfund program, suggested moving away from a modeling approach. This is a team that has evaluated the subject of contaminated sediment, weighed the effort of model development against the possible benefits, and found that a modeling approach like that put forth by the Requestors was a poor use of limited resources. There are few groups as qualified as CSTAG to review model proposals for the Tar Creek EPA Superfund Site, and their primary recommendation was to **not** pursue this type of modeling.

For these same reasons, FERC staff should reject the proposed Contaminated Sediment Transport Study on the basis that its methodologies are not "generally accepted in the scientific community," as study Criterion No. 6 requires.[271]

3.8 The Proposed Contaminated Sediment Transport Study Would Be Prohibitively Expensive, Delay the Relicensing Process, and Fail to Produce Any Reliable Results (Criterion No. 7)

The City estimated that its proposed Contaminated Sediment Transport Study would cost approximately $342,000. According to the City, this would include all fieldwork, although the proposal stated that data collection (fieldwork) costs "could vary significantly from estimated costs." It also includes time spent in model development and coordination meetings.

This is a profound understatement of the costs of producing the model the City seeks; GRDA estimates that the total price tag for a study of the magnitude sought by Requestors would be closer

[270] CH2M HILL, 2001
[271] 18 C.F.R. § 5.9(b)(6).

to $2,000,000. Such an undertaking requires a literature review to find existing contaminant datasets throughout the study area, detailed review of the contaminants listed as CoCs and evaluation of how they are typically transported (attached to sediment or dissolved in water), and additional understanding of the accuracy of various sediment and water quality tests to assess uncertainty in the existing datasets. It requires analysis of the temporal and spatial resolution of the existing data and documentation of existing data gaps that need to be filled to support model calibration.

Fieldwork is the next major cost component of the proposed study. This includes survey equipment for portions of the study area not already covered by the existing datasets (the City notes upper reaches of Tar Creek and potential portions of the Spring River upstream of the Sediment Transport Model boundary), sediment grab sampling, sediment core sample collection, and water column sampling for dissolved contaminants over a range of flow conditions. There are also coordination, equipment, travel, and lodging fees required for such intensive fieldwork. Depending on the specific contaminants being analyzed, there may be a need to preserve samples for testing. Thus, sample collection, shipment of water and sediment samples to a laboratory, and laboratory analyses may need to happen on a constricted schedule with accompanying costs. Some sampling efforts would be contingent on target stream flows or precipitation events, and there is no guarantee that those conditions would be met, so schedule adjustments may be required.

Simultaneously, the team would begin building a new model in EFDC or similar software (following the City's proposed plan). HEC-RAS is not the ideal tool for this task, so the team would need to develop an entirely new model using the data already gathered during the Sedimentation Study. The process includes building the geometry and then calibrating the hydraulics before calibrating sediment transport. Once the fieldwork is complete and contaminant information is available, the team would then calibrate the contaminant transport portion of the model.

Throughout the process, there will likely be multiple conferences to present study reports. These would also serve as opportunities for stakeholders to provide comment, and GRDA would then respond to those comments. The contentious nature of this relicensing effort is well-documented, so it is reasonable to assume this would include several months of additional effort to host technical conferences, respond to filings, revise the model and report, and provide litigation support.

The idea that this could be accomplished for just $342,000 is absurd. Developing and documenting a defensible contaminant transport study as requested by the City will cost far more and would be closer to $2,000,000 to support an intensive fieldwork campaign, model development effort, responses to stakeholder comments, and model and report revisions.

And yet, even with the expensive process described above, there is no guarantee this effort will produce a model that provides more confidence than simple field measurements as advocated by CSTAG (2022) and summarized in Section 3.7.

This is a significant cost in an already very expensive relicensing effort, where GRDA to date has expended over $16,000,000 through the submittal of the FLA and over $5,000,000 on the H&H Modeling and Sedimentation studies alone.

Adopting the Requestors' proposed Contaminated Sediment Transport Study at this late stage of the relicensing effort—where all studies are now complete and the FLA has been filed—would be highly disruptive and cause unreasonable delay. GRDA estimates that implementing this study would take at least two years to complete—particularly in light of the City's aggressive advocacy demonstrated during the ISR and USR phases of the prefiling ILP. All the public benefits that will result from FERC's issuance of a new license will be significantly delayed by this study, if required.

As demonstrated by the CSTAG conclusions[272] when reviewing a modeling proposal similar to that of the City,[273] there is no reason to believe the results would be accurate enough to inform FERC's decision-making in this relicensing effort.

For all these reasons, FERC staff should reject the proposed Contaminated Sediment Transport Study based on Study Criterion No. 7's requirement to consider "level of effort and cost."[274] Simply stated, this study would be inordinately expensive in a relicensing effort that has already significantly taxed GRDA's electric customers, would considerably delay the entire relicensing effort, and would fail to provide meaningful data to inform an analysis of Project effects and mitigation measures—measures that, as described throughout this Response, the Commission has no authority to require.

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[272] CSTAG, 2022.
[273] FERC Accession No. 20180313-5162.
[274] 18 C.F.R. § 5.9(b)(7).

4 References

Anchor QEA (Anchor QEA, LL) and Simons and Associates, 2022. *Grand Lake Sedimentation Study Updated Study Report.* September 2022

Andrews, W.J., M.F. Becker, S.L. Mashburn, and J.D. Smith, 2009. *Selected Metals in Sediments and Streams in the Oklahoma Part of the Tri-State Mining District, 2000-2006.* USGS Scientific Investigations Report 2009-5032.

Atkinson, Clare A., Jolley, Dianne F., and Simpson, Stuart L., 2007. Effect of Overall pH, Dissolved Oxygen, Salinity, and Sediment Disturbances on Metal Release and Sequestration from Metal Contaminated Marine Sediments. Chemosphere, 69:1428-1437. 2007.

Bollinger, C.E., 1983 *Tar Creek Feasibility Investigation. Task II.3.D. Assignment of Appropriate Alternatives to Inflow Points.* U.S. Department of Agriculture. Soil Conservation Service. Stillwater, Oklahoma. December 1983.

CH2M HILL, 2001. *Technical Memorandum Tar Creek Superfund Site March 2001 Screening Level Sampling Results – Miami, OK.* Prepared for US EPA. May 29, 2001.

CH2M HILL, 2005. *Five-Year Review Report Third Five-Year Review Report for the Tar Creek Superfund Site Ottawa County, Oklahoma.* September 2005.

CSTAG (Contaminated Sediments Technical Advisory Group), 2022. Memorandum to: Katrina Higgins-Coltrain, Remedial Project Manager US EPA Region 6, and Elizabeth Hagenmaier, US EPA Region 7. Regarding: CSTAG Recommendations on the Tri-State Mining District Watershed. CSTAG Milestone Meeting 1 – Site Characterization. October 21, 2022.

CSTAG (Contaminated Sediment Technical Advisory Group), 2023. *CSTAG Roundtable Stakeholder Discussion Tri-State Mining District.* April 2023.

EcoAnalysts, Inc., 2018. Final Report: Tri-State Mining District Unionid Assessment, Missouri, Kansas, and Oklahoma, 2016-2018. Unpublished report prepared for U.S. Fish and Wildlife Service, Columbia, Missouri.

EPA (U.S. Environmental Protection Agency), 1984. Record of Decision, Remedial Alternative Selection. June 6, 1984.

EPA, 1994. Five-Year Review, Tar Creek Superfund Site, Ottaway County, Oklahoma. April 1994.

EPA, 1998. EPA Superfund Record of Decision: Tar Creek (Ottawa County), OU2, Ottawa County, OK, 8/27/1997. January 1998.

EPA Region 6, 2000. *Five-Year Review Tar Creek Superfund Site Ottawa County, Oklahoma*. April 2000.

EPA, 2008. U.S. *EPA Signs Record of Decision for the Tar Creek Superfund Site, Operable Unit 4 – Chat Piles, Other Mine and Mill Wastes and Smelter Wastes*. February 2008.

EPA, 2019. *Tar Creek Superfund Site Strategic Plan Cleanup Progress & Plans for the Future.*

EPA, 2022. "Contaminated Sediments Technical Advisory Group | US EPA." Last modified December 23, 2022; accessed July 20, 2023. Available at: https://www.epa.gov/superfund/contaminated-sediments-technical-advisory-group

Fey, D.L., M.F. Becker, and K.S. Smith, 2010. *Geochemical Data for Core and Bottom-sediment Samples Collected in 2007 from Grand Lake O' the Cherokees, Northeast Oklahoma*. USGS Open File Report 2010-1298.

Garvin, E.M., C.F. Bridge, and M.S. Garvin, 2017. *Screening Level Assessment of Metal Concentrations in Streambed Sediments and Floodplain Soils within the Grand Lake Watershed in Northeastern Oklahoma, USA*. Springer Science +Business Media, New York. February 22, 2017

Hayhow, 2021. *A Participatory Approach to Tracing Legacy Metals to Evaluate Future Public Health Risk from Tar Creek Superfund Site: Integrating Geochemistry with Tar Creek's political roots to study floodplain soils as a unique geochemical fate.*

Ingersoll, Christopher G., Ivey, Christopher D., Brumbaugh, William G., et.al., 2009. Toxicity Assessment of Sediments from Grand Lake O' the Cherokees with the Amphipod Hyella Azteca. Columbia Environmental Research Center - U.S. Geological Survey. Administrative Report CERC-8335-FY09-20-01. August 27, 2009.

Juracek, Kyle E. and Becker, Mark F., 2009. Occurrence and Trends of Selected Chemical Constituents in Bottom Sediment, Grand Lake of the Cherokees, Northeast Oklahoma, 1940-2008. U.S. Geological Survey Scientific Investigations Report 2009-5258.

Keating, F., 2000. *Tar Creek Superfund Task Force Drainage and Flooding Subcommittee*. July 2000.

Keheley, E., 2002. *Early Water Pollution in the Tri-State Mining Field.* March 2002.

Li, J., and J. McDonald-Gillespie, 2020. "Airborne Lead (Pb) From Abandoned Mine Waste in Northeastern Oklahoma, USA." *GeoHealth* 4(9):e2020GH000273. https://doi.org/10.1029/2020GH000273

McCormik, C.A. 1985. Water Quality and Sediments of an Area Receiving Acid-mine Drainage in Northeastern Oklahoma. MS Thesis. Oklahoma State University, Stillwater, OK. 1980.

MacDonald, D.D. et.al., 2010. Advanced Screening-Level Ecological Risk Assessment (SLERA) for Aquatic Habitats within the Tri-State Mining District, Oklahoma, Kansas, and Missouri. Draft Final Technical Report. Nanaimo, British Columbia, MacDonald Environmental Services Ltd.

Morrison, S, S. Nikolai, D. Townsend, J. Belden. 2018. Distribution and Bioavailability of Trace metals in Shallow Sediments from Grand Lake, Oklahoma. Archives of Environmental Contamination and Toxicology. 76:31-41. https://doi.org/10.1007/s00244-018-0559-1.

NDAA, 2000. National Defense Authorization Act for Fiscal Year 2020.

Nirenberg, M., 2020. *Earth A.D.: The Poisoning of the American Landscape and the Communities that Fought Back*. Port Townsend, WA: Process Media.

Oklahoma Department of Environmental Quality. 2007. Fish Tissue Metals Analysis in the Tri-State Mining Area Follow-Up Study-Revision 2. December 4, 2007.

OWRB (Oklahoma Water Resources Board) and OSU (Oklahoma State University). 1995. Diagnostic and Feasibility Study of Grand Lake O' The Cherokees, Phase I of a Clean Lakes Project, Final Report. March 10, 1995 March 1995.

Riley, R.C., 1983. *Tar Creek Feasibility Investigations. Task II.3.e.f. Assessment of Changes in Drainage Patterns (Particularly Flooding Potential) Resulting from Proposed Diversion and Diking.* USDA Soil Conservation Service. Stillwater, Oklahoma. December 1983.

Tetra Tech, 2018. Letter to: Kimberly D. Bose, Secretary, FERC. Regarding: Study Plan Request for Contaminated Sediment Transport Study. March 12, 2018.

U.S. Army Corps of Engineers, 1980. *Arkansas River Basin Water Control Master Manual*. Tulsa and Little Rock Districts.

U.S. Army Corps of Engineers, 2016a. *HEC-RAS River Analysis System 2D Modeling User's Manual.* Hydrologic Engineering Center. Davis, California.

U.S. Army Corps of Engineers, 2016b. *HEC-RAS River Analysis System Hydraulic Reference Manual.* Hydrologic Engineering Center. Davis, California.

U.S. Fish & Wildlife Service, Oklahoma Ecological Services Field Office, Tulsa, OK, 2013. *Tri-State Transition Zone Assessment Study, Kansas Missouri and Oklahoma*.

Vitek, J.D., 1983. *Tar Creek Feasibility Investigation. Task II.3. Diking and Diversion Feasibility Study.* Department of Geography. Oklahoma State University. Stillwater, Oklahoma.

Zota, A.R., R. Willis, R. Jim, G.A. Norris, J.P. Shine, R. Duvall, L.A. Schaider, and J.D. Spengler, 2009. "Impact of Mine Waste on Airborne Respirable Particulates in Northeastern Oklahoma USA." *Journal of the Air & Waste Management Association* 59:1347–1357. doi: 10.3155/1047-3289.59.11.1347. PMID: 19947116.

Zota, A.R., A.M. Riederer, A.S. Ettinger, L.A. Schaider, J.P. Shine, C.J. Amarasiriwardena, R.O. Wright, and J.D. Spengler, 2016. "Associations Between Metals in Residential Environmental Media and Exposure Biomarkers Over Time in Infants Living Near a Mining-Impacted Site." *Journal of Exposure Science and Environmental Epidemiology* 26(5):510–9. doi: 10.1038/jes.2015.76.

July 2023

Response to Requests for Contaminated Sediment Transport Study for the Relicensing of the Pensacola Hydroelectric Project (FERC No. 1494)

Exhibit 1: City’s Study Plan Request for Contaminated Sediment Transport Study

Pensacola Hydropower Project
FERC Project No. 1494-438

Study Plan Request for Contaminated Sediment Transport Study

100-SET-T33800
March 12, 2018

SUBMITTED TO

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

PREPARED BY TETRA TECH ON BEHALF OF THE CITY OF MIAMI

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1.0 INTRODUCTION

1.1 BACKGROUND

The Grand River Dam Authority (GRDA) intends to file an application to relicense the Pensacola Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) Project No. 1494, on the Grand Neosho River (Grand River), in the Craig, Delaware, Mayes, and Ottawa counties of northeastern Oklahoma. The current license was issued on April 24, 1992 and expires on March 31, 2022. GRDA filed a Notice of Intent to File Application for New License (NOI) and a Pre-Application Document (PAD) to initiate FERC's Integrated Licensing Process (ILP) for the Project on February 1, 2017. This document serves as the requested study plan in response to those filings, and was written on behalf of the City of Miami, OK.

1.1.1 Project Description

As stated in the PAD, the Project is located at river mile (RM) 77 on the Grand River and creates the Grand Lake O' The Cherokees (Grand Lake). Under the current FERC license, the Project serves multiple purposes, including flood control, hydropower generation, water supply, public recreation, and wildlife enhancement. It has an installed capacity of 105.176 megawatts (MW) and the main dam summarily consists of a reinforced concrete dam with a multiple-arch section, a spillway, a non-overflow gravity section, and two non-overflow abutments, which comprise an overall length of 5,950 feet and a maximum height of 147 feet. The Grand Lake reservoir created by the Project has a surface area of approximately 45,200 acres and a storage capacity of 1,680,000 acre-feet at normal maximum water-surface elevation of 745 feet Pensacola datum (PD) (FERC 1996; GRDA 2010). With a drainage area of 10,300 square miles across Kansas, Oklahoma, Missouri and Arkansas, Grand Lake has approximately 667 miles of shoreline that extend about 66 miles upstream from the Pensacola Dam. The Project's defined boundary as discussed in the PAD encompasses 53,965 acres, including GRDA owned lands, the 45,200 acres of the Grand Lake reservoir and a shoreline buffer. GRDA developed a Shoreline Management Plan (SMP) in 2008 that comprehensively specifies the shoreline management objectives and policies of GRDA and FERC – including the protection of environmental and socioeconomic resources – in accordance with Project operations under the current license (GRDA 2008).

The following political subdivisions are included in the PAD as either located near or potentially affected by Project operations:

- Cities of Miami, Grove, and Vinita
- Townships of Wyandotte, Langley, Bernice, Disney, Afton, Fairland, and Ketchum
- The following Indian Tribes:
    - The Caddo Nation of Oklahoma
    - The Eastern Shawnee Tribe of Oklahoma
    - The Shawnee Tribe of Oklahoma
    - The Apache Tribe of Oklahoma
    - The Osage Nation
    - The Cheyenne and Arapaho Tribes of Oklahoma
    - The Cherokee Nation
    - The Delaware Tribe
    - The Wichita and Affiliated Tribes of Oklahoma
    - The Muscogee (Creek) Nation
    - The Alabama-Quassarte Tribal Town
    - The Seneca-Cayuga Nation
    - The Modoc Tribe of Oklahoma
    - The Quapaw Tribe of Indians
    - The Miami Tribe of Oklahoma

- The Ottawa Tribe of Oklahoma
- The United Keetoowah Band of Cherokees
- The Wyandotte Tribe of Oklahoma
- The Little Traverse Bay Bands of Odawa Indians.

1.1.2 Rule Curve

The current FERC license outlines target reservoir surface elevations known as the Project's Rule Curve. The Rule Curve specifies the target maximum water-surface elevation throughout the year. The Rule Curve has been modified 5 times (1958, 1981, 1984, 1992 and 2017) since construction of the dam with the maximum power-pool elevation increasing from the original 735-feet PD in 1942 to the current 744-feet PD. The current amendment to the seasonal Rule Curve for Pensacola Dam went into effect on August 2017, and established target maximum water-surface elevations that vary from 741-feet PD between September 1 and October 15 to 744 feet-PD from June 1 through July 31.

The PAD describes the flood control pool of the Project as the storage volume available between the target pool elevation and the upper elevation of 755-feet PD. GRDA yields water release controls to the USACE Tulsa District when reservoir elevations are either within the flood control pool or are projected to rise into the flood control pool (FERC 1996). When the lake elevation is higher than 755-feet PD, GRDA is responsible for reservoir releases.

The City of Miami, OK along with tribes and other parties, expressed concerns regarding an increase in flooding frequency and higher water-surface elevations in the area surrounding the upper reaches of Grand Lake and its tributaries due to the increases in the Rule Curve as well as the general presence and operation of the dam. FERC issued these variances on August 15, 2012 to alleviate drought conditions, and August 14, 2015 and August 12, 2016 to increase water levels for recreation and boater safety, and to maintain acceptable dissolved oxygen (DO) levels downstream in the event of a drought (FERC 2012, 2015, 2016). Though the PAD describes the ruling on GRDA's application as pending, FERC favored the proposed rule amendment in its environmental assessment filed on January 12, 2017, which included review of the recent hydraulic studies and other public comments (FERC 2017).

The City of Miami, OK commissioned and submitted to FERC two flood routing studies in response to a draft application filed by GRDA to permanently amend the Rule Curve (Tetra Tech, 2015, 2016). These studies identify potential flaws in previous hydraulic models and show that Project operations have already caused unauthorized flooding in the vicinity of Miami, OK, and show that the proposed permanent Rule Curve amendment would further increase risk to structures and human life. Increased sedimentation, particularly near Twin Bridges, has increased the upstream flooding risk.

1.1.3 Tar Creek Superfund Site

The Tar Creek Superfund Site (EPA ID: OKD980629844) is located about 3 ½ miles north of Miami, OK and spans approximately 40 square miles (Pre-Assessment Screen for the Tar Creek Superfund Site, Ottawa County, Oklahoma, Sept. 2004). The site represents the Oklahoma portion of the Tri-State Mining District and was placed on EPA's National Priorities List in 1983. A 2004 Pre-assessment Screen report developed for a future Natural Resource Damages (NRD) claim notes that numerous studies have shown that hazardous substances have been released into the environment from the Tar Creek Site through multiple pathways, and are still released to this day. Elevated concentrations of metals have been documented in the surface waters and sediment of Tar Creek and other streams and rivers downstream of the site (Tar Creek PAS), some of which are direct tributaries to Grand Lake. The Project's SMP also acknowledges that contaminants such as lead, zinc, and cadmium are present in sediment of the upstream portion of the reservoir (GRDA 2008).

Tar Creek, Neosho River and Lower Spring River flow through the Tar Creek Superfund Site downstream, through the City of Miami and/or adjacent properties, and discharge into Grand Lake. During high water levels, the Grand Lake Reservoir extends upstream into the Tar Creek, Neosho River and Lower Spring River floodplains and onto City property. Consequently, the City and Tribes are concerned that the backwater, due to the Project, is also causing contaminated sediment to be deposited throughout the floodplains of its upper tributaries, including on City property.

1.2 PROPOSED STUDY

The proposed study is a comprehensive sediment transport analysis to assess the effect of increased flooding associated with Project operations on contaminated sediment deposition within the floodplains of the Neosho River, Tar Creek, and Lower Spring River in areas near Miami, OK.

2.0 STUDY PLAN

The following sections address the study request criteria required by FERC as part of the Project's relicensing application using FERC's Integrated Licensing Process (ILP).

2.1 GOALS AND OBJECTIVES

The goal of the proposed study is to determine Project impacts on flooding and toxic sediment deposition in the upper reaches of Grand Lake and the areas surrounding the Tar Creek, Neosho River, and Spring River tributaries, including in the vicinity of Miami. The results of the proposed study will provide critical information to the Commission which can mitigate Project Impacts identified in the proposed study through changes to Project operations, such as the SMP and/or Rule Curve. The study will satisfy the following specific objectives:

- Develop a comprehensive hydraulic model using existing and any required additional information to establish baseline flood inundation areas in the upper reaches of Grand Lake and in the vicinity of the City of Miami
- Specify toxins of concern and quantify toxicity of sediments from the Grand Lake tributaries of Tar Creek, Neosho River, and Spring River
- Establish a baseline sediment transport model using existing and any required additional information
- Estimate the change of toxic sediment deposition in the upper reaches of Grand Lake and in the vicinity of the City of Miami as a result of proposed operating scenarios.
- Estimate the future impacts of deposition of contaminated sediments near Miami and into Grand Lake over the duration of the license.

2.2 PUBLIC INTEREST CONSIDERATIONS

Sections 4(e) and 10(a) of the Federal Power Act require the Commission to give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, the Commission must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the project, as well as power and developmental values. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses.

The level of contamination at the Tar Creek Superfund site, which is hydraulically connected to Grand Lake, is considered highly toxic to humans, wildlife, and vegetation communities. Grand Lake is a public destination for boating, fishing, and other recreational activities. Public comments throughout GRDA's operation of the Project have consistently called attention to flooding and contamination issues. Investigating the impact of the Project on human health and environmental resources through increased flooding and deposition of contaminated sediments in Grand Lake and beyond the existing Project Boundary, including the vicinity of the City of Miami, is necessary to fulfill the Commission's responsibilities under National Environmental Policy Act (NEPA). Ensuring that environmental measures and public health are considered following accepted scientific methods is essential to the Commission's public interest determination.

2.3 EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Several studies regarding Project effects on flooding impacts in areas upstream of Grand Lake already exist, and many of them are mentioned in the PAD. These studies consist of hydraulic models that rely on datasets from a variety of sources. Additionally, many other publications by government agencies, as well as non-governmental organizations, contain useful topographic, bathymetric, and hydraulic data. An initial inquiry was conducted to gain an understanding of the type and extent of existing data pertaining to hydraulic model setup and development that already exists, and to identify the type and quantity of additional information required to create a comprehensive model. A list of relevant documents reviewed is provided in Appendix A. Existing information obtained from these documents include:

- Historic streamflow data and sources for current streamflow data collected by the U.S. Geological Society (USGS)
- Historic water-surface elevation data and sources for current water surface elevation data USGS and GRDA
- Grand Lake bathymetry data collected by the Oklahoma Department of Water Resources (ODWR, 2009)
- Bathymetric survey data for Neosho River (Tetra Tech, 2015)
- Bathymetric survey data for Neosho River, Spring River and Elk River (USGS, 2017)
- LiDAR Survey of the project area (Dewberry, 2011)
- Hydraulic models of the Neosho River and Grand Lake (University of Oklahoma (OU), 2014; FERC, 2015; Tetra Tech, 2015)

Upon review of the LiDAR data and the Tar Creek hydraulic model, additional data may be required for comprehensive hydraulic model development. In particular, further cross-sectional surveys may be needed for segments of Tar Creek to develop complete channel geometry at an appropriate resolution.

The OU (2014) study was performed by Mr. Alan Dennis for his M.S. Thesis. Mr. Dennis developed a HEC-RAS model of the Neosho River system and major tributaries from Pensacola Dam to Commerce Gage. FERC reviewed the OU (2014) HEC-RAS model and found limitations in the model. FERC modified the OU model to perform their independent analysis. The modifications included removing the Grand Lake portion of the model. Tetra Tech reviewed both the OU and FERC models and concluded that both studies suffer from limitations that reduce the reliability of the results with respect to potential flooding in the City of Miami associated with the Rule Curve changes. In particular, the FERC study assumed that the water-surface elevations at Twin Bridges (U.S. Highway 60) are the same as the Grand Lake elevations at Pensacola Dam, over 40 miles downstream. Modeling by Tetra Tech (2015) indicates that the water-surface can be as much as 3 feet higher at Twin Bridges than at the dam, particularly during high flows that are the subject of concern to the City of Miami. It is strongly recommended that neither the OU or FERC models form the basis for any hydraulic modeling associated with the Pensacola Dam re-licensing.

Water quality sources cited in the PAD provide a useful foundation for understanding the state of water quality throughout the Grand Lake reservoir. However, for the purposes of developing a sediment transport model, a review of existing data relevant to Neosho River, Spring River, and Tar Creek was necessary to ascertain the type and quantity of additional information required to evaluate sediment toxicity in those reaches. A list of relevant documents reviewed is provided in Appendix A. Existing information obtained from these documents include:

- Sediment particle size analyses for sections of Neosho River, Spring River, and Tar Creek
- Historic depositional profiles and concentrations of metals in riverine and floodplain sediment samples from locations in Grand Lake

- Concentrations of metals in riverine and floodplain sediment samples from transects in Neosho River, Spring River, and Tar Creek
- Toxicity threshold concentrations for Neosho River, Spring River, and Tar Creek sediment samples

Additional information may be required in the form of sediment gradation data for the upper portion of Grand Lake, Neosho River, Spring River, and Tar Creek. It appears that particle-size analyses have been performed for these waterbodies and some floodplains in the past, however, complete datasets seem to be unavailable.

The contamination of soils, groundwater, and surface water in the areas surrounding the Tri-State Mining District has been a major concern for decades, providing numerous sources of data specific to the Tar Creek Superfund Site. A comprehensive sediment contamination study conducted in 2012 by the U.S. Fish and Wildlife Service (USFWS) provides a list of proposed future sampling locations where concentrations of metals were particularly high in the upper portion of Grand Lake, multiple locations in Spring River, and one location near the confluence of Neosho River and Tar Creek. The accuracy of a sediment transport model depends on the detail and quality of the input data. Considering continuous depositional activity in the reaches of concern, more recent datasets are preferred for model inputs to accurately represent current conditions upstream of the Project.

2.4 PROJECT NEXUS

Studies have found that Project operations affect flood inundation areas beyond the Project Boundary (Holly, 2001, 2004; FERC, 2015; OU, 2014; Tetra Tech 2015, 2016, USACE, 1986, 1998). In its Water Quality Data section, the PAD mentions heavy metal contamination from the Neosho River and Spring River watersheds while also acknowledging, in the Project Effects section, that Project operations have the potential to cumulatively affect changes in sediment transport and deposition in the reservoir. The PAD also recognizes that Project operations have the potential to impact sedimentation, as well as floodplain, wetland, riparian, and littoral habitat types. The requested study results will inform the Commission which can mitigate Project impacts through changes to Project operations, such as the SMP and Rule Curve, that may be required by FERC as a condition of relicensing.

2.5 PROPOSED METHODOLOGY

A sediment transport model will be developed and calibrated to assess the quantity of contaminated sediment from the Tar Creek superfund site that is deposited within the floodplains in the vicinity of City of Miami. Currently, backwater effects from the Pensacola Dam occur upstream of the City of Miami, which may result in deposition of contaminated sediment within stream channels and their associated floodplains in the City of Miami and vicinity.

The sediment transport model will need to simulate flows, hydraulic conditions, including velocity, depth, and water surface elevation, and sediment movement in the model domain. This model domain area will encompass the Neosho River from the upper portion of the Grand Lake pool, beginning immediately upstream at the Elk River arm, past the City of Miami. The model will simulate two tributaries whose headwaters are in the superfund site: Tar Creek, which flows through the City of Miami, and Spring River. Both streams discharge into the Neosho River.

The sediment transport model must accurately estimate the amount of sediment deposited in the City of Miami's floodplain during out-of-bank flow events. The volume of sediment deposited within the channel should also be computed, along with the typical residence time of the sediment. Several model scenarios will be required to assess the deposition of contaminated sediment caused by backwater effects from the Pensacola Dam, identify alternatives to reducing the dam related effects, and evaluate future conditions over the term of the license.

2.5.1 Task 1 – Data Review

The contractor will perform a data inventory and review of publicly-available data for the City of Miami, Neosho River, Tar Creek, and Spring River. The data review should focus on gathering any historical sediment data, such as dredging volumes, sediment transport, historical bathymetric surveys, etc. If available, this information should be used to help determine historical quantities of sediment deposition throughout the area of concern.

The contractor shall develop a database to store the data and will fully document the available data. A technical memorandum will be provided to FERC describing the types and quality of available data.

2.5.2 Task 2 – Model Approach and Selection

The contractor will use the Environmental Fluid Dynamics Model (EFDC) hydrodynamic and sediment transport modules, or another similar and appropriate model such as Delft3D, to simulate sediment movement in the Neosho River, Tar Creek, Spring River, and their floodplains. The model will need to represent the floodplain deposition quantities along Tar Creek and Spring River separate from the in-stream and bed load sediment. Models should be evaluated to identify the best model by considering a variety of factors; including availability in the public domain, readily available, source code available, channel morphology capabilities, and efficacy of sediment transport solutions.

EFDC is a general-purpose modeling package for simulating one- or multi-dimensional flow, transport, and bio-geochemical processes in surface water systems including rivers, lakes, estuaries, reservoirs, wetlands, and coastal regions. The EFDC model was originally developed by Hamrick (1992) at the Virginia Institute of Marine Science for estuarine and coastal applications and is considered public domain software. This model is now EPA-supported and has been used extensively to support receiving water modeling studies throughout the world. The EFDC model also has a wide range of options for simulating sediment deposition and erosion processes. Its modular sediment processes library formulation allows for timely incorporation of new options including site specific parameterizations, if needed. In addition, the EFDC toxicity module can be used to quantify the heavy metal contaminant transport and transformation processes.

The contractor will evaluate the EFDC models and examine the appropriateness of the general conceptual structures. Given the findings of Task 1, other models may be more appropriate depending on the amount of data available to setup, parameterize, and calibrate the model. The modeling approach should be a balance between accurately representing the system, reasonable assumptions, model capability, and limitations.

A Technical Memorandum will be developed outlining the contractor’s approach for model setup, including available data for model setup, parameterization, and calibration. The contractor will provide information documenting how the available data will be used, what additional data should be collected in addition to the available data outlined in Task 3, what parameters will need to be estimated, and how the model grid or domain will be developed. If the contractor feels that another model may be more appropriate, the contractor can suggest that model, document the ability of the model to address the project needs, and the advantages to the proposed model as opposed to the EFDC model. The model selection and modeling approach will be developed and reviewed by FERC before proceeding with the next tasks. It is critical that all parties be in agreement on the workflow used to simulate key processes, including selected model, flood events and potential overbank and in-channel deposition.

2.5.3 Task 3 – Data Collection

Additional data will likely need to be collected as part of the sediment transport modeling to supplement historic sediment surveys. These new data will be directly input or used to calculate parameters used in the sediment model. Data collection will be broken into three parts: a) ASTM Geotechnical tests b) SEDFlume tests and c) Water Column TSS tests. In addition, bathymetric and floodplain transect data may need to be collected as well, depending on the availability of historic surveys and recent LiDAR (Light Detection and Radar) data collections.

2.5.3.1 ASTM Tests

The contractor will collect a minimum of 30 sediment grab samples throughout project area. These data will be used to characterize and parameterize the sediment within the model domain. The exact location of each of the sediment grab samples will be determined by the contractor, and reviewed by FERC. Sediment sample locations should be distributed throughout key areas in the model domain to adequately characterize the system. At a minimum, ten sediment grab samples should be collected in Tar Creek, ten in Spring River, two in the Neosho River upstream of City of Miami, five in the Neosho River between City of Miami and City of Wyandotte, and three in the Neosho River downstream of Wyandotte. In addition, if the sediment leaving the Tar Creek superfund site has not been characterized, three (3) representative sediment grab samples should be taken from the chat pilings and analyzed.

The contractor will conduct the following standard geotechnical lab tests on each soil sample:

- Sieve Analysis with hydrometer - ASTM D2974
- Specific Gravity - ASTM D854
- Water Content - ASTM D2216
- Organic Content - ASTM D2974
- Bulk Density – ASTM D7263

2.5.3.2 SEDFlume Tests

In addition to standard ASTM lab tests, the contractor may need to conduct SEDFlume testing to determine site specific critical shear stress values. The need for these samples will be dependent on the ASTM test results. If the river has a predominately sandy bottom, SEDFlume tests will not be necessary. If there is a cohesive sediment bottom, then these data will be needed to better define the critical shear stress values for model development and calibration. Since core data will not be collected in the field, grab sample data will be used to reconstruct cores for laboratory testing. The contractor will conduct SEDFlume testing for 15 of the 30 grab river and stream samples. Five (5) samples each from Tar Creek, Spring River, and Neosho River will be tested. If SEDFlume tests have not been conducted on the Tar Creek superfund site sediments, SEDFlume tests will need to be performed on all three (3) sediment grab samples from the site. Through accurate measurements of sediment erosion properties, sediment stability can be realistically quantified with a minimal amount of calibration or fine-tuning of analytical and numerical models.

2.5.3.3 Water Column TSS Tests

The contractor will collect six (6) water column grab samples at each of a minimum of 12 locations. These data will be used to assist with model calibration. The samples will be analyzed for Total Suspended Solids (TSS) or Suspended Sediment Concentrations (SSC) in accordance with procedures in EM-1110-2-5025 Appendix G and H. Two (2) sample locations will be co-located at existing U.S. Geological Survey (USGS) gage stations: USGS 07185095 Tar Creek at 22nd Street Bridge at Miami, OK and USGS 07185080 Neosho River at Miami, OK. Two (2) sample sets should be collected during baseflow, two (2) sample sets should be collected during or immediately after 0.5” rainfall events, and two (2) sample sets should be collected during or immediately after 1.0” rainfall events.

2.5.3.4 Bathymetric and Floodplain Transect Data

The following bathymetric and topographic data are available for use to developing the model:

- A bathymetric survey of Pensacola Reservoir and approximately 4.5 miles of the Neosho River upstream from the confluence of the Spring River conducted by the OWRB (2009).

- A hydraulic model of Tar Creek developed for a FEMA study that includes cross-sections data (FEMA, 2015).
- A bathymetric survey of the Neosho, Spring and Elk Rivers conducted by the USGS (2017). The survey extends along the Neosho River from Twin Bridges (HWY 60 bridge) to the Kansas border, along the Spring River from Twin Bridges to the Missouri border, and along the Elk River from Oklahoma State Highway 10 Bridge near Grove, OK to Noel, Missouri.
- A high-accuracy Light Detection and Ranging (LiDAR) survey of the Grand Lake area conducted for the U.S. Geological Survey by Dewberry (2011). The survey encompassed the entire overbank area of Grand Lake and its tributaries.

The LiDAR survey (Dewberry, 2011) may not have captured the bed topography of Tar Creek, in which case, a bathymetric survey will need to be conducted to collect cross-section data approximately every 750 feet along the reach. The contractor should document in writing to FERC the proposed survey data that will be used and the reasoning for its use, or lack thereof.

2.5.4 Task 4 – Hydrodynamic and Sediment Model Development

The contractor will set up the hydrodynamic and sediment transport model to represent current conditions of the project area. The model domain will represent the Neosho River in the upper pool of the Grand Lake o' the Cherokees to approximately 11 miles upstream of its confluence with Tar Creek. The Neosho River downstream boundary will begin immediately upstream of the Grand Lake Elk River arm, which is located approximately 15 miles downstream of Wyandotte, OK. This downstream boundary location assumes that GRDA can provide stage or water surface elevations from the flow-routing model to apply as a boundary condition. If data are not available, the downstream boundary may need to extend to the Pensacola Dam. USGS 07185000 at Neosho River near Commerce, OK discharge should be used to define the upper Neosho River boundary.

Spring River will be represented from the Neosho River confluence to the Spring River Dam at Highway 166 near Baxter Springs, OK. Tar Creek will be represented from the Neosho River confluence to its headwaters. Discharge flows should be defined using USGS data collected at USGS 07188000 Spring River near Quapaw, OK and USGS 07185090 Tar Creek near Commerce, OK, respectively. Major tributaries other than Spring River and Tar Creek entering the Neosho River throughout the model domain should be represented through direct model inputs by area-weighting nearby stream discharge flows, such as discharge flows collected at USGS 07185030 at Elm Creek near Commerce, OK.

The hydrodynamic and sediment model will be setup to simulate an approximately 11-year period that allows for full model stabilization and covers a range of climatic and precipitation events. For this project, the simulation period should be at least from 2006-2017 (1 spin up year, 10 validation/calibration years). However, if historic data are available for an earlier period, the model should be extended to capture data from this period.

The sediment bed will be modeled as a series of computationally-active vertical layers. The actual number and thickness of the layers will be determined based on data analysis of the dynamics of the overall domain and the final sediment transport model selected to provide an appropriate bed representation. The sediment will be simulated in a number of solid classes, cohesive and non-cohesive. The classes will be determined based on effective particle diameters for non-cohesive sediment and erosion parameters, including critical stress and mass erosion rates for cohesive sediment based on the data collected in Task 3.

Measured sediment data will be used as input to the model when available; however, measured data will likely not cover all the inputs required. Where direct measurements are not available, the load data will be interpolated/extrapolated from the available measured data and adjusted based on total mass balance of the system. Turbidity data collected at USGS 07185090 could be used to help develop the sediment boundary at this location, although suspended or total sediment data would be more appropriate to use to define the boundary.

2.5.5 Task 5 - Calibrate Model

The hydrodynamic and sediment model will be calibrated and validated by comparing model predictions to available measured water surface elevations, flows, velocities, temperatures, depositional data, and suspended sediment data. Model calibration and validation consists of the process of adjusting model parameters, within expected ranges, to provide a match to observed conditions. Although these models are formulated from mass balance principles, most of the parameterization in the models are empirically derived. These empirical derivations contain multiple coefficients that are usually determined by calibration to data collected in the waterbody of interest.

The hydrodynamic model will be calibrated for water surface elevation, flows, velocities, and temperature. The main hydrodynamic data source will be USGS and gaging stations in the project area available. The calibration of the hydrodynamic model will be based on graphical and statistical comparisons between the model predictions and the observations. The temporal analyses will be performed creating comparison plots using the model results and available field observations. Final calibration will be determined based on both the graphical evaluation and the goodness-of-fit statistics. The following goodness-of-fit statistics should be evaluated to compare model predictions to time series of observations:

Correlation coefficient: $$R^2 = \frac{\left(n\sum_{i=1}^{n}(P_i \times O_i)\right) - \left(\sum_{i=1}^{n}O_i \times \sum_{i=1}^{n}P_i\right)}{\sqrt{\left[n\sum_{i=1}^{n}(P_i^2) - \sum_{i=1}^{n}(P_i)^2\right]} \times \sqrt{\left[n\sum_{i=1}^{n}(O_i^2) - \sum_{i=1}^{n}(O_i)^2\right]}}$$

Mean Absolute Error: $$MAE = \frac{\sum_{i=1}^{n}\left|P_i - O_i\right|}{n}$$

Root Mean Squared Error: $$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(P_i - O_i)^2}{n}}$$

Normalized Root Mean Squared Error: $$NRMSE = \frac{RMSE}{\overline{O}} * 100$$

Index of Agreement: $$IA = 1.0 - \frac{\sum_{i=1}^{n}\left|P_i - O_i\right|}{\sum_{i=1}^{n}\left[\left|P_i - \overline{O}\right| + \left|O_i - \overline{O}\right|\right]}$$

Sediment transport calibration is based on a comparison of model-predicted and observed suspended sediment concentrations, bed morphology changes, and net flux at selected locations. Sediment transport calibration parameters include river, watershed, internal sediment, and solids loads and their distribution into modeled classes, suspended sediment concentration, effective particle diameters or settling velocities for sediment and solids classes, and erosion parameters, including critical stress and mass erosion rates for cohesive sediment.

Deposition and erosion parameterizations will be initially selected to be consistent with literature values and previous studies. Sediment and solids class settling velocities and the distribution of total loads among the particle size classes may be the primary calibration parameters. To evaluate settling velocities and load distributions, sensitivity analyses will be conducted to assist in developing the final values (Task 6).

Graphical comparison of model-predicted and observed total suspended solids concentrations will be made where suspended solids data are available. If enough solids data are available, a goodness-of-fit statistics analysis will be performed.

After calibration has been completed, the contractor will provide the draft model, including all geospatial, raw data, and processing data files, to FERC. The models and files can be provided on an external hard drive. FERC will review the draft model and deliver comments to the contractor. The contractor will provide written responses to FERC draft model comments. The contractor will update the hydrodynamic and sediment model per FERC comments. The final model files should be provided to FERC. All geospatial, raw data, and processing data files will also be provided. The models and files can be provided on an external hard drive.

2.5.6 Task 6 - Sensitivity Analysis

The contractor will conduct sensitivity analyses on the hydrodynamic and sediment model to identify the factors that most significantly impact the flow and sediment simulation. The sensitivity analysis will provide an assessment of the uncertainty or variability in the fate and transport model predictions in critical aspects of the model. Uncertainties include simplifying assumptions of the model framework, data limitations (e.g., bathymetry, source inputs, boundary conditions, calibration data), and rate constant assumptions. The sensitivity analysis should not be used to accept or reject a calibrated model, but to document the most important sources of uncertainty involved in a model application and to estimate the level of confidence that may be expected in the model predictions due to these sources of uncertainty. The contractor will prepare a technical memorandum documenting the results of the sensitivity analysis.

2.5.7 Task 7 – Draft Report

The contractor will prepare a draft report to document all hydrodynamic and sediment modeling methods and procedures. The draft report will include thorough discussions on the model setup, assumptions, the approach to determine the model parameterization, and model results. The Technical Memoranda developed during Tasks 1, 2 and 6 will be included in the draft report as appendices. The draft report will be delivered to FERC and GRDA in both electronic and hard copy. FERC and GRDA will review the draft report and deliver comments to the contractor.

2.5.8 Task 8 – Develop and Run Scenarios

The contractor will apply the calibrated hydrodynamic and sediment model to develop and simulate the following scenarios.

- Existing conditions under the current Rule Curve - model as is, with WSE/release rates that represent the conditions requested in the FERC relicensing
- Mitigation conditions – evaluate alternatives for reducing the channel and floodplain contamination to communities (including the City of Miami and Tribal Lands) and any other improved properties within the reservoir floodplain. The alternatives will include evaluating the previous Rule Curves, modifying the current Rule Curve to remove dam related sedimentation effects, and evaluating pre-release scenarios.
- Future conditions – evaluate future conditions for the anticipated license period under the current Rule Curve and under the mitigation alternatives. The future conditions will include applying projections of

potential changes in dam operations, land use changes and impacts of continued reservoir sedimentation.

The scenarios will be simulated for a minimum duration of ten (10) years plus the spin up year. The simulation period must contain a full range of flow conditions that can reasonably be expected to occur. The contractor will compare the scenario results to the calibrated model to determine the potential increase in sediment deposition in the City of Miami floodplain and impacted communities, to determine the historic rate of sediment deposition in the floodplain and predict future conditions. The results will be summarized in the final report.

2.5.9 Task 9 – Final Report

The contractor will address the FERC and GRDA comments on the draft report. In addition to the information provided in the draft report, the final report must address and quantify the amount of sediment deposition that occurs in the City of Miami floodplain and channel due to current and future Pensacola Dam operations.

All the final model and scenario modeling files should be provided and the model must run on FERC and City of Miami computers. All geospatial, raw data, and processing data files will also be provided. The models and files can be provided on an external hard drive.

2.5.10 Task 10 – Meetings and Coordination

The contractor will attend and present at five (5) meetings over the duration of the project. The five meetings include the following: (1) Kick-Off Meeting, (2) Data Review, Model Selection, and Collection (Tasks 1, 2, and 3), (3) Model Development (Task 4), (4) Calibration and Sensitivity Analysis Results (Tasks 5 and 6), and (5) Final Report and Scenario Results (Task 8 and 9). The contractor shall present the findings and results at the appropriate meeting. Each meeting will be attended by FERC, and FERC may invite GRDA, City of Miami, and other stakeholders as required. The contractor will take meeting minutes, and the minutes will be delivered to FERC within one week after each meeting. Meeting duration shall be one day, not including travel.

The contractor will provide monthly progress reports to FERC detailing the work completed within the period. The contractor will also hold a minimum of one (1) conference call each month to update FERC and interested parties on project progress.

2.6 LEVEL OF EFFORT AND COST

The estimated cost of this project, not including Task 3 Data Collection, is approximately $180,000 including overhead direct costs (ODCs, meeting travel). Assuming a 15 percent contingency, actual costs could range up to $205,000, excluding Task 3.

The data collection costs could vary significantly from estimated costs and is dependent on available data, final model selection and methodology, and bathymetric survey equipment and required longitude resolution. Total costs for Task 3 are estimated to be $96,000 including ODCs for travel, boats, lab fees, LiDAR, and bathymetric equipment. The total cost of the study, including Task 3 and a 15-percent contingency, except on Task 3, could range up to approximately $342,000.

An estimated cost breakdown of the tasks is provided below.

Task	Hours	Labor Cost	ODCs
Task 1 – Data Review	139	$16,040	
Task 2 – Model Approach and Selection	93	$11,920	
Task 4 – Hydrodynamic and Sediment Model Development	240	$27,400	
Task 5 – Calibrate Model	208	$26,720	
Task 6 – Sensitivity Analysis	146	$19,620	
Task 7 – Draft Report	172	$19,720	
Task 8 – Develop and Run Scenarios	69	$8,300	
Task 9 – Final Report	54	$6,340	
Task 10 – Meetings and Coordination	216	$37,320	$5,000
Tasks 1 through 10 Sub-Total Hours and Cost	**1,337**	**173,380**	**$5,000**
Task 3 – ASTM Tests	80	$7,200	$23,000
Task 3 – SEDFlume Tests	80	$7,200	$1,200
Task 3 – TSS Tests	120	$10,800	$600
Task 3 – Bathymetric and Floodplain Transect Data*			$45,000
Task 3 Sub-Total Hours and Cost	**280**	**$25,200**	**$69,800**
Total Estimated Hours and Costs	1,617	$198,580	$74,800

* Assumes this task will be subcontracted and there will be no direct labor costs from contractor

APPENDIX A EXISTING INFORMATION

A.1 RELEVANT DOCUMENTS – HYDRAULIC STUDIES

Referee Report: Dalrymple, et al v. GRDA, Case number CJ 94-444 (Holly 1999)

Flood Level and Duration Determination – Neosho River Below Commerce Gage (Holly 2001)

Analysis of Effect of Grand Lake Power-Pool Elevations on Neosho River Levels During a Major flood (Holly 2004)

Hydraulic Analysis: Grand Lake Real Estate Adequacy Study (USACE 1998)

Floodplain Analysis of the Neosho River Associated with Proposed Rule Curve Modifications For Grand Lake O' The Cherokees (Dennis 2014)

August 31, 2015 Memorandum, Pensacola Project No. 1494, Supporting information for Commission staff's independent analysis of GRDA's request for expedited approval of a temporary variance from Article 401 (FERC 2015)

Hydraulic Analysis of the Effects of Pensacola Dam on Neosho River Flooding in the Vicinity of Miami, Oklahoma (Tetra Tech 2015)

Hydraulic Analysis of the Effects of Proposed Rule Curve Change at Pensacola Dam on Neosho River Flooding in the Vicinity of Miami, Oklahoma (Tetra Tech 2016)

Tetra Tech Neosho River Structure Inundation (Tetra Tech 2016)

Tetra Tech Rule Curve Memo (Tetra Tech, 2016)

Hydrographic Survey of Grand Lake (OWRB 2009)

Bathymetric surveys of the Neosho River, Spring River, and Elk River, northeastern Oklahoma and southwestern Missouri, 2016–17 (USGS 2017)

Reconnaissance and Preliminary Stream Classification of the Major Tributaries of the Grand Lake O' the Cherokees (OKCC 1998)

Environmental Assessment of Habitable Structures on Grand Lake (OSU 2008) Dewberry, 2011.

Dewberry 2011. USGS Grand Lake, OK LiDAR Project. Prepared for the U.S. Geological Survey. November, 63 p.

Federal Energy Regulatory Commission (FERC), 2015. Supporting information from Commission staff's independent analysis of GRDA's request for expedited approval of a temporary variance from Article 401. Technical Memorandum. August 31.

University of Oklahoma (OU), 2014. Floodplain Analysis of the Neosho River Associated with Proposed Rule Curve Modifications for Grand Lake O' the Cherokees. Master's Thesis submitted by Alan C. Dennis. Norman, Oklahoma

A.2 RELEVANT DOCUMENTS – SEDIMENT/CONTAMINANT STUDIES

Sedimentary Characteristics of Pleistocene Deposits, Neosho River Valley, Southeastern Kansas (KGS, 1967)

Preliminary Assessment of Floodplain Soil Metal Concentrations, Neosho River, Oklahoma (Mignona, et al, 2012)

Occurrence and Variability of Mining-Related Lead and Zinc in the Spring River Flood Plain and Tributary Flood Plains, Cherokee County, Kansas, 2009–11 (USGS 2013)

Preassessment Screen for the Tar Creek Superfund Site (Natural Resource Trustees, 2004)

Toxicity assessment of sediments from the Grand Lake O' the Cherokees with the amphipod (USGS, 2009)

Reconnaissance Assessment of Heavy Metals in the Clay Fraction of Sediments Downstream of the Tar Creek Superfund Site in Northeastern Oklahoma (TEMS, 2012)

Grand Lake O' the Cherokees Natural Resource Damages: Restoration and Compensation Determination Plan (Tar Creek Trustee Council, 2014)

Diagnostic and Feasibility Study of Grand Lake O' the Cherokees, Phase 1 of a Clean Lakes Project (OWRB, OSU 1995)

Occurrence and Trends of Selected Chemical Constituents in Bottom Sediment, Grand Lake O' the Cherokees, Northeast Oklahoma, 1940–2008 (USGS 2009)

Occurrence, Distribution, and Volume of Metals- Contaminated Sediment of Selected Streams Draining the Tri-State Mining District, Missouri, Oklahoma, and Kansas, 2011–12 (USGS 2016)

Contaminated Streambed Sediment in the Kansas Part of the Tri-State Lead and Zinc Mining District, 2004 (USGS 2005)

July 2023

Response to Requests for Contaminated Sediment Transport Study for the Relicensing of the Pensacola Hydroelectric Project (FERC No. 1494)

Exhibit 2: Chronological Compendium of Historical Flooding

Appendix B. Chronology of Flooding in the Neosho (Grand) River Watershed

Neosho River Watershed Flooding Chronology

Year	Event
1826	Kansas climatologist T. B. Jennings described flooding on the Neosho in 1826 as "**carrying away wigwams, houses, and gathered and ungathered crops**."
1836	According to accounts gathered in the Coffey County Historical Society,(CCHS) Sac and Fox chief Soconut, "**swam his horse from bluff to bluff** (Indian Hill to Ottumwa Hill)" during the 1836 Neosho flood.
1844	Superintendent Thomas H. Harvey arrived at the Osage Sub Agency on May 22, 1844, where he found the Neosho, "very high, having overflowed its banks and covered the bottoms to a considerable depth, . . . **in most places more than a mile wide**."
1854	According to residents of Osage Mission (later St. Paul), the flood that year was a "**record breaker**."
ca. 1855-1856	"Spring rains sent the Neosho River out of its banks, flooding lowlands all through the area that was to be colonized [by a group of vegetarians." (*Iola Register*)
1857	A compilation of historical information from Emporia and Lyon Counties, Kansas, reported, "**A destructive flood swept down the Neosho**, carrying with it wigwams, houses and crops."
1865	*Neosho County Journal (NCJ)* described the Neosho as "very high."
1866	Neosho Indian Agent, G. C. Snow, reported that the Quapaws had suffered "severely" in 1866 "for food and clothing. Their crops were quite **all destroyed last year by the floods**"
1867	Neosho "overflow" in early July. *(NCJ)*
1868	Neosho "**overflowed for several days** during the first part of September." *(NCJ)*
1869	Neosho"**rose twenty feet in nine hours** and washed the ferry boats away." July saw the region "**submerged with the highest water in fifteen years**," with the Neosho "**rushing along over a stretch a mile in width**." *(NCJ)*
1870	A "small flood" occurred in late October. *(NCJ)*
1871	In July, the Neosho valley was flooded. *(NCJ)*
1873	Neosho was "very high" and had flooded the Osage Mission fairgrounds. *(NCJ)*
1875	A "small flood" occurred in August. *(NCJ)*
1876	Another "small flood" occurred in May. *(NCJ)*
1877	May 1877 flood was one "which makes the traditional oldest inhabitant shrug his shoulders and scratch his head, and reluctantly admit that he '**never did saw anything like it in these parts afore**.'" *(Marion County Record)*
1878	The Neosho **washed out the railroad track** "again." *(NCJ)*
1881	Another flood on the Neosho. *(NCJ)*
1884	"Big flood; no mail for four days" in May and another Neosho overflow in October. *(NCJ)*
1885	A 1948 Kansas State Board of Agriculture climate report noted that the July 1885 flooding of the Neosho was "**one of the greatest on record**" at Burlington and "**also close to the highest water ever known**" at Oswego.
1888	Chanute resident and weather watcher, Henry Stoelzing, reported a Neosho flood that year.
1889	Neosho "**was five miles wide at Humboldt**" during the 1889 flood. *(Spirit of Kansas)*

Neosho River Watershed Flooding Chronology

Year	Event
1890	Three separate Neosho floods at Chanute in 1890, with the highest in November. (Stoelzing)
1891	***City of Miami founded within Indian Territory.***
1891	According to a history of Emporia and Lyon Counties, in June 1891, the water was **within three inches of the 1877 high mark**.
1892	***First levees built on the Neosho in Neosho County.***
1892	Neosho had "**been out of its banks for the past week, and within two feet of the 1885 marks**. Much wheat has been destroyed." *(NCJ)*
1894	Neosho was "very high" that spring. *(Terral Times)*
1895	The U.S. Army Corps of Engineers (Corps) called the 1895 flood, "**one of the greatest floods**" in the history of the Neosho River valley. Originating in southern Kansas, the flood "was constantly augmented in crest flow as it traveled downstream throughout the Oklahoma reach, where it caused exceptionally high stages at Wyandotte as well as at Wagoner." **The Corps estimated the peak discharge at Grove at 250,000 cfs**.
1896	"Rising" Neosho was expected to cause "much damage" at Humboldt in late May. *(Tecumsah Herald)*
1898	"Average-size flood" lasted approximately a week in May. *(NCJ)*
1899	Neosho was "out of its banks . . . and steadily rising," with levees breached "in several places," the bottom lands flooded "for miles up and down the river," and the water **nearly reaching the height of the 1885 flood**. *(Kansas City Star)*
1900	Flood in Chanute lasted seven days in September. (Stoelzing)
1901	***St. Louis–San Francisco Railway ("Frisco") railroad truss bridge constructed over the Neosho in Miami.***
1901	As reported in a local history, on April 13 the Cottonwood River south of Emporia was a mile wide and **the Neosho up 22 feet**.
1902	Neosho "reached the highest mark this morning and is still rising. . . . The river is a **mile wide**." *(Oklahoma City Weekly Times Journal)*
1903	"Floods in Indian territory have delayed traffic on the railroads seriously." Neosho was **three miles wide** in some locations and "covered with water [up] to ten feet deep. The Neosho river above Miami, I.T. has covered the prairie farms for miles south of the river's main channel." *(Guthrie Daily Leader)*
1904	Neosho inundated the new Miami toll bridge with "three feet of water. The freshet **ruined a thousand acres of corn**. Rural mail wagons cannot get one mile from the post office. The water reached within two feet of the Frisco bridge." *(Norman Democrat Topic)*
1905	"One of the heaviest rains known to the oldest settlers visited this section of the country Friday night. As a result, both the Neosho and Spring rivers were out of their banks." *(Miami Record-Herald [MRH])*
1906	Heavy rains "caused flood stages in a considerable portion of the Neosho River." *(Monthly Weather Review [MWR])*
1907	Neosho overflowed from January 18–24, 1907. *(NCJ)*
1908	**Flood stages at almost every location on the Neosho between Iola and Fort Gibson**. *(MWR)*
1909	Neosho and Cottonwood Rivers "**broke all previous records**" for flooding during the winter season. *(Topeka Capital)*

Neosho River Watershed Flooding Chronology

Year	Event
1910	January floods again "**broke all records**" for winter flooding with ice dams causing flooding in the streets of Strawn. *(CCHS)*
1911	Flood at Lowell on the Spring River "**was worst ever experienced** at that place with the water nearly running over the dam." *(Galena Evening Times)*
1912	Neosho at flood stage "from Oswego southward, causing damage to crops and enforced suspension of business," and an estimated loss of $40,000. *(MWR)*
1912	***Missouri, Oklahoma & Gulf railroad bridge constructed over the Neosho.***
1915	Neosho on a "week's spree, a wild and reckless rampage, spreading ruin in its wake, overflowing its banks and surrounding territory. . . . **The city park is completely inundated**." *(MRH)*
1916	In June, the Neosho had been "in flood throughout its entire course in Kansas during the month. **In duration the flood was one of the longest on record**." *(MWR)*
1917	Tar Creek "on a rampage." *(MRH)*
1918	Heavy rain caused flooding in low places in the city, "and in many sections yards and streets were submerged. Water flowed over sidewalks in streams even in the high residence sections." *(MRH)*
1919	Workers building a new railroad bridge at Miami were discouraged from starting the job until "after the usual floods . . . had come and gone." *(MRH)*
1920	Neosho and Spring Rivers and Tar Creek, "[were] extremely high and [had] inundated the lowlands." *(MRH)*
1921	At their own peril, "hundreds of people" gathered at the South Main St. bridge to watch water "**14 feet above normal**" and a log jam wash out the approaches to the new bridge over the Neosho. *(MRH)*
1922	Due to heavy rains and flooding in Kansas, the Neosho was once again out of its banks at Miami where water "**entirely covered Riverview Park . . . and was flowing approximately two feet deep through the auditorium**." *(MRH)*
1923	1923 was a year of "outstanding floods" on the Neosho in both Kansas and Oklahoma brought on by "**four weeks of almost continuous and frequently excessive rains**" and with crest stages "**higher than any previously recorded**." *(MWR)*
1924	***Low dam at Riverview Park in Miami completed.***
1924	Crews repairing damages caused by fall and winter floods to the low dam and dance pavilion at Riverview Park were again facing setbacks due to the Neosho's rapid rise that spring. *(Miami News-Record [MNR])*
1926	"**Disastrous floods**" on the Neosho. *(MWR)*
1927	In April, the Neosho **rose 24 feet in the Miami area**, inundating highways and railroads, **causing 22 deaths**, and leading to an estimated half million dollars in damage. *(MNR)*
1928	Neosho was out of its banks in Iola and "from two to three feet over its banks in Coffey county, Parsons, and south to the Oklahoma line." *(Topeka Journal)*
1929	Neosho "flooding most of the bottom farms and causing considerable damage to growing crops." *(MNR)*
1930	June saw flood stages on the Neosho at Oswego and Fort Gibson. *(MWR)*
1931	Late fall rains caused "moderate" floods on the Neosho, which achieved flood stages at Le Roy, Iola, Chanute, Parsons, and Oswego. *(MWR)*
1932	"Young men with a knack for doing dangerous tricks" were riding logs on the Neosho over the "inundated" low dam in Miami "during its perilous flood stage." *(Miami Daily News-Record [MDNR])*

Neosho River Watershed Flooding Chronology

Year	Event
1933	Neosho flood waters had blocked highways in the Miami area in three directions; Ottawa County was expected to experience "**its highest water in several years**." *(MDNR)*
1935	***State of Oklahoma created the Grand River Dam Authority (GRDA).***
1935	***In 1935, the "largest truss span in Oklahoma" at the time, according to a history of Ottawa County, was completed over the Neosho at Miami (location of current Rte. 66 bridge at approximate corner of E and 3rd Streets SW).***
1935	"Disastrous floods" occurred on the Neosho. (Kansas State Planning Board)
1936	***Congress enacted the Flood Control Act of 1936, which authorized several levee projects along stretches of the Neosho in Kansas, as well as "preliminary examinations and surveys for flood control" at "Pensacola Reservoir, Oklahoma."***
1937	Two "moderate overflows" of the Neosho. *(MWR)*
1938	***Congress enacted the Flood Control Act of 1938, which authorized many projects, arguably including the Pensacola Dam, and required the Secretary of War to acquire title to all lands necessary for the authorized dam and reservoir projects.***
1938	"Big flood" of the Neosho reported in numerous news outlets in Kansas and Oklahoma.
1939	***The Federal Power Commission issued the original license for the Pensacola Project to GRDA.***
1939	***Iola levee operational.***
1940	***Congress enacted a special statute that granted GRDA title to all federal and Native American–owned lands in the Project area, up to elevation 750 feet.***
1940	***Pensacola Dam completed.***
1941	**Floods were "the rule, rather than the exception," in the Neosho watershed** from April to October, where flood stages were "reached or exceeded . . . every month during this period except in May." *(MWR)*
1941	***Congress enacted the Flood Control Act of 1941, which directed the Corps to provide flood control at Pensacola Dam.***
1941	***FDR's Executive Order 8944 directed FWA administrator to take over Pensacola Dam for the war effort.***
1942	On the Cottonwood and Neosho, "crest stages were generally 3 to 5 feet above bankfull" in June "with the **overflow lasting about a week**." *(MWR)*
1943	***1901 Frisco railroad truss bridge replaced with another with no trusses.***
1943	According to FEMA, the Neosho "rose to its crest stage above bankfull in 76 hours at an average rate of 0.13 foot per hour with a maximum rate of 0.6 foot per hour and remained above bankfull stage for about 11 days."
1944	Flooding broke "all known records at Chanute, Erie, and St. Paul, and at the highway bridge east of Parsons," with the Neosho "**one vast sea, in some places four or five miles wide**." *(Parsons Sun)*
1944	***Congress enacted the Flood Control Act of 1944, which again granted the Corps all flood-control responsibilities at the Project.***
1945	"Big flood" washed out a railroad track near St. Paul and water from the Neosho overtopped levees. *(NCJ)*
1946	Neosho reached flood stage at Oswego in January. *(MWR)*
1946	***Congress enacted special legislation that returned the Pensacola Hydroelectric Project to GRDA following World War II, and in doing so, confirmed ownership responsibilities related to the conservation and flood pools.***

Neosho River Watershed Flooding Chronology

Year	Event
1948	According to gaging information, the two crests that occurred at Commerce in 1948 were the **third- and fourth-highest known floods**, respectively, in order of magnitude at that location (prior to 1969).
1949	"Minor flooding along the Neosho at various locations." *(MWR)*
1950	The Corps reported that heavy rainfall caused a spring flood on the Neosho.
1951	U.S. Geological Survey reported that the Neosho "reached **flood heights far in excess of any previously known** as result of heavy storms."
1954	According to a 1979 consultant's report on the Miami Area Comprehensive Plan, "major floods causing **extensive damage to Miami development** occurred."
1955	Gaging information recorded the Neosho at Commerce above the 15-foot flood stage.
1957	"Swollen Neosho river waters spread over farmlands and roads." (*MNR*).
1958	"Neosho was flooding from Burlington, KS, to its mouth, with four to five feet of flooding lowlands in Miami." *(Tulsa Tribune)*
1959	Flooding on the Neosho. (CCHS)
1960	Another Neosho flood. (CCHS)
1961	Gaging information recorded that the crest at Commerce was the **fifth-highest known flood in order of magnitude** at Commerce (prior to 1969).
1962	Four separate floods on the Neosho. (CCHS)
1964	***Council Grove Dam/Reservoir completed.***
1964	High floodwaters at the Third Ave. bridge and **Miami fairgrounds had been flooding for a few days**. *(MNR)*
1965	***John Redmond (Strawn) Dam/Reservoir completed.***
1965	Another Neosho flood. (CCHS)
1967	***New "fairgrounds" bridge constructed over Neosho at Miami immediately upstream from the 1921 concrete arch bridge, which it replaced.***
1967	Neosho crested near Commerce above flood stage. *(MNR)*
1968	***Marion Dam/Reservoir completed.***
1969	In Miami, the Neosho **flooded Riverview Park and closed the park road**. *(Daily Oklahoman)*
1970	"Neosho rampage." *(Parsons Sun)*
1971	"Minor flooding" on Neosho. *(Tulsa World)*
1972	Neosho 2 feet over flood stage at Commerce. *(Daily Oklahoman)*
1973	Neosho "did the expected" and overflowed into Labette County lowlands. *(Parsons Sun)*
1974	Due to flooding, "Miami's Fairground . . . could have accommodated a water polo match last week, or a racing meet for sea horses." (clipping, Dobson Museum)
1975	Neosho receding after a "hit-run" flood of from 3 to 4 feet. *(Parsons Sun)*
1976	"**At least 3 bridges across Neosho and Spring in Ottawa County were blocked**" due to flooding. *(Tulsa World)*
1977	"High water brought a halt" to construction near the Miami fairgrounds. *(MNR)*
1978	Neosho 3 feet over flood stage at Commerce and expected to crest at 5 feet over flood stage. *(Tulsa World)*

Neosho River Watershed Flooding Chronology

Year	Event
1979	Neosho "spilling out of its banks . . . gorged by rain concentrations." *(Parsons Sun)*
1980	Neosho "takes generous swath of land near Chanute." *(Wichita Eagle)*
1982	"Pumped up by heavy rains," the Neosho overflowed in Labette and Neosho Counties; more flooding expected into NE Oklahoma. *(Parsons Sun)*
1985	Ottawa County declared a disaster area due to flooding. Neosho **crested 13 feet above flood stage at Miami, damaging 300 homes and dozens of businesses**. *(Daily Oklahoman/Times)*
1986	"**One of the worst floods ever experienced in Miami** resulted from days of record-setting rainfall." (Miami Kiwanis Club pamphlet)
1987	***Congress enacted Public Law No. 100-202, which directed the Corps to investigate solutions to flooding problems in the City of Miami, including the adequacy of the United States' easements for flood control at the Pensacola Project.***
1987	Runoff from Tar Creek flooded streets and "at least 10 houses" in Miami and the Neosho was expected also to flood. *(Tulsa World)*
1988	Neosho crested at Chanute 7.9 feet above flood stage. *(Chanute Tribune)*
1989	Neosho flooding near Parsons and at Oswego; at Chetopa, "**most of the city park near the banks of the Neosho was standing under water**." *(Parsons Sun)*
1990	Neosho caused the flooding of Miami's Riverview Park. *(Daily Oklahoman)*
1992	Rain "forced the Neosho River from its banks, causing flooding" and closing streets in Miami. *(Daily Oklahoman)*
1992	***FERC relicensed the Pensacola Project for a new 30-year term, maintaining that "The Grand Lake flood pool . . . is controlled by the Corps for flood control storage, as mandated by the Flood Control Act of 1944, and not subject to Commission authority."***
1993	Neosho crested 9.5 feet above flood stage at Miami, **covering nearly two dozen city streets with water**." *(Daily Oklahoman)*
1994	"In Miami, **30–35 homes were evacuated** as the Neosho River inched out of its banks . . . eight months ago, a flood prompted the evacuation of the same homes." *(Tulsa World)*
1995	Neosho floodwaters **closed State Highway 125 near Miami fairgrounds**. *(Grove Sun)*
1996	***Congress enacted the Water Resources Development Act of 1996, which directed the Corps to undertake a real estate adequacy analysis at the Pensacola Project and authorized the Corps to acquire additional acreage from willing sellers.***
1997	"Neosho River spilling out of its banks near Commerce." *(Daily Oklahoman)*
1998	"**Major flooding** along the Neosho River near Oswego." *(Iola Register)*
2000	***Congress enacted the Water Resources Development Act of 2000, which directed the Corps to purchase easements for lands adversely affected by backwater flooding at the Pensacola Project.***
2000	"Neosho "**came within a foot of homes" in Miami**. *(Iola Register)*
2002	"A two-day total of 2.84 inches of rain at Miami helped push the Neosho River out of its banks, sending it six feet above flood stage." (Oklahoma Climatological Survey)
2004	Neosho and Spring both above flood levels, "cutting off access to low-lying areas." *(Oklahoman)*
2007	Neosho **overflow "engulfed" Miami, flooding over 600 homes in Miami alone**. (Oklahoma Farm Bureau)

Neosho River Watershed Flooding Chronology

Year	Event
2015	"Moderate" flooding of Neosho near Commerce. (National Weather Service)
2018	***Congress enacted the Water Infrastructure Improvements for the Nation Act, which directed the Corps to convey to GRDA all property interests of the United States at the Pensacola Project, while retaining the Corps' exclusive jurisdiction over flood control.***
2019	Neosho had its eighth-highest crest at Commerce since 1940 with **Miami hit hard by a "record-breaking" flood**. *(Joplin Globe)*
2019	***Congress enacted the National Defense Authorization Act for Fiscal Year 2020, which Congress confirmed the Corps' exclusive jurisdiction over flood control at the Pensacola Project, prohibited other agencies from regulating water surface elevations, and defined the FERC-licensed project to consist only of lands within the then-current Project boundary.***